

# Hutton + Rostron Environmental Investigations Limited

## 41-43 Hay's Mews: Re-visit to reassess roof timber condition investigation (revised)

Site note 9 for December 2023, job no. 159-31

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### Attachments

- A Schedule
- B Photographs
- C Drawings

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## **1 INTRODUCTION**

### **1.1 AUTHORITY AND REFERENCES**

Hutton + Rostron Environmental Investigations Limited carried out site visits to 41-43 Hay's Mews during December 2023 in accordance with instructions from Heather Jackson-Wall by email, on 28 November 2023. Drawings provided by UberRaum Architects were used for the identification of structures. For the purpose of orientation in this report, the site entrance to the building into no.43 was taken as facing east

### **1.2 AIM**

The aim of this survey was to re-investigate the construction and condition of roof timbers so as to identify the extent of any structural defects or decay since revealed after exposure works. Remedial advice has been provided where appropriate using environmentally sound and sympathetic methods

### **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 or Rothounds. The condition of concealed timbers may be deduced from the reactions of the Rothounds or 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  
Pat Hughes

### **2.2 PERSONNEL CONTACTED**

Heather Jackson-Wall – Site Manager, Coniston

## **3 OBSERVATIONS AND RECOMMENDATIONS**

### **3.1 SUMMARY OF CONSTRUCTION**

#### **3.1.1 Arrangement and build-up**

*Notes:*

*Roof numbering is shown on attached plans*

*This site note should be read in conjunction with H+R site note 1 from July 2023*

For detailed constructional information including build-up and dimensions of structural timber elements for each roof, see attached schedule

#### **3.1.2 Material**

All timbers were preliminarily identified as being of a softwood variety. This was likely to be of the *Pinus* genus, and most likely European redwood (*Pinus sylvestris*); however, confirmation of this can be seen in H+R site note 6 on strength grading of in-situ timber roof elements which includes microscopic species identification of relevant structural elements within each of the roof voids

#### **3.1.3 History of remediation**

For the most part, there was very little evidence of significant structural remedial works noted throughout the investigation; however, in Roof 3, a number of common rafters had been replaced with newer timber, including the valley rafter to the west side of the largest dormer structure. This was suspected to have been a result of localised water penetration and decay. In Roof 6, there was widespread replacement of historic rafters with newer timber along the north side, although confined to the lower section of the roof void, below the purlin. At the western end of Roof 6 there was also some localised reconfiguration of the structure, with newer sections of purlins. A number of partner repairs and individual rafter replacements with new chemically pre-treated timber were also identified in Roofs 6 and 5

## **3.2 CONDITION**

### **3.2.1 Initial investigation July 2023**

See H+R site note 1

### **3.2.2 Re-inspection December 2023**

Since the initial survey of July 2023, various areas had been exposed, and structural timbers revealed, to allow further investigations. This was especially pertinent to roofs 5 and 6 which had been fully stripped externally and mostly internally, and enabled detailed inspection of rafters, purlins, collars, and plate sections. This revealed significant defects, most of which were structural, and the results are shown in the attached schedule.

- Fungal decay: Visible and inspected defects were for the most part a direct result of historic water penetration and subsequent decay from both fungal decay organisms and wood-boring beetle infestation, almost certainly from defective flashings, holes in/missing roof finishes (see H+R site note 3), and degradation of gutter linings and leadwork allowing water penetration during inclement weather or from overcharging of existing rainwater goods. Moisture content readings were in almost all cases typically well below the decay threshold of ~20 per vent w/w, and as such all decay was deemed historic

- Wood-boring beetle infestation: There was widespread evidence of historic wood-boring beetle infestation suspected to be a result of inadequate ventilation of the roof voids during previous occupancy resulting in significant condensation forming on the faces and undersides of the timber elements, raising the surface moisture content readings above the level which could sustain beetle activity, particularly on vulnerable sapwood content retained on timbers during original conversion. The lack of 'formal' through and cross-ventilation pathways was also evidenced by extensive mould growth on the faces of structural timbers at the time of the original investigation prior to the roofs being stripped and exposed. Moisture content readings taken from timbers during the initial survey (July 2023) were typically above the decay threshold and indicative of inadequate ventilation, although readings were significantly reduced since exposure works
- Damage/splitting to rafter feet and heads (roofs 5 and 6): Where rafters were damaged at heads and feet, the splitting and degradation of the timber was almost certainly due to the repeated re-fixing of the timbers to the ridge/plate after past refurbishment works as original holes were likely deemed unsuitable for new fixings or through the change in nail sizing. This had resulted in loss of fixing between the underlying plates/ridges and movement, and in some instances complete detachment, of the rafters in-situ
- Structural defects: The general sagging of the purlins in roof 5 was likely to be a result of removal of intermediate supports during previous rounds of refurbishment works, indeed it would be unusual for a purlin of this length to be structurally unsupported via struts/bracing onto internal walls along the length. Likewise, and depending on the view of the Structural Engineer, the general racking of roof 5 towards the north was likely a combination of both the lack of intermediate support for the purlins and of any form of diagonal bracing

Elsewhere, roof 1 had been fully stripped internally, and had revealed further localised decay adjacent to the area of decay identified during the initial survey (south-west corner) and included decay to associated vertical and horizontal elements comprising the studwork. In the remaining roofs (2, 3, and 4), plate sections and rafter feet were drilled where exposure had been undertaken, and no structurally significant decay detected. Roofs 7 and 8 had also been stripped and no decay was detected with the exception of 2no. decayed noggins adjacent to the dome within roof 8. Roof 9 remained inaccessible due to the presence of sensitive internal finishes below

*See attached schedule for detailed recommendations; however, as a general rule, decayed timber should be cut back to sound material and replaced, or partner repaired by through-bolting to new timber. New timber should match existing and be fully isolated from contact with damp or potentially damp masonry using a through-ventilated air hap, continuous layer of dpc, or cut back and re-supported on a bracket or hanger*

*All roof voids should be through and cross-ventilated in accordance with current building regulations. This can be achieved by using eaves vent strips in combination with vented ridges*

*Chemical remedial treatment of timber or wall irrigations are neither required nor recommended in relation to fungal decay organisms or wood-boring beetle infestation. H+R strongly believe that chemical treatment is not only ineffective against beetle and fungal decay organisms, but also expensive and environmentally damaging, and should not be employed even as a fail-safe option*

### **3.3 WATER PENETRATION PROVIDING THE CONDITIONS FOR DECAY**

Deep and surface moisture content readings were, for the most part, well within 'dry' parameters; however, there were isolated locations where elevated moisture content readings suggested ongoing issues with water penetration. Moisture readings, at over 20 per cent w/w, in the south-west corner of Roof 1 were consistent with defective/missing roof finishes and localised saturation of the flat roof timbers and subsequent structural

decay. Thermographic imagery of the largest of the south-facing dormer structures along the south perimeter of the building also indicated localised water penetration affecting the dormer cheeks, this was noted in conjunction with internal finish failure and mould growth. There was water-staining on the faces of timbers in multiple areas, especially around chimney projections; however, for the most part deep and surface moisture readings were below the decay threshold of ~20 per cent w/w, indicating historic issues with moisture ingress

*Note: As of December 2023, the roof structures, and the building as a whole, are fully covered by temporary roofing*

#### **4 H+R WORK ON SITE**

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

#### **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

SCHEDULE OF OBSERVATIONS AND RECOMMENDATIONS

REFERENCE	ITEM	OBSERVATIONS	RECOMMENDATIONS	CLIENT COMMENTS
<b>SN9.1 ROOF 1</b>				
SN9.1.1	Construction	<p>Roof 1 was of mansard construction and found in the north-west corner of the building perimeter. Raking mansard rafters were noted on all sides, and the roof adjoined a pitched roof to the south, and a flat roofed area to the north where a circular domed roof light was positioned. Mansard rafters were supported by plates spanning the perimeters of the outline, with flat roof joists spanning between upper mansard plates</p> <p>Dimensions</p> <p>Mansard rafters - ~100 x 50mm at ~350mm centres</p> <p>Flat roof joists - ~150 x 55mm at ~400mm centres</p> <p>Upper plate - ~100 x 75mm</p> <p>Lower plate (east) - ~150 x 75mm</p> <p>Lower plate (west) - ~160 x 75mm</p> <p>Sarking boards - ~150 x 20mm</p> <p>Internal studs - ~100 x 50mm</p> <p>Mansard hip rafter - ~170 x 50mm</p>	<p><i>No chemical remedial treatment is required or recommended in relation to fungal decay of timber elements</i></p> <p><i>Decayed timber should be cut back to sound material and replaced, or partner repaired, to new material to match existing. New timber in contact or in close proximity to damp or potentially damp masonry should be fully isolated from contact using standard plastic damp-proof material, through-ventilated air gaps, or cut back and re-supported on hangers or brackets. All repairs to be under the direction of the Structural Engineer and in consultation with the Architect and the Conservation Officer</i></p> <p><i>Roof is suitable for retention at the discretion of the Structural Engineer who may wish to comment on the suitability of the structure to bear any increase in loadings envisaged on refurbishment</i></p>	
SN9.1.2	Condition	<p>July 2023:</p> <p>1no. flat roof joist was found to be structurally decayed in the south-west corner of the flat roofed area on inspection. Moisture content readings, at over ~20per cent w/w, suggested there was ongoing issues with water penetration in this location, saturating timbers below, as a result of defective/missing roof finishes above. No evidence of dry rot or wood-boring beetle infestation was noted</p> <p>December 2023:</p> <p>The roof has since been fully exposed. Localised evidence of historical damp and decay was identified to a stud header/rail in the south-west corner during the re-inspection</p>		
<b>SN9.2 ROOF 2</b>				
SN9.2.1	Construction	<p>Roof 2 comprised large-section king-post roof trusses spanning east-west supporting rafters and purlins. The underside of the roof was not exposed at the time of survey preventing access to rafter feet and truss ends; however, visual assessment and use of non-invasive survey equipment was utilised for the investigation. Metal strapping was noted at the heads and bases of the trusses between the tie-beam/post and tie-beam/principal rafters. Purlins were supported by blocks bolted to the principal rafters and there was further through-bolts between the principal rafters and the tie-beams and the truss ends. There were concrete blocks noted within the void of Roof 3 forming the south gable end of the roof, and shadowing consistent with blockwork was noted to the north gable both providing support for purlin ends. All structural timber elements were painted white</p> <p>Dimensions</p> <p>Tie-beam - ~215 x 120mm</p> <p>Principal rafter - ~140 x 120mm</p> <p>Struts - ~95 x 95mm</p> <p>King post - ~115 x 120mm (widening to ~200mm at head)</p> <p>Purlins - ~150 x 75mm</p>	<p><i>No chemical remedial treatment is required or recommended in relation to fungal decay of timber elements</i></p> <p><i>No immediate timber repairs required. Roof is suitable for retention at the discretion of the Structural Engineer who may wish to comment on the suitability of the structure to bear any increase in loadings envisaged on refurbishment</i></p>	



REFERENCE	ITEM	OBSERVATIONS	RECOMMENDATIONS	CLIENT COMMENTS																					
SN9.2.2	Condition	<p>July 2023: No structurally significant timber decay from dry or wet rot fungal organisms or wood-boring beetle infestation was noted on inspection. Rafters and plates were disguised behind internal finishes</p> <p>December 2023: Rafters and plates remained disguised behind internal finishes however, localised exposure works revealed relatively recent construction, with a cavity wall to the east side. Plates were isolated from masonry using plastic dpc, and no structurally significant timber decay, mould growth, or wood-boring beetle activity was noted. Deep and surface moisture content readings were typically well within 'dry' parameters</p>																							
<b>SN9.3 ROOF 3</b>																									
SN9.3.1	Construction	<p>Roof 3 aligned along an east-west axis along the southern perimeter of the building and adjoined the southern section of Roof 2 on the west side, and the southern end of Roof 4 in the east. The roof was formed by rafters and purlins with additional purlin support elements in intermediate locations. Purlin supports were positioned onto large-section ceiling beams running the length of the roof voids. A number of dormer structures were formed onto the south pitch of the roof, varying in size but with the largest positioned generally centrally but slightly to the west. Access to Roof 4 was through the void of Roof 3, below the east side water tank. Rafters were supported at eaves onto a plate. The rooms below were formed partially into the roof structure leaving plates and rafter feet hidden behind internal finishes. It was noted that all timbers were generally isolated from damp or potentially damp masonry at gable ends via air gaps, with purlins supported by projecting masonry corbels at bearing ends</p> <p>Dimensions</p> <table border="0"> <tr> <td>Common rafters</td> <td>-</td> <td>~110 x 50mm at ~380mm centres</td> </tr> <tr> <td>Hip rafters</td> <td>-</td> <td>~230 x 75mm</td> </tr> <tr> <td>Purlins</td> <td>-</td> <td>~135 x 75mm</td> </tr> <tr> <td>Ceiling beams</td> <td>-</td> <td>~175 x 60mm</td> </tr> <tr> <td>Purlin supports</td> <td>-</td> <td>~100 x 75mm (variable)</td> </tr> <tr> <td>Ridgeboard</td> <td>-</td> <td>~170 x 50mm</td> </tr> <tr> <td>Perimeter beam</td> <td>-</td> <td>~220 x 120mm (acting as plate to north)</td> </tr> </table>	Common rafters	-	~110 x 50mm at ~380mm centres	Hip rafters	-	~230 x 75mm	Purlins	-	~135 x 75mm	Ceiling beams	-	~175 x 60mm	Purlin supports	-	~100 x 75mm (variable)	Ridgeboard	-	~170 x 50mm	Perimeter beam	-	~220 x 120mm (acting as plate to north)	<p><i>No chemical remedial treatment is required or recommended in relation to fungal decay of timber elements</i></p> <p><i>No immediate timber repairs required. Roof is suitable for retention at the discretion of the Structural Engineer who may wish to comment on the suitability of the structure to bear any increase in loadings envisaged on refurbishment</i></p>	
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SN9.3.2	Condition	<p>July 2023: No structurally significant timber decay from dry or wet rot fungal organisms or wood-boring beetle infestation was noted on inspection. Rafters and plates were disguised behind internal finishes. Thermal imagery suggested potential decay to plate sections and rafter feet on the east and west sides of the central south-facing dormer structure</p> <p>December 2023: The plates and rafter feet have since been exposed along the south side. These were all drilled for decay detection and probed for deep and surface moisture content readings. No decay detected on drilling, and moisture content readings were all well within dry parameters</p>																							
<b>SN9.4 ROOF 4</b>																									
SN9.4.1	Construction	<p>Roof 4 was constructed in mostly identical fashion to that of Roof 3 above, with rafters supported by purlins and purlin struts. Struts supported by large-section ceiling beams</p> <p>Dimensions</p> <table border="0"> <tr> <td>Common rafters</td> <td>-</td> <td>~110 x 50mm at ~380mm centres</td> </tr> <tr> <td>Hip rafters</td> <td>-</td> <td>~230 x 75mm</td> </tr> <tr> <td>Purlins</td> <td>-</td> <td>~135 x 75mm</td> </tr> <tr> <td>Ceiling beams</td> <td>-</td> <td>~175 x 60mm</td> </tr> <tr> <td>Purlin supports</td> <td>-</td> <td>~100 x 75mm (variable)</td> </tr> <tr> <td>Ridgeboard</td> <td>-</td> <td>~170 x 50mm</td> </tr> <tr> <td>Perimeter beam</td> <td>-</td> <td>~220 x 120mm (acting as plate to north)</td> </tr> </table>	Common rafters	-	~110 x 50mm at ~380mm centres	Hip rafters	-	~230 x 75mm	Purlins	-	~135 x 75mm	Ceiling beams	-	~175 x 60mm	Purlin supports	-	~100 x 75mm (variable)	Ridgeboard	-	~170 x 50mm	Perimeter beam	-	~220 x 120mm (acting as plate to north)	<p><i>No chemical remedial treatment is required or recommended in relation to fungal decay of timber elements</i></p> <p><i>Roof is suitable for retention at the discretion of the Structural Engineer who may wish to comment on the suitability of the structure to bear any increase in loadings envisaged on refurbishment</i></p> <p><i>Decayed section of rafter plate should be cut-back and a replacement section should be installed, using a suitable scarf joint detail and mechanical fixings, with adjoining common rafters re-fixed to their original positions. The plate section should be fully isolated from likely</i></p>	
Common rafters	-	~110 x 50mm at ~380mm centres																							
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REFERENCE	ITEM	OBSERVATIONS	RECOMMENDATIONS	CLIENT COMMENTS																																				
			<i>damp-affected masonry using a continuous strip of plastic dpc to the underside. All remedial works to structural elements should follow guidance from a Structural Engineer</i>																																					
SN9.4.2	Condition	<p>July 2023: No structurally significant timber decay from dry or wet rot fungal organisms or wood-boring beetle infestation was noted on inspection. Rafters and plates were disguised behind internal finishes. Thermal imagery suggested potential decay to plate sections and rafter feet on the east side of the roof although no access possible for drilling at the time of survey</p> <p>December 2023: The plates and rafter feet had since been exposed along the east side. These were all drilled for decay detection and probed for deep and surface moisture content readings.</p> <p>1 no. section of rafter plate at the south-east was found to be decayed for ~400mm, adjoining common rafters only displayed superficial decay at their feet. Moisture readings were below the threshold for the survival of decay organisms</p>																																						
<b>SN9.5 ROOF 5</b>																																								
SN9.5.1	Construction	<p>Roof 5 appeared to be of significantly older construction to that found to the south and west side of the building. Markings suggested that rafters and other structural timbers had been converted by hand rather than by machine. Rafters were supported by purlins at the approximate mid-span, with collars spanning east-west at intermediate locations throughout. Purlins were embedded into masonry pockets at both the north and south ends of the roof structure. Historic (now redundant) mortices for previous ceiling joists were noted in the collars spanning east-west across the void. This form of construction continued to the west into Roof 6 and as such the roofs were considered likely to have been constructed concurrently</p> <p>Dimensions  Common rafters - ~100 x 80mm at ~400mm centres  Collars - ~140 x 140mm  Purlins - ~140 x 160mm</p>	<p><i>No chemical remedial treatment is required or recommended in relation to fungal decay of timber elements</i></p> <p><i>Decayed timber should be cut back to sound material and replaced, or partner repaired, to new material to match existing. New timber in contact or in close proximity to damp or potentially damp masonry should be fully isolated from contact using standard plastic damp-proof material, through-ventilated air gaps, or cut back and re-supported on hangers or brackets. All repairs to be under the direction of the Structural Engineer and in consultation with the Architect and the Conservation Officer</i></p> <p><i>Rafters loose or unfixed to the purlin or to the plate should be assessed for damage (from a history of re-nailing during periods of refurbishment works) and refixed</i></p>																																					
SN9.5.2	Condition	<p>July 2023: There was structurally significant timber decay detected to the purlin bearing ends in Roof 5. Decay detection drilling revealed total decay to the purlins where fully embedded into the masonry. The decay did not extend beyond the embedment however, and moisture content readings were too low for further decay to occur, indicating decay was almost certainly historic and likely a result of historic issues with water penetration from defective flashings directly above. There was partial decay detected on inspection to a number of common rafters throughout Roof 5, although this was not considered structurally significant, and more likely localised mechanical damage occurring during later refurbishment efforts</p> <p>December 2023: After full exposure of the roof structure, significant issues were revealed affecting both upper and lower rafters either side of the purlin. The following observations were made:</p> <p><u>West pitch</u></p> <table border="0"> <tr><td>UR1</td><td>–</td><td>loose, unfixed at head adjacent to chimney</td></tr> <tr><td>LR1</td><td>–</td><td>loose, unfixed at head</td></tr> <tr><td>UR2</td><td>–</td><td>loose, unfixed at head and foot</td></tr> <tr><td>UR5-6</td><td>–</td><td>loose connections to purlin</td></tr> <tr><td>UR7</td><td>–</td><td>fully detached from location</td></tr> <tr><td>UR8</td><td>–</td><td>50% loss of cross-section at head ~300mm</td></tr> <tr><td>UR9</td><td>–</td><td>loose and split at foot ~500mm</td></tr> <tr><td>UR11</td><td>–</td><td>loss of cross-section at head ~150mm</td></tr> <tr><td>UR12</td><td>–</td><td>~400mm split at head</td></tr> <tr><td>UR13</td><td>–</td><td>~50% loss of cross-section from wane</td></tr> <tr><td>UR14</td><td>–</td><td>fully detached from location</td></tr> <tr><td>UR16-18</td><td>–</td><td>loosening of purlin connection</td></tr> </table>	UR1	–	loose, unfixed at head adjacent to chimney	LR1	–	loose, unfixed at head	UR2	–	loose, unfixed at head and foot	UR5-6	–	loose connections to purlin	UR7	–	fully detached from location	UR8	–	50% loss of cross-section at head ~300mm	UR9	–	loose and split at foot ~500mm	UR11	–	loss of cross-section at head ~150mm	UR12	–	~400mm split at head	UR13	–	~50% loss of cross-section from wane	UR14	–	fully detached from location	UR16-18	–	loosening of purlin connection	<p><i>Salvage of common rafters affected by loss of cross-section from historic beetle infestation and subsequent loss of sapwood content should be assessed for remaining load-bearing capacity by the SE. Those found to be defective should be replaced, partner repaired, or provided with intermediate support via insertion of additional timbers within the rafter space, with new material to match existing</i></p> <p><i>The decayed purlin ends should be cut back to sound material and the purlins re-supported on steel brackets/shoes fixed to the south end masonry gable</i></p> <p><i>Rafters wedged at the heads (likely from an historic necessity to increase individual rafters lengths) may be found to be long enough once the ridgeboard has been thickened, in accordance with intended works, hence it may be possible to remove the wedges/packing</i></p>	
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UR16-18	–	loosening of purlin connection																																						

REFERENCE	ITEM	OBSERVATIONS	RECOMMENDATIONS	CLIENT COMMENTS
		<p>LR19 – ~60% loss of cross-section at head ~150mm</p> <p>LR20 – decayed at foot</p> <p>LR21 – decayed at foot</p> <p>UR23 – loosening of fixing at head and foot</p> <p>UR24 – detached at head - loss of cross-section ~100mm</p> <p>UR25 – ~25% loss of cross-section to underside</p> <p>UR27 – hole at head ~30mm in diameter affecting ~100mm</p> <p>UR28-29 – detached and wedged at head</p> <p>UR30 – degradation to midspan and loosening of fixings</p> <p>UR31 – mechanical damage to head ~100mm</p> <p>UR32 – fully detached from location</p> <p><u>East pitch</u></p> <p>UR1 – loss of section at rafter head ~25%, inadequate purlin connection, resulting in loosening</p> <p>UR2 – inadequate ridge and purlin connections, resulting in loosening</p> <p>UR3 – inadequate ridge and purlin connections, resulting in loosening</p> <p>LR3 – inadequate connection at head</p> <p>UR4 – inadequate purlin connection, resulting in loosening</p> <p>UR6 – loose connections to ridge and purlin</p> <p>LR6 – excessive splitting at head</p> <p>UR7 – loose connections at head and foot</p> <p>UR8 – loose connections at head and foot</p> <p>UR9 – poor joint connection to ridge, resulting in loosening</p> <p>UR13 – loose connections to ridge and purlin, loss of section ~30%</p> <p>UR15 – excessive knot ratio to vertical face</p> <p>UR16 – excessive splitting at head, resulting in loosening</p> <p>LR16 – inadequate connection at head, decayed at foot</p> <p>UR17 – inadequate foot connection, insufficient mating surfaces</p> <p>LR17 – inadequate foot connection, decayed at foot</p> <p>UR18 – inadequate foot connection, excessive splitting</p> <p>LR18 – wedged at ridge connection</p> <p>LR19 – wedged at ridge connection, decayed at foot</p> <p>LR20 – wedged at ridge connection</p> <p>UR21 – inadequate foot connection, excessive splitting</p> <p>LR21 – wedged at head connection</p> <p>LR22 – wedged at head connection</p> <p>UR23 – inadequate foot connection, insufficient mating surfaces</p> <p>LR23 – wedged at head connection</p> <p>UR24 – excessive splitting to head and foot connections, resulting in loosening</p> <p>LR24 – wedged at head connection</p> <p>UR25 – ~30% loss of section due to decay</p> <p>LR25 – wedged at head connection, decayed at foot</p> <p>LR26 – inadequate head connection – partial separation (wedged), decayed at foot</p> <p>LR27 – inadequate head connection – partial separation (wedged), decayed at foot</p> <p>LR28 – inadequate head connection – loss of section (wedged)</p> <p>UR29 – loose connections to head and foot</p> <p>LR29 – wedged at head connection</p> <p>UR30 – excessive splitting at foot connection</p> <p>LR30 – wedged at head connection</p> <p>UR33 – loose connections to head and foot</p> <p>(rafters numbered from south end towards north, UR = upper rafter, LR = lower rafter)</p>		

REFERENCE	ITEM	OBSERVATIONS	RECOMMENDATIONS	CLIENT COMMENTS																																																																																	
<b>SN9.6 ROOF 6</b>																																																																																					
<b>SN9.6.1</b>	Construction	<p>As described above, the construction of Roof 6 was likely to have been concurrent with Roof 5 to the east and the arrangement was generally identical, with the exception that purlins were not embedded into masonry pockets at bearing ends, but were supported onto masonry corbels projecting from the gables, as per Roof 3</p> <p><u>Dimensions</u></p> <table> <tr> <td>Rafters (later)</td> <td>-</td> <td>~100 x 50mm at ~360mm centres</td> </tr> <tr> <td>Rafters (historic)</td> <td>-</td> <td>~110 x 70mm</td> </tr> <tr> <td>Purlins (historic)</td> <td>-</td> <td>~160 x 160mm</td> </tr> <tr> <td>Purlins (later)</td> <td>-</td> <td>~190 x 125mm</td> </tr> <tr> <td>Collars</td> <td>-</td> <td>~150 x 150mm</td> </tr> </table>	Rafters (later)	-	~100 x 50mm at ~360mm centres	Rafters (historic)	-	~110 x 70mm	Purlins (historic)	-	~160 x 160mm	Purlins (later)	-	~190 x 125mm	Collars	-	~150 x 150mm	<p><i>No chemical remedial treatment is required or recommended in relation to fungal decay of timber elements</i></p> <p><i>Decayed timber should be cut back to sound material and replaced, or partner repaired, to new material to match existing. New timber in contact or in close proximity to damp or potentially damp masonry should be fully isolated from contact using standard plastic damp-proof material, through-ventilated air gaps, or cut back and re-supported on hangers or brackets. All repairs to be under the direction of the Structural Engineer and in consultation with the Architect and the Conservation Officer</i></p>																																																																			
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<b>SN9.6.2</b>	Condition	<p>July 2023:</p> <p>December 2023: After full exposure of the roof structure, significant issues were revealed affecting both upper and lower rafters either side of the purlin, as well as to additional structural elements. The following observations were made: (rafters counted from south end towards north, UR = upper rafter, LR = lower rafter)</p> <p><u>North pitch</u></p> <table> <tr> <td>UR1</td> <td>-</td> <td>inadequate head connection, poor fixing quality</td> </tr> <tr> <td>UR4</td> <td>-</td> <td>excessive splitting ~1200mm</td> </tr> <tr> <td>UR5</td> <td>-</td> <td>excessive splitting ~350mm</td> </tr> <tr> <td>LR5</td> <td>-</td> <td>inadequate foot connection, superficial decay and corroded fixings</td> </tr> <tr> <td>UR6</td> <td>-</td> <td>undersized, inadequate head connection, loss of section ~20/25% due to decay</td> </tr> <tr> <td>LR6</td> <td>-</td> <td>inadequate foot connection, superficial decay and corroded fixings</td> </tr> <tr> <td>LR7</td> <td>-</td> <td>inadequate foot connection, superficial decay and corroded fixings</td> </tr> <tr> <td>LR8</td> <td>-</td> <td>inadequate foot connection, superficial decay and corroded fixings</td> </tr> <tr> <td>UR9</td> <td>-</td> <td>inadequate foot connection, loss of section ~20/25% due to decay</td> </tr> <tr> <td>LR9</td> <td>-</td> <td>inadequate foot connection, superficial decay and corroded fixings</td> </tr> <tr> <td>LR10</td> <td>-</td> <td>inadequate foot connection, superficial decay and corroded fixings</td> </tr> <tr> <td>UR11</td> <td>-</td> <td>loss of section ~30% due to decay</td> </tr> <tr> <td>UR14</td> <td>-</td> <td>loose head connection (atop masonry corbel)</td> </tr> <tr> <td>UR17</td> <td>-</td> <td>partial separation of head connection</td> </tr> <tr> <td>UR18</td> <td>-</td> <td>partial separation of head and foot connection, resulting in loosening, loss of section</td> </tr> <tr> <td>UR19</td> <td>-</td> <td>partial separation of head connection, resulting in loosening</td> </tr> <tr> <td>UR20</td> <td>-</td> <td>partial separation of head connection</td> </tr> <tr> <td>UR21</td> <td>-</td> <td>inadequate mating surfaces and splitting at head connection ~200mm</td> </tr> <tr> <td>UR23</td> <td>-</td> <td>inadequate fixings at head connection, excessive knot on vertical face</td> </tr> <tr> <td>UR24</td> <td>-</td> <td>loose</td> </tr> <tr> <td>UR26</td> <td>-</td> <td>loose, undersized and excessive splitting to foot</td> </tr> <tr> <td>UR27</td> <td>-</td> <td>loose, undersized due to decay (~30%)</td> </tr> <tr> <td>UR28</td> <td>-</td> <td>multiple splits to head and foot</td> </tr> </table> <p>Rafter plate – partial decay to external edge for ~1m, at west end</p> <p>*Significant damage to brickwork forming the parapet wall at the approximate mid-section. This had not damaged timber elements in close proximity at the time of survey</p> <p><u>South pitch</u></p> <table> <tr> <td>LR1</td> <td>-</td> <td>~50% loss of cross-section along length, wane</td> </tr> <tr> <td>UR2-3</td> <td>-</td> <td>loose at heads</td> </tr> <tr> <td>UR6</td> <td>-</td> <td>~40% loss of cross-section to underside</td> </tr> <tr> <td>UR7</td> <td>-</td> <td>~40% loss of cross-section to underside</td> </tr> </table>	UR1	-	inadequate head connection, poor fixing quality	UR4	-	excessive splitting ~1200mm	UR5	-	excessive splitting ~350mm	LR5	-	inadequate foot connection, superficial decay and corroded fixings	UR6	-	undersized, inadequate head connection, loss of section ~20/25% due to decay	LR6	-	inadequate foot connection, superficial decay and corroded fixings	LR7	-	inadequate foot connection, superficial decay and corroded fixings	LR8	-	inadequate foot connection, superficial decay and corroded fixings	UR9	-	inadequate foot connection, loss of section ~20/25% due to decay	LR9	-	inadequate foot connection, superficial decay and corroded fixings	LR10	-	inadequate foot connection, superficial decay and corroded fixings	UR11	-	loss of section ~30% due to decay	UR14	-	loose head connection (atop masonry corbel)	UR17	-	partial separation of head connection	UR18	-	partial separation of head and foot connection, resulting in loosening, loss of section	UR19	-	partial separation of head connection, resulting in loosening	UR20	-	partial separation of head connection	UR21	-	inadequate mating surfaces and splitting at head connection ~200mm	UR23	-	inadequate fixings at head connection, excessive knot on vertical face	UR24	-	loose	UR26	-	loose, undersized and excessive splitting to foot	UR27	-	loose, undersized due to decay (~30%)	UR28	-	multiple splits to head and foot	LR1	-	~50% loss of cross-section along length, wane	UR2-3	-	loose at heads	UR6	-	~40% loss of cross-section to underside	UR7	-	~40% loss of cross-section to underside	<p><i>Rafters loose or unfix to the purlin or to the plate should be assessed for damage (from a history of re-nailing during periods of refurbishment works) and if possible refixed</i></p> <p><i>Salvage of common rafters affected by loss of cross-section from historic beetle infestation and subsequent loss of sapwood content should be assessed for remaining load-bearing capacity by the SE. Those found to be defective should be replaced, partner repaired, or provided with intermediate support via insertion of additional timbers within the rafter space, with new material to match existing</i></p> <p><i>Rafters wedged at the heads (likely from an historic necessity to increase individual rafters lengths) may be found to be long enough once the ridgeboard has been thickened, in accordance with intended works, hence it may be possible to remove the wedges/packing</i></p> <p><i>SE to determine the significance of the discrepancies in adjacent sizing of the purlin connection at the western end of the roof. Allowance should be given to strengthening the purlin with steel/timber. The SE may also wish to determine the necessity for further strutting of the purlin along the north pitch of the roof</i></p>	
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REFERENCE	ITEM	OBSERVATIONS	RECOMMENDATIONS	CLIENT COMMENTS
		<p>UR9 - ~30% loss of cross-section to underside  UR11 - ~40% loss of cross-section to underside  LR11 - wedged at head suggesting loss of material/reduction in length  UR12 - split at head ~100mm, loose fixings  UR13 - split at head ~1m in length  LR13 - wedged at head suggesting loss of material/reduction in length  UR14 - ~40% loss of cross-section along length  UR15 - detached from fixings, damage to foot ~200mm  LR15 - damage to head ~200mm in length  UR16 - detached from fixings  UR17 - decayed full length, historic wood-boring beetle infestation  UR18 - decayed from fixings, split at foot ~250mm  LR18 - split at head ~400mm in length  LR20 - damage to upper face ~200mm  UR21 - decayed at foot ~600mm in length, historic wood-boring beetle  LR21 - damage to midspan  UR24 - ~40% loss of cross-section along length, loss of fixings  UR25 - ~30% loss of cross-section along length, partial decay to foot ~200mm  UR26 - loose, infixed at head due to loss of cross-section</p> <p>(rafters numbered from east end towards west, UR = upper rafter, LR = lower rafter)</p> <p>There were dimensional discrepancies between the historic and newer section of the purlin at the western end of the roof structure, which was also simply through-bolted with one bolt. Support to the purlin was potentially inadequate with only one strut to the southern pitch and none to the northern pitch. This may be structurally significant</p>		
<b>SN9.7 ROOF 7</b>				
SN9.7.1	Construction	<p>Roof 7 was of flat roof construction, with flat roof joists spanning east-west and supported to the east and west ends by plates on the heads of the masonry walls</p> <p><u>Dimensions</u>  Flat roof joists - ~205 x 60mm at ~380mm centres</p>	<p><i>No chemical remedial treatment is required or recommended in relation to fungal decay of timber elements</i></p> <p><i>No immediate timber repairs required. Roof is suitable for retention at the discretion of the Structural Engineer who may wish to comment on the suitability of the structure to bear any increase in loadings envisaged on refurbishment</i></p>	
SN9.7.2	Condition	<p>July 2023:  There was minimal access to roof 7 at the time of the original survey due to ceiling finishes remaining intact and in position. Borescope inspection did not reveal any significant issues with damp and decay</p> <p>December 2023:  The roof has since been fully exposed. No evidence of significant issues with damp and decay was identified during the re-inspection</p>		
<b>SN9.8 ROOF 8</b>				
SN9.8.1	Construction	Roof 8 was of flat roof construction with a central domed structure. There was no access to determine the details of th3 construction due to sensitive listed internal finishes in the room below	H+R to inspect the roof structure when clear and safe access is available	
SN9.8.2	Condition	-	-	
<b>SN9.9 ROOF 9</b>				
SN9.9.1	Construction	<p>Roof 9 was of flat roof construction, with flat roof joists spanning east-west and supported to the east and west ends by plates on the head of the masonry wall to the west and internal load bearing stud walls to the east. A domed lightwell was positioned approximately central to the roof structure</p> <p><u>Dimensions</u></p>	<p><i>No chemical remedial treatment is required or recommended in relation to fungal decay of timber elements</i></p> <p><i>The mechanical fixings securing the decayed noggings should be cut using a reciprocating saw with a metal-cutting blade, allowing for the</i></p>	

REFERENCE	ITEM	OBSERVATIONS	RECOMMENDATIONS	CLIENT COMMENTS
		Flat roof joists - ~205 x 60mm at ~380mm centres	<i>removal of each. Replacement noggings should be inserted and re-secured using skewed contemporary fixings. Replacement timber should be air or kiln-dried and of the same or similar species</i>	
<b>SN9.9.2</b>	Condition	<p>July 2023: There was minimal access to roof 9 at the time of the original survey due to ceiling finishes remaining intact and in position. Borescope inspection did not reveal any significant issues with damp and decay</p> <p>December 2023: The roof has since been fully exposed.</p> <p>2 no. noggings adjacent to the domed lightwell were found to be structurally decayed for ~150/200mm</p>		

# Attachment B



**Fig 1:**

Roof 5, west pitch; showing general view towards south end



**Fig 2:**

Roof 5, west pitch; showing area of decay to purlin at south end





**Fig 3:**

Roof 5, west pitch; showing perimeter upper rafter at extreme south end unfixed to timber or masonry at head



**Fig 4:**

Roof 5, west pitch; showing no access to drill or probe wall plate along west side



**41-43 Hay's Mews**  
Photographs  
December 2023  
Not to scale



**Fig 5:**

Roof 5; showing disconnection between ridge board sections at southern end



**Fig 6:**

Roof 5, west pitch; showing loss of cross section to head of upper common rafter



**Fig 7:**

Roof 5, west pitch; showing localised loss of cross section to head of upper common rafter and also split to adjacent rafter at head



**Fig 8:**

Roof 5, west pitch; showing occasional use of softwood replacement rafters



**41-43 Hay's Mews**  
Photographs  
December 2023  
Not to scale



**Fig 9:**

Roof 5; showing large longitudinal split to ridge board at jointing location at approximate mid-span of roof



**Fig 10:**

Roof 5, west pitch; showing typical damage to head of lower rafter



**41-43 Hay's Mews**  
Photographs  
December 2023  
Not to scale



**Fig 11:**

Roof 5, north end, west pitch; showing large hole through head of upper common rafter



**Fig 12:**

Roof 5, west pitch, north end; showing upper common rafters packed between ridge board and plumb cut suggesting lengthening of space between upper rafter and ridge board further confirming racking and structural movement



**41-43 Hay's Mews**  
Photographs  
December 2023  
Not to scale



**Fig 13:**

Roof 5, west pitch, north end; showing complete detachment of upper common rafter at extreme north end



**Fig 14:**

Roof 5, west pitch; showing outward movement of purlin support post at extreme north end suggesting dropping at purlin connection point



**41-43 Hay's Mews**  
Photographs  
December 2023  
Not to scale



**Fig 15:**

Roof 5, west pitch; showing purlin connection approximately 2m back from north wall pegged Essex scarf joint



**Fig 16:**

Roof 5; showing a general view of the east pitch of roof 5



**41-43 Hay's Mews**  
Photographs  
December 2023  
Not to scale