

TIMBER & DAMP SURVEY



8-14 KEMBLE STREET
PRESCOT

December 2022

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1.0 BRIEF:

- 1.1 Instructions were received via Andrea Hawksey, Clerk of Works, Knowsley Council, to visit site, carry out an assessment of timber condition and damp, including microdrilling and thermographic survey, and prepare a report with recommendations for any necessary repair and/or remediation

2.0 NOTES:

- 2.1. Site Address: 8-14 Kemble Street, Prescott, L34 5SQ
- 2.2. The site investigation was carried out on 7 & 8 December 2022
- 2.3. The weather was bright, dry and very cold during the site visit.
- 2.4. % *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).
- 2.5. All measurements are in millimetres. Where an area of degradation is dimensioned, the dimension defines the limit of the degradation's significance, unless otherwise defined.
- 2.6. The floor plans and other drawings used in this report are derived from supplied survey drawings, and are for identification purposes only.

3.0 SPECIALIST EQUIPMENT USED

3.1. Sibert DDD200 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 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 FLIR 540 Thermographic camera

The thermographic camera measures very small temperature differences at the surface of elevations caused by variations in the thermal properties and moisture content etc of the various materials that make up the fabric of the wall, and which are often concealed behind the surface finishes. The FLIR 540 is capable of identifying temperature variations as small as 0.02°C. Frequently architectural features and historical alterations can be identified, that would otherwise remain hidden behind later surfaces etc. However, absence of 'visible' evidence is not evidence of absence: concealed elements will sometimes show up thermographically in certain conditions and remain completely invisible in other.

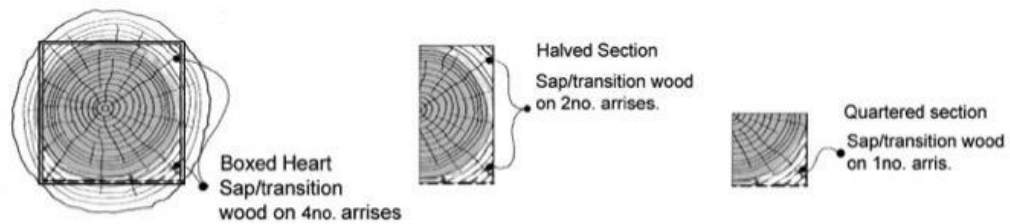
3.3 Protimeter MS moisture meter

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

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.

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

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). In external walls, the upper face is always outward facing.

Timbers (except lintels) were generally incorporated into a building while still green (unseasoned), and dried slowly *in-situ*. During the drying process, tangential shrinkage can be up to 12% across the grain. In boxed heart sections, radial shrinkage almost inevitably creates one or more longitudinal splits. In most cases, these splits are not structurally significant.

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. When square baulks are re-sawn to smaller sections, the proportion of retained sapwood varies, with some containing a relatively high proportion.

Oak and elm were the most common timbers used in traditional framing, but poplar and chestnut were also used. Softwood, mainly imported from the Baltic States, was used increasingly from the mid C18th.

The sapwood of most timbers is not durable, and can readily be attacked by fungi and various insects, including Deathwatch beetle *Xestobium rufovillosum*, furniture beetle *Anobium punctatum* and Lyctus powderpost beetle (*Lyctus brunneus*). Degradation of sapwood will often occur within fifty years of construction, and will often die out naturally as food supply and/or conditions change.

The structural timbers used in 8-14 Kemble Street, and the auditorium to the rear are all softwood, almost certainly imported, either from the Baltic States or North America.

5.0 REPORT

In this report, for clarity, the building complex is divided into two main sections, comprising of the front building facing Kemble Street, and the auditorium to the rear.

Front Building

Roof Structure

5.01 No drawings of the roof structure were available.

5.02 The roof spaces were accessed via the ceiling hatch marked A in the second floor ceiling shown in Figure 1.



Figure 1. Front Building: Second Floor Plan

5.03 Debris covering the ceiling timbers prevented safe access to the area shown green in Figure 1. No significant degradation was identified in the structural roof timbers or ceiling timbers by visual inspection.

5.04 The relatively slender ceiling joists restricted access to other areas of the roof space, in particular the area around the parapet gutter on the north elevation and the purlins built into the east wall.

5.05 The parapet gutter has failed over a long period, and the presence of widespread fungal attack at lower levels in the wall below the parapet gutter would suggest that there is significant to severe degradation to all timbers within 900-1200 of the front (north) elevation.

5.06 Detailed visual inspection did not identify significant degradation in the purlins and other timbers in contact with the east wall, but this will need to be checked when the area can be safely accessed.

5.07 No significant degradation was identified in other roof and ceiling timbers but some areas of the ceiling remain concealed by debris.

5.08 Moisture content of accessible timbers in the roof space was typically 17-20%mc. In a typical well maintained ventilated unheated roof space timber moisture content would typically be 16-18%mc.

First and Second Floors

- 5.09 Floors are mostly covered in carpet laid over sheet material securely nailed down. No floor coverings were lifted.
- 5.10 The ceilings and walls within 900-1200 of the front elevation show evidence of long-term water penetration effectively saturating the masonry in most areas.
- 5.11 Fruiting bodies of *Serpula lacrymans*, commonly if misleadingly called “Dry rot” can be seen growing on/through the plaster. There are likely to be other fungi present, some of which may also degrade timber.
- 5.12 No significant degradation was identified by visual inspection in other areas.

Ground Floor

- 5.13 All floors appear to be solid, presumably concrete.
- 5.14 There is less evidence of mould and fungal growth associated with the saturated front elevation, but it should be assumed that any timbers built into or in contact with the masonry of the front elevation will be ceilings and walls within 900-1200 of the front elevation show evidence of long-term water penetration effectively saturating the masonry in most areas.
- 5.15 Fruiting bodies of *Serpula lacrymans*, commonly if misleadingly called “Dry rot” can be seen growing on/through the plaster. There are likely to be other fungi present.
- 5.16 No significant degradation was identified by visual inspection in other areas of the front building.
- 5.17 The very cold temperatures prevailing during the site survey, with very little diurnal variation prevented the effective use of infrared thermography in an unheated building.

Auditorium

Roof Structure

- 5.18 The roof structure consists of 6 no. riveted steel arched trusses (possibly with some wrought iron elements) linked with steel angle and timber composite purlins, supporting timber common rafters and timber sarking.
- 5.19 All timber is softwood, probably *Pinus sylvestris* imported from the Baltic States, or possibly a North American timber.
- 5.20 The roof structure could only be safely accessed from the walkways laid over the ceiling.
- 5.21 Generally, the roof timbers are in remarkably good condition. Where there is degradation, it is very localised and relates directly to specific failures in the roof coverings. There is no evidence of significant racking or other deformations.
- 5.22 The eaves could not be safely accessed from the walkways, but no significant degradation was identified by visual inspection from the walkways within the roof and from external ground level using binoculars.
- 5.23 The exact configuration of the structural elements at eaves level could not be determined, but it seems that the timber elements of the roof structure are

largely independent of the wall masonry, with the lowest purlin set close to the wall head, acting as a 'wall plate'. There may be a secondary plate bearing on the wall, but if present, it is not a significant structural element.

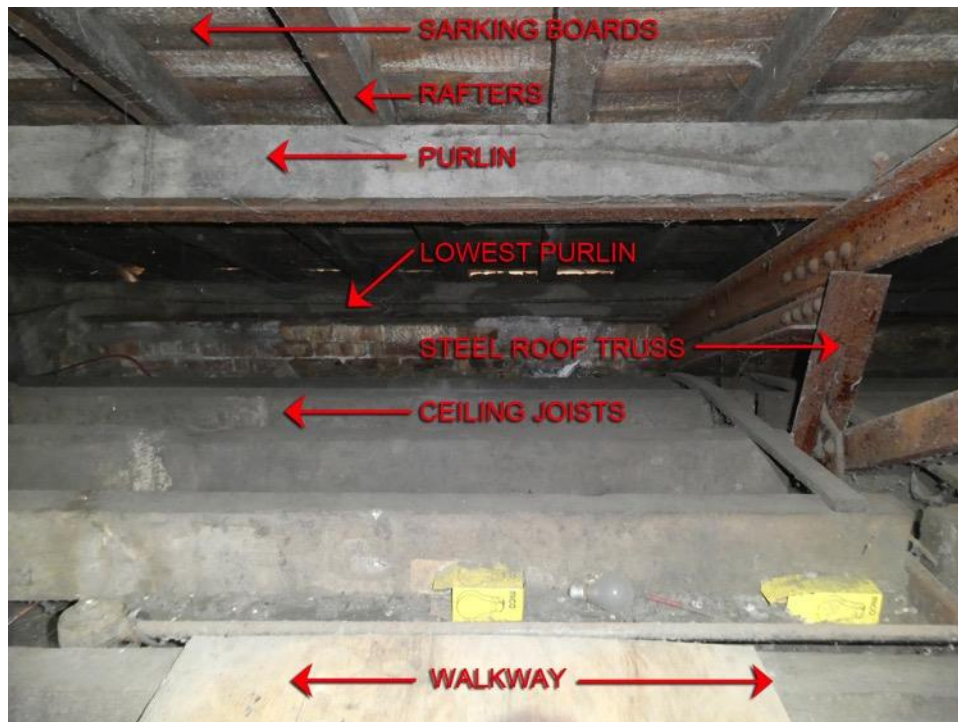


Figure 2. Main elements of roof structure.

- 5.24 There is very localised fungal degradation around the ventilation cupola, and also where roof slates have slipped. Generally these have affected small areas of sarking board, which can easily be replaced locally.
- 5.25 Where fungal activity has spread to rafters, the weakened section can be easily partnered with a timber section fixed to one or both sides. See *Figure 3*



Figure 3. Localised decay of sarking boards.

- 5.26 This leak due to slipped slates visible in Figure 3 has caused relatively little damage in the immediate area, but significantly more lower in the building where the water has accumulated and been absorbed by ceiling plaster etc. See *Figure 4*. Even here, necessary interventions are modest and straightforward. The affected ceiling joists will need to be partnered with new softwood elements fixed to one or both sides of the degraded joists, and probably spanning from truss to truss.



Figure 4. Damage to plaster ceiling caused by a roof failure directly above.

- 5.27 There is some fungal activity visible in the timber elements of the purlins in the south-most bay of the auditorium roof. See *Figure 5*. It is possible that water from a leak higher in the roof is collecting in the steel angle element of the purlin, allowing fungal activity to initiate and thrive on the timber section.



Figure 5. Fungal activity in purlin in south bay.

- 5.28 There is also evidence of fruiting body of a fungus (probably *Serpula lacrymans*) adjacent to the south gable wall. See Figure 6.



Figure 6. Fungal fruiting body on purlin

- 5.29 There is some evidence of corrosion of some of the steel elements particularly close to the south gable wall, which will need to be assessed when there is safe access to all areas.

Walls and Floors

- 5.30 No structural elements could be identified within the main external walls of the auditorium. However, there is evidence of fungal strands growing between the internal plaster and the brickwork (circled), and there are non-structural timber elements to provide a food source. See Figure 7.



Figure 7. Mycelium growing on non-structural timbers and between plaster layers.

- 5.31 The timbers are probably later insertions used to infill recesses in the masonry walls.

- 5.32 The plaster is almost certainly later and relatively impermeable. The walls generally are likely to be effectively saturated.
- 5.33 The south-most bay of the auditorium contains softwood doors and lintels etc. All accessible timbers built into, and/or in contact with the masonry walls are severely degraded by fungal attack. There are widespread fruiting bodies of *Serpula lacrymans* present, and all horizontal surfaces are liberally covered with fungal spores. See Figure 8



Figure 8. Spores of 'Dry rot' *Serpula lacrymans* covering all horizontal surfaces.

- 5.34 No significant degradation was located in timbers away from the masonry walls.

6.0 Conclusions

Front Building

Front elevation

- 6.01 The front (north) elevation has suffered from water penetration via a failed parapet gutter and blocked downpipes etc over a long period. Wood decaying fungi, including so-called 'Dry rot' *Serpula lacrymans*, are well established in timbers built into the masonry walls and timbers within 900-1200mm of the front wall.
- 6.02 The building has been altered many times since construction. Originally, the front elevation would almost certainly have incorporated structural timber elements including window and door lintels, and quite possibly also horizontal bonding timbers and plates. Given the date of construction, these elements are likely to have been softwood. Some or all of these timbers may have been replaced with concrete or steel in later alterations.
- 6.03 Any timbers remaining in the walls are likely to be significantly to severely degraded, and allowance should be made for their replacement.
- 6.04 As a listed building, it could be argued that they should be replaced in the same material. However, timbers built into masonry will remain vulnerable to degradation, and chemical pre-treatments do not necessarily provide long-term protection.
- 6.05 The last major phase of work dates from the early C20th, and it is this phase of work which gives the building much of its historic significance. The use of lime-based renders and breathable paints may not be historically accurate or appropriate, and furthermore, may not sufficiently improve the breathability of the wall to sufficiently reduce the moisture content of any timbers embedded in, or in contact with, the external walls.
- 6.06 None of the floor coverings or ceiling plaster could be removed to assess the timber elements within the floors etc, but it is clear from the presence of fungal fruiting bodies, surface moulds and damaged plasterwork that there is widespread, and almost certainly structurally significant, fungal degradation within the floor timbers adjacent to the front elevation.
- 6.07 The floor coverings will need to be removed before an assessment of their condition and also their historic significance can be made. At this stage, it should be assumed that all structural timber floor elements within 1500mm of the front elevation will need to be replaced, or substantially strengthened.

Roof Structure

- 6.08 There has been long-term creep deflection of the roof elements that creates the visible 'sag' between trusses commonly seen in buildings of this age. This is usually not in itself structurally significant, and should not require intervention or remedy.
- 6.09 Timbers within 1000mm of the failed parapet gutter will need to be assessed in detail when there is safe access. At this stage, it should be assumed that all structural timber roof elements within 1000mm of the front elevation will need to be replaced, or substantially strengthened.

- 6.10 It should be assumed that all support structure for the parapet gutter will need to be replaced.
- 6.11 By visual inspection the purlins are not significantly degraded where they are in contact with the masonry walls, but this should be checked when they are safely accessible.
- 6.12 Minor very localised repairs are likely to be required, for example to valley boards.
- 6.13 No significant degradation was identified elsewhere in the front building.

Auditorium

Roof structure

- 6.14 The roof structure generally is in good condition: areas of degradation are localised and relate directly to identifiable faults, mainly slipped/broken slates and failed flashings etc.
- 6.15 Necessary repairs should be relatively simple and mainly consist of 'repair by addition' partnering of degraded elements.
- 6.16 The peak of the south (rear) brick gable has moved outward, but no significant racking of the roof was evident within the roof space.

Walls and Floors

- 6.17 No structural timber elements could be identified in the external walls, but the masonry is generally very damp, and joinery items and later interventions provide a food source for current and widespread fungal activity.
- 6.18 At this stage, it should be assumed that all timber elements in contact with the external walls will need to be replaced or strengthened, or at least isolated from the masonry.

7.0 Recommendations

- 7.01 The masonry in the north elevation of the front building, and the external walls of the auditorium are effectively saturated, and will take many months to dry down sufficiently to remove the risk of continuing or future fungal attack. Viable fungal spores are present in all environments, and will only germinate if specific conditions (primarily moisture content) are suitable: however, inevitably where there is current or recent widespread fungal activity, as here at Kemble Street, the spore load is significantly higher. Not all spores are viable, and their viability reduces over time (several years), but the risk of new or renewed activity is greater. If the moisture content of the timber and surrounding fabric can be reduced below ~27%emc, the risk of germination is eliminated, and if reduced below ~24%emc, the fungus will die.
- 7.02 It is therefore essential that the fabric is dried down, and that the process is started as soon as possible. The first steps are:
 - eliminate, or at least greatly reduce, points of water entry, using temporary measures if necessary,
 - rainwater discharge must be made to work reliably
 - as much as possible of the existing impermeable finishes should be stripped out to improve evaporation
 - airflow should be increased while maintaining security.

- 7.03 The stripping out should include all finishes and other fabric that is not to be retained. Some caution is required in this process, as renders can provide surprising additional strength and stability to an otherwise fragile wall, and floorboards etc create horizontal diaphragms that stiffen an otherwise unstable structure.
- 7.04 These works are urgent, and any delay will prolong the time required to dry the building sufficiently, leading to consequential delays in the contract duration and pressure to install new finishes etc before the building fabric is dry. This will often result in future fungal outbreaks (sometimes years after completion) and consequent legal disputes over liability.
- 7.05 It would be sensible to install an environmental monitoring system that can be monitored remotely as soon as possible, which can then be maintained during the contract works and subsequently when the building is in commission.
- 7.06 To a large extent, the type and extent of any interventions required will depend on what is revealed when existing finishes are removed, and also on the detail designs and materials proposed for the upgrading of the building.
- 7.07 In the front building, necessary interventions in the front wall and adjacent floor structures will depend on the type and extent of any existing interventions; for example, whether the original timber lintels have been already been replaced with inert materials.
- 7.08 In many cases, required strengthening could be incorporated within necessary performance upgrading. For example, it should be possible to retain almost all the roof structure of the auditorium with minimal intervention if a breathable insulation such as ~100mm thickness of wood-fibre board or similar could be fitted above the existing sarking boards. This would provide additional resistance to racking, and all the existing timber elements including the sarking boards could be retained in a dry and stable environment.
- 7.09 Similarly, if external insulation could be installed to the external walls of the auditorium, this would ensure that the masonry walls, and any timber elements in contact with them would be permanently dry. It would also allow the original plaster and internal proportions to be retained and conserved.
- 7.10 Any new timber used in the building should of course be pre-treated to the relevant British/EU standard. In-situ treatment of existing timbers is unlikely to provide effective long-term protection, and should certainly not be used as a 'short cut' to avoid drying the building down adequately.
- 7.11 There may be specific situations in which existing timber elements cannot be isolated from potentially or actually damp fabric where a localised application of boron-based paste or pellet may provide necessary short term protection, but for reliable long-term protection, the surrounding fabric must be maintained below 22%emc or the timber must be physically isolated from the fabric.