Hutton + Rostron
Environmental Investigations Limited

Aston Hall: Investigation of structural timber elements – South range barns

Site note 1 for March 2021, job no. 153.32

CONTENTS

Distribution:

Giles Quarme - Giles Quarme Architects
Giulia Baldin - Giles Quarme Architects

Prepared by:	Technical review by:	Administration by:
Joe Lovelock BSc (Hons)	Matt Smith MA, Msc.	Jennifer Potter BA(Hons)

Hutton+Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA

Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

1 INTRODUCTION

1.1 AUTHORITY AND REFERENCES

Hutton + Rostron Environmental Investigations Limited carried out site visits to Aston Hall on 2, 3, and 5 March 2021 in accordance with instructions from Giles Quarme by email, on 16 February 2021 (17:43) on behalf of the clients, David and Ros Cleevely. Drawings provided by Giles Quarme Architects were used for the identification of structures. For the purpose of orientation in this report, the south barn was taken as facing into the courtyard to the north

1.2 AIM

The aim of this survey was to investigate the structural timber elements for condition, and to assess the building for likely intervention in the past. Cost-effective remedial recommendations for repair have been provided where necessary using environmental means

1.3 LIMITATIONS

This survey was confined to the accessible structures. Concealed timbers and cavities have been investigated where necessary by the use of high-powered fibre optics. The condition of concealed timbers may be deduced from the general condition and moisture content of the adjacent structure. Only demolition or exposure work can enable the condition of timber to be determined with certainty, and this destroys what it is intended to preserve. Specialist investigative techniques are therefore employed as aids to the surveyor. No such technique can be 100 per cent reliable, but their use allows deductions to be made about the most probable condition of materials at the time of examination. Structures were not examined in detail except as described in this report, and no liability can be accepted for defects that may exist in other parts of the building. We have not inspected any parts of the structure which are covered, unexposed or inaccessible and we are therefore unable to report that any such part of the property is free from defect or in the event that such part of the property is not free from defect it will not contaminate and/or affect any other part of the property. Any design work carried out in conjunction with this report has taken account of available pre-construction or construction phase information to assist in the management of health and safety risks. The sample remedial details and other recommendations in this report are included to advise and inform the design team appointed by the client. The contents of this report do not imply the adoption of the role of Principal Designer by H+R for the purposes of the Construction (Design and Management) (CDM) Regulations 2015. No formal investigation of moisture distribution was made

2 STAFF ON SITE AND CONTACTS

2.1 H+R STAFF ON SITE

Joe Lovelock
Matt Smith
Will Woodward

2.2 PERSONNEL CONTACTED

David and Ros Cleevely - Owners

3 OBSERVATIONS AND *RECOMMENDATIONS*

3.1 SUMMARY OF CONSTRUCTION

3.1.1 Arrangement

1 Roof structures: The Barn was split into two main areas, one consisting of the large barn to the east and formed from 7no. trusses, dividing the interior space into 7no. bays, and an additional smaller area to the west, currently being used as a bike storage space, itself comprising 3no. trusses and subsequently 4no. bays. The simple trusses and rafters were supported on wall plates running on masonry walls to the east and west part of the barns, with timber framing supporting the roof structure centrally. Principal rafters were in the most part supported by raking struts down to tie-beams, although 2no. cross walls also comprised timber studwork, finished with either historic or more recent timber boarding. 2no. purlins supported rafters throughout both roof structures, and these were embedded in masonry at the extreme east end, although supported by timber gables elsewhere. Construction method in employment for both the east and west ends of the barn roof structures could be placed circa 1600-1700, albeit with remedial intervention in the intervening years since, as described in 3.4 below

2 Floor structures: First floor structures were not found throughout, but were evident in the outer sections of the main east barn, in bays 1, 2, and 3, and also in bays 7 and 8. There was no first floor structure in the west part of the barn, although ceilings had been installed consisting of polystyrene boards laid between truss tie-beams on T-sections of plywood and softwood battening. Bay 5 of the east part of the barn was noted to have a timber ground floor structure, suspected to be simple boarding over battens laid directly onto earth substrate below. Access was not available at the time of survey to inspect this in detail, although was presumed to be highly vulnerable to both wet rot decay and wood-boring beetle infestation, and would almost certainly have lacked any form of damp-proofing provision. All other areas of ground floor were either of bare earth (east part of barn) or concrete (west part). Historic areas of floor were confined to the extreme east end in bays 1 and 2 with later construction elsewhere, as described in 3.4 below

3 West barn dry-lining: The west end of the south range of barns had been fully isolated from the surrounding external masonry with a dry-lining system comprising 100 x 50mm timber studs and lined with chipboard flooring laid horizontally. This limited accessibility, although generally only to the wall plate sections

3.1.2 Materials

Timber samples were taken throughout both sections of the barn so as to identify timber species for strength grading (see Site Note 5), and to highlight the differing interventions in the past, helping to create a narrative. The majority of timber preliminarily identified on-site was found to be of White Oak (*Quercus robur/petraea*), although there was some use of softwood in areas of recent localised repair, or wholesale replacement, particularly of floor structures. Softwood boarding was noted on first floor finishes, and on the cross wall of truss 3 (*Pinus sylvestris*), and all cladding was noted to be of softwood also (most likely Larch – *Larix decidua*)

3.1.3 Dimensions

As expected of a building of this age and condition, truss component dimensions varied greatly across the building, with often elements from the same truss even differing. In addition to this, the nature of the construction relies on the tapering strength of timbers, with greater thicknesses at the base of the trusses, and narrower at the apex. As such, only an indication of dimensions is provided, and accurate measurements should be taken prior to any repairs

1 Roof structures:

Tie-beams	-	~280-300 x 150-180mm
Principal rafters	-	~150-180 x 105-125mm
Raking struts	-	~190-230 x 90-125mm
Common rafters	-	~80-110 x 80mm at ~450mm centres (again variable)
Wall plates	-	~200 x 135mm (variable)
Posts	-	~300 x 230mm (variable)
Studs	-	~225 x 100mm (variable)

2 Floor structures:

Bays 1 and 2:

Floor beam	-	~280-300 x 260-290mm
Historic floor joists	-	~100 x 125-150mm at ~300mm centres
Softwood floor joists	-	95 x 85mm at ~300mm centres

Bay 3:

Floor beam	-	~230 x 170mm
Floor joists	-	~110 x 80mm at ~430mm centres
Floor boards	-	~25 x 200mm

Bays 7 and 8:

Floor beam	-	~240-300 x 120-250mm (variable
Post supporting beam	-	~180 x 160mm
Floor joists	-	~110 x 75mm at ~300mm centres

3.2 TIMBER CONDITION

3.2.1 Roof structures

1 General: Overall the building appeared in very good condition considering the age. There was widespread evidence of remedial works, with almost all trusses and bays showing intervention since original construction. Very few areas of timber decay from wet rot were noted on inspection, with only a small area to the north side directly in line with the bearing end of truss 6 affected by structurally significant timber decay and although this had been partially dealt with in the past, the repairs were deemed inadequate to support the truss, and may be resulting in further structural issues at the associated south bearing end, as described below

No chemical remedial treatment is either required or recommended in relation to wood-boring beetle infestation or fungal decay organisms. The roof structure was deemed suitable for retention at the discretion of the Structural Engineer, albeit with localised repairs

2 Trusses: Trusses were drilled for decay detection and probed for deep and surface moisture content readings to determine the extent of any decay and vulnerability to further decay. No structurally significant decay was detected on drilling all at-risk bearing ends, and in general, moisture content readings were considered ‘normal’ for the ambient internal environmental conditions and exposed nature of the building and too low to provide the conditions for wet rot decay, but elevated enough to allow for wood-boring beetle infestation of non-structural sapwood bands of the timber

Structural issues were identified at the north and south bearing ends of truss 6 (T6) where persistent water penetration from defective rainwater guttering had caused localised timber decay in the past, and was likely to continue to cause timber decay from both wet rot and wood-boring beetle infestation. This was particularly evident when seen from ground floor below, where introduction of a large concrete pillar formed from concrete blockwork laid face up was supporting the failed wall plate. A steel angle bracket had been positioned below the tie-beam and stainless steel threaded rods drilled into the beam to fix in position. This method of strengthening the joint may not be structurally sound. A large fracture at the head of the south post had developed suggesting that northwards movement of the tie-beam may be ongoing, and had caused adjacent wall plate jointing, located to the east, to also fail by snapping the retention pins

No chemical treatment required. Structural Engineer to comment on suitability of previous repairs to tie-beam of truss 6 at north end. Significant strengthening works with steel required to repair head of post at south end of truss 6. Every effort should be made to re-direct water away from the building to prevent further structural decay affecting vulnerable timber elements. Allowance should be made for strengthening/repairing the failing wall plate joints to the east of truss 6 at both the north and south sides

2no. pockets of structural decay were noted at the bearing ends of both the north and south principal rafters of truss 6 (T6). The ‘book-matching’ of the principal rafters suggested they were likely to have been converted from the same piece of timber. The sections of decay approximated to a 40 per cent loss of cross-section which may be structurally significant

No chemical treatment required. The decayed timber around the pockets should be cut back to sound material and the resulting voids in-filled with timber to match existing, or resin as directed by the Structural Engineer

The tie-beam of truss 8, within the west part of the barns, had decayed in the past and been partner repaired with 2no. softwood timbers, one to either side. No further decay was identified affecting the partnering timbers

All truss principal rafters within the west part of the barn were noted to contain large notches on the upper face. This could suggest either radical alteration of this part of the roof structure in the past, the timbers were salvaged for re-use from elsewhere, or a combination of both. In either situation, the resulting loss of cross-section was considered likely to be structurally significant

The notches within the upper face of the principal rafters should be assessed for structural significance by the Structural Engineer. At this stage, allowance should be made for repairing the rafters with new timber to match existing to reinstate strength capability

Historic structural decay had affected the south bearing end of truss T8 within the west end of the barn (bike store). This had been remedied using softwood partnering timbers fixed to both sides of the tie-beam. No structural decay was found to be affecting the partnering timbers, and moisture content readings were too low for decay to occur. No further deflection of the tie-beam was noted at the time of survey, although the west side partner may have been inadequately sized

The partner repair to truss 8 should be assessed for suitability by the Structural Engineer

There was localised loss of sapwood content which could be regarded as loss-of cross-section and a reduction in the strength capacity of the elements, but was most likely not structurally significant. These areas have been identified on the attached plans

3 Purlins: There was widespread evidence of purlins having been replaced during previous repair efforts, and a clear distinction between suspected more recent timbers and ‘older’ timbers was visible even from below. For the most part, no issues with damp and decay were detected on drilling, despite being embedded within potentially damp masonry (east end – although in this location timbers were generally isolated with through-ventilation and placed on large padstones)

The bridle joint between sections of the upper purlin to the south of bay 3 was noted to be separating and it was suspected the joint retention pins may have snapped in-situ. There was damp-staining and evidence of water penetration around the lower purlin on the south pitch within the roof void of the west part of the barn, above the bike store. External visual assessment of the flashing between the east and west parts of the south barns was noted to be failing and inadequate. There was no access to inspect the bearing end of the purlin at the time of survey, but the water penetration from above may have resulted in structural decay

Purlin sections suspected to be non-original are shown on attached plans

Purlins were in the most part deemed suitable for retention at the discretion of the Structural Engineer. However, allowance should be made for strengthening the separating bridle joint of the upper purlin on the south pitch of bay 3 with steel strapping as directed by the Structural Engineer

4 Common rafters: All rafters were preliminarily identified as being of oak at the time of survey, and well over 50 per cent suspected to be non-original and replacements during roof repair efforts in the past. In general, common rafters were found to be in good condition, largely due to adequate ventilation and eaves coverage. 1no. rafter in Bay 3 was noted to be split at the foot, and 1no. rafter suspected to be decayed at the extreme east end of the west part of the barn on the south pitch, although due to access restrictions this could not be drilled

Common rafters were deemed suitable for retention at the discretion of the Structural Engineer. The split rafter should be replaced with new to match existing. The existing rafter should be cut back to the lower purlin and replaced with new material to bridge from the lower purlin to the south wall plate

5 Wall plates: No structurally significant timber decay was detected on drilling wall plates, although localised evidence of sapwood loss from wood-boring beetle, and subsequent loss of cross-section, was identified, as well as one instance of missing retention pins in Bay 2. There was no access to inspect the wall plate in the west part of the barns due to the dry-lining installation throughout, but risk of structural decay affecting the wall plate was considered low due to no evidence of issues with penetrating moisture to the south, west, or north side of the building at ceiling/eaves height in this area

Wall plates were deemed suitable for retention at the discretion of the Structural Engineer who may wish to comment on those areas where loss of cross-section has been identified

6 Hip/valley rafters: Hip and valley rafters were confined to the conjoining between the south barn complex and the west barn. Water-staining was noted at the hip rafter to the north-west corner of the roof, and although no structural decay was detected on drilling, this area was considered highly vulnerable and at high-risk of structural decay, and most likely related to failing flashings at the roof structure interface

Hip and valley rafters, where identified, were suitable for retention at the discretion of the Structural Engineer. During stripping of the roof, timber directly within the suspected area of water penetration should be drilled for decay detection and any decayed timber partner repaired or replaced with new to match existing (oak)

3.2.2 First floor structures

1 General: As with the roof structures, overall structural condition of first floors were found to be very good - however this was mainly due to the fact that the majority of timbers which made up the floors across Bays 1-2, 3 and 6-7 had been replaced in the 20th Century, with no timbers suspected to be original. Localised areas of

timbers affected by wet rot decay were observed at the east end of Bay 1 and across Bays 6 and 7 on the north side. Natural defects were found on a number of ceiling joists within Bays 1 and 2 and evidence of wood boring beetle was found throughout the structures, with some areas of infestation currently active, sustained by surface moisture contents found to be at the decay threshold of ~20 per cent w/w

No chemical remedial treatment is either required or recommended in relation to wood-boring beetle infestation or fungal decay organisms. The floor structure was deemed suitable for retention at the discretion of the Structural Engineer, although it is understood that the proposed use of the barns may require alteration/removal of existing floor structures

2 Floor beams: No structurally significant decay was detected on drilling floor beams, including those within Bays 1 and 3, which had bearing ends embedded into masonry. These beams did however feature tracking water and salt staining due to this contact with damp masonry, with superficial decay to the east beam of Bay 1 because of this movement of moisture. Structural vulnerability was also noted at the south end of this same beam because of a minimal depth of bearing, decay to the embedded timber below, and a removed supporting post. Deep moisture contents of beams taken at vulnerable areas were all less than 12 per cent w/w, which is too low to sustain decay organisms. As described above, floor beams were all 20th Century replacements, indicated by clean and square faces and chamfered edges, with all beams showing characteristics as being of oak

Floor beams were deemed suitable for retention at the discretion of the Structural Engineer. However, the cut out supporting post to the easternmost beam should be replaced. Consideration should be given to isolating the bearing ends of beams in contact with masonry using a suitable DPM

3 Floor joists: A small number of floor joists with localised areas of decay or defects were recorded, including decay to 2no. bearing ends where joists were tenoned into floor beams, one of which was structurally significant and likely caused by tracking water as described above. Preliminarily-identified oak floor joists in Bays 1 and 2 were heavily deflected and structurally significant fissure defects and knot decay was noted to 2no. and 1no. joists, respectively. Softwood joists were also partnered to 11no. oak joists however it was clear these were installed to facilitate a level, flat floor above, rather than being remedial repair works. Within Bay 3, joists were found to all be softwood replacements in good condition, with bowing to several joists not deemed to be an issue. Replacement oak floor joists were found throughout Bays 6 and 7, many showing localised loss of sapwood from wood boring beetle but none of which was considered structurally significant. Deep moisture contents of floor joists taken throughout were all less than 12 per cent w/w

Floor joists were deemed suitable for retention at the discretion of the Structural Engineer. Floor joists with defects should be partner repaired or replaced, while floor joists with decayed bearing ends should be cut back to sound material and repaired using matching timber

4 Floorboards: Floor finishes were not inspected in detail at the time of survey as they were not deemed to be of any historical significance: across all floor structures, floorboards were preliminary identified as being of softwood (*Pinus Spp.)* and installed in the 20th Century. Floorboards in Bays 1 and 2 appeared to have been the most recent addition, evidenced by the rich colour of the timbers unaffected by fading, staining or surface finishes. In contrast, floorboards in Bays 6 and 7 had faded, showed signs of staining, with a localised area affected by wet rot and collapse

No chemical treatment required. Decayed floorboards should be removed and replaced to provide safe access to the existing structure. Proposed plans may require floor finishes to be replaced entirely

3.2.3 Suspended timber ground floor to threshing bay

1 Form: Floorboards laid on joists running north to south with a substantial void under of approximately 300mm (unconfirmed) with significant level of debris in void and limited access for confirmation of sleeper wall/joist bearing arrangement. Joist were suspected of being jointed into the threshold beam along the north elevation, again unconfirmed

2 Condition: Given the partial decay of the threshold beam, high adjacent ground levels to the north forming the access ramp, deep moisture content of adjacent timbers including posts which extended below floor level above the threshold for decay, and limited ventilation of the floor due to debris and dust filling gaps between floorboards, significant decay may have occurred to the floor structure towards the north

Further investigation recommended following clearance of the floor of debris and materials

3.2.4 Timber framing

1 Form: Timber framed areas of the south wing were of box frame form built off mid-height masonry with square panels and principal posts of possible earlier construction phase missing several curved braces. Where present behind the weatherboarding, infill panels were woven cleft pales in stud rebates

2 Condition: As with other elements timber framing components were subject to decay detection drilling and deep probing for moisture content readings. Moisture content readings were generally well below the decay threshold of ~20 per cent w/w but significant decay had occurred in the past to the mid-height sill beam topping the half height masonry walls of bays 4 to 6 from east. This appeared to relate to faulty (or absence of) rainwater goods in the past, but some measurements of elevated deep moisture content. The sill beam on both north and south elevations of bay 4 from east had lost up to 75 per cent of its cross-section, with the most significant decay at stud mortices. Total loss of the outer face of the beam had occurred over multiple stud tenons (see elevation drawings for locations). The area of water penetration to the north bearing end of truss 6 had resulted in historic decay and significant deflection/fracturing of the sill beam in this location. Remedial works had introduced a column formed from concrete blocks and a steel lintel over to reintroduce the lost support; however, this did not encompass the plate to the east which was noted to be supported only by a relatively thin pole of softwood timber. This may be structurally significant

No chemical treatment required. Timber framing elements were suitable for retention at the discretion of the Structural Engineer. Allowance should be made for multiple repairs to the mid-height sill beam. Retention of the exposed internal face is likely to be possible with consolidation of joints achieved by partner repairing the external and lower faces and splice repairs to stud tenons

3.2.5 Cross walls

1 Form: Boarding of cross walls was in the most part of historic oak timber, although there were a number of elm boards identified at the time of survey. These were in varying states, with many having lost cross-sectional dimensions due to historic wood-boring beetle infestation of vulnerable sapwood content. The cross wall between bays 3 and 4 was of modern softwood timber, suspected to be from late

C20th intervention. The majority of the timber studwork was considered to be non-original and likely to be contemporary to the widescale remedial works suspected to be from the mid-C19th. Restraint bolt/straps had been included in the west cross-wall to bay 5 between sill beam and bridging beam of the cross-wall

2 Condition: No structurally significant defects were noted, but embedded bearings of sole timbers (especially 1 no. north bearing end between bays 4 & 5 was considered at risk with a deep moisture content of 18 per cent (no decay detected). Door post bearings below suspended timber ground floor in this area were also found to have elevated moisture contents

Cross walls were suitable for retention on refurbishment, and the historic boarding is likely to require retention, removal of which should be in consultation with the Conservation Officer

3.2.6 Lintels

1 Form: Lintels were either formed by the wall plate at eaves height, the mid-height sill beam (see Section 3.2.4, above), or of timber with embedded bearings. Where the sill beam had decayed and fractured over the north door opening in bay 6, the lintel was formed of twin RSJs on masonry piers

2 Condition: No decay was found to embedded bearing ends of lintels

Lintels were suitable for retention at the discretion of the Structural Engineer, and no chemical treatment is required

3.2.7 Wood-boring beetle infestation

Typically, as on most temperate hardwood constructions, wood-boring beetle damage was clearly visible on the majority of timber components forming both roof and floor structures. Flight hole diameter and frass samples identified both Common furniture beetle (*Anobium punctatum*) and Death watch beetle (*Xestobium rufovillosum).* This was in all cases considered historic and not an indication of on-going activity, with the exception of the floor structures above Bays 1 and 2, and Bays 6 and 7. Small piles of frass were visible throughout these floor structures, and although concentrated in certain locations, suggested that there was widespread infestation of the softwood boarding. Ambient moisture content readings taken from the boarding in these locations were generally above 20 per cent w/w, therefore above the decay threshold and high enough to sustain further infestation. As described above, there was also localised infestation confined to natural pockets in the principal rafters of truss 7 (T7) on both the north and south sides

No chemical treatment is required in relation to wood-boring beetle infestation. All actively infested first floor softwood boarding, as highlighted on the attached drawings, should be removed and destroyed prior to refurbishment works to prevent further outbreaks. It is recommended that all first floor softwood boarding, none of which was considered historically significant, is removed as part of these works. Once internal environments are under control, no further outbreaks will be likely as moisture content will tend to drop below the level required to sustain beetle activity (18-20 per cent w/w for Common furniture beetle)

3.3 WATER PENETRATION PROVIDING THE CONDITIONS FOR DECAY

1 Roof and rainwater goods: In general, the south range of barns appeared to be relatively water-tight, other than in the areas described above (notably the north bearing end of truss 6). There were signs of tile slippage at the east end of the north facing pitch sufficient to allow ongoing direct water ingress, and historic decay suggested faulty rainwater goods and/or compromised roof coverings in the past.

There was also water-staining and evidence of water penetration at the extreme east end apex which may be resulting in localised decay of the ridge beam. No access was possible for decay detection drilling at the time of survey due to height restrictions; however, darkening of the timber and staining to masonry below suggested this may be an area of concern. Weatherboarding on the south elevation had been subject to chronic concentrated soaking due to unjointed eaves gutter sections resulting in concentrated discharge down the cladding

2 Ground levels: Ground levels had been built up for an access ramp to the north doors of the threshing barn (bay 5), thereby leading to partial decay of the threshold beam on which the suspended floor joists were (assumed) to be bearing. Conversely the footings of the south elevation had been exposed to enable flat access through the south of bay 6. Falls were generally away from the building and downpipes discharged through open shoes

3.4 REMEDIAL INTERVENTION AND HISTORIC SIGNIFICANCE

3.4.1 Methods of timber conversion

1 Hand conversion: Timber conversion markings are a useful by-product left from construction, and help to build an image of the chronology and alterations that may have been made to a building. Prior to the industrial revolution in the late 18th century, conversion of structural timber was generally by the ‘pit sawn’ method. This conversion technique left slightly off-vertical markings to the faces of timbers, at about 80 degrees to the axis, often with either marginally steeper or shallower markings adjacent which represent the ‘up-down’ method of the sawing action from above and below with the timber resting horizontally on two trestles. This varies from the ‘see-saw’ method of earlier where the timber would be converted on a single central trestle and sawn from either end at an approximate 45-degree angle and ‘cleft’ at the intersection. Tie-beams, being the largest of the elements, were often pit-sawn from large logs roughly in half, and then hewn on the opposite face to remove any bark or sapwood content. Hewing leaves a slightly undulating surface most visible using a low-angled light source, with the sawn face described as the ‘good face’ and mostly positioned to face the most commonly used areas

2 Mechanical and electrical conversion: The industrial revolution and the use of steam-powered machines brought about the introduction of the circular saw which is easily identifiable by the radial cuts in a circular fashion. This was a quick and accurate conversion method which was adopted by most sawmills during the 19th Century. Later on, in the mid-late 19th Century, the bandsaw conversion technique was employed. This left clear vertical markings at 90 degrees to the face of the timber often with repeated patterns reflecting the slight discrepancies in the ‘setting’ of the bandsaw blade. Furthermore, planer/thicknesser markings are similar to bandsaw markings, and still perpendicular to the timber grain direction but less pronounced and closer spaced, and seen on timber converted from the mid C20th onwards. The spindle moulder was introduced in the first few decades of the C20th, but is rarely used for structural timbers unless providing a decorative feature

3.4.2 Visible tooling conversion marks, history of remediation, and likely age

1 General: There was very little evidence of mechanical timber conversion techniques as described in 3.4.1 (2) above suggesting that much of the timber was either from original construction, had been replaced in the past with new or salvaged material, or had been replaced sympathetically recently. Due to the size of the timber elements involved, it was considered highly unlikely that any conversion would have been recently undertaken by hand, but the general condition and patina of the timbers almost certainly indicated the majority of timbers were ‘new’ when installed, albeit mixed in with considerable amounts of salvaged material, further suggesting

widespread remedial repairs to the roof structures in the past

2 In line through butt purlins: Domestic vernacular use of butt-purlins, such as seen throughout the east part of the barn, are typically dated from post-1550 up until 1650. In higher-status buildings, butt side purlins in line occur sporadically much earlier, from about 1400 but seeing as these roof structures belong to agricultural buildings it is likely they are behind the trend (agricultural buildings typically trailed behind any architectural fashions and are generally more prosaic in design) and may date from 1600-1700

3 Trenched purlins: In the west part of the barn over the bike storeroom, the trusses were heavily trenched for purlins to the north with the south pitch retaining the original purlins. This represents a configuration of staggered purlins at 1:2:1 to a bay. This no doubt gave the roof more lateral support and provided more fixing locations for roof finishes. Additionally, judging from the original steep pitch of the roof truss (approx. 55 degrees) it is probable that the roof was originally thatched (a steeper pitch encourages water and snow run-off- which is desirable from an absorbent roof material such as thatch). The additional pair of purlins would also have been advantageous as thatched roofs were heavier than their tiled counterparts. It is therefore likely that the extended more gradual pitch to the north was introduced when the roof was converted from thatch to tile and the inner set of purlins removed

4 Windbracing: A striking dating feature of historic roof structures concerns the almost abrupt straightening of windbraces. Prior to the 1550s, curved windbraces were the norm, but from this date straight windbraces come into use over most of southern England, and became almost universal by the 1570s. The windbraces seen in bay 5 are of fairly straight construction and will therefore date from 1570 onwards, discussed further in 3.7.2 below. In was also noted that there were no historic mortices on either principal rafters or purlins consistent with previous use of wind-bracing. Due to the relatively thin cross-section, and the half-lap joint method of construction, brace elements are often removed during remedial works and replaced with longer trans-truss bracing leaving mortices exposed on both purlins and principal rafters, but this did not appear to be the case at the Aston Hall south barn, further suggesting an earlier construction date. In addition to this, this form of wind-bracing was replaced entirely with other methods around the start of the C18th

5 Diminishing principal rafters: Typically, principal rafters diminished in size towards the apex of the roof. This was common practice until about 1600. None of the principal trusses identified on site were of the diminishing sort, being of fairly uniform dimensions from top to bottom. Therefore, it can be confidently assumed that none of the structures are older than ~1600

6 Raking queen struts: This type of strut trickles into use from the 1550s onwards - another post Dissolution change - without at first matching the normal queen-strut method in numbers. After circa 1600 the general observation is that the queen strut and raking queen strut are equal in popularity for the rest of the timber-framing period, and the relatively rapid changeovers between the different roof and truss types make them useful features in dating

7 Conversion and location: All of the roof truss elements, tie-beams, principal rafters, and strutting were noted to have a ‘good face’ (sawn) with the opposite (less visible) face showing signs of having been rough-hewn with an adze, and although this suggests pre-mechanised timber conversion, the location of the barn being many miles from any form of industry and technology suitable for economically efficient conversion of timber, could allow for misinterpretation of the correct age; however, the condition, patina, dust and debris build-up, and the extent of wood-boring beetle, most likely places the roof structures circa 1600-1700

8 Floor structures: There were, in some instances, large areas of the floor structures that were clearly of a later date, most likely of the mid-late C20th using softwood timber, where clear evidence of mechanical bandsaw conversion,

planer/thicknesser markings, and radial cuts typical of mechanised circular saw conversion were noted. Species identification of suspected modern floor structures indicated Spruce (*Picea spp.)*. Use of softwood, particularly Spruce timber which for economic reasons was only recently imported for structural timber due to inherent poor durability, for the floor coverings in the east part of the south barn complex also indicated mid-late C20th intervention. Bandsaw markings were also noted on the softwood cross wall boarding of truss 3, and the general condition and cleanliness of the timber also indicated this was clearly a recent intervention, most likely late C20th or early C21st. In addition to this, and with the exception of the easternmost bay where historic oak floor joists had been partnered with new softwood timbers, there was little to no evidence elsewhere of large-scale repair work involving splicing/scarfing or partnering of timbers suggesting that any repairs had comprised complete removal and replacement of historic hardwood timbers with new softwood. Main primary beams were also noted to have chamfered edges, a modern form of decoration to the undersides, and slightly incongruous for use in a barn

9 Truss infill panels: Interestingly the remaining intact wattle infill panels have never been 'daubed' i.e., finished with a thick coating of clay-like mud mixed with bonding agents such as straw and animal hair and finished in lime render and paint. Although the staves were conventional with stave holes at the upper joint and channels at the base, the cleft withies were fitted so tightly and fashioned so accurately that there would be no room for any daub to 'key' or hold to. This suggests that the woven infill panels were never intended to be daubed but were simply a visual screen or to prevent the worst of a draft passing through

3.4.3 Re-roofing

Visual appraisal of the bituminous roofing felt on the south pitch revealed a grid patterning, typical of 1970-80s roofing materials, whereas on the north pitch the generally coarse but smooth felt is indicative to a later period, circa 1990. This suggested the roof had most likely been recovered during these two periods. This may have coincided with localised repairs or replacement of timber elements, although it certainly appeared that if replacements had been undertaken new or salvaged material to match existing had been used

3.5 SPECIES IDENTIFICATION

1 Methodology: Samples were taken from timber elements throughout the building using a 12mm plug-cutter drill attachment, labelled and bagged, and subsequently analysed using light microscopy in the H+R laboratory. Microscopic images taken during the process can be viewed in attachments.

2 Results: The vast majority of timber components were found to be of oak (*Quercus spp*.), although as mentioned elsewhere softwood timbers were found in areas of remedial intervention, although generally confined to floor structures. Historic clapboarding on cross-walls was also identified as oak, although several were preliminarily identified as elm (*Ulmus spp.)*, but as in roof structures use of softwood was also evident

3.6 AVIAN NESTING

There were several large nests throughout the building, all of either magpie or jackdaw, evidenced by the typical large-diameter twig content and large piles of discarded feathers. These will locally reduce natural ventilation and provide the conditions for damp and decay and wood-boring beetle infestation of non-structural timbers

All nesting material (and tent wall hangings) should be removed to allow for ventilation to structural timbers, eliminating the conditions in which wood-boring beetle and dampness can thrive. If the building is to be left for a significant period of time prior to refurbishment, installation of netting over holes in the facades should be considered to prevent further avian intrusion

3.7 OTHER STRUCTURAL CONCERNS

3.7.1 East end masonry cracks

Two large cracks were noted at the south-east and north-east corners of the east part of the building, travelling downwards from the eaves to the approximate mid-point. An oak timber tie had been introduced, and large radial cuts from mechanised circular saw conversion suggested this was relatively recent, in an attempt to prevent further eastward structural movement, although it was not clear whether this had been successful or not. There was no evidence that the structural movement had resulted in timber decay as a consequence of water penetration, although may have caused localised racking of the roof and possible dislodgement of timbers embedded in the masonry wall

Structural Engineer to comment on large cracks at north-east and south-east corners, although allowance should be made for significant works to prevent further outward (eastwards) movement of the east gable end

3.7.2 Wind-bracing

There was only wind-bracing noted in one bay, Bay 5, and no indication such as mortices in purlins and principal rafters that would suggest that bracing had been part of the construction in the past. Other than the large cracking in the south-east and north-east corners of the building, there was no evidence to suggest that the lack of bracing had resulted in widespread structural movement or racking of the roof structure; however, bracing of the roof will almost certainly be required to control any fluctuations in live loads

Structural Engineer to assess the necessity of installing wind-bracing. This may require long-term assessment to determine extent of any racking towards the east or west. One method could be to install a structural diaphragm using plywood sheeting; however, this would dramatically alter the internal aesthetics and should be carefully considered

3.8 ACCESS TO ROOF STRUCTURE TO WEST

There was limited access to physically inspect the roof structure to the west above the current bike storeroom. This was due to no walkboards within the void, and polystyrene boarding positioned at ceiling height. Therefore, vulnerable bearing ends of truss tie-beams were drilled from below and only timbers within arm’s reach were drilled and probed for decay detection and deep and surface moisture content readings. However, a visual inspection indicated localised water penetration at the interface between the west and east barns as described above

H+R can return to inspect the roof structure in detail if instructed when clear and safe access is available

4 H+R WORK ON SITE

4.1 H+R inspected all structural timbers by deep drilling and probing, as necessary, so as to determine their decay state and deep moisture content

4.2 H+R inspected all structural timbers for evidence of conversion techniques so as to allocate a likely construction date

5 PROPOSED ACTION BY H+R

5.1 H+R will advise on repair and conservation of timber elements, so as to minimise the risk of decay after refurbishment if instructed

5.2 H+R will advise on remedial detailing, so as to minimise the risk of damp and decay problems after refurbishment if instructed

5.3 H+R will advise on conservation of original fabric with regard to damp, decay and salt damage, as necessary and if instructed

5.4 H+R will review proposed remedial details as these become available if instructed

5.5 H+R will liaise with conservation and historic building authorities, if instructed, so as to ensure the cost-effective conservation of original fabric

5.6 H+R will return to site to inspect other buildings on site for structurally significant decay; and advise on timbers at risk of decay during the latent defect period due to water penetration before and during refurbishment if instructed

6 INFORMATION REQUIRED BY H+R

6.1 H+R require up-to-date copies of project programmes, as these become available

6.2 H+R require copies of up-to-date lists of project personnel and contact lists as these become available

6.3 H+R require copies of proposed remedial details for comment as these become available

6.4 H+R should be informed as a matter of urgency if further significant water penetration occurs onto site; so that advice can be given on cost-effective remedial measures, to minimise the risk of cost or programme overruns and so as to minimise the risk of damp or decay problems during the latent defect period

7 ADMINISTRATION REQUIREMENTS

7.1 H+R require formal instructions for further investigations and consultancy on this project

7.2 H+R require confirmation of distribution of digital and printed copies of reports and site notes

Attachment A

Fig 1:

North elevation; showing a general view of the east part of the south barn

Fig 2:

North elevation; showing a general view of the west part of the south barn

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 3:

South elevation; showing a general view of the east part of the south barn

Fig 4:

South elevation; showing a general view of the west part of the south barn

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 5:

Bays 1 and 2; showing a general view of the roof structure

Fig 6:

Bays 1 and 2; showing significant build-up of debris on the first floor structure within the loft space preventing ventilation and providing the conditions conducive to wood-boring beetle infestation, which was evident in a number of areas

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221   Email: ei@handr.co.uk

Fig 7:

Bays 1 and 2; showing large nest in south-east corner of the east end, again, limiting ventilation around vulnerable structural timbers and may provide the conditions for damp and decay

Fig 8:

Bays 1 and 2; showing partnering of the purlin at the east end

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 9:

Bays 1 and 2; showing significant and well-established plant growth emanating from between the structure and the external cladding, and penetrating the roof structure. This was not considered detrimental at the time of survey, but should be eliminated to prevent detachment of external boarding in the future

Fig 10:

Bays 1 and 2; showing bearing end of truss 1. Note the relatively 'clean' face of the timber elements suggesting almost certain replacement in the past

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221   Email: ei@handr.co.uk

Fig 11:

Bays 1 and 2; showing the cross wall between bays 2 and 3. Boards were of historic oak timber, with hand sawn conversion markings throughout

Fig 12:

Bays 1 and 2; showing softwood packing timbers between rafters and the purlin on the north pitch of bay 1, indicating relatively recent intervention to straighten the roof pitch, possibly during re-roofing works circa 1980s

Note the bituminous roofing felt

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 13:

Bays 1 and 2; showing piles of wood-boring beetle frass on the upper face of the softwood floorboards. Size and consistency of the frass was typical of Common furniture beetle (*Anobium punctatum*)

Fig 14:

Bays 1 and 2; showing large crack in masonry in south-east corner of the building. This matched an equally large crack in the north-east corner, and should be assessed by the Structural Engineer for significance

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 15:

South wing, bay 1; showing example of suspected more recent hardwood intervention in the roof structure on the north side. Rafters generally square, more square than historic elements elsewhere

Fig 16:

South wing, bay 1; showing handsaw timber conversion technique on face of suspected later hardwood intervention rafter

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221   Email: ei@handr.co.uk

Fig 17:

South wing, bay 1; showing typical slightly off perpendicular sawing marks on suspected original historic timber, consistent with pit sawn timber conversion

Fig 18:

South wing, bay 1; showing typical off square pit sawn timber markings on west face of north principal rafter

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221   Email: ei@handr.co.uk

Fig 19:

South wing, bay 2; showing typical off perpendicular pit sawn timber conversion techniques on tie beam at north end

Fig 20:

Bay 1, south wing; showing undulating markings on east face of tie beam of truss 1, typical with adze conversion use

Fig 21:

South wing, bay 1; showing adze conversion markings on east face of south strut for T1

Fig 22:

South wing, bay 1; showing pitsaw conversion markings on west face of south strut for T1

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221   Email: ei@handr.co.uk

Fig 23:

South wing, bay 2; showing roof structure between upper and lower purlins and marked difference between newer elements and original historic components

Fig 24:

South wing, bay 2; showing relatively new oak pins at purlin joint on north pitch

Fig 25:

South wing, bay 2; showing cross wall between bays 2 and 3

Fig 26:

South wing, bay 2; showing adze shaping on face of larger board comprising cross wall between bay 2 and 3

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 27:

South wing, bay 2; showing hand sawn conversion markings on boards between bays 2 and 3

Fig 28:

South wing, bay 2; showing clear irregular band saw markings on face of boards between bays 2 and 3, suggesting the boards may originate from varying stages of the past

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 29:

South wing, bay 1; showing clear circular saw markings on timber tie between truss 1 and extreme east masonry wall

Fig 30:

South wing, bay 1, ground floor; showing timber beam supporting the first floor joists and cleanly shaped to the underside and relatively straight clear lines, suggesting most likely from much later than original construction, although remains clear pit sawn timber conversion markings

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 31:

Ground floor, south wing, bay 2; showing floor beam to west side, again with clean chamfered edges but with also visible pit sawn timber markings

Fig 32:

South wing, ground floor, bay 1; showing clear planer/thicknesser markings on door frame elements to east and west, showing much later hardwood intervention, most likely late 20th Century

Fig 33:

Bay 3; showing a general view of th cross wall between bays 2 and 3 from the west side. Note the general squareness and patina of the timber studs above and below the tie-beam, suggesting intervention in the past

Fig 34:

Bay 3; showing the cross wall between bays 3 and 4. All boards had been replaced relatively recently with new machined softwood timber. Note the large halvings on the principal rafters indicating re-use

Fig 35:

Bay 3; showing some loss of cross-section to the upper edge of the principal rafter of truss 2 although not sufficient to result in any structural significance

Fig 36:

Bay 3; showing again, rafters generally square and clean suggesting likely intervention in the past

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221   Email: ei@handr.co.uk

Fig 37:

Bay 3; showing the cross wall between bays 2 and 3 and the relative squareness and good condition of the studwork above the tie-beam

Fig 38:

Bay 3; showing further nesting material (most likely jackdaws/magpies) in the north-east corner of the bay, locally reducing ventilation to vulnerable timber elements

Fig 39:

Bay 3; showing further small piles of frass consistent with Common furniture beetle, and although no structurally significant timber decay was detected, these localised areas will almost certainly extend if left unchecked

Fig 40:

Bay 3; showing further evidence of avian nesting material

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221   Email: ei@handr.co.uk

Fig 41:

Bay 3; showing north post of truss 4. No structural decay detected on drilling, and deep moisture content readings well below the decay threshold. No structural issues identified

Fig 42:

Bay 3; showing the separation of the bridle joint between the upper south pitch purlins. Pins remained in position, but may require strengthening with timber or steel to prevent further movement

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 43:

Bay 3; showing a large fracture in the underside of the north pitch lower purlin. This was not considered a direct result of structural loadings, but more likely an inherent defect in the timber, exacerbated by the natural drying process

Fig 44:

Bay 3; showing the south post of truss 4. No decay detected on drilling, although the element consisted of a high sapwood content and is therefore at elevated risk of wood-boring beetle infestation

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 45:

Bay 3; showing the hand sawn conversion markings on the underside of a rafter on the south pitch

Fig 46:

Bay 3; showing pitsaw markings on the face of the large post to the east side of the south upper storey opening

Fig 47:

Bay 3; showing pitsaw markings on the face of the north pitch lower purlin

Fig 48:

Bay 3; showing clear regular bandsaw markings on the face of the softwood boards of the cross wall between bays 3 and 4

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 49:

Bay 3; showing the large halvings on the east face of the south principal rafter consistent with re-use

Fig 50:

Bay 1 ; showing a general view of the 1st floor structure spanning across bays 1 and 2

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 51:

Bay 1 ; showing localised decay to the bearing end of 1no. floor joist tenoned in to the floor beam

Also showing surface decay and water and salt staining to the face of the floor beam, caused by moisture tracking from damp masonry at the bearing ends of the beam

Fig 52:

Bay 1 ; showing a cut post and decayed embedded timber, which were supporting the floor beam above. Note the depth of bearing of the beam onto the embedded timber is slight. Collectively, this has made the floor beam structurally vulnerable

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 53:

Bay 2; showing a structurally significant large knot defect to an oak floor joist

Note the softwood partner joist, solely installed to provide a level surface for the floor above

Fig 54:

Bay 3; showing a general view of the 1st floor structure

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 55:

Bay 3 ; showing flight holes of wood boring beetle filled with frass, as well as adjacent loose frass caught on the surface of the timbers, which collectively strongly suggests that there is active infestation

Fig 56:

Bay 6; showing a general view of the 1st floor structure spanning across bays 6 and 7

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

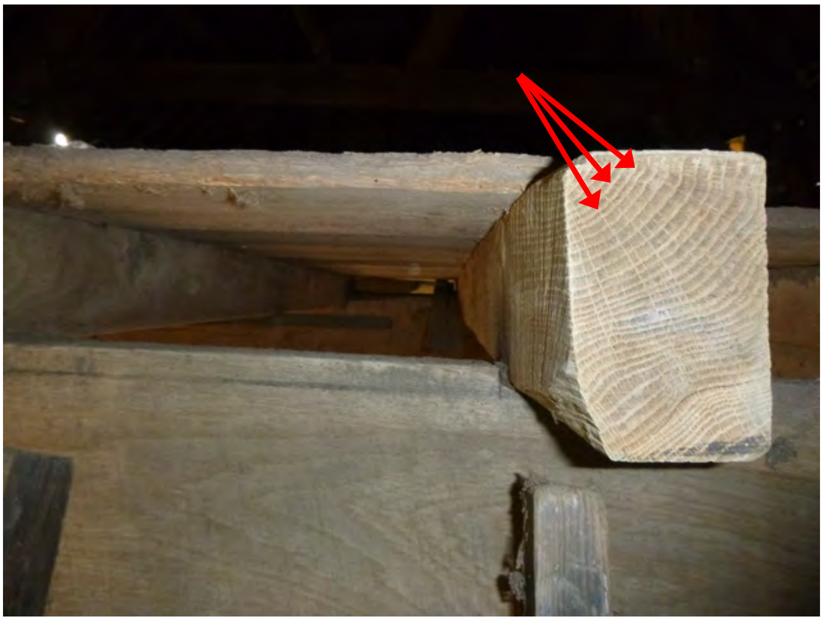


Fig 57:

Bay 5; showing medullary rays on the bearing end of the floor joist, which span out from the pith and are perpendicular to the growth rings. This is a key feature of oak (Quercus spp.) timber

Fig 58:

Bay 6; showing localised loss of sapwood from wood boring beetle to the face of a floor joist, not considered structurally significant

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 59:

Bay 5; showing a general view of the roof structure to the east side and Bay 4. Note the wind bracing in Bay 5, the only Bay to include this element

Fig 60:

Bay 6; showing the bituminous roofing felt suspected to be a result of roof covering intervention during the 1980s

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 61:

Bay 6; showing the general condition of the tie-beam of truss 5. Again, pitsaw conversion markings were noted, as well as the patina suggesting introduction of the timber into the building well after initial construction

Fig 62:

Bay 6; again showing widespread evidence of wood-boring beetle infestation of the softwood first floor coverings. Ambient moisture contents were generally high enough to support further infestation

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221   Email: ei@handr.co.uk

Fig 63:

Bay 6; showing the south wall plate just to the east of truss 6. There was significant structural movement noted of the adjacent truss which was reflected in the separation of the purlin bridle joint and had resulted in snapping of the joint retention pins

Fig 64:

Bay 7; showing the south bearing end of truss 6 and the large fracture in the head of the main post. This was most likely a direct result of decay from water penetration at the north end of the truss tie-beam dragging the tie-beam away towards the north, fracturing the post

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 65:

Bay 7; showing the small fractures at the top of the main post for truss 7. These were not considered structurally significant but may require strengthening with steel to prevent further unwanted movement

Fig 66:

Bay 7; showing a large pocket of decay at the bearing end of the south principal rafter. This was a result of localised wood-boring beetle (Deathwatch) infestation of vulnerable sapwood content. The north principal rafter was also noted to have a matching pocket of decay suggesting both elements had been converted from the same piece of timber

Fig 67:

Bay 7; showing the pocket of decay at the bearing end of the north principal rafter

Fig 68:

Bay 7; showing a general view of the cross wall between bays 7 and the west part of the barn (bike store). The over-sized lath construction panel in-fill is a local feature, removal of which should be in consultation with the Conservation Officer and may require detailed recording prior to refurbishment

Fig 69:

Bay 7; showing the large fracture in the tie-beam at the north bearing end of truss 6. This was considered most likely a result of failure of structural elements below, particularly in the main post and the supporting plate, primarily from persistent rain water penetration and subsequent decay. Note remediation in the recent past using steel angle bracket, threaded rods, and softwood bracing

Fig 70:

Bay 6; showing the failure and separation of the north wall plate bridle joint to the east of truss 6

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 71:

Bay 6; showing carpenters markings on the east face of truss 6 tie-beam

Fig 72:

Bay 5; showing a general view of the south pitch of the roof structure from the west. Again, note the wind brace which was a feature not seen elsewhere, but was most likely throughout on original construction

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 73:

Bay 6; showing failure of the rainwater drainage system at the time of survey resulting in saturation of external cladding and structural timber elements within

Fig 74:

Bay 6; showing saturation of structural timber elements on the north side from inadequate rainwater drainage, which had clearly resulted in structural decay of elements in the past, and was considered likely to do so in the future unless remedied

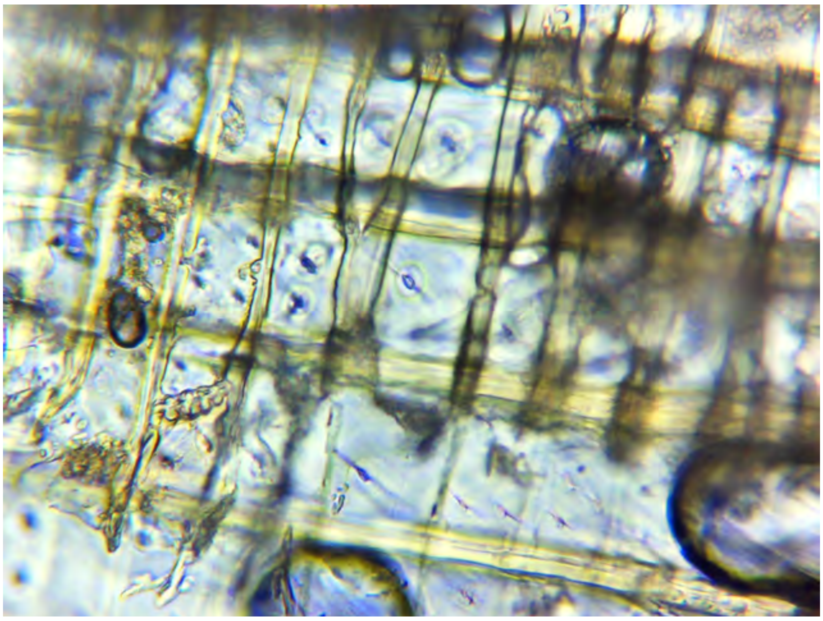


Fig 75:

Laboratory image; showing a microscopic image of a radial section cut from a floor joist in bay 3

Note the piceoid pitting in the cross-field typical of timber relating to Spruce (*Picea app.)*

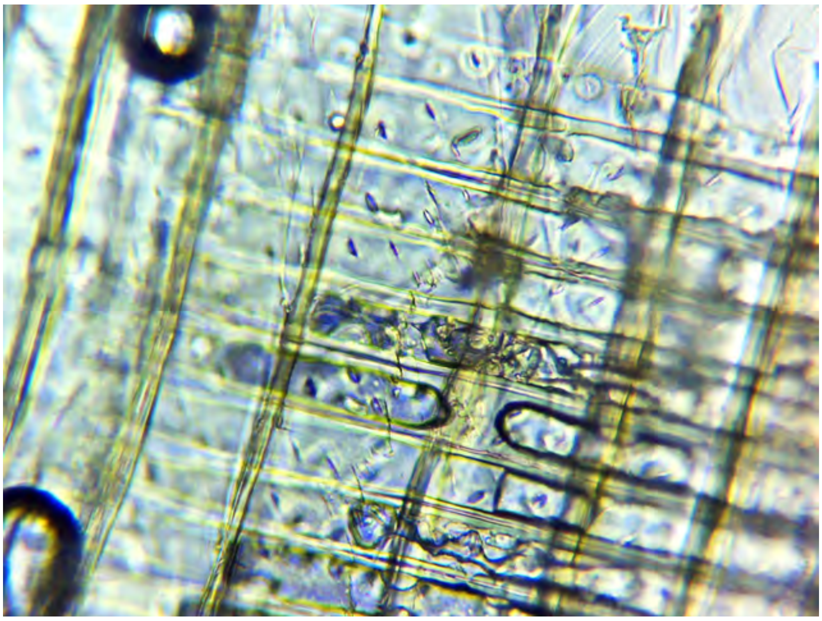


Fig 76:

Laboratory image; showing a microscopic image of a radial section cut from a tie-beam partner from truss 8

Note the piceoid pitting in the cross-field typical of timber relating to Spruce (*Picea app.)*

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

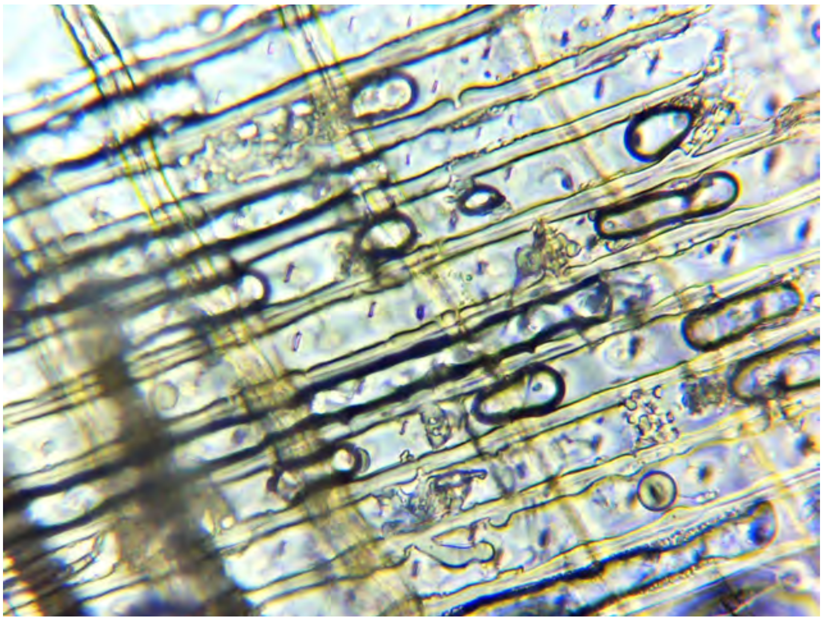


Fig 77:

Laboratory image; showing a microscopic image of a radial section cut from a sample retrieved from one of the studs of the cross-wall between bays 3 and 4

Note the piceoid pitting in the cross-field typical of timber relating to Spruce (*Picea app.)*

Fig 78:

Laboratory image; showing a microscopic image of a timber sample retrieved from a tie-beam at the time of survey

The ring-porous nature of the growth, and the strong medullary rays perpendicular to the growth rings are both features consistent with oak (*Quercus spp.)*

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 79:

Laboratory image; showing a microscopic image of a timber sample retrieved from a principal rafter at the time of survey

The ring-porous nature of the growth, and the strong medullary rays perpendicular to the growth rings are both features consistent with oak (*Quercus spp.)*

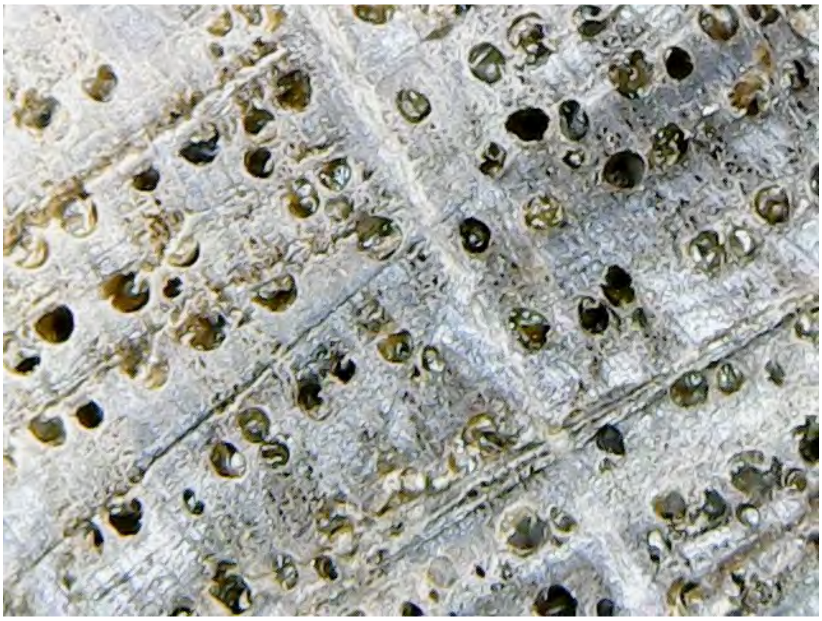


Fig 80:

Laboratory image; showing a microscopic image of a timber sample retrieved from a truss strut at the time of survey

The ring-porous nature of the growth, and the strong medullary rays perpendicular to the growth rings are both features consistent with oak (*Quercus spp.)*

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

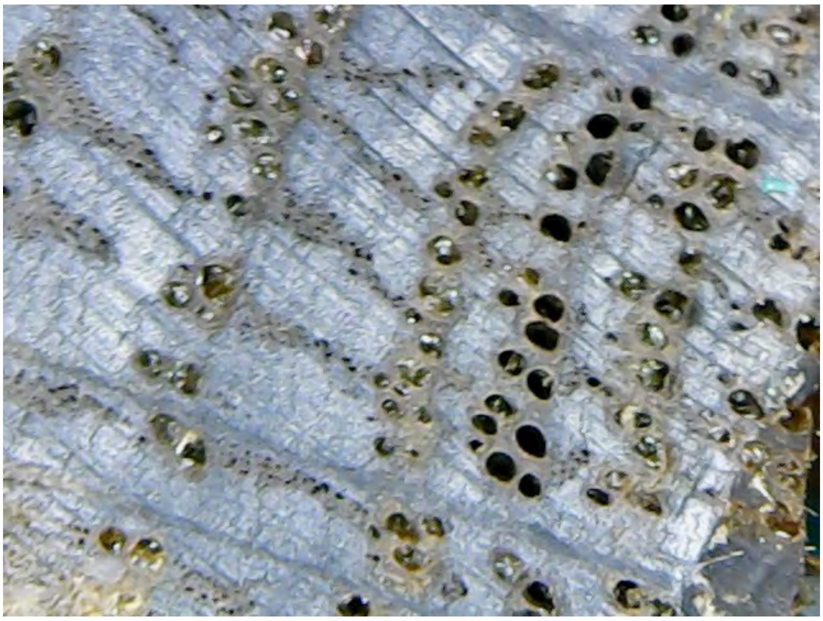


Fig 81:

Laboratory image; showing a microscopic image of a timber sample retrieved from a hardwood floor joist in bay 1 at the time of survey

The ring-porous nature of the growth, and the strong medullary rays perpendicular to the growth rings are both features consistent with oak (*Quercus spp.)*

Fig 82:

Laboratory image; showing a microscopic image of a timber sample retrieved from a common rafter in bay 6 at the time of survey

The ring-porous nature of the growth, and the strong medullary rays perpendicular to the growth rings are both features consistent with oak (*Quercus spp.)*

Fig 83:

West part of south barn; showing a general view of the area from the west. Note there was no access to assess the roof timbers due to no boarding being in place; however, tie-beams were visible from ground floor below and drilled and probed for decay and moisture content

Fig 84:

West part of south barn; showing a general view of the roof structure and truss 10, from hatch in west end. Note the large notches in the upper edge of the principal rafter indicating either re-use or re-configuration of the structure (likely)

Fig 85:

West part of south barn; showing the extreme west gable end where there were indications of water penetration, but no suggestion of structural timber decay as a result

Fig 86:

West part of south barn; showing the polystyrene ceiling boards and lack of walkboards for access to assess timber elements

Fig 87:

West part of south barn; showing large area of nesting material in south-east corner of roof void, again, limiting ventilation to vulnerable structural timbers and providing the conditions conducive to wood-boring beetle infestation and decay

Fig 88:

West part of south barn; showing evidence of water penetration at the interface between the main part of the south barn and the bike store area. Externally it was clear that flashings required replacement

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221   Email: ei@handr.co.uk

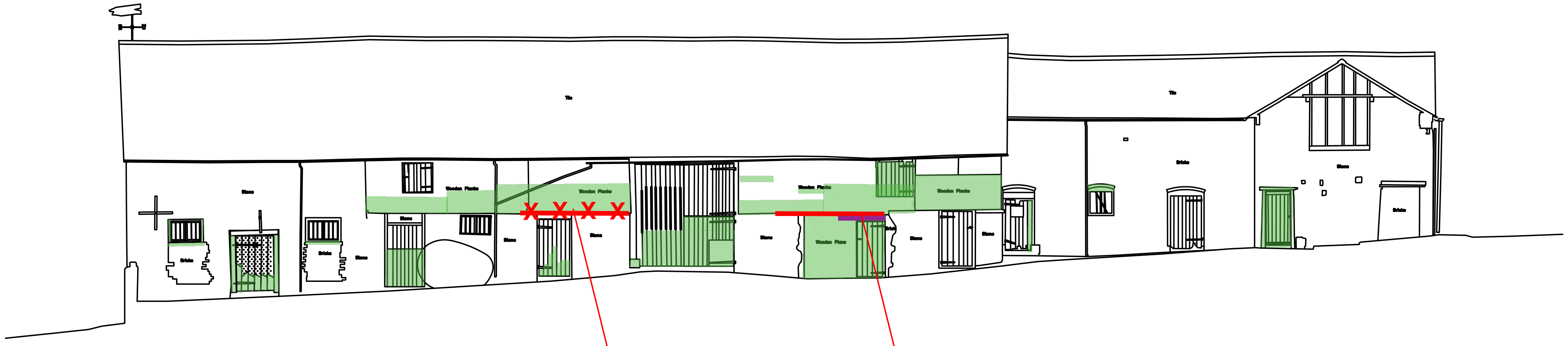
Fig 89:

West part of south barn; showing a general view of truss 8. Access was unavailable to inspect timbers in detail

Fig 90:

West part of south barn; showing the void formed by the dry-lining in this part of the barn, isolating the internal space from the external walls

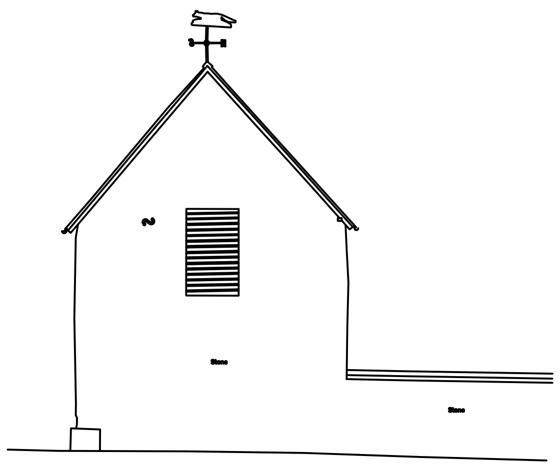
Attachment B



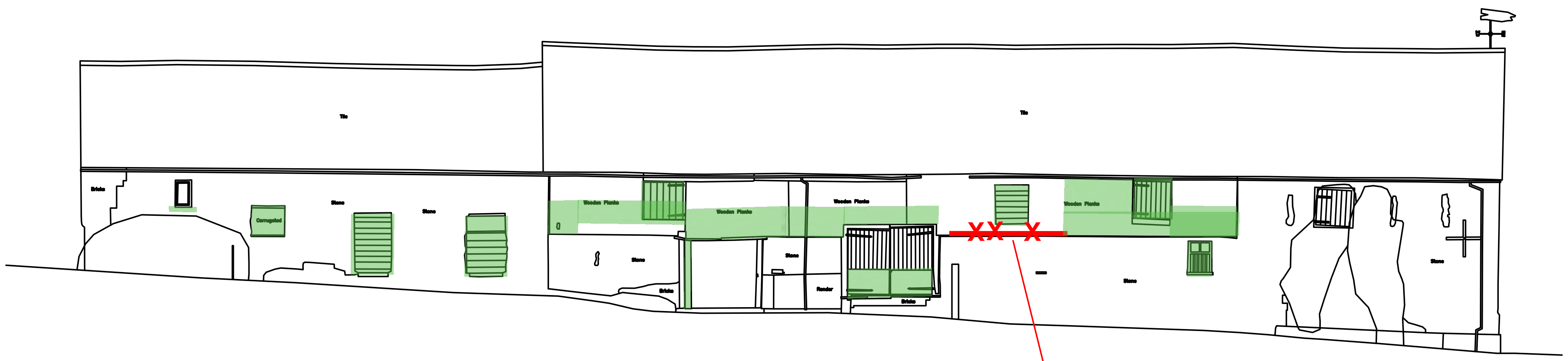
Decayed mid-height sole plate/sill beam - concentrated at stud mortices with up to 75% loss of x-section (lower and exterior faces) Principal post tenon ok

Decayed/fractured mid-height sole plate/sill beam - twinned RSJ insertion on brick pier. Generally high superficial and 'dry' deep moisture content suggestive of past treatment or condensation conditions

Elevation 3



Elevation 4



Elevation 5

Decayed mid-height sole plate/sill beam - 30% loss of x-section to east (underside) and compromised mortices - front face of joint decayed over 2 no. tenons. 1 no post bearing floating

Aston Hall, South barn range, elevations

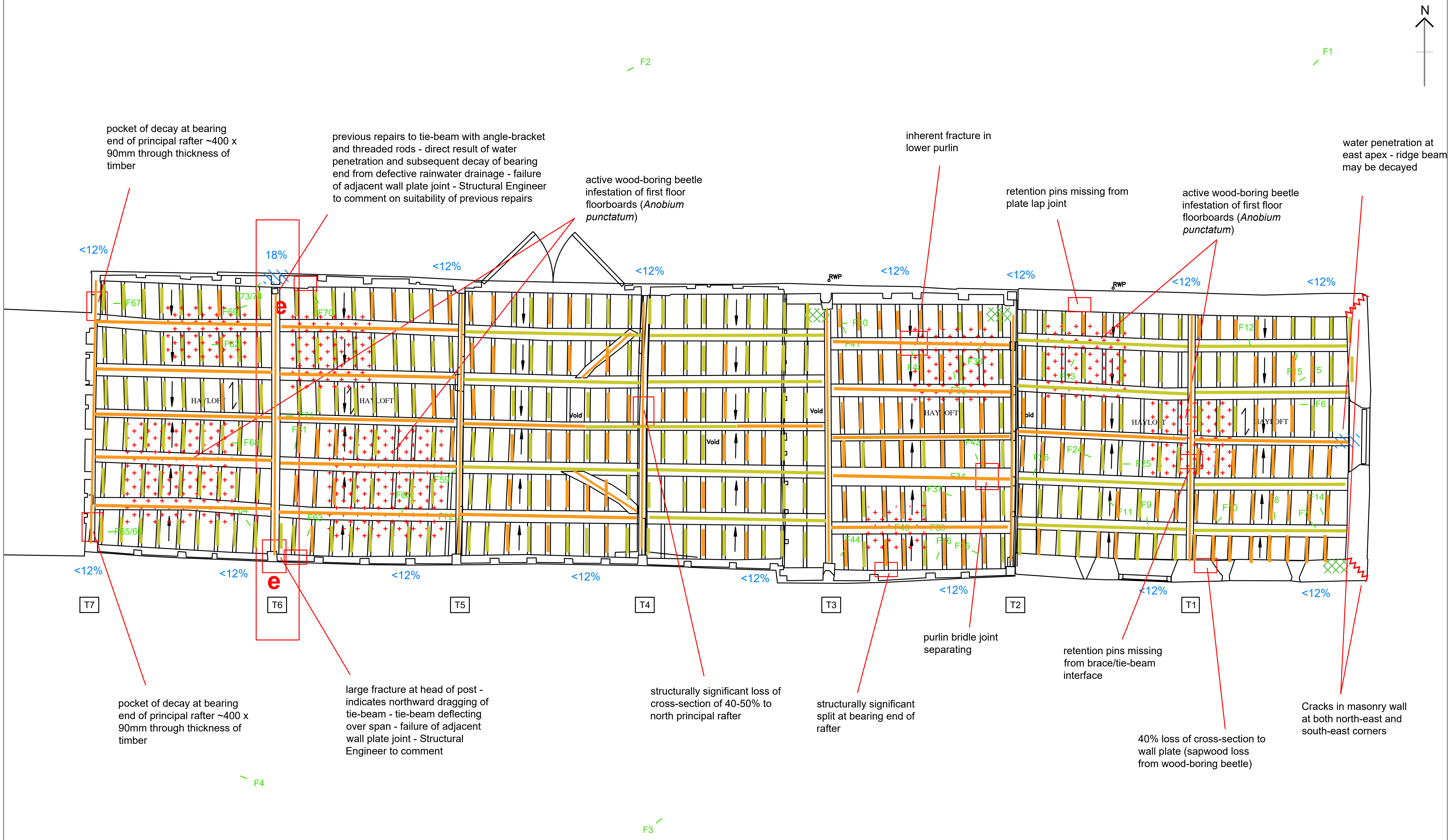
Investigation of structural timber elements

March 2021

Key:

- Timber element suspected to be non-original
- Structurally decayed timber element
- X Decay at mortice
- RSJ repair to sill beam/lintel

Hutton + Rostron Environmental Investigations Ltd
Netley House, Gomshall, Surrey, GU5 9QA Tel: 01483 203221



Key:

- Area of wet rot decay (1st floor boards)
- Area of active wood-boring beetle infestation (1st floor boards)
- <12% Deep moisture content (w/w%)
- F Approximate location of photograph
- T2 Truss reference number
- Timber element of c.C20th intervention
- Timber element of c.C19th intervention
- Timber most likely original (c.C17th)
- **e** Structural Engineer to comment

H+R

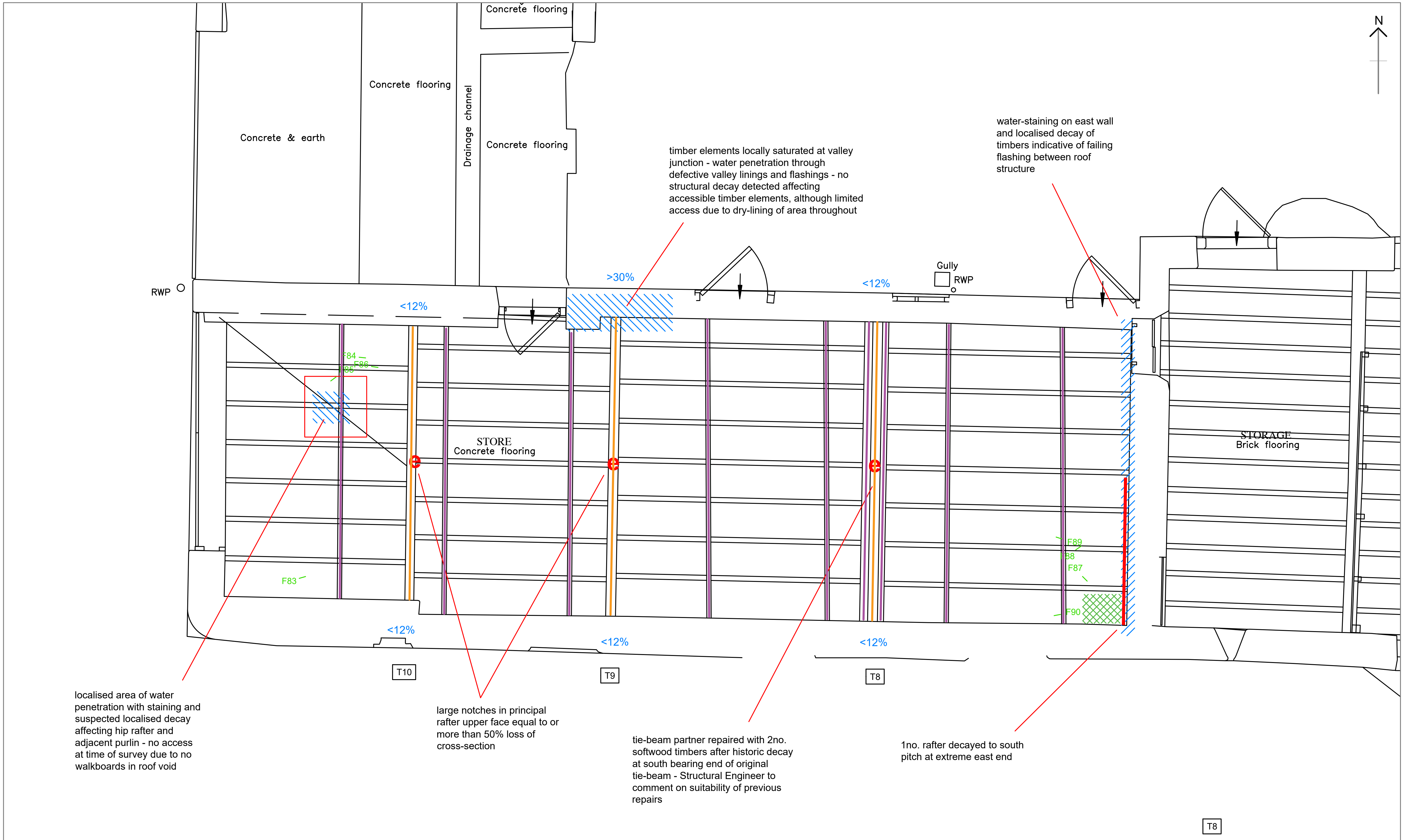
Aston Hall, South barn range, roof - east end

Investigation of structural timber elements

March 2021

Hutton + Rostron Environmental Investigations Ltd
Netley House, Gomshall, Surrey, GU5 9QA Tel: 01483 203221

153.32 Site Note 1 -Not to scale-



Aston Hall, South barn range - roof, west end

Investigation of structural timber elements

March 2021

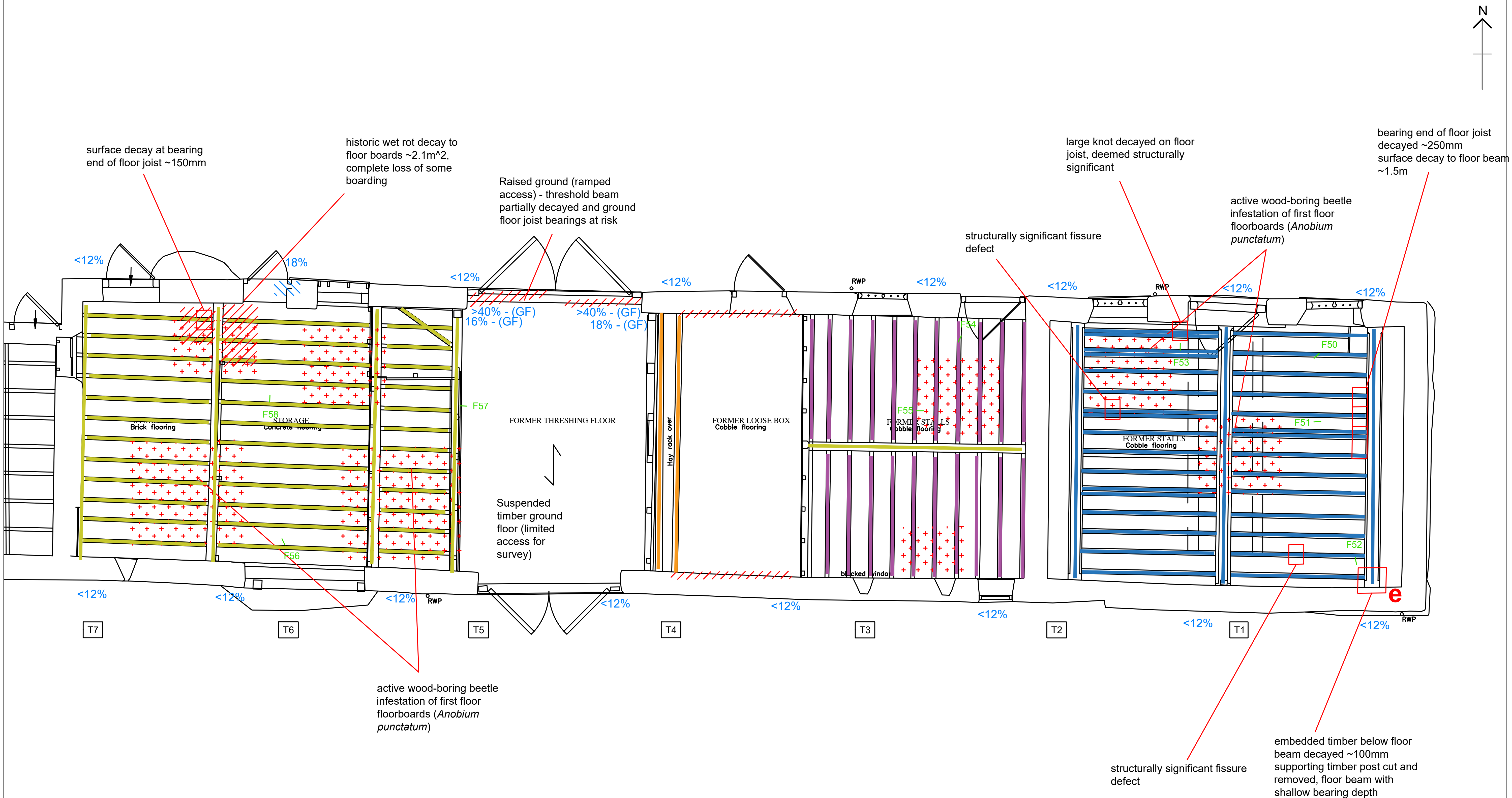
Hutton + Rostron Environmental Investigations Ltd

Netley House, Gomshall, Surrey, GU5 9QA Tel: 01483 203221

153.32 Site Note 1 -Not to scale-

Key:

- Area of wet rot decay (1st floor boards)
- Area of active wood-boring beetle infestation (1st floor boards)
- <12% Deep moisture content (w/w%)
- F Approximate location of photograph
- T2 Truss reference number
- Timber element of c.C20th intervention
- Timber element of c.C19th intervention
- Timber most likely original (c.C17th)
- e Structural Engineer to comment



H+R

Aston Hall, South barn range, first floor - east end

Investigation of structural timber elements

March 2021

Hutton + Rostron Environmental Investigations Ltd

Netley House, Gomshall, Surrey, GU5 9QA Tel: 01483 203221

153.32 Site Note 1 -Not to scale-

Key:

- Area of wet rot decay (1st floor boards)
- Area of active wood-boring beetle infestation (1st floor boards)
- <12% Deep moisture content (w/w%)
- F Approximate location of photograph
- T2 Truss reference number
- Timber element of c.C20th intervention
- Timber element of c.C19th intervention
- Timber most likely original (c.C17th)
- e Structural Engineer to comment
- Timber element of c.C18th intervention

Hutton + Rostron
Environmental Investigations Limited

Aston Hall: Investigation of structural timber elements – West barns

Site note 2 for March 2021, job no. 153.32

CONTENTS

Attachments

Distribution:

Giles Quarme
Giulia Baldin

Prepared by:	**Technical review by:**	**Administration by:**
Joe Lovelock BSc (Hons)	James Hutton	Kim Meredith

Hutton+Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA

Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

1 INTRODUCTION

1.1 AUTHORITY AND REFERENCES

Hutton + Rostron Environmental Investigations Limited carried out site visits to Aston Hall on 2, 3, and 5 March 2021 in accordance with instructions from Giles Quarme by email, on 16 February 2021 (17:43) on behalf of the clients, Ros and David Cleevely. Drawings provided by Giles Quarme Architects were used for the identification of structures. For the purpose of orientation in this report, the south barn was taken as facing into the courtyard to the north

1.2 AIM

The aim of this survey was to investigate the structural timber elements for condition, and to assess the building for likely intervention in the past. Cost-effective remedial recommendations for repair have been provided where necessary using environmental means

1.3 LIMITATIONS

This survey was confined to the accessible structures. Concealed timbers and cavities have been investigated where necessary by the use of high-powered fibre optics. The condition of concealed timbers may be deduced from the general condition and moisture content of the adjacent structure. Only demolition or exposure work can enable the condition of timber to be determined with certainty, and this destroys what it is intended to preserve. Specialist investigative techniques are therefore employed as aids to the surveyor. No such technique can be 100 per cent reliable, but their use allows deductions to be made about the most probable condition of materials at the time of examination. Structures were not examined in detail except as described in this report, and no liability can be accepted for defects that may exist in other parts of the building. We have not inspected any parts of the structure which are covered, unexposed or inaccessible and we are therefore unable to report that any such part of the property is free from defect or in the event that such part of the property is not free from defect it will not contaminate and/or affect any other part of the property. Any design work carried out in conjunction with this report has taken account of available pre-construction or construction phase information to assist in the management of health and safety risks. The sample remedial details and other recommendations in this report are included to advise and inform the design team appointed by the client. The contents of this report do not imply the adoption of the role of Principal Designer by H+R for the purposes of the Construction (Design and Management) (CDM) Regulations 2015. No formal investigation of moisture distribution was made

2 STAFF ON SITE AND CONTACTS

2.1 H+R STAFF ON SITE

Joe Lovelock
Will Woodward

2.2 PERSONNEL CONTACTED

Ros and David Cleevely - Owners

3 OBSERVATIONS AND *RECOMMENDATIONS*

3.1 SUMMARY OF CONSTRUCTION

3.1.1 Arrangement

1 Roof structures: The west barn was aligned along a north-south axis, with a smaller section to the extreme north considered to be a later addition to the structure. To the south the west barn was hipped onto the south-west range. The roof structure consisted of 10no. king-post trusses spanning east-west between the masonry walls dividing the space into 11no. bays. An additional bay was present at the north end with masonry walls to both north and south sides. Trusses were supported at external walls by wall plates, and 1no. purlin per pitch supported rafters at mid-spans. There was significant evidence of remedial intervention throughout the years, and due to historic mortices, slack within brace pockets, and notches in incongruous locations, all of the trusses were considered to have been salvaged from elsewhere, but had however most likely been in the current location since circa mid-C19th

2 Floor structures: Floor structures were found within all bays with the exception of bays 1 and 7, where the building was open to the roof. Main floor beams spanned the building east-west and were in the most part supported within masonry pockets at external walls. The majority of joists, within the main area of the west barn, spanned north-south, although there were localised areas of floor structure to the north end of the building with altering configurations

3.1.2 Materials

Timber samples were taken throughout of the barn so as to identify timber species for strength grading (see Site Note 5), and to highlight the differing interventions in the past, helping to create a narrative. The majority of timber preliminarily identified on-site was found to be of White Oak (*Quercus robur/petraea*), although as in the south range of barns, there was some more recent use of softwood in areas of localised repair, or wholesale replacement, particularly of floor structures, although this was mostly confined to the north areas. Floorboarding was in the most part of double-boarded and lapped waney-edged historic oak; however, this had failed in the past and been sheeted over with modern plywood. Species identification also revealed unusual use of Horse chestnut (*Aesculus hippocastanum*) timber for joists at the north-west area of the barn suggesting adaptation to availability of local products may have determined timber selection

3.1.3 Dimensions

In stark contrast to the construction of the south range of barns, the timber elements comprising the roof structures in the west barn had been converted in a more methodical manner, and in general dimensions were consistent throughout. As such, the west barn roof structure was considered of a much later date than the south barn. Floor structures however, were deemed to be much earlier than the roof, suggesting widespread remedial intervention in the past

1 Roof structures:

Tie-beams	-	~260 x 105mm
Principal rafters	-	~220 x 120mm
Raking struts	-	~80 x 90mm
Common rafters	-	~90 x 80mm at ~480mm centres
Wall plates	-	~190 x 100mm
King posts	-	~140 (300) x 120mm
Purlins	-	~140 x 140mm

2 Floor structures:

Bays 2-10:

Floor beam	-	~270 x 130mm
Post supporting beam	-	~150 x 160mm
Floor joists	-	~120 x 90mm at ~500mm centres

Bay 11:

Floor beam	-	~280 x 130mm
Floor joists	-	~180 x 50mm at ~350mm centres

Bay 12:

Floor beam	-	~110-125 x 80-100mm (variable)
Post supporting beam	-	~110 x 110mm
Floor joists	-	~100-140 x 75mm at ~375mm centres

3.2 TIMBER CONDITION

3.2.1 Roof structures

1 General: As with the south range of barns, there was limited evidence of water penetration resulting in structural timber decay. However, the introduction of large steel structures at the approximate mid-point of the building, and the obvious outward leaning of the east façade, indicated attempts at remedying significant structural movement

No chemical remedial treatment is either required or recommended in relation to wood-boring beetle infestation or fungal decay organisms. The roof structure was deemed suitable for retention at the discretion of the Structural Engineer, albeit with localised repairs

2 Trusses: Trusses were drilled for decay detection and probed for deep and surface moisture content readings to determine the extent of any decay and vulnerability to further decay. No structurally significant decay was detected on drilling at at-risk bearing ends, and in general, moisture content readings were considered ‘normal’ for the ambient internal environmental conditions and exposed nature of the building and too low to provide the conditions for wet rot decay, but elevated enough to allow for wood-boring beetle infestation of non-structural sapwood bands of the timber

Truss 10 (T10) at the north end of the barn was noted to have decayed in the past, and had been repaired using steel L-brackets and re-supported on a post, itself supported on the floor structure. The post being supported by the floor structure was considered unlikely to be adequate to support the re-direction of the loading, and additionally was suspected to be affected by active wood-boring beetle infestation and subsequently weakened further. Active water penetration was occurring at this location on the west side of the building, resulting in decay of adjacent elements such as wall plate sections and rafters

No chemical treatment required. Structural Engineer to comment on suitability of previous repairs to tie-beam of truss 10 at north end. Consideration should be given to repairing the bearing end of truss 10 using a traditional beam repair eliminating the necessity to support the post on the floor structure. Every effort should be made to re-direct water away from the building to prevent further structural decay affecting vulnerable timber elements

3 Purlins: Purlins were considered contemporary to the king-post trusses and were visually assessed and physically probed for decay detection and deep moisture content readings which were generally well below the decay threshold of ~20 per cent w/w

Drilling of the purlins in the northernmost bay revealed structurally signification decay at the approximate mid-point of the bay on the east pitch. This was associated with localised water penetration due to cut-edge corrosion of the sheet metal roof deck, providing capillary action movement of moisture to the inside face of the roof and tracking down to the purlin

On the east side of bay 9 fungal growth and subsequent decay was detected in the purlin. Again, this was due to localised water penetration through missing roof coverings

The purlin in bay 3 was not supported at either end by a truss. This may be structurally significant

No chemical treatment required. Purlins were in the most part deemed suitable for retention at the discretion of the Structural Engineer. However, allowance should be made for repairs to the purlins of bay 9 and 12 on the east side, and every effort should be made to prevent water penetration before, during, and after refurbishment. Structural Engineer to comment on significance of unsupported purlin in Bay 3. New timber in contact with masonry should be fully isolated using a continuous damp-proof material, through-ventilated air gap, or cut back and re-supported on stone/brick corbels or stainless steel brackets/hangers

4 Common rafters: All rafters were preliminarily identified as being of oak at the time of survey, although several had been replaced with softwood timber in the past, most likely as localised remedial repair

The southernmost rafter on the west side of the building was noted to be affected by a number of inherent defects evidenced as cracks across the face. This was considered unlikely to be structurally adequate

1no. rafter on the west side of bay 11 was found to be decayed at the foot for a length of ~150mm

There was widespread evidence of partnering of decayed/defective timbers, suggesting a history of issues with damp and decay. These were not confined to a specific area, and were noted throughout the roof structure, hinting towards an 'as-and-when' maintenance programme. Partnering timbers were inspected alongside historic elements, and were all considered functional and decay-free, albeit visually unsightly

No chemical treatment required. Common rafters were deemed suitable for retention at the discretion of the Structural Engineer. The southernmost rafter on the west side should be replaced with new to match existing. The decayed rafter foot should be partner repaired by fixing timbers alongside to reinstate support. New timber in contact with potentially damp masonry should be fully isolated using a continuous damp-proof material, through-ventilated air gap, or re-supported on brackets/hangers

5 Wall plates: There were localised instances of wet rot decay affecting wall plate sections, although this was generally confined to the west side of the building where localised moisture ingress was ongoing

A small section of decay ~600mm in length was noted at the bearing end of truss 1 on the west side, although no decay was detected in the associated truss elements. Further small sections of structural decay on the west side were detected in bays 9 - ~200mm, 10 - ~700mm, and bay 11 - ~300mm, each resulting in >50 per cent loss of effective cross-section. One further section on the east side was detected in bay 12 for a length of ~500mm

Wall plates were deemed suitable for retention at the discretion of the Structural Engineer who may wish to comment on those areas where loss of cross-section has been identified. Decayed sections of wall plate should be cut back to sound *material and replaced with new to match existing, and jointed to remaining sections using traditional lap joints. New wall plate timber in contact with potentially damp masonry should be fully isolated using a continuous damp-proof material*

3.2.2 Floor structures – WW

1 General: Given the suspected historic age of the floor structures, particularly the structural beams (discussed in detail in 3.5 below), the condition observed was generally consistent with its timeline. The history of significant structural faults with the west barn is reflected in many of the structural beams, whereas floor joists assumed to be later replacements of varying ages were generally in much better condition. Wet rot decay had extensively affected the floor finishes, leaving the first floor unsafe and unusable. There was some evidence of historic wood-boring beetle however the considerable build-up of limewash to the timbers between Bays 2-10 had clearly provided some protection from attack over the years

No chemical remedial treatment is either required or recommended in relation to wood-boring beetle infestation or fungal decay organisms. The floor structure was deemed suitable for retention once structural failures are addressed, at the discretion of the Structural Engineer, although it is understood that the proposed use of the barns may require alteration/removal of existing floor structures

2 Floor beams: No structurally significant decay was detected on drilling floor beams, despite the fact that the bearing ends of all beams were embedded into masonry. The majority of floor beams were sat on timber pads embedded in the masonry, with 1no. pad weakened by a large mortice (evidence of the timber being salvaged from elsewhere, as described in 3.5). There was evidence that another pad within Bay 4 had been replaced with masonry, which meant the beam above was currently vulnerable to decay as no DPC was noted. Within the same bay 1no. partner-repaired beam was structurally compromised due a shear crack 1m in length, and the supporting post underneath was structurally decayed at the base, with ~40 per cent loss of section size. The beam to the north of the bay was also structurally compromised, due to a large split through an open mortice. Elsewhere, 2no. floor beams between Bays 8-10 had lost 25-35mm of bearing depth, due to the outward spreading of the east masonry wall before (and perhaps after too) the installation of the remedial steel structures

No chemical treatment required. Floor beams were mostly deemed suitable for retention at the discretion of the Structural Engineer, however, the 2no. split beams and the 1no. decayed supporting post within Bay 4 should be replaced. Consideration should be given to isolating the bearing ends of beams in contact with masonry using a suitable DPM, and allowance should be made for in-filling the mortice in the 1no. pad with timber to match existing or resin to reinstate structural support for the floor beam. The movement of masonry of the east wall must also be addressed so that the reduced bearing depth of 2no. beams is addressed, providing structural integrity to the floor beams and the west barn as a whole

3 Floor joists: Floor joists throughout were generally in good condition, with defects and decay being limited to within Bays 9 and 10. Surface decay and staining was noted to several joists in Bay 10, associated with wet rot decay to floorboards above, and 1no. joist had split at the bearing end to the south side of Bay 9. A number of ceiling joists had been partnered repaired, mainly within Bay 4. All floor joists between Bays 2 and 10 appeared to be of oak, although this could not be confirmed due to the thick limewash finish. Floor joists within Bays 11 and 12 were of varying dimensions and configurations, however all were softwood construction with no decay detected on drilling

Floor joists were deemed suitable for retention at the discretion of the Structural Engineer. The floor joist with a decayed bearing end should be cut back to sound material and repaired using matching timber

4 Floorboards: Floor finishes were not inspected in detail at the time of survey as the extent of structurally significant decay to floorboards from wet rot was beyond realistic salvage or repair, with large areas of the floor structure devoid of floor finishes due to a history of water penetration and disuse of the first floor area

No chemical treatment required. Decayed floorboards should be removed and replaced to provide safe access to the existing structure. Proposed plans may require floor finishes to be replaced entirely

3.2.3 Lintels and embedded timbers

Lintels and embedded timbers were drilled for decay detection and probed for deep moisture content to determine vulnerability to decay. All lintels were preliminarily identified as being of oak (Quercus spp.) on-site during the investigation, and generally were formed by 2no. sections of large dimension timber. 2no. lintels were found to be decayed by a combination of wet rot and wood-boring beetle infestation within the roof void above the first floor structure. These are shown on attached plans. At ground floor level, lintels on the west side of the building were considered particularly vulnerable to decay from both wet rot and subsequent wood-boring beetle infestation due to the relative high levels of apparent moisture within the masonry, a consequence of high external ground levels and defective roof drainage above saturating lower and upper levels of the wall. In total, 5no. lintels were found to be decayed at ground floor, with embedded bonding timbers generally free of decay. Main floor bam ends were positioned on large embedded oak pads. One of these was found to be decayed at the time of survey. Several of the lintels and embedded beam pads throughout the building were noted to contain large notches, which effectively reduced the cross-section by more than 50 per cent. This may be structurally significant

No chemical treatment required in relation to wood-boring beetle infestation or fungal decay organisms. Decayed timber lintels and main floor beam pads should be cut out and replaced with steel or concrete as directed by the Structural Engineer, who may also wish to comment on the large notches present in many of the timber lintels over window openings at both ground and first floor levels. If required for refurbishment, it would be prudent to cut back the embedded beam ends and re-support on stone corbels or steel brackets to reduce the risk of further structural decay

3.2.4 Wood-boring beetle infestation

Typically, as on most temperate hardwood constructions, wood-boring beetle damage was clearly visible on the majority of timber components forming both roof and floor structures. Flight hole diameter and frass samples identified both Common furniture beetle (*Anobium punctatum*) and Death watch beetle (*Xestobium rufovillosum).* There were a number of areas where active infestation was suspected, this was mainly concentrated in the floor boarding where debris build-up had prevented ventilation, although the post supporting truss 10 was also noted to be actively infested. Small piles of frass were visible throughout these floor structures, and although concentrated in certain locations, suggested that there was widespread infestation of the more recent softwood boarding and historic hardwood. Ambient moisture content readings taken from the boarding throughout the building were generally above 20 per cent w/w, therefore above the decay threshold and high enough to sustain further infestation

No chemical treatment is required in relation to wood-boring beetle infestation. Areas heavily damaged by wood-boring beetle, or highlighted on the drawings as actively infested should be removed and destroyed to prevent further infestation. The post *supporting truss 10 should be removed and the truss bearing end repaired using traditional beam end repairs, as directed by the Structural Engineer*

3.4 WATER PENETRATION PROVIDING THE CONDITIONS FOR DECAY

In general, the west barns appeared to be relatively water-tight; however, there were a number of missing slates on the east pitch of the roof allowing direct water penetration to vulnerable timber elements below, resulting in localised timber decay, primarily at the mid-point of bays 9 and 12. There was also moisture ingress along the west sides and wall plate/eaves height, through defective and missing rainwater goods again saturating internal structural timbers, raising the moisture content to a level that could sustain both fungal decay organisms and wood-boring beetle infestation. External ground levels were particularly high on the west side which was likely to be saturating masonry which could affect embedded timber elements within the west façade

1 West: The west elevation was battered out towards the base. Given the lack of eaves overhang, and in the absence of effective rainwater goods, this had led to concentrated run-off down the rubble stone wall surface with associated deterioration of pointing, accelerated stone decay, loosening and loss of facing stones, and high likelihood of water penetration creating conditions for decay of any first floor joists embedded in this wall. Depressions in the hardstanding, ground and plant growth adjacent to sub-surface downpipe terminations suggested blockage and saturation of adjacent ground. The central section had been re-pointed/rebuilt relatively recently. The valley termination was drained by a high-capacity eaves gutter, but the wall may have been subject to water penetration in the past

CCTV inspection should be carried out for sub-surface rainwater drainage routes/condition. Repointing and consolidation of deteriorated rubble stone walls, especially given tie rod S-pattresses in this location. Consideration should be given to reconfiguring the rainwater goods

2 North: Stepped cracking was evident at the north-east corner and centrally in the north gable end which may allow water penetration into the core of the walls. The widest cracks had been repointed relatively recently and had not recurred. Purlins and wall plates were exposed under a verge with limited overhang and no barge board, and had weathered as a result. The east verge rafter had slipped towards the eaves, but the resulting deflection at the ridge did not appear to have led to significant movement of the slate roof covering

Verge rafter repair, consideration given to barge board to cap exposed end grain of principal timbers. Crack monitoring at direction of Structural engineer (note tie rods in east elevation)

3 East: Some spalling to brickwork of walls over the previously abutting barrel roofed structures had occurred suggestive of ineffective eaves gutter and splashback from adjoining roofs. This may have had implications for embedded timbers in the highly porous brickwork. Efflorescence and spalling towards ground level was localised at assumed locations of previous concentrated run-off and downpipe terminations. Downpipes terminated in open shoes draining directly into the ground but with falls tending to drain away from the footings to the east

Consideration given to dedicated surface or sub-surface drainage for downpipe terminations subject to proposals for re-use

3.5 REMEDIAL INTERVENTION AND HISTORIC SIGNIFICANCE

3.5.1 Background

1 Hand conversion: Timber conversion markings are a useful by-product left from construction, and help to build an image of the chronology and alterations that may have been made to a building. Prior to the industrial revolution in the late 18th century, conversion of structural timber was generally by the ‘pit sawn’ method. This conversion technique left slightly off-vertical markings to the faces of timbers, at about 80 degrees to the axis, often with either marginally steeper or shallower markings adjacent which represent the ‘up-down’ method of the sawing action from above and below with the timber resting horizontally on two trestles. This varies from the ‘see-saw’ method of earlier where the timber would be converted on a single central trestle and sawn from either end at an approximate 45-degree angle and ‘cleft’ at the intersection. Tie-beams, being the largest of the elements, were often pit-sawn from large logs roughly in half, and then hewn on the opposite face to remove any bark or sapwood content. Hewing leaves a slightly undulating surface most visible using a low-angled light source, with the sawn face described as the ‘good face’ and mostly positioned to face the most commonly used areas

2 Mechanical and electrical conversion: The industrial revolution and the use of steam-powered machines brought about the introduction of the circular saw which is easily identifiable by the radial cuts in a circular fashion. This was a quick and accurate conversion method which was adopted by most sawmills during the 19th Century. Later on, in the mid-late 19th Century, the bandsaw conversion technique was employed. This left clear vertical markings at 90 degrees to the face of the timber often with repeated patterns reflecting the slight discrepancies in the ‘setting’ of the bandsaw blade. Furthermore, planer/thicknesser markings are similar to bandsaw markings, and still perpendicular to the timber grain direction but less pronounced and closer spaced, and seen on timber converted from the mid C20th onwards. The spindle moulder was introduced in the first few decades of the C20th, but is rarely used for structural timbers unless providing a decorative feature

3.5.2 Tooling marks and history of remediation

1 General: There was very little evidence of mechanical timber conversion techniques as described in 3.5.1 (2) above suggesting that much of the timber was either from original construction, had been replaced with new or salvaged material, or had been replaced sympathetically recently. Due to the size of the timber elements involved, it was considered highly unlikely that any conversion would have been recently undertaken by hand, but the general condition and patina of the timbers almost certainly indicated the timbers were ‘new’ when installed, albeit mixed in with considerable amounts of likely original or salvaged material, further suggesting widespread remedial repairs to the roof structure in the past, estimated to most likely have been the early C19th. In contrast to the south barns, both faces of the majority of the larger timber elements such as tie-beams, principal rafters, king-posts, and purlins showed typical slightly off-perpendicular markings of having been subject to pit sawn timber conversion, best viewed when shining a light along the timber highlighting the high points of the grain. Smaller timbers were also noted to have been hand converted, with more diagonal up-down markings consistent with common see-saw method of converting dimensionally smaller timber

2 Roof: All tie-beams, bar one, contained a full-span series of historic mortices along the face, indicating either previous use as floor beams (supporting floor or ceiling joists) or that the barn had originally contained a roof void with the mortices providing ceiling joist locations. The exception tie-beam only contained mortices for a half-span and most likely was previously in use to trim an opening. The slot directly above the post/tie-beam interface provides a tightening location for the rod inserted within the truss tying the tie-beam to the king-post (referred to as a captured nut), further suggesting the trusses were constructed as individual elements, i.e. not repaired in-situ. This method of repair is however, a common

operation when replacing tie-beams of historic trusses. The incorporation of metal work such as this, and abandonment of traditional pegging of joints indicates late 1700s to early 1800s. In addition to this, it was noted that in general the tie-beams were of a slightly different thickness to posts, bracing, and principal rafters which may indicate a process of wholescale truss removal, replacement of tie-beams using salvaged materials, and subsequent reinstatement

As described in 3.2.1 (4) above, there was widespread use of partnering of timbers, particularly common rafters, to remedy historic decay. This form of repair can be viewed as sympathetic, retaining much of the original fabric and relatively easy to undertake in-situ, but is however unsightly when done in a haphazard fashion, and provides some disturbance to the visual regularity of the roof structure. On the other hand, this also indicates a form of maintenance scheme, albeit irregular, preventing widespread decay and neglect of the building

3 Floors: As in the roof structures above, historic floor structures were noted to have been entirely hand-converted; however, there were, in some instances, large areas particularly at the north end of the building that were clearly of a later date, most likely of the mid-late C20th using softwood timber joists and flooring. Main beams were considered to be of an earlier date than the roof structure due to having a ‘good’ face and a roughly hewn face indicating earlier methods of conversion, and historic joists were deemed most likely to be contemporary to the earlier period. At the north end, bandsaw markings were noted on faces of joists, specifically on timber floor structures to the north end of the building, where various campaigns of remediation had occurred during the intervening years. None of the ‘newer’ timbers had importation information or strength grading stamps, therefore were not ‘off the shelf’ timbers, but were considered most likely to have been converted locally

4 Lintels and bonding timbers: All lintels and bonding timbers were identified with large mortices and notches within them, indicating clear evidence of reuse and salvage. Many were over 2m in length and considered likely to have previously been in use as large barn door stiles or jambs, with smaller timbers deemed to be salvaged from gates and smaller door openings

3.5.3 Re-roofing

There was widespread use of foam blocks adhered to the underside of the slate roof coverings, and it was unclear at the time of survey what purpose these attempted to achieve, but was most likely to prevent slate slippage. However, this does suggest that re-roofing took place relatively recently, probably within the last 30 or so years, which also may coincide with the introduction of the steel structures to remediate against the outward movement of the east facade mentioned above

3.6 STRUCTURAL CONCERNS

1 Floor beams: A consequence of the outward movement of the east façade of the building, primary floor elements embedded in masonry pockets to the west side showed evidence of having also been dragged to the east, opening up ~50mm gaps between the embedded timber pads and the shoulder of the beam housing. One of the beams had been tied to the plate using wrought-iron strapping, now heavily corroded, although any further movement would be likely to simply detach the plate from the embedment

2 Lintels: As mentioned above, several of the timber lintels contained large notches (presumed to remain from previous use as door components as described above) at the approximate mid-point of the window opening which may be structurally significant. In some instances, the reduction in cross-section approximated to ~70-80 per cent, albeit locally over ~150mm

The efficacy of the steel structures to prevent outward movement of the east façade should be assessed by the Structural Engineer who may wish to comment on the gaps opening up between the main floor beams and the west façade. Allowance should be made for additional tying back of the beams to secure masonry fixings. The large notches in the window opening lintels, and the noticeable deflection of a number of the lintels, should also be assessed for structural significance, but allowance should be made for in-filling notches with timber to match existing or resin to reinstate structural support for the masonry above, or replacement with concrete or steel as necessary, at the discretion and as directed by the Structural Engineer. New timber in contact with masonry should be fully isolated using a damp-proof material, through-ventilated air gap, or re-supported on stainless steel brackets/hangers or stone/brick corbels

4 H+R WORK ON SITE

4.1 H+R inspected all structural timbers by deep drilling and probing, as necessary, so as to determine their decay state and deep moisture content

4.2 H+R inspected all structural timbers for evidence of likely conversion techniques

5 PROPOSED ACTION BY H+R

5.1 H+R will advise on repair and conservation of timber elements, so as to minimise the risk of decay after refurbishment if instructed

5.2 H+R will advise on remedial detailing, so as to minimise the risk of damp and decay problems after refurbishment if instructed

5.3 H+R will advise on conservation of original fabric with regard to damp, decay and salt damage, as necessary and if instructed

5.4 H+R will review proposed remedial details as these become available if instructed

5.5 H+R will liaise with conservation and historic building authorities, if instructed, so as to ensure the cost-effective conservation of original fabric

5.6 H+R will return to site to inspect other buildings on site for structurally significant decay; and advise on timbers at risk of decay during the latent defect period due to water penetration before and during refurbishment if instructed

6 INFORMATION REQUIRED BY H+R

6.1 H+R require up-to-date copies of project programmes, as these become available

6.2 H+R require copies of up-to-date lists of project personnel and contact lists as these become available

6.3 H+R require copies of proposed remedial details for comment as these become available

6.4 H+R should be informed as a matter of urgency if further significant water penetration occurs onto site; so that advice can be given on cost-effective remedial measures, to minimise the risk of cost or programme overruns and so as to minimise the risk of damp or decay problems during the latent defect period

7 ADMINISTRATION REQUIREMENTS

7.1 H+R require formal instructions for further investigations and consultancy on this project

7.2 H+R require confirmation of distribution of digital and printed copies of reports and site notes

Attachment A

Fig 1:

East elevation; showing a general view of the west barn from the south-east

Fig 2:

South end; showing a view of the king-post roof trusses from the southernmost bay

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

Fig 3:

Truss T1; showing the base of the central part of the truss. Note the embedded metalwork and the slot for the captured nut tying the tie-beam to the king-post, the only joint under tension rather than compression. Also note the historic mortices indicating previous possible use as floor beams, or previous installation of ceiling joists

Fig 4:

Upper floor; showing general view towards the south. Note the floor below which was considered unstable and dangerous preventing inspection to a limited number of areas

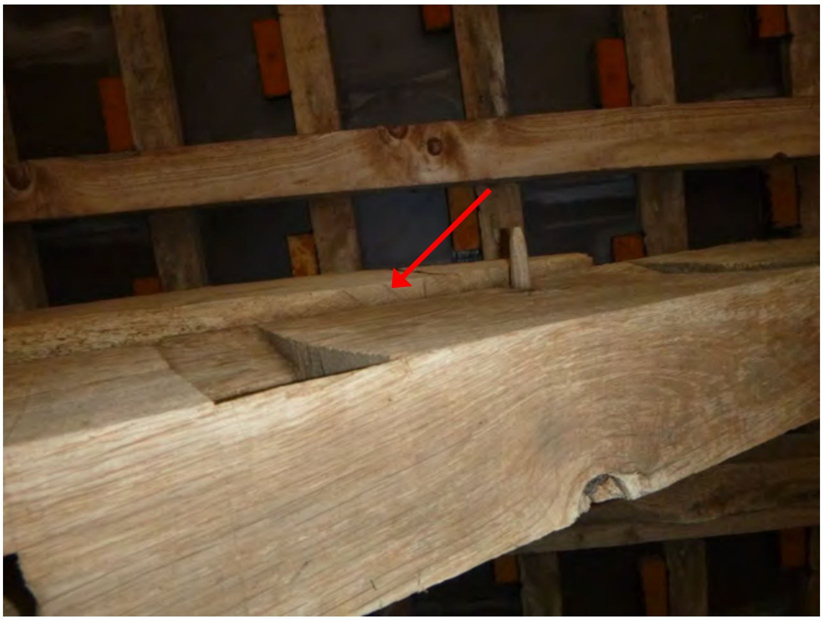


Fig 5:

Truss T2; showing the thickness discrepancy between the tie-beam and the remaining truss elements, measured at ~10-15mm. Note the historic mortices are bevelled

Fig 6:

Truss T2; showing again the discrepancy in thickness between the tie-beam and the king post above, suggesting tie-beam replacement, or reuse of existing materials on original construction

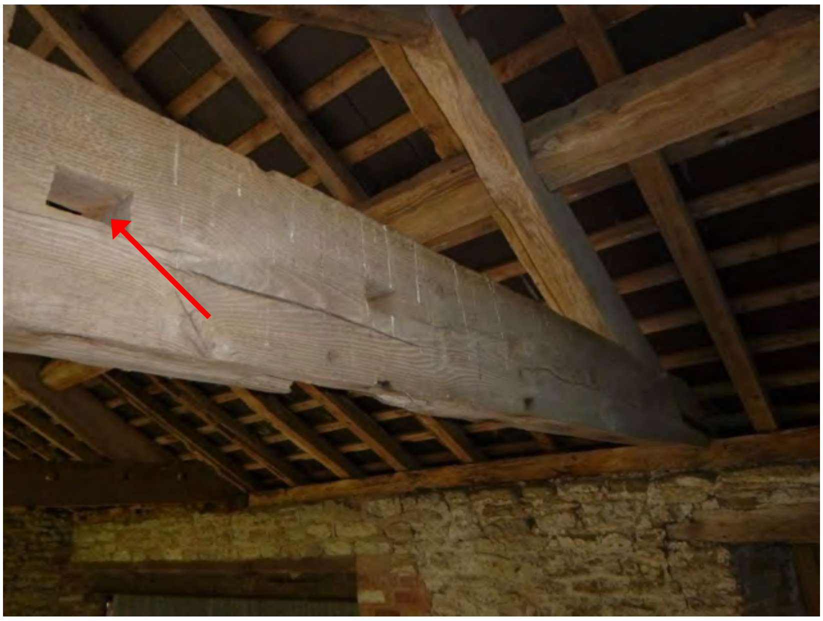


Fig 7:

Truss T3; showing general view of the truss and the historic mortices along the length

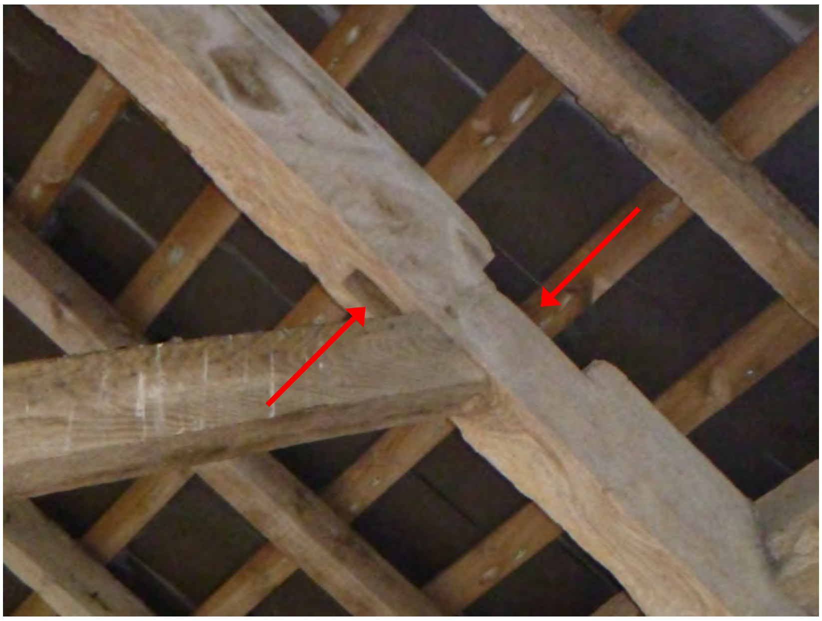


Fig 8:

Truss T3; showing the overlarge brace strut mortice, indicating replacement of struts in the past, and the significant notch on the outer edge of the principal rafter, suggesting possible previous trenched purlins. Both indicating likely reuse or salvage of elements comprising trusses

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

Fig 9:

Truss T2; showing large notch in underside of tie-beam, likely for stud element in previous cross wall. Note circular markings left by brace and auger bit prior to chiselling out remaining ‘meat’

Fig 10:

Tie-beam of truss T3; showing typical pitsaw conversion markings

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

Fig 11:

Roof structure, bay 4; showing mortice in purlin for previous wind brace

Fig 12:

Truss T3; showing metal strapping on truss and carpenters markings on struts and tie-beam usually carved into timbers during construction and may indicate all elements were assembled concurrently, but using salvaged material

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

Fig 13:

Roof structure; showing foam pads glued to undersides of slates to prevent slippage

Fig 14:

Roof structure; showing the historic mortices in the large beam/lintel over the opening at the south end

Fig 15:

Roof structure, truss T4; again showing the discrepancy in thickness between the king-post and the tie-beam

Fig 16:

First floor; showing the overlapping floor boards which had been significantly damaged by widespread wood-boring beetle limiting safe access to inspect areas of roof structure

Fig 17:

First floor; showing the overlapping floor boards which had been significantly damaged by widespread wood-boring beetle limiting safe access to inspect areas of roof structure

Fig 18:

Ground floor; showing general view of the upper floor access point at the south end. Note first floor beams embedded within masonry to east and west

Fig 19:

Ground floor; showing circular saw markings on face of upright timber stud at south end, indicating early C19th or later conversion

Fig 20:

Ground floor; showing typical pitsaw timber conversion markings on face of primary floor beam

Fig 21:

Ground floor; showing primary floor beam positioned directly over large mortice in timber pad embedded within masonry wall to west side of building. This may be structurally significant

Fig 22:

Ground floor; showing general view of the west side corridor

Fig 23:

Ground floor; showing large mortice in lintel over window opening on west side of the building which may be structurally significant. Typical example of reuse of materials for lintels and bonding timbers

Fig 24:

Ground floor; showing reuse of materials such as large door stiles for bonding timbers or embedded timber pads during construction or remedial works

Fig 25:

Ground floor; showing one of the decayed lintels over window openings on the west side of the building. Note again the mortice within the lintel which may be structurally significant. Also note the deflection occurring over the length

Fig 26:

Ground floor; showing the steel structure installed to counter the outward movement at the top of the east masonry wall

Fig 27:

Ground floor; showing the bearing end of one of the primary beams. Note the water-staining and darkening of the timber suggesting ongoing issues with damp and decay. Moisture content readings taken from timbers on the west side were generally above the decay threshold

Fig 28:

Ground floor; showing the bearing end of one of the primary beams. Note the water-staining and darkening of the timber suggesting ongoing issues with damp and decay. Moisture content readings taken from timbers on the west side were generally above the decay threshold

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

Fig 29:

Ground floor; showing one of the decayed lintels on the west side. Note the two-part build-up and decay of the outermost element by wet rot and subsequent wood-boring beetle infestation

Fig 30:

Ground floor; showing the opening up of gaps between the bearing ends of the beams and the west masonry wall, in this instance ~55mm

Fig 31:

Ground floor; showing another of the decayed lintels on the west side. The innermost section was decayed by active wet rot and wood-boring beetle infestation

Fig 32:

Ground floor; showing large fracture to underside of main floor beam on west side. Crack travelled through thickness of beam and is highly likely to be structurally significant

Fig 33:

Ground floor; showing opposite side of beam in previous image, with crack clearly evident on both north and south sides

Fig 34:

Ground floor; showing fracture in floor beam at north ed of historic section of barn. Crack travelled across thickness of beam and was considered likely to be structurally significant

Fig 35:

First floor; showing previous repairs to west bearing end of tie-beam at north end of the barn, re-supported on oak timber post. Post supported on floor structure below which may not be structurally adequate

Fig 36:

First floor; showing support post of truss shown in image above supported by floor structure below which may not be structurally adequate. Also post noted to be significantly infested with wood-boring beetle

Fig 37:

First floor; showing timber support post described in previous 2no. images above. Note flight holes filled with frass, and moisture content readings were high enough to sustain further infestation

Fig 38:

Roof structure; showing further foam padding to sides of rafters at north end of barn roof. This was possibly to aid in fitting of insulation in the past

Fig 39:

Ground floor; showing typical hewn timber conversion markings on face of primary floor beam

Fig 40:

Ground floor; showing widespread water-staining marks to underside of floor boards of first floor above, indicating issues with water penetration in the past and the likely cause of the elevated moisture content readings supporting widespread wood-boring beetle infestation

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

Fig 41:

Ground floor; showing area of newer floor structure at north end of building. Joists and boards were of softwood timber and no structural decay was detected in this location

Fig 42:

Ground floor; showing area of newer floor structure at north end of the building. There were areas of localised wood-boring beetle infestation of softwood floorboards above, although joists were mostly free of decay

Fig 43:

Ground floor; showing area in north-west corner of building, where historic oak timbers had been replaced with alternative hardwood material. Joists embedded within the west masonry wall were found to be decayed, and the lintel over the doorway to the west was also found to be decayed

Fig 44:

Ground floor; showing one of the areas of softwood floorboarding affected by wood-boring beetle infestation, at the north end of the barn, as shown on attached plans

Fig 45:

Ground floor; showing one of areas of softwood floorboarding affected by wood-boring beetle infestation, at the north end of the barn, as shown on attached plans

Fig 46:

Roof structure; showing previous patching of historic notching with timber

Fig 47:

Roof structure; showing previous trench for purlin on east side of the roof

Fig 48:

Floor structure; showing area of historic replacement floor structure at the south-east end of building. Joists and beams were of oak timber and no structural decay was detected in this location

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

Fig 49:

Floor structure; showing partner repairs to most floor joists in this area, with the supporting partner timbers distinguishable by their clean and square edges

Fig 50:

Floor structure; showing a critical fracture to the underside of a primary floor beam

Note this has been subject to remedial support including the timber post below and partner repairs along the face of the beam. Given the decay noted in Fig51 below, this arrangement was deemed structurally significant

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

Fig 51:

Floor structure; showing timber decay to the base of a supporting timber post of the primary beam in Fig50 above, affecting up to ~50 per cent of the cross section (arrowed)

Fig 52:

Floor structure; showing localised masonry repairs around and below the bearing end of a primary floor beam

Note this repair without a timber pad has encased the beam in masonry, leaving the beam vulnerable to damp and decay

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

Fig 53:

Floor structure; showing a critical fracture to the underside of a primary floor beam

Note this fracture has occurred at an old mortice where the beam is weaker, and has been subject to remedial partner repairs along the face of the beam

Fig 54:

Floor structure; showing an ad-hoc arrangement of structural floor timbers. 2no. Primary beams are supported by a secondary beam, which is supported by a post and cross-wall

Note despite this arrangement appearing to function, Structural Engineer to comment, paying attention to the fracture as described in Fig53 above

Fig 55:

Floor structure; showing primary floor beam positioned directly over large mortice in timber pad embedded within masonry wall to east side of building. This may be structurally significant

Fig 56:

Floor structure; showing the opening up of gaps between the bearing ends of the beams and the east masonry wall, in this instance ~30mm

Fig 57:

Floor structure; showing a historic partner repair to a primary floor beam

Also showing a supporting timber post, the arrangement of which was assumed to have been ‘as built’, given the span distance of the beams

Fig 58:

Floor structure; showing structurally significant outward movement of the east masonry wall

Note the floor beam has held itself and the masonry below it in its original position, whilst the majority of this section of wall has moved outwards, forming the crack observed

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

Fig 59:

Floor structure; showing a critical fracture affecting the tenon of a floor joist

Note this arrangement, with the tenon at the top third of the joist and jointed near the top of the face of the beam, subjects the joist to high levels of compressive forces, which without a 'tusk', leaves only the thickness of the tenon to resist said forces, leading to shear fractures as seen here

Fig 60:

Floor structure; showing a general view of the floor structure seen from the east side

Also showing an extensive area of water staining and decay to floor boards, with superficial staining only affecting floor joists below

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

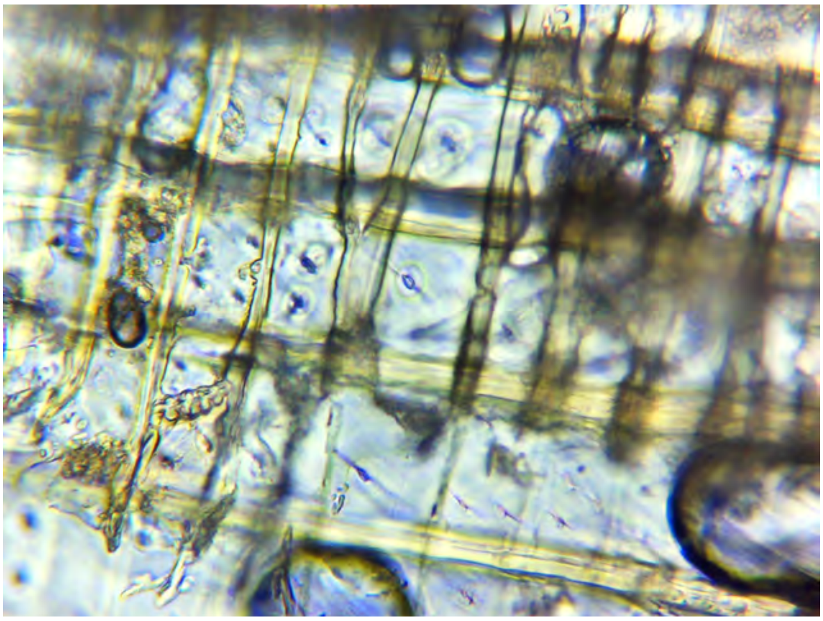


Fig 61:

Laboratory image; showing a radial view of a timber sample retrieved from a joist in the second bay from the north end of the barn

The piceoid features of the cross-field pitting are consistent with reference material and library samples relating to Spruce timber (*Picea spp*.)

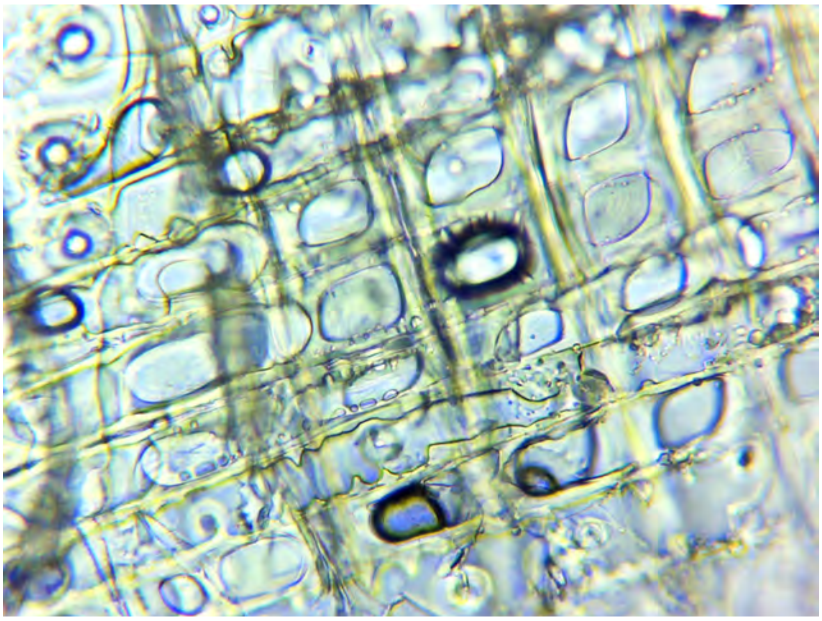


Fig 62:

Laboratory image; showing a radial view of a timber sample retrieved from a floor joist at the north end bay of the barn, on the east side

The fenestriform nature of the cross-field pitting, and the dentate ray tracheids are both features consistent with library samples and literature relating to Scots pine (European redwood—*Pinus sylvestris*)

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

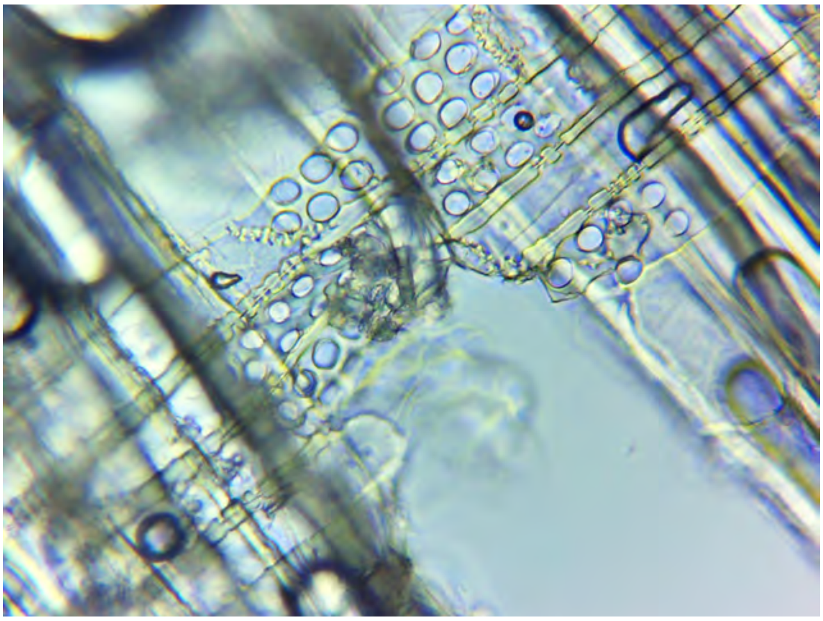


Fig 63:

Laboratory image; showing a radial view of a samples taken from a joist on the west side of the northernmost bay

The alternate intervessel ray pitting confined to outer edges of ray, and other microscopic features were consistent with timber of the Salicaceae family of trees, most likely *Salix alba* (willow)

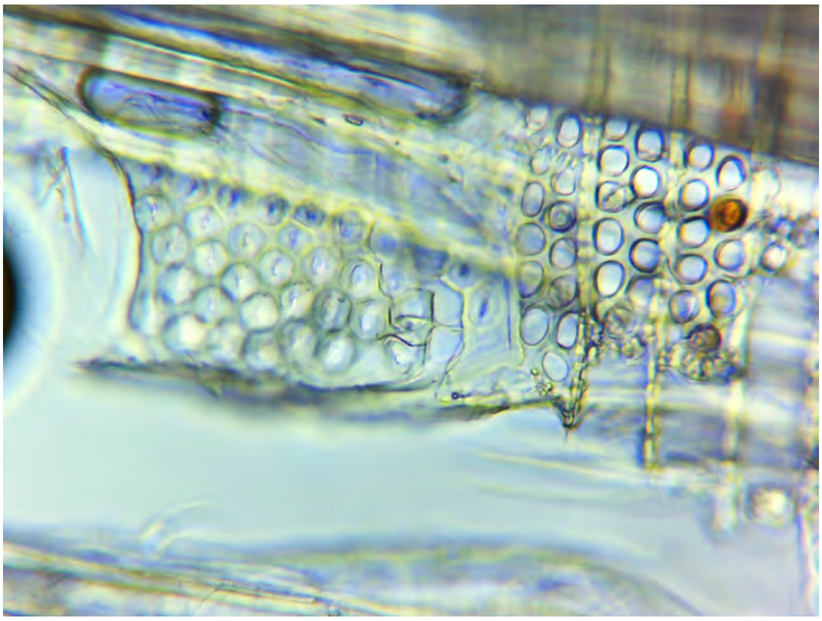


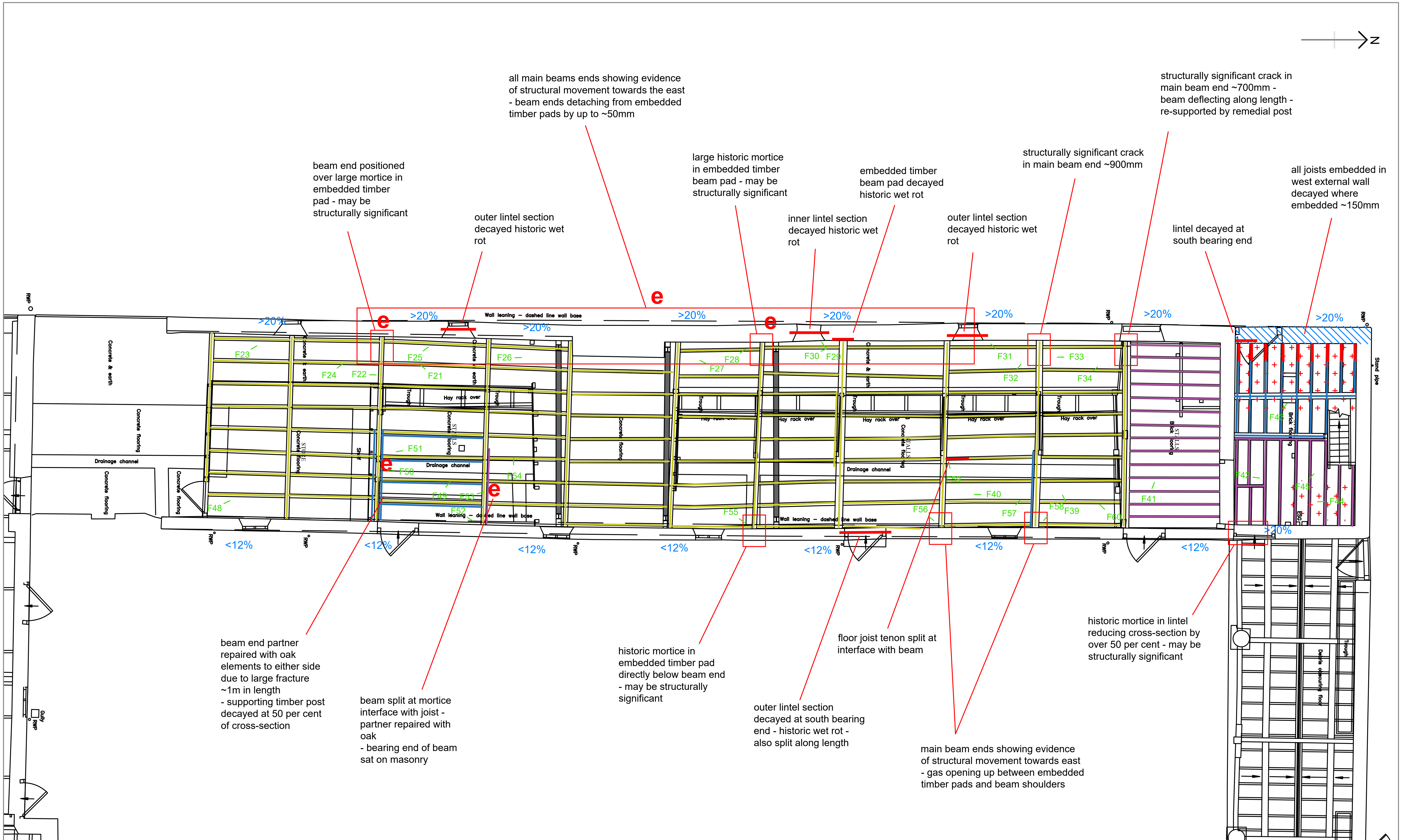
Fig 64:

Laboratory image; showing a radial view of a samples taken from a joist on the west side of the northernmost bay

The alternate intervessel ray pitting confined to outer edges of ray, and the hexagonal shape of the pits were both features consistent with timber of the Salicaceae family of trees, most likely *Salix alba* (willow)

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

Attachment B



Key:

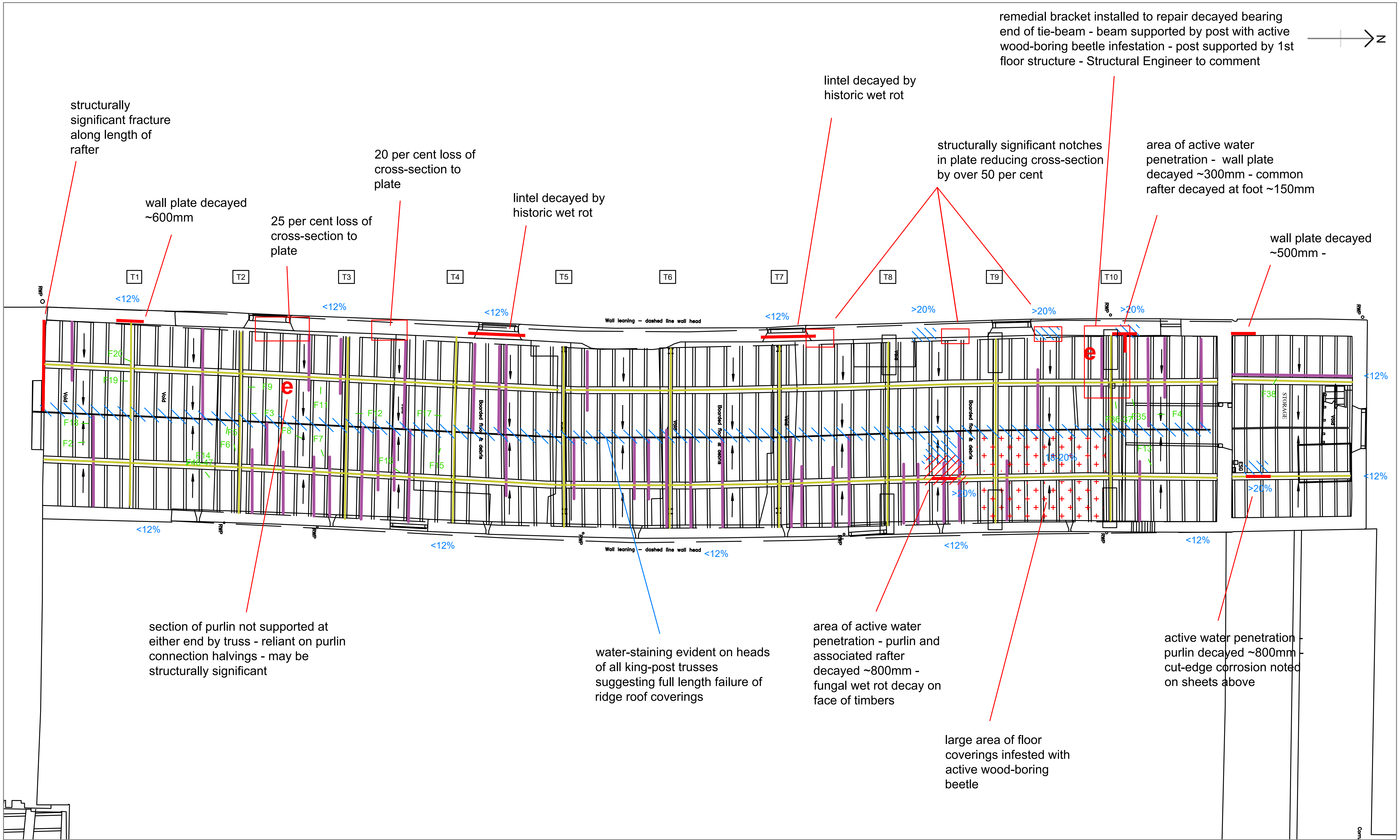
- Area of wet rot decay (1st floor boards)
- Area of active wood-boring beetle infestation (1st floor)
- <12% Deep moisture content (w/w%)
- — F Approximate location of photograph
- T2 Truss reference number
- Timber element of c.C20th intervention
- Timber most likely original (c.C19th)
- e Structural Engineer to comment
- Timber of late c.C19th intervention
- Decayed/defective timber element

H+R

Aston Hall, West barn range - 1st floor structure

Investigation of structural timber elements
March 2021

Hutton + Rostron Environmental Investigations Ltd
Netley House, Gomshall, Surrey, GU5 9QA Tel: 01483 203221
153.32 Site Note 2 -Not to scale-



Key:

- Area of wet rot decay (1st floor boards)
- Area of active wood-boring beetle infestation (1st floor boards)
- <12% Deep moisture content (w/w%)
- F Approximate location of photograph
- T2 Truss reference number
- Timber element of c.C20th intervention
- Timber element of c.C19th intervention
- Timber most likely original
- e Structural Engineer to comment
- Decayed/defective timber element

Aston Hall, West barn range, roof

Investigation of structural timber elements

March 2021

Hutton + Rostron Environmental Investigations Ltd
Netley House, Gomshall, Surrey, GU5 9QA Tel: 01483 203221

153.32 Site Note 2 -Not to scale-

Hutton + Rostron
Environmental Investigations Limited

Aston Hall: Investigation of structural timber elements – north barn range

Site note 3 for March 2021, job no. 153.32

CONTENTS

Distribution:

Giles Quarme
Giulia Baldin

Prepared by:	**Technical review by:**	**Administration by:**
Joe Lovelock BSc (Hons)	Joe Lovelock BSc (Hons)	Jennifer Potter BA(Hons)

Hutton+Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA

Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

1 INTRODUCTION

1.1 AUTHORITY AND REFERENCES

Hutton + Rostron Environmental Investigations Limited carried out site visits to Aston Hall on 2, 3, and 5 March 2021 in accordance with instructions from Giles Quarme by email, on 16 February 2021 (17:43) on behalf of the clients, David and Ros Cleevely. Drawings provided by Giles Quarme Architects were used for the identification of structures. For the purpose of orientation in this report, the south barn was taken as facing into the courtyard to the north

1.2 AIM

The aim of this survey was to investigate the structural timber elements for condition, and to assess the building for likely intervention in the past. Cost-effective remedial recommendations for repair have been provided where necessary using environmental means

1.3 LIMITATIONS

This survey was confined to the accessible structures. Concealed timbers and cavities have been investigated where necessary by the use of high-powered fibre optics. The condition of concealed timbers may be deduced from the general condition and moisture content of the adjacent structure. Only demolition or exposure work can enable the condition of timber to be determined with certainty, and this destroys what it is intended to preserve. Specialist investigative techniques are therefore employed as aids to the surveyor. No such technique can be 100 per cent reliable, but their use allows deductions to be made about the most probable condition of materials at the time of examination. Structures were not examined in detail except as described in this report, and no liability can be accepted for defects that may exist in other parts of the building. We have not inspected any parts of the structure which are covered, unexposed or inaccessible and we are therefore unable to report that any such part of the property is free from defect or in the event that such part of the property is not free from defect it will not contaminate and/or affect any other part of the property. Any design work carried out in conjunction with this report has taken account of available pre-construction or construction phase information to assist in the management of health and safety risks. The sample remedial details and other recommendations in this report are included to advise and inform the design team appointed by the client. The contents of this report do not imply the adoption of the role of Principal Designer by H+R for the purposes of the Construction (Design and Management) (CDM) Regulations 2015. No formal investigation of moisture distribution was made

2 STAFF ON SITE AND CONTACTS

2.1 H+R STAFF ON SITE

Joe Lovelock
Will Woodward

2.2 PERSONNEL CONTACTED

David and Ros Cleevely - Owners

3 OBSERVATIONS AND *RECOMMENDATIONS*

3.1 SUMMARY OF CONSTRUCTION

3.1.1 Arrangement

The north barn roof structure aligned along an east-west axis and was formed from 8no. simple trusses with principal rafters bridled at the apex dividing the space into 9no. bays. The south façade was open with truss ends and wall plate supported on a mixture of timber posts and circular brickwork columns. The roof structure abutted the west barn complex to the west side, and the east wall was formed by the wall of the cottage garages. Rafters were supported by in-line butt purlins, scarfed and table-jointed and embedded into masonry pockets at the east and west ends. Rafters were face-nailed to a ridgeboard and seat-cut onto the wall plates running along a masonry wall to the north, and supported by the posts and columns to the south. The roof covering was of corrugated metal

3.1.2 Material

Timber samples were taken throughout the barn so as to identify timber species for strength grading (see Site Note 5), and to highlight any differing interventions in the past. All timber preliminarily identified on-site was found to be of White Oak (*Quercus robur/petraea*), and subsequently all samples were identified as such

3.1.3 Dimensions

Tie-beams	-	~300 x 180mm (variable)
Principal rafters	-	~250 x 160mm (v)
Rafters	-	~80 x 80mm at ~450mm centres (v)
Purlins	-	~170 x 160mm (v)
Wall plate	-	~125 x 160mm (v)

3.2 TIMBER CONDITION

3.2.1 Roof timbers

1 General: Overall there was very little structural timber decay detected on drilling at vulnerable locations such as bearing ends. However, where active water penetration was occurring, this was associated with localised decay, particularly where timbers were embedded in damp masonry

No chemical remedial treatment required or recommended. The north barn roof structure was considered suitable for retention if required for refurbishment, at the discretion of the Structural Engineer. Localised timber repairs are however necessary, and new/replacement timber in contact with potentially damp masonry should be fully isolated using a continuous damp-proof material, through-ventilated air gap, or cut back and re-supported on a bracket/hanger. Repairs to be directed by the Structural Engineer and in consultation with the Architect and the Conservation Officer

2 Trusses: Trusses were probed and drilled for decay detection and moisture content, with no structural decay detected, and moisture contents generally well below the decay threshold of ~230 per cent w/w. This was attributable to the exposed nature of the construction and the subsequent increased ventilation throughout. The tie-beams of truss 3 and trusses 5-8 were noted to have large notches out of the underside resulting in a loss of cross-section in some instances of more than 50 per cent. This may be structurally significant

No chemical treatment required. Truss elements were deemed suitable for retention at the discretion of the Structural Engineer who may wish to comment on the large notches apparent in the tie-beams. Allowance should be made for repair using timber to match existing so as to re-instate cross-section

3 Purlins: Purlins were found to be structurally decayed at both the east and west ends where embedded within damp masonry pockets. The south pitch purlin was decayed for ~600mm at the west end, and decayed where embedded at the east. The north pitch purlin was only decayed at the east end, and only for the embedded depth. 3no. purlin sections were not supported at either end by an adjacent truss, and reliant solely on the condition of the pegged tabled scarf joints. No structural failure was noted as a result, but this arrangement may be structurally significant

Purlins were deemed suitable for retention on refurbishment at the discretion of the Structural Engineer who may wish to comment on the lack of purlin support in several of the bays. Allowance should be made for strengthening with metal strapping if necessary. The decayed sections of purlin at the east and west ends should be cut back to sound material and partner repaired or replaced with new or salvaged timber to match existing, i.e. oak (Quercus spp.). On reinstatement, it would be prudent to re-support the purlins on exposed stone corbels or steel brackets to prevent further decay, with provision for isolation from any masonry. Repairs to be directed by the Structural Engineer

4 Rafters: One rafter was found to be structurally decayed, at the east end on the north pitch. Remaining rafters were free of structurally significant timber decay, and no further structural concerns were identified at the time of survey; however, one rafter foot on the south pitch was noted to have lost almost total cross-section due to historic wet rot

Rafters were deemed suitable for retention for refurbishment at the discretion of the Structural Engineer. The decayed rafter at the east end should be partner repaired or replaced with new to match existing, with provision for isolation from potentially damp masonry. The loss of cross-section affecting the rafter identified on the south pitch should be reinstated using partnering with new timber

5 Wall plates: No structural decay detected on drilling of the wall plates along the lengths; however, there was a large notch directly above the doorway in the north-west corner reducing the overall cross-section of the plate by more than 50 per cent which may be structurally significant, and a number of notches along the north length, although these were not likely to be structurally compromising due to the substantial dimensional attributes

The wall plates were deemed suitable for retention at the discretion of the Structural Engineer who may wish to comment on the notch causing reduction in cross-section affecting the pate in the north-west corner of the barn which may require in-filling with timber to match existing

3.2.2 Supporting timber posts

The ends of trusses T2, T7, T8, and T9 were supported by timber posts. The support post of truss T2 was embedded fully into the bare ground below, and was subsequently found to be partially decayed at the extreme base. The post had also suffered from extreme weathering to the lower approximate third with subsequent ~50 per cent loss of cross-section. The supporting posts of trusses T7-T9 had previously decayed, had been cut short and were now positioned on brickwork plinths of varying heights. These had been flaunched with cementitious material resulting in partial decay at the base. No structurally significant loss of cross-section had occurred; however, moisture was being trapped within the gap opening up during natural seasonal movement of the timber and was considered likely to cause further decay

No chemical remedial treatment required in relation to fungal decay organisms or wood-boring beetle infestation. The timber post supporting the end of truss T2 should be cut back to sound material (~1m up from ground level) and re-supported on brickwork isolated from the masonry using a stainless-steel dowel inserted into the base of the post allowing for through-ventilation and preventing moisture entrapment. The cementitious flaunching around the bases of the timber posts supporting trusses T7-T9 should be removed and the bases of the posts cut back so as to allow for reinstatement positioned on a stainless-steel dowel, again to allow for through-ventilation and preventing moisture entrapment. Any repairs to be directed by the Structural Engineer

3.2.3 Wood-boring beetle infestation

All timbers were noted to have been affected to some extent by wood-boring beetle activity; however, in no cases was this considered currently active, with all evidence suggesting historic infestation, and in any case had been exclusively confined to non-structural sapwood content. Due to the widespread use of oak, flight hole diameter was consistent with both Common furniture beetle (*Anobium punctatum*) and Death watch beetle (*Xestobium rufovillosum*)

No chemical treatment required in relation to wood-boring beetle infestation. Every effort should be made to prevent water penetration into the structure so that moisture contents of timber elements are kept well below the decay threshold of ~20 per cent

3.3 WATER PENETRATION PROVIDING THE CONDITIONS FOR DECAY

There was active water penetration at both the east and west ends, both associated with failing flashings at the roof abutments. As described above this was also resulting in localised timber decay of structural elements, and raising the risk of wood-boring beetle infestation. No roof drainage was identified at the time of survey, and rainwater was freely draining off the roof onto the surrounding earth on the south side of the barn; however, due to the relatively generous eaves overhang, this did not appear to be affecting the roof structure, although decay had affected supporting timber posts in the past, evidenced by the replacement of several with brickwork piers

Allow for repair or replacement of flashings at the roof interfaces at east and west ends to prevent further water penetration. Timber repairs to be conducted as described in 3.2 above. Consideration should be given to installing an effective roof drainage system to prevent saturation of masonry below

3.4 REMEDIAL INTERVENTION AND HISTORIC SIGNIFICANCE

3.4.1 Methods of timber conversion

1 Hand conversion: Timber conversion markings are a useful by-product left from construction, and help to build an image of the chronology and alterations that may have been made to a building. Prior to the industrial revolution in the late 18th century, conversion of structural timber was generally by the ‘pit sawn’ method. This conversion technique left slightly off-vertical markings to the faces of timbers, at about 80 degrees to the axis, often with either marginally steeper or shallower markings adjacent which represent the ‘up-down’ method of the sawing action from above and below with the timber resting horizontally on two trestles. This varies from the ‘see-saw’ method of earlier where the timber would be converted on a single central trestle and sawn from either end at an approximate 45-degree angle and ‘cleft’ at the intersection. Tie-beams, being the largest of the elements, were often pit-sawn from large logs roughly in half, and then hewn on the opposite face to remove any bark or sapwood content. Hewing leaves a slightly undulating surface most visible using a low-angled light source, with the sawn face described as the ‘good face’ and mostly positioned to face the most commonly used areas

2 Mechanical and electrical conversion: The industrial revolution and the use of steam-powered machines brought about the introduction of the circular saw which is easily identifiable by the radial cuts in a circular fashion. This was a quick and accurate conversion method which was adopted by most sawmills during the 19th Century. Later on, in the mid-late 19th Century, the bandsaw conversion technique was employed. This left clear vertical markings at 90 degrees to the face of the timber often with repeated patterns reflecting the slight discrepancies in the ‘setting’ of the bandsaw blade. Furthermore, planer/thicknesser markings are similar to bandsaw markings, and still perpendicular to the timber grain direction but less pronounced and closer spaced, and seen on timber converted from the mid C20th onwards. The spindle moulder was introduced in the first few decades of the C20th, but is rarely used for structural timbers unless providing a decorative feature

3.4.2 Visible tooling marks, history of remediation, and likely age

As in the south and west barns, all timbers were inspected for evidence of conversion, and all were deemed to have been converted by hand, either via pit saw, or see-saw methods. There was however, evidence of intervention, with two distinct ages of rafters noted, the more recent being of sharper edges and of a squarer nature, with suspected older rafters clearly crudely shaped and retaining high levels of bark content. As in the south barn, butt-purlins featured in the roof structure; however, these were noted to contain historic mortices for wind-bracing and were subsequently deemed most likely salvaged from elsewhere, as wind-bracing a roof such the north barn would have been considered unnecessary. The joint retention pegs/pins were mostly intact and appeared more recent suggesting repair intervention in the past, albeit sympathetically and using oak for pegs. Similarly, the large notches to the undersides of the tie-beams mentioned in 3.2 above also suggested reuse, and possible rejection, and the notches were dull-edged and had not been cut using mechanised methods; faint marks from a carpenters’ marking gauge remained along the cut edges. The condition and general patina of the timbers suggested they were of considerable age, and most likely contemporary to the main part of the south barn, circa 1650, and may comprise elements initially formed as off-cuts during construction of the larger barn. No softwood elements were identified during the investigation

4 H+R WORK ON SITE

4.1 H+R inspected all structural timbers by deep drilling and probing, as necessary, so as to determine their decay state and deep moisture content

4.2 H+R inspected all structural timbers for evidence of conversion techniques so as to allocate a likely construction date

5 PROPOSED ACTION BY H+R

5.1 H+R will advise on repair and conservation of timber elements, so as to minimise the risk of decay after refurbishment if instructed

5.2 H+R will advise on remedial detailing, so as to minimise the risk of damp and decay problems after refurbishment if instructed

5.3 H+R will advise on conservation of original fabric with regard to damp, decay and salt damage, as necessary and if instructed

5.4 H+R will review proposed remedial details as these become available if instructed

5.5 H+R will return to site to inspect sample remedial details if instructed

5.6 H+R will liaise with conservation and historic building authorities, if instructed, so as to ensure the cost-effective conservation of original fabric

5.7 H+R will liaise with building guarantors, as necessary, so as to ensure the issuing of collateral warranties and building guarantees at practical completion, if required

5.8 H+R will return to site to inspect other buildings on site for structurally significant decay; and advise on timbers at risk of decay during the latent defect period due to water penetration before and during refurbishment if instructed

6 INFORMATION REQUIRED BY H+R

6.1 H+R require up-to-date copies of project programmes, as these become available

6.2 H+R require copies of up-to-date lists of project personnel and contact lists as these become available

6.3 H+R require copies of proposed remedial details for comment as these become available

6.4 H+R should be informed as a matter of urgency if further significant water penetration occurs onto site; so that advice can be given on cost-effective remedial measures, to minimise the risk of cost or programme overruns and so as to minimise the risk of damp or decay problems during the latent defect period

7 ADMINISTRATION REQUIREMENTS

7.1 H+R require formal instructions for further investigations and consultancy on this project

7.2 H+R require confirmation of distribution of digital and printed copies of reports and site notes

Attachment A

Fig 1:

North stable run; showing general view of stables from south

Fig 2:

North stables; showing a general view down stables towards the east

Fig 3:

North stable block; showing structurally significant timber decay affecting bearing end of purlin on south pitch at west end. Also localised decay around wall plate embedded in west masonry wall

Fig 4:

North stable block; showing large historic mortise in wall plate, directly above north -west corner doorway, may be structurally significant

Fig 5:

North stable block; showing general view of typical brickwork column, supporting wall plate at intermediate locations along south façade

Fig 6:

North stable block; showing oak timber post supporting south eaves between bays 2 and 3. Note almost over 50 per cent loss of cross section at base of post embedded in earth below and vulnerable to issues with decay and wood-boring beetle

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

Fig 7:

North stable block; showing large notch in north end of truss 3. May be structurally significant

Fig 8:

North stable block; showing end grain visible at notch in beam of truss 3. Note strong medullary rays emanating from pith, consistent with oak timber

Fig 9:

North stable block; showing relatively large notches on underside of tie beam of truss 5 which may be structurally significant

Fig 10:

North stable block; showing localised loss of cross section of timber plate due to wood-boring beetle infestation of sapwood content. However, not likely to be structurally significant as wall plate is relatively substantial along north eaves

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

Fig 11:

North stable block; showing support timber posts on brickwork plinths along south eaves at east end, likely to be a result of decay affecting bases of posts in the past. Now flaunched with cement at bases and resulting in localised timber decay from both wet rot and wood-boring beetle

Fig 12:

North stable block; showing large notch on underside of tie beam of truss 6, likely to be structurally significant, reducing overall cross section by approximately 40 per cent

Fig 13:

North stable block; showing large notches in wall plate. However, wall plate relatively substantial in this location, therefore, unlikely to be structurally significant

Fig 14:

North stable block; showing large notch in tie beam of truss 8 at north end and notch also noted at south end, reducing overall cross section by 40 per cent, may be structurally significant

Fig 15:

North stable block; showing widespread wood-boring beetle flight holes on post at south eaves of truss 8. No structurally significant timber decay detected on drilling

Fig 16:

North stable block; showing extreme east end. Note visible dampness on face of masonry wall. Both purlins embedded in east wall were found to be structurally decayed on drilling

Fig 17:

North stable block; showing structurally decayed common rafter on north pitch at east end

Fig 18:

North stable block; showing section of north pitch purlin, not supported at either end by truss, may be structurally significant

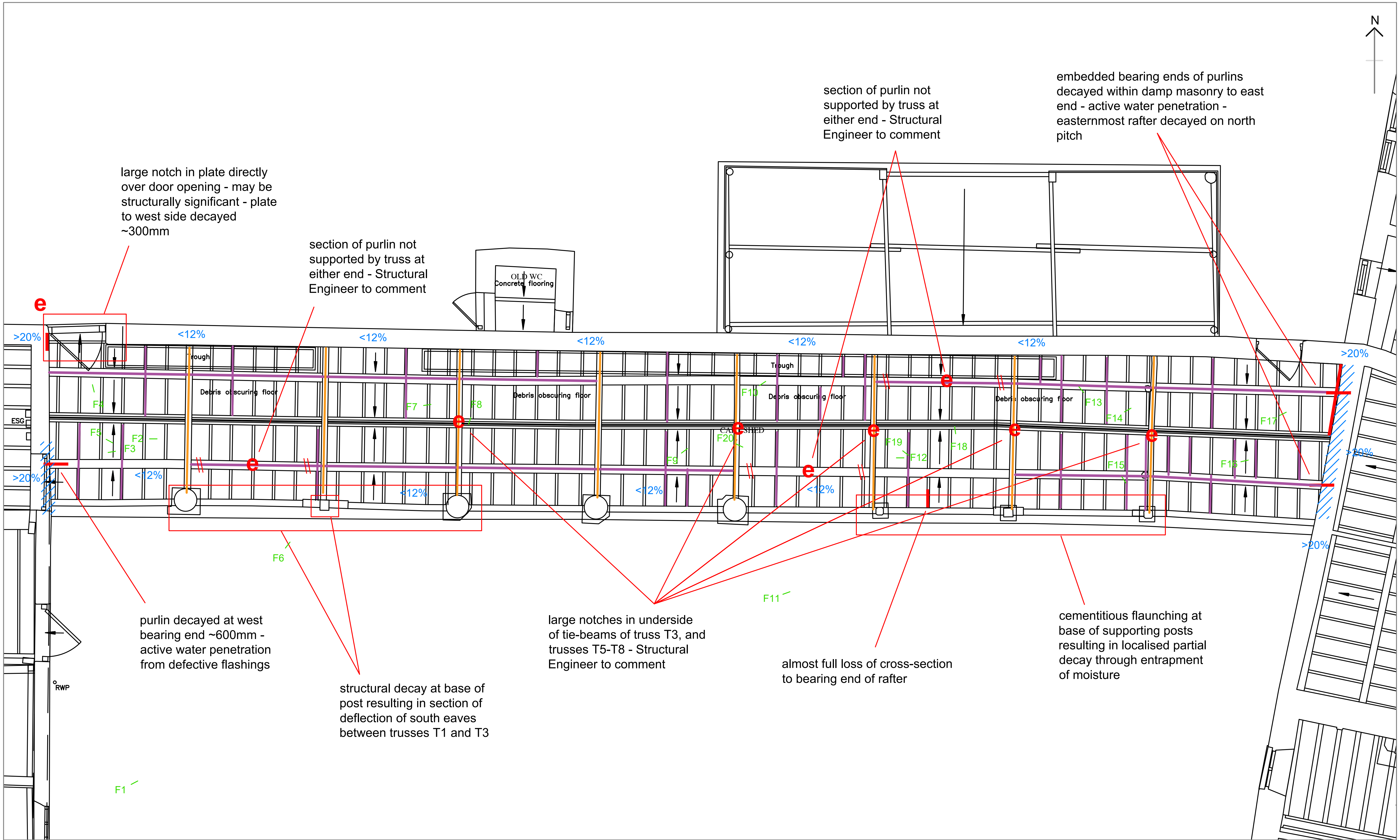
Fig 19:

North stable block; showing localised loss of cross section from historic wood-boring beetle to north side of purlin in bay 7

Fig 20:

North stable block; showing section of purlin not supported at one or other ends by a truss, fully reliant on purlin bridled half lap. May be structurally significant

Attachment B



Key:

- e — Structural Engineer to comment
- <12% — Deep moisture content (w/w%)
- F — Approximate location of photograph
- Area of water penetration
- Decayed/defective timber element
- Timber element likely to be of original material (c.C17th)
- Timber of salvaged/intervention

H+R

Aston Hall, North Barn - Roof

Investigation of structural timber elements

March 2021

Hutton + Rostron Environmental Investigations Ltd
Netley House, Gomshall, Surrey, GU5 9QA Tel: 01483 203221

Hutton + Rostron
Environmental Investigations Limited

Aston Hall: Preliminary timber condition investigation – Coach House

Site note 4 for March 2021, job no. 153.32

CONTENTS

Distribution:

Giles Quarme
Giulia Baldin

Prepared by:	Technical review by:	Administration by:
Will Woodward *BSc (Hons)*	Will Woodward *BSc (Hons)*	Kay Webb

Hutton+Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA

Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

1 INTRODUCTION

1.1 AUTHORITY AND REFERENCES

Hutton + Rostron Environmental Investigations Limited carried out site visits to Aston Hall on 2, 3, and 5 March 2021 in accordance with instructions from Giles Quarme by email, on 16 February 2021 (17:43) on behalf of the clients, Ros and David Cleevely. Drawings provided by Giles Quarme Architects were used for the identification of structures. For the purpose of orientation in this report, the coach house was taken as facing towards the main property to the east

1.2 AIM

The aim of this preliminary stage 1 risk assessment survey was to investigate timber elements for condition and to determine the extent of any structurally significant timber decay that may be present. Environmentally-friendly and cost-effective remedial advice has been provided where necessary, using traditional repair methods consistent with maximum retention of historic fabric

1.3 LIMITATIONS

This survey was confined to the accessible structures. Concealed timbers and cavities have been investigated where necessary by the use of high-powered fibre optics. The condition of concealed timbers may be deduced from the general condition and moisture content of the adjacent structure. Only demolition or exposure work can enable the condition of timber to be determined with certainty, and this destroys what it is intended to preserve. Specialist investigative techniques are therefore employed as aids to the surveyor. No such technique can be 100 per cent reliable, but their use allows deductions to be made about the most probable condition of materials at the time of examination. Structures were not examined in detail except as described in this report, and no liability can be accepted for defects that may exist in other parts of the building. We have not inspected any parts of the structure which are covered, unexposed or inaccessible and we are therefore unable to report that any such part of the property is free from defect or in the event that such part of the property is not free from defect it will not contaminate and/or affect any other part of the property. Any design work carried out in conjunction with this report has taken account of available pre-construction or construction phase information to assist in the management of health and safety risks. The sample remedial details and other recommendations in this report are included to advise and inform the design team appointed by the client. The contents of this report do not imply the adoption of the role of Principal Designer by H+R for the purposes of the Construction (Design and Management) (CDM) Regulations 2015. No formal investigation of moisture distribution was made

2 STAFF ON SITE AND CONTACTS

2.1 H+R STAFF ON SITE

Joe Lovelock
Will Woodward

2.2 PERSONNEL CONTACTED

Ros and David Cleevely - Owners

3 OBSERVATIONS AND *RECOMMENDATIONS*

3.1 SUMMARY OF CONSTRUCTION

3.1.1 Arrangement

1 Roof structures: The coach house was aligned along a north-south axis, with an adjoining garage and store section to the north, with outbuildings beyond these to the extreme north. The roof structure of the coach house consisted of 1 no. A-frame truss spanning east-west between the masonry walls, dividing the space into 2 no. bays. The truss was supported at external walls by wall plates, and 2 no. purlins per pitch supported rafters, 2 no. of which were oak and 2 no. were of replacement softwood timber, the arrangement of which differed at various sections along the full span of the purlins. The roof structure of the adjoining garage and store consisted of 2 no. purlins spanning north-south between masonry walls, which supported common rafters running east-west

2 Floor structures: Timber floor structures were found on the first and second floors, while the ground floor was of solid and stone material. Floor beams spanned the building east-west and were supported within masonry pockets at external walls. Floor joists spanned north-south and were tenoned into beams, and were also supported within masonry at north and south walls

3.1.2 Methodology

All vulnerable sections of timbers were drilled for decay detection, and probed for deep and surface moisture content readings. This included plate sections, bearing ends of structural timbers supported on wall plates, and any embedded structural timbers supported within masonry. Deep and surface moisture recordings were taken to determine vulnerability to further structurally significant timber decay by wet rot fungal decay organisms or wood-boring beetle infestation

3.1.3 Selection of structural timber dimensions

1	Roof structure:		
	Ridge beam	-	~150 x 150mm
	Principle rafters	-	~160 x 150mm (taken at smallest section)
	Tie beam		~300 x 160mm
	Common rafters	-	~90 x 80mm at ~350mm centres
	Wall plates	-	~140 x 140mm
	Purlins	-	~180-210 x 160-180mm (variable)
2	Floor structures:		
	Second floor:		
	Floor beams	-	~280 x 280mm
	Floor joists	-	~100 x 100mm at ~330mm centres
	First floor:		
	Floor beams	-	~280 x 260m
	Floor joists	-	~80 x 110mm at ~350mm centres

3.1.4 History

A visual assessment of the timbers supported by desktop research suggest that the coach house was constructed in the late 19th Century, and its use was likely consistent with its name. The building was later adapted to a residential dwelling in the late 1980s, with timber alterations to openings and joinery, floor structures and partition walls

3.2 TIMBER CONDITION

3.2.1 Roof structures

1 Truss: Bearing ends of the tie-beam was drilled for decay detection and probed for deep moisture content readings. No structurally significant decay was noted during the investigation to either the north or south ends of the truss and deep moisture content readings were less than 12 per cent which is considered 'dry'

2 Purlins: The original and replacement sections of purlins were visually assessed and physically probed for decay detection and deep moisture content readings which were generally below 12 per cent with no decay detected. However, there was evidence of historic wood-boring beetle infestation to the hardwood purlins, particularly to the south ends, with flight hole diameter consistent with Common furniture beetle (*Anobium punctatum*). The beetle attack was thought to have occurred long before the building was heated and occupied as a dwelling. The west upper purlin was noted to have been repaired with a face half-lap joint, with a ~2.5m section of new timber. Bearing ends of purlins were exposed to the elements and were found to be weathered but free of structural decay. Hairline cracking to plaster was noted around the ends of purlins on the interior south wall, which was believed to have been caused by a combination of subtle movement of purlins and lack of a gap or movement joint between purlins and plaster skim and board

3 Common rafters: The scope of the survey meant that the common rafters were only inspected from the access hatch, with all visible rafters preliminarily identified as being of oak at the time of survey. Sapwood decay was noted to some rafters from wood boring beetle attack, affecting only a superficial amount of cross-section and softwood partner repairs were noted. Historic water staining was noted to the faces of rafters; however, a breathable roof membrane had since been installed

4 Wall plates: The wall plates were concealed in the masonry walls with no accessible voids at the eaves for inspection. As with the purlins, the ends of the wall plates were weathered as they were exposed to the elements. Plates were probed at these areas with no decay observed

No chemical remedial treatment is either required or recommended in relation to wood boring beetle infestation or fungal decay organisms. The roof structure was deemed suitable for retention at the discretion of the Structural Engineer. A full survey would confirm whether or not damp-proof provisions are in place for timbers embedded in masonry, and remedial detailing advice could be given where required

3.2.2 Floor structures

1 Floor beams: No structurally significant decay was detected on drilling floor beams; however, it could not be confirmed whether the floor beams were sat on a suitable DPM or timber pads embedded in the masonry. On the first floor in the living room, drying-out fissures of a considerable size were noted on 1 no. second-floor beam, but this natural defect was not considered structurally significant. The second-floor beam visible within the first-floor bedroom was found to have twisted, the bearing ends had rotated in opposite directions and hairline cracking was noted near the beam ends. Given the minimal size of the cracking and no further evidence of movement to the structure (including no outward lean of masonry walls), it was determined that this was not significant as the beam had now settled in its current position

2 Floor joists: Floor joists throughout were in good condition, with no evidence of decay observed. A very large knot was noted to 1 no. joist in the living room and 1no. joist with knots within 100mm of each other was noted in the first-floor bedroom. Neither of these were decayed however and there was no evidence of

structural stress to the timbers. The majority of floor joists appeared original, with only a handful of replacement timbers, which could be distinguished by their straighter edges and cleaner faces, free of lath nail holes

4 Floorboards: Floor finishes were not inspected in detail at the time of survey, however there were no signs of defects and decay, and the majority of floorboards had been painted

No chemical remedial treatment is either required or recommended in relation to wood-boring beetle infestation or fungal decay organisms. No action is necessary in regards to the natural defects observed. The floor structure was deemed suitable for retention at the discretion of the Structural Engineer

3.2.3 Lintels

The majority of lintels were found to be timber, with 2 no. solid lintels noted on east elevation on the ground floor. Timber lintels were drilled for decay detection and probed for deep moisture content to determine vulnerability to decay. Lintels were generally were formed by several smaller section timbers. No decay was detected on drilling and moisture contents were too low to sustain decay organisms. It was believed that the 2 no. solid lintels were installed when the building was converted, and the window and door openings were altered

No chemical treatment required in relation to wood-boring beetle infestation or fungal decay organisms. The timber lintels were deemed suitable for retention at the discretion of the Structural Engineer

3.2.4 Joinery

All joinery had been replaced during the conversion project and so were no more than ~30 years old. Windows were of side-hung casement and fixed light construction. Doors were of panelled design with small lights, to evoke a traditional design. Window and door frames were not inspected in detail, but were noted to be in good working order, with an adequate maintenance schedule seemingly in place. All windows and doors were operational

No chemical treatment required. The existing maintenance schedule for windows and doors and associated framing elements should continue to be adhered to

3.3 WATER PENETRATION PROVIDING THE CONDITIONS FOR DECAY

There was no evidence of water penetration to the building, it appeared well maintained and watertight, with roof finishes, rainwater goods and external joinery finishes all in good order. On a separate note, historic water staining was noted to plaster finishes between first floor joists, likely caused by a water leak from the bathroom directly above

No immediate action necessary. The existing maintenance schedule for the coach house should be adhered to, which should include regular inspection of the water pipes and drains serving both bathrooms

4 H+R WORK ON SITE

4.1 H+R inspected all structural timbers by deep drilling and probing, as necessary, so as to determine their decay state and deep moisture content

4.2 H+R inspected all structural timbers for evidence of likely conversion techniques

5 PROPOSED ACTION BY H+R

5.1 H+R will advise on repair and conservation of timber elements, so as to minimise the risk of decay after refurbishment if instructed

5.2 H+R will advise on remedial detailing, so as to minimise the risk of damp and decay problems after refurbishment if instructed

5.3 H+R will advise on conservation of original fabric with regard to damp, decay and salt damage, as necessary and if instructed

5.4 H+R will review proposed remedial details as these become available if instructed

5.5 H+R will liaise with conservation and historic building authorities, if instructed, so as to ensure the cost-effective conservation of original fabric

5.6 H+R will return to site to inspect other buildings on site for structurally significant decay; and advise on timbers at risk of decay during the latent defect period due to water penetration before and during refurbishment if instructed

6 INFORMATION REQUIRED BY H+R

6.1 H+R require up-to-date copies of project programmes, as these become available

6.2 H+R require copies of up-to-date lists of project personnel and contact lists as these become available

6.3 H+R require copies of proposed remedial details for comment as these become available

6.4 H+R should be informed as a matter of urgency if further significant water penetration occurs onto site; so that advice can be given on cost-effective remedial measures, to minimise the risk of cost or programme overruns and so as to minimise the risk of damp or decay problems during the latent defect period

7 ADMINISTRATION REQUIREMENTS

7.1 H+R require formal instructions for further investigations and consultancy on this project

7.2 H+R require confirmation of distribution of digital and printed copies of reports and site notes

Attachment A

Fig 1:

Exterior, east elevation; showing a general view of the property and of the joinery, which was in good, serviceable order

Fig 2:

Exterior, east elevation; showing a localised area of cracking to the finish of the garage lintel fascia board

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221   Email: ei@handr.co.uk

Fig 3:

Exterior, south elevation; showing a general view of the property

Fig 4:

Exterior, south elevation; showing the exposed bearing ends of purlins and wall plates, found to be weathered but free of decay

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221   Email: ei@handr.co.uk

Fig 5:

Exterior, west elevation; showing a general view of the property

Fig 6:

Exterior, east elevation; showing the adjoining garage and store at the north end of the coach house

Fig 7:

Exterior, north-west corner of coach house; showing a dog legged downpipe and configuration of wall head plates along west elevation with external rafter plate and tie beam plate on internal face of head of wall

Fig 8:

Exterior, east face of brick parapet wall at east facing pitch of coach house stable roof; showing significant loss of face of bricks due to excessively vapour impermeable hard cementitious pointing and water ingress through coping stones above. Note spalling is particularly acute at coping stone joints

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 9:

Exterior, stable yard driveway, west of cottage; showing depression in hardcore suggestive of ponding and perched water at base of cottage at south-west corner

Fig 10:

Interior, west wall base in coach house garages; showing signs of natural water penetration through wall/floor junction

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 11:

Interior, attic space; showing a limited view of the roof structure

Also showing superficial sapwood loss from beetle attack and historic water staining to the ridge beam

Fig 12:

Interior, second floor; showing a general view of the bathroom

Note the hairline cracking to plaster near to the purlins, not deemed structurally significant

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 13:

Interior, second floor; showing a general view of the historic purlins

Fig 14:

Interior, second floor; showing historic beetle attack at the south end of the west upper purlin, with flight holes consistent with Common furniture beetle

Fig 15:

Interior, second floor; showing a face half-lap joint repair to the west upper purlin

Note roof finishes had likely failed in the past, allowing water penetration providing the conditions for decay to the upper face

Fig 16:

Interior, second floor; showing a view of the replacement softwood sections of purlin

Note the timbers had been paired-up and bolted, which is an economical alternative to large section timbers

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221   Email: ei@handr.co.uk

Fig 17:

Interior, second floor; showing tooling marks on the face of a replacement softwood purlin which are consistent with a circular saw

Fig 18:

Interior, second floor; showing a view of the principle rafter which makes up the single truss in the coach house, as well as the stud wall built within the truss

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 19:

Interior, second floor; showing a general view of the bedroom

Fig 20:

Interior, first floor; showing a general view of the living room

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221   Email: ei@handr.co.uk

Fig 21:

Interior, first floor; showing a large knot covering ~90 per cent of the face of 1no. second floor joist, as seen in the living room. No action required

Fig 22:

Interior, first floor; showing a particularly wide drying-out fissure on a second-floor beam, which is a natural defect and not considered to be an issue

Fig 23:

Interior, first floor; showing hairline cracking to plaster near to the timber stud wall. Subtle movement of timbers and the plaster skim finished without a movement gap was thought to be the cause

Fig 24:

Interior, first floor; showing a general view of the stud wall timbers

Fig 25:

Interior, first floor; showing a section of second floor timber structure

Also showing timber pegs in the floor beam, where studs forming the wall below have been tenoned in

Fig 26:

Interior, first floor; showing a general view of the second floor structure

Fig 27:

Interior, first floor; showing another general view of the second floor structure

Also note the drying-out fissure to the floor beam

Fig 28:

Interior, first floor; showing a view of the twisted floor beam and associated cracking to plaster. The movement was believed to have settled and was not deemed structurally significant

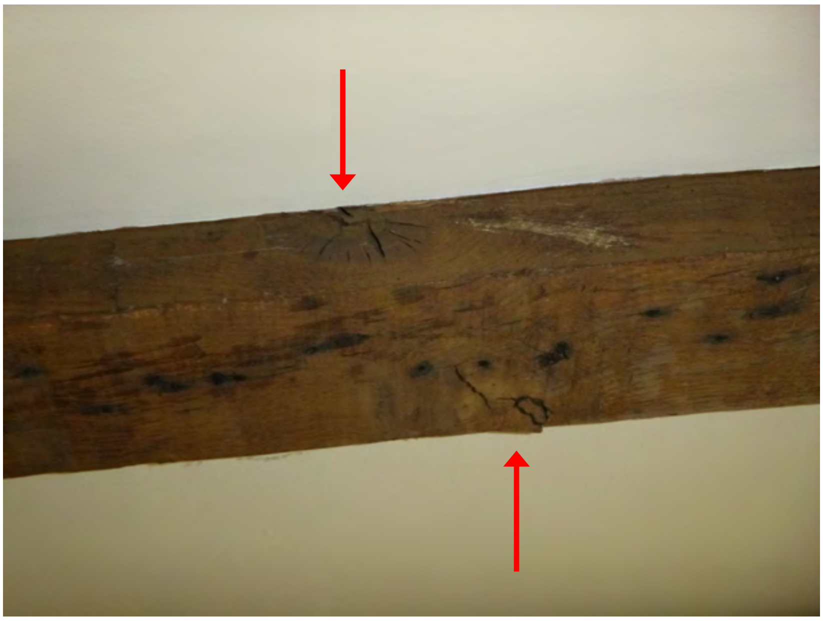


Fig 29:

Interior, first floor bedroom; showing 2 no. knots within 100mm of each other. No evidence of stress to the floor joist and so no action required

Fig 30:

Interior, first floor; showing mortice holes to the first floor beam

Note the floor joists that were once here have been removed when the staircase was installed for residential use

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Fig 31:

Interior, ground floor; showing a general view of the first floor structure

Fig 32:

Interior, ground floor; showing the lintel arrangement made up of several smaller section timbers, no decay detected on drilling

Fig 33:

Interior, ground floor; showing metal reinforcement to the trimmer joist at the stair opening

Fig 34:

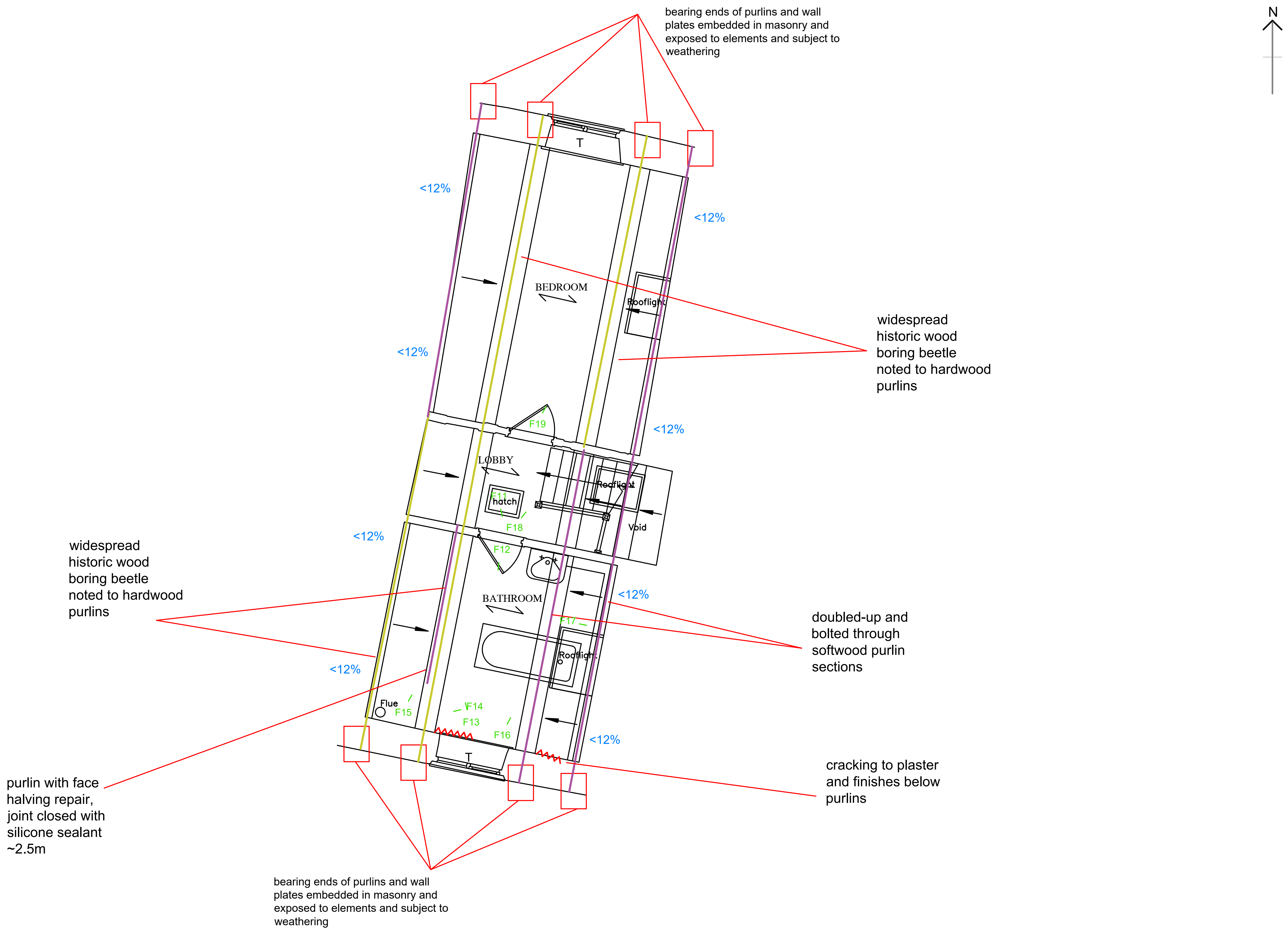
Interior, ground floor; showing a general view of the first floor structure as seen in the hallway

Fig 35:

Interior, ground floor; showing localised water staining to plaster and finishes between first floor joists, thought to be caused by a water leak from the bathroom directly above

Hutton + Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA
Tel: 01483 203221 Email: ei@handr.co.uk

Attachment B



Aston Hall, Coach house - roof structure

Preliminary timber condition investigation

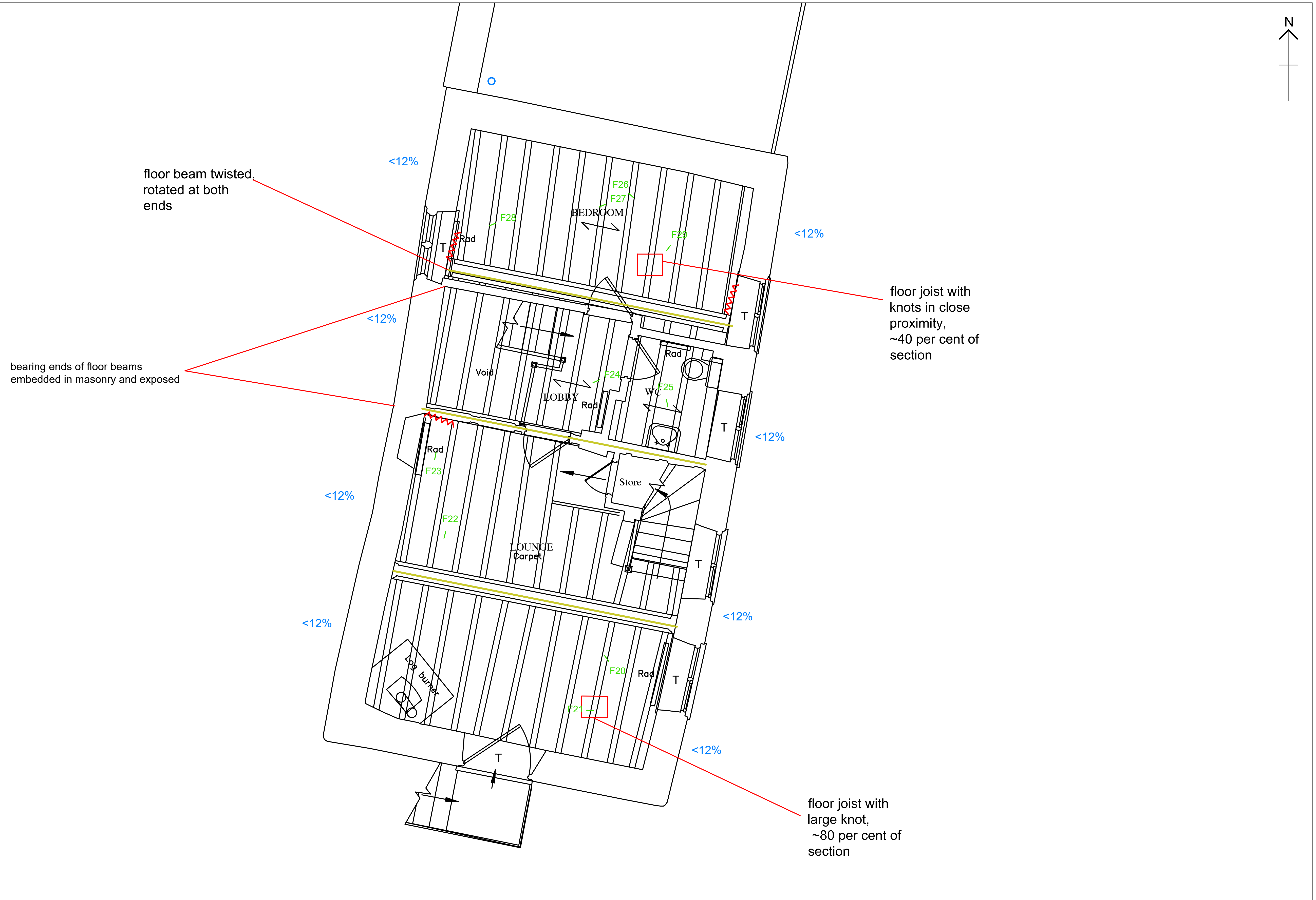
March 2021

Key:

(red line)	Decayed/defective timber element
<12%	Deep moisture content (w/w%)
F	Approximate location of photograph
(purple line)	Timber element of c.C20th intervention
(yellow line)	Timber most likely original (late c.C19th)
T	Lintel of timber construction
S	Lintel of solid construction
(blue hatching)	Area subject to water staining

Hutton + Rostron Environmental Investigations Ltd
Netley House, Gomshall, Surrey, GU5 9QA Tel: 01483 203221

153.32 Site Note 4 -Not to scale-

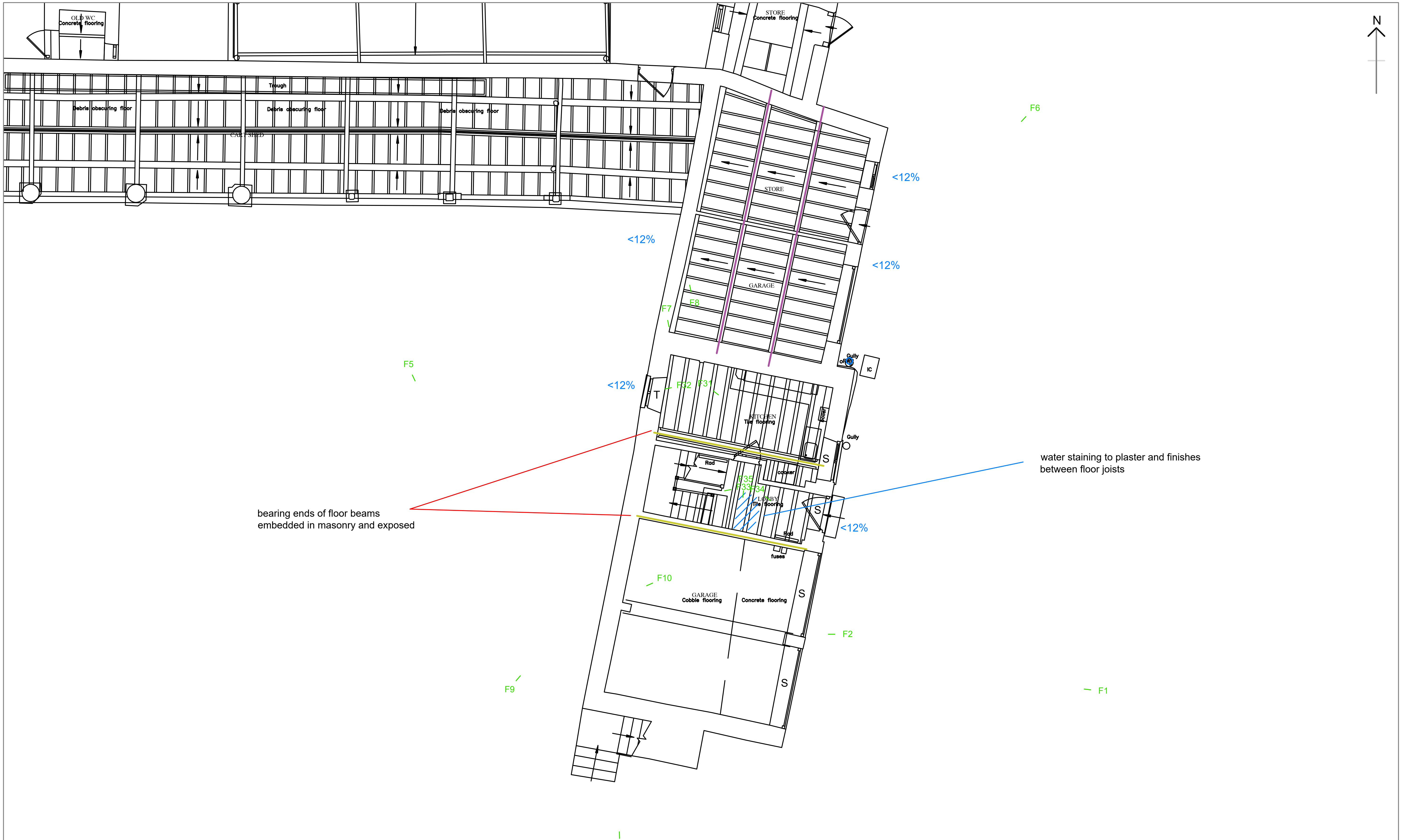


Aston Hall, Coach house - second floor structure
Preliminary timber condition investigation
March 2021

Hutton + Rostron Environmental Investigations Ltd
Netley House, Gomshall, Surrey, GU5 9QA Tel: 01483 203221
153.32 Site Note 4 -Not to scale-

Key:

(red line)	Decayed/defective timber element
<12%	Deep moisture content (w/w%)
F	Approximate location of photograph
(purple line)	Timber element of c.C20th intervention
(yellow line)	Timber most likely original (late c.C19th)
T	Lintel of timber construction
S	Lintel of solid construction
(hatching)	Area subject to water staining



H+R

Aston Hall, Coach house - first floor structure

Preliminary timber condition investigation

March 2021

Key:

(red line)	Decayed/defective timber element
<12%	Deep moisture content (w/w%)
F	Approximate location of photograph
(purple line)	Timber element of c.C20th intervention
(yellow line)	Timber most likely original (late c.C19th)
T	Lintel of timber construction
S	Lintel of solid construction
(hatching)	Area subject to water staining

Hutton + Rostron Environmental Investigations Ltd
Netley House, Gomshall, Surrey, GU5 9QA Tel: 01483 203221
153.32 Site Note 4 -Not to scale-