Hutton + Rostron
Environmental Investigations Limited

55 Cumberland Terrace, Mews: Timber Visual Strength Grading

Site note 2 for 25 June 2021, job no. 154.11

CONTENTS

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1 INTRODUCTION

1.1 AUTHORITY AND REFERENCES

Hutton + Rostron Environmental Investigations Limited carried out a site visit to 55 Cumberland Terrace on 25 June 2021 in accordance with instructions from Antonella Noto of Millbridge Group by email, on 23 June 2021 reference 10:08. Drawings provided by Millbridge Group were used for the identification of structures. For the purpose of orientation in this report, the carriage doors at ground floor level were taken as facing east towards the barracks

1.2 AIM

The aim of the visual strength grading exercise was to indicate the probable strength grade of each of the elements within the roof structure and first floor structures

1.3 LIMITATIONS

The assessment of strength grade is based physical observation of strength-reducing characteristics such as knots, rate of growth, fissures, wane distortions and bowing. The assessment of *in-situ* timbers therefore requires all of the faces to be examined. The technique is based on the judgement and experience of the grader and is inherently subjective. Properties such as density and notches, both of which have an important influence on stiffness, are not considered as part of the strength grading process but are reported on if these are known to be present. It was not possible, in all timbers, to assess slope of grain, rate of growth, knots, and other strength reducing defects. This was because the timbers were not fully accessible along their spans, however, from samples taken, the rate of growth fell well within the requirements of BS 4978: 2007 '*Visual strength grading of softwood*'. In view of these limitations, the visual strength grading procedure cannot be 100 per cent reliable. Accordingly, in all of the timbers inspected, the probable strength grade can only be deduced from the strength reducing features visible on exposed faces at the time of inspection

1.4 METHODOLOGY

The timber elements were inspected on the basis of exhibiting strength reducing features such as slope of grain, distortion, wane and fissures. A probable strength grade assessment of ungradeable (UG), general structural (GS) grade or special structural (SS) grade was made on the basis of measuring these features. The extent of strength reducing features that are permissible within strength grades are detailed in British Standard 4978: Specification for Visual Strength Grading of Softwood. Identification of timber species was carried out in various locations from each roof area. Samples were core-dilled from representative structural elements and initially examined visually with a x10 lens to determine their gross characteristics. Thin sections were subsequently cut from each sample and examined microscopically. The anatomical features of each sample were compared with published information and where applicable with reference timber samples

1.5 CLASSIFICATION

The combination of probable visual grade and timber species was undertaken to enable the assessment of strength class

1.6 STAFF ON SITE AND CONTACTS

1.6.1 H+R staff on site

Andrew Ellis
Matt Amis

1.6.2 Personnel contacted

Site Team

2 TIMBER SPECIES EXAMINATION REPORT

2.1 SAMPLE DETAILS

Samples of timber were examined on 25 June 2021. H+R coded the samples with the sample code numbers below

2.2 TIMBER SPECIES EXAMINATION

The samples were examined visually with a x10 lens to determine their gross characteristics. Thin sections were also cut from each sample and examined microscopically. The anatomical feature of each sample was then compared with published information and, where applicable, with reference timber samples. Microscopic images are shown at the end of the attached photograph pages

2.3 TIMBER SPECIES

2.3.1 Table of species identification

Sample reference	Common name	Botanical name
ROOF		
1. Tie-beam	European redwood	*Pinus sylvestris*
2. Principal rafter	European redwood	*Pinus sylvestris*
3. Purlin	European redwood	*Pinus sylvestris*
4. Historic common rafter	European redwood	*Pinus sylvestris*
FIRST FLOOR		
10. Historic floor joist	European redwood	*Pinus sylvestris*
11. Modern floor joist	Spruce	*Picea Spp.*
12. Wall plate	European redwood	*Pinus sylvestris*

2.3.2 Conclusion of species identification and sampling

1 Species: As shown in the table above, all timber components were found to be of softwood and therefore are grading against the softwood standards of British Standard 4978: Specification for Visual Strength Grading of Softwood

2 Rate of growth: Analysis of the samples core-drilled from representative timber elements showed a suitably slow rate of growth with rings falling between 3-5mm, well within the BS guidance of a maximum of 6mm

3 Source country of origin: British Standard BS EN 1912:2012 can permit grading of *Pinus sylvestris* at C27 provided the country of origin can be verified as either France or Spain. This is presumably due to the growing of timber at higher altitudes. No markings on the timber components that would indicate source were noted at the time of survey. There are currently no British Standards stating guidelines or rules for visually strength grading timber at a class higher than C24

2.4 TABLE OF STRENGTH GRADES

Code/room no/element	Dimension (mm)	Allocated probable grade	Timber species	Allocated probable strength class	Comments
ROOF					
Common rafters	100 x 62mm @ 770mm centres	90%GS 10% UG	*ER*	C16 UG	
Purlins	265 x 145mm	100% GS	*ER*	C16	
Truss 1 (T1)					
Tie-beam	215 x 110mm	N/A (excessive paint layers)	*ER*	-	
Principal rafters	130 x 110mm	50% SS 50% UG (decay)	*ER*	50% C24 50% UG	
King posts	195 x 120mm <120 x 100mm	N/A (excessive paint layers)	*ER*	-	
Struts	120 x 110mm	N/A (excessive paint layers)	*ER*	-	
Truss 2 (T2)					
Tie-beam	215 x 110mm	100% GS	*ER*	100% C16	
Principal rafters	130 x 110mm	50% SS 50% UG (decay)	*ER*	50% C24 50% UG	
King posts	195 x 120mm <120 x 100mm	100% SS	*ER*	100% C24	
Struts	120 x 110mm	100% SS	*ER*	100% C24	
Truss 3 (T3)					
Tie-beam	215 x 110mm	100% UG	*ER*	100% UG	
Principal rafters	130 x 110mm	100% UG	*ER*	100% UG	
King posts	195 x 120mm <120 x 100mm	100% UG	*ER*	100% UG	
Struts	120 x 110mm	100% UG	*ER*	100% UG	
Truss 4 (T4)					
Tie-beam	215 x 110mm	100% SS	*ER*	100% C24	
Principal rafters	130 x 110mm	100% SS	*ER*	100% C24	
King posts	195 x 120mm <120 x 100mm	100% SS	*ER*	100% C24	
Struts	120 x 110mm	100% SS	*ER*	100% C24	
FIRST FLOOR					
Historic floor joists	190 x 55 mm (Over-sized joists 190 x 75mm	55% UG 45% GS	*ER*	55% UG 45% C16	
Modern floor joists	-	100% GS	*SP*	100% C16	
Plate	100 x N/A mm	-	*ER*	-	

ER = European Redwood SP= Spruce SS = Special Structural
GS = General Structural UG = Ungradable

Notes

1 No 'formal' strength grading was undertaken

2 The strength grades given above are based on preliminary observation of accessible faces of the timber only

3 The actual grades may be less on the basis of defects that were previously not apparent at the time of the assessment

3 SUMMARY OF CONDITION

1 Timber decay: As described in Site Note 1, there was significant evidence issues of historic penetrating moisture and subsequent structural decay of timber. Decayed timbers have not been included in visual strength grading assessment

2 Wood-boring beetle infestation: There was localised evidence of historic wood-boring beetle infestation, although this was exclusively confined to non-structural sapwood bands of timber components and in no case was this structurally significant

3 Moisture content readings: Both deep-probed and surface moisture content readings were generally well below the level required to sustain fungal decay organisms or wood-boring beetle infestation, and were regularly below 12 per cent w/w

4 H+R WORK ON SITE

4.1 H+R inspected structural timbers for strength reducing characteristics

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:

Visual strength-grading, roof structures; showing general view of exposed roof timbers formed of 4 no. trusses of kingpost assembly. All timbers apparently of European Redwood with good access for strength grading assessment

Fig 2:

Visual strength-grading, roof structures; showing truss 1. Note limited to poor visual access of timber surfaces from historic build-up of paint layers

55 Cumberland Terrace
Photographs
25 June 2021
Not to scale

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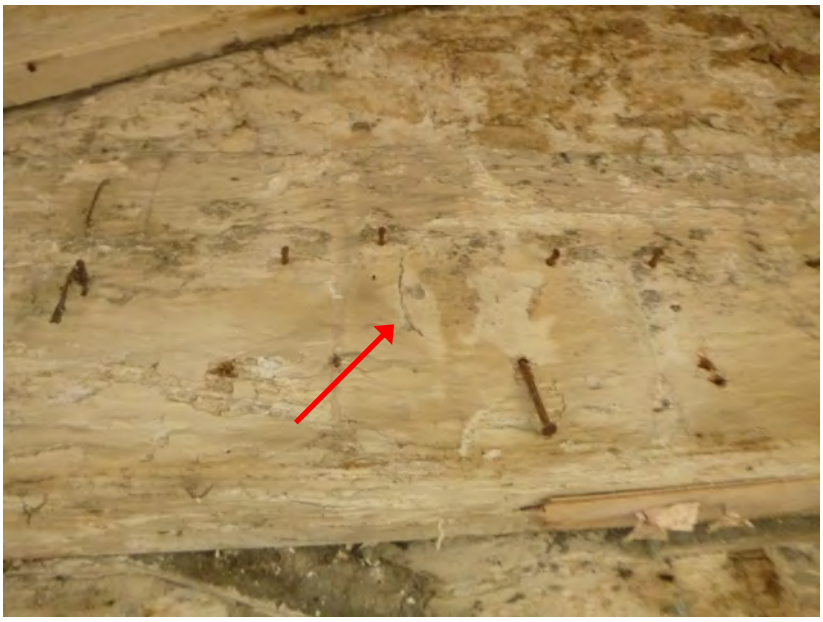

Fig 3:

Visual strength-grading, roof structures; showing some evidence for large knot location to truss tie beam 1, however, knot largely concealed by generations of paint build-up. Timber cannot be visually graded

Fig 4:

Visual strength-grading, roof structures; showing west bearing end of truss tie beam 2 subject to moderate slope of grain and heart shake, however, slope of grain did not exceed 1 in 6 gradient. Timber graded C16

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Fig 5:

Visual strength-grading, roof timbers; showing east bearing end of truss tie beam 2 showing moderate slope of grain at bearing end, however, slope of grain did not exceed parameters for strength-reducing weakness. Timber graded C16

Fig 6:

Visual strength-grading, roof timbers; showing principal rafter to truss tie beam 2 east pitch subject to excessive through knot. Timber graded UG (Ungradable)

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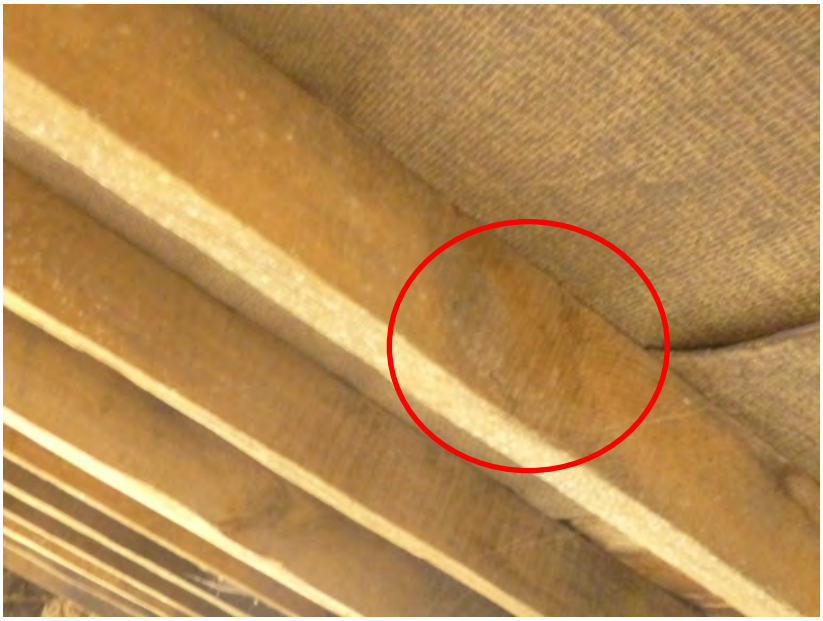

Fig 7:

Visual strength-grading, roof timbers; showing view of common rafter east pitch between trusses 2 and 3 subject to excessive through knot at approximately 60% of section size. Timber graded UG (Ungradable)

Fig 8:

Visual strength-grading, roof timbers; showing sporadic heart shake checking to the underside of truss tie beam 3, however, timber failed due to excessive notching to opposing west end of beam

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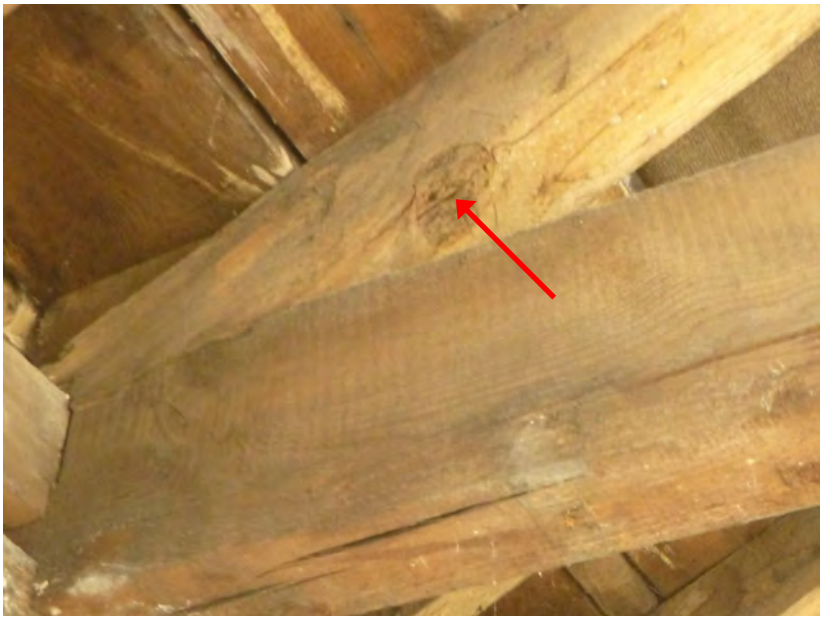

Fig 9:

Visual strength-grading, roof structures; showing excessive arris through knot to east principal rafter to truss 3. Principal rafter graded UG (Ungradable)

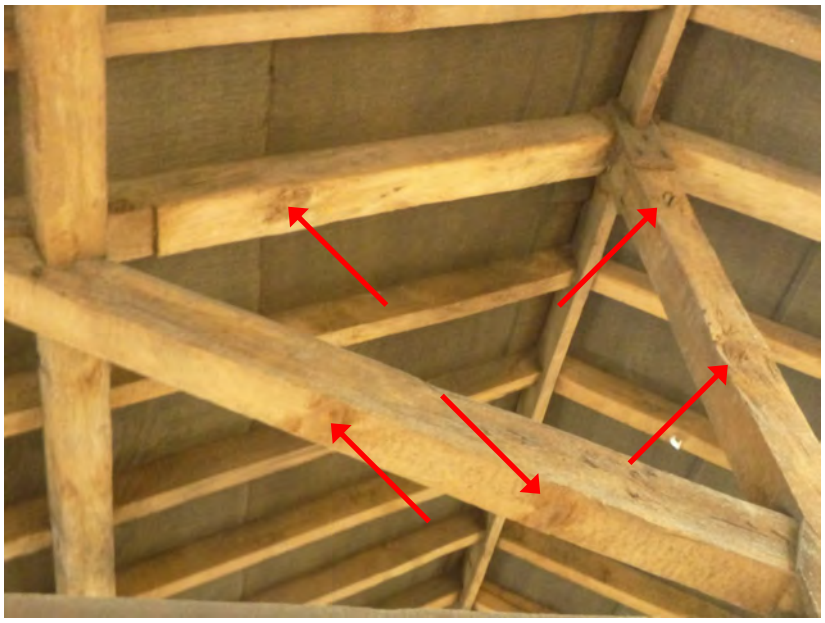

Fig 10:

Visual strength-grading, roof timbers; showing multiple significant large section through knots to all principal timbers forming truss tie beam 3 including raking struts, principal rafter and kingpost. Entire truss graded UG (Ungradable)

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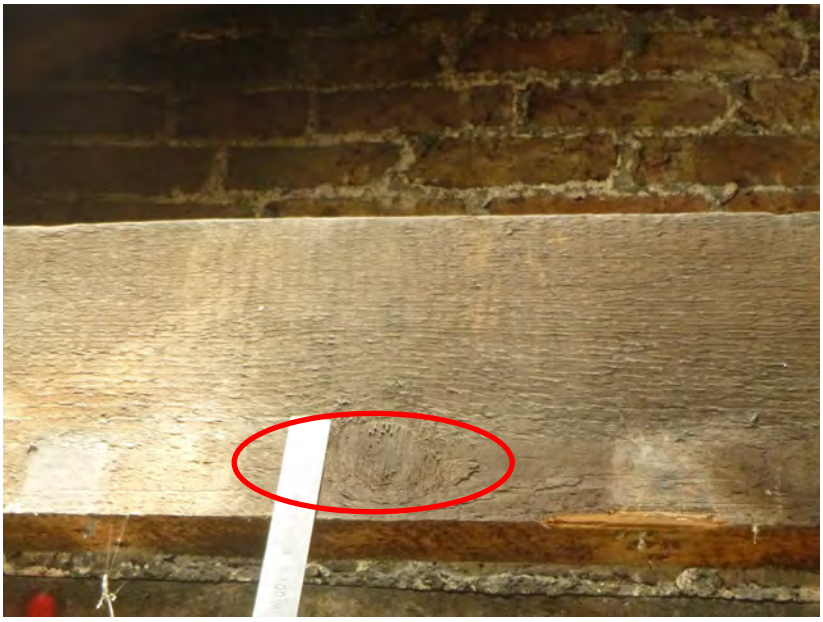

Fig 11:

Visual strength-grading roof timbers showing small through knots to side face of truss tie beam 4 at approximately nearing the 40mm as typically found throughout the remaining sections of timber which is not deemed a strength-reducing characteristic. Tie beam graded SS (Special Structural) or C24 grade

Fig 12:

Visual strength-grading, roof timbers; showing general view of truss 4 tie beam. Note good straight grain growth without any apparent strength-reducing characteristics. Timber graded SS (Special Structural) or C24

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Fig 13:

Visual strength-grading; roof timbers; showing general view of east pitched common rafter assembly at north east area. Note timbers generally of reasonable condition with limited strength-reducing characteristics. Majority of common rafters were graded as GS (General Structural) or C16 grade excepting 10% which were graded UG (Ungradable)

Fig 14:

Visual strength-grading, roof timbers; showing failed or UG (Ungradable) timber to west pitch south west corner between trusses 1 and 2

Fig 15:

Visual strength-grading, roof structures; showing typical common rafter subject to moderate through arris knot which, although deemed a strength-reducing characteristic, was not large enough to grade it as UG (Ungradable). Timber graded C16 or GS (General Structural)

Fig 16:

Visual strength-grading, first floor; structures showing view in general of south room 17 no. floor joists spanning north/south between masonry walls. All timbers were assessed for their strength-reducing characteristics such as knot margins, slope of grain, wane and rate of growth

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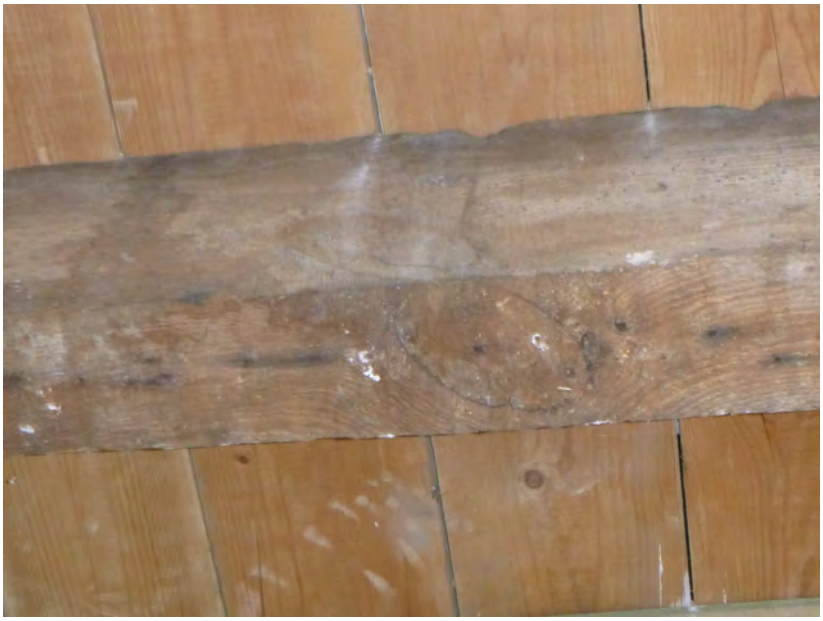

Fig 17:

Visual strength-grading, first floor; showing typical floor joist at east perimeter wall subject to excessive through knot at bottom face. Timber graded UG (Ungradable)

Fig 18:

Visual strength-grading, first floor; structures showing 2 no. floor joists at east area subject to excessive knot margins to their upper and lower faces. Timbers graded UG (Ungradable)

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Fig 19:

Visual strength-grading, first floor; structures showing large splay knot to side of face to floor joists. Timber borderline between C16 and UG (Ungradable)

Fig 20:

Visual strength-grading, first floor; structures showing modern addition remedial floor joists subject to excessive slope of grain and structural cracking or fissure. Timber graded UG (Ungradable)

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Fig 21:

Visual strength-grading, first floor; structures showing 2 no. floor joists embedded into internal party wall subject to excessive mechanical damage or failure at inherent grain weaknesses within timbers. Timbers graded UG (Ungradable)

Fig 22:

Visual strength-grading, first floor; structures showing trimmer joist at central south wall subject to excessive slope of grain and structural fissure to timber. Timber graded UG (Ungradable)

Fig 23:

Visual strength-grading, first floor; showing floor joists with excessive knot margin

Fig 24:

Visual strength-grading, first floor; showing floor joists to south room subject to excessive knot margin as well as slope of grain to upper face. Timber graded UG (Ungradable)

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Fig 25:

Visual strength-grading, first floor; showing north room carport in general looking east. Note majority of floor joists appear to be of poor quality converted timbers with approximately 11 of the 70 no. floor joists spanning north/south graded UG (Ungradable)

Fig 26:

Visual strength-grading, first floor structures; showing 1 no. floor joist at west area subject to excessive knot margin as well as multiple service holes. Timber graded UG (Ungradable)

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Fig 27:

Visual strength-grading, first floor structures; showing joist at central area of the room subject to loss of section from knot location as well as excessive slope of grain which represents an innate strength-reducing characteristic within the timber. Timber graded UG (Ungradable)

Fig 28:

Visual strength-grading, first floor structures; showing 2 no. floor joists at north area adjacent to bressummer rolled steel joist subject to excessive knot margins. Both timbers graded UG (Ungradable)

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Fig 29:

Visual strength-grading, first floor structures; showing core samples taken from historic and modern floor joists for microscope analysis and species identification back at H+R laboratories

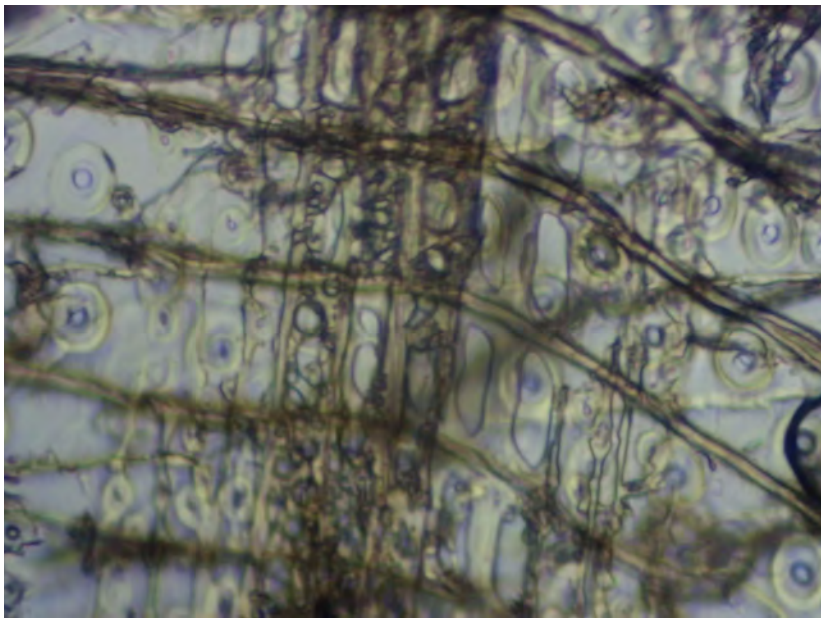

Fig 30:

Laboratory image; showing a microscopic radial image of a sample retrieved from a tie-beam at the time of survey from Roof Truss 1

The large window-like openings in the cross-field pitting, and the dentate ray tracheids, are both characteristics associated with relevant literature and library samples relating to European redwood (*Pinus sylvestris*, or Scots Pine)

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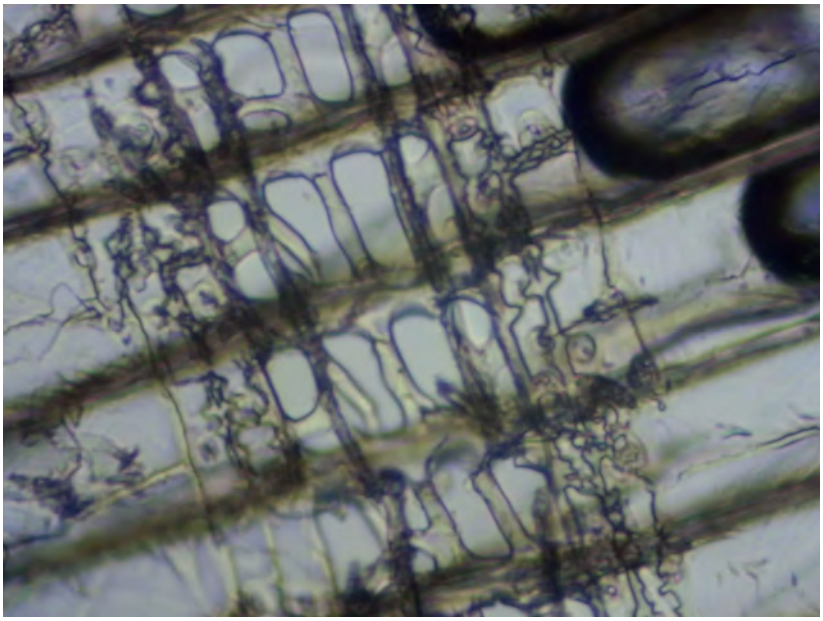

Fig 31:

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

The large window-like openings in the cross-field pitting, and the dentate ray tracheids, are both characteristics associated with relevant literature and library samples relating to European redwood (*Pinus sylvestris*, or Scots Pine)

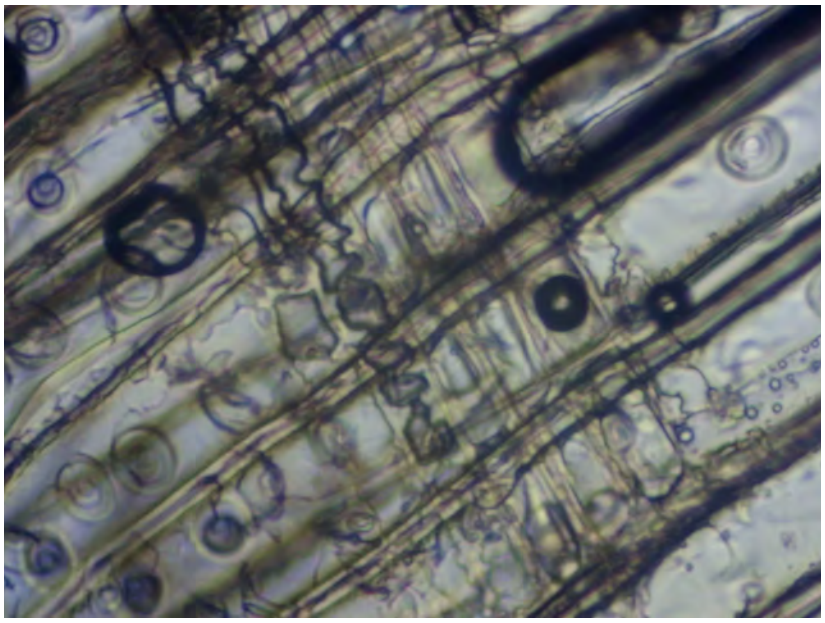

Fig 32:

Laboratory image; showing a microscopic radial image of a sample retrieved from a new common rafter at the time of survey from a roof purlin element

The large window-like openings in the cross-field pitting, and the dentate ray tracheids, are both characteristics associated with relevant literature and library samples relating to European redwood (*Pinus sylvestris*, or Scots Pine)

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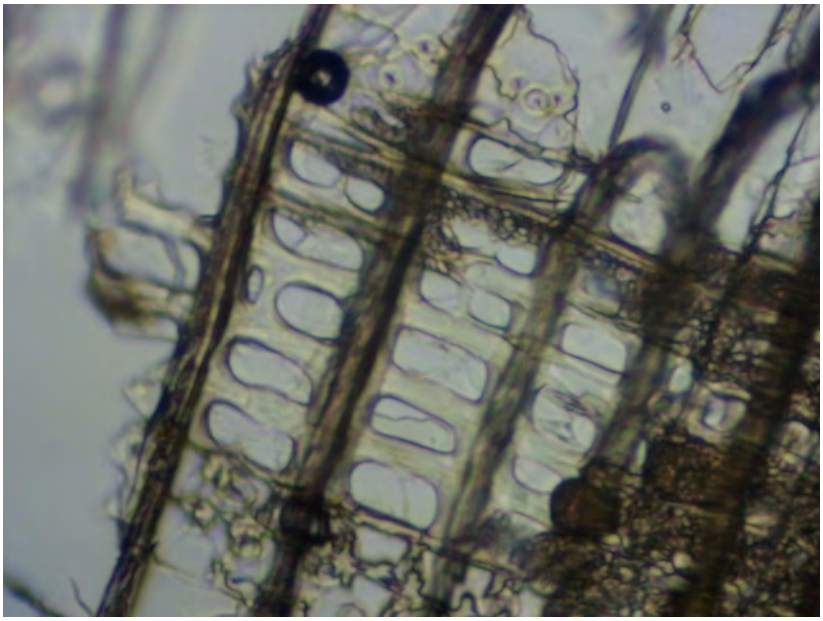


Fig 33:

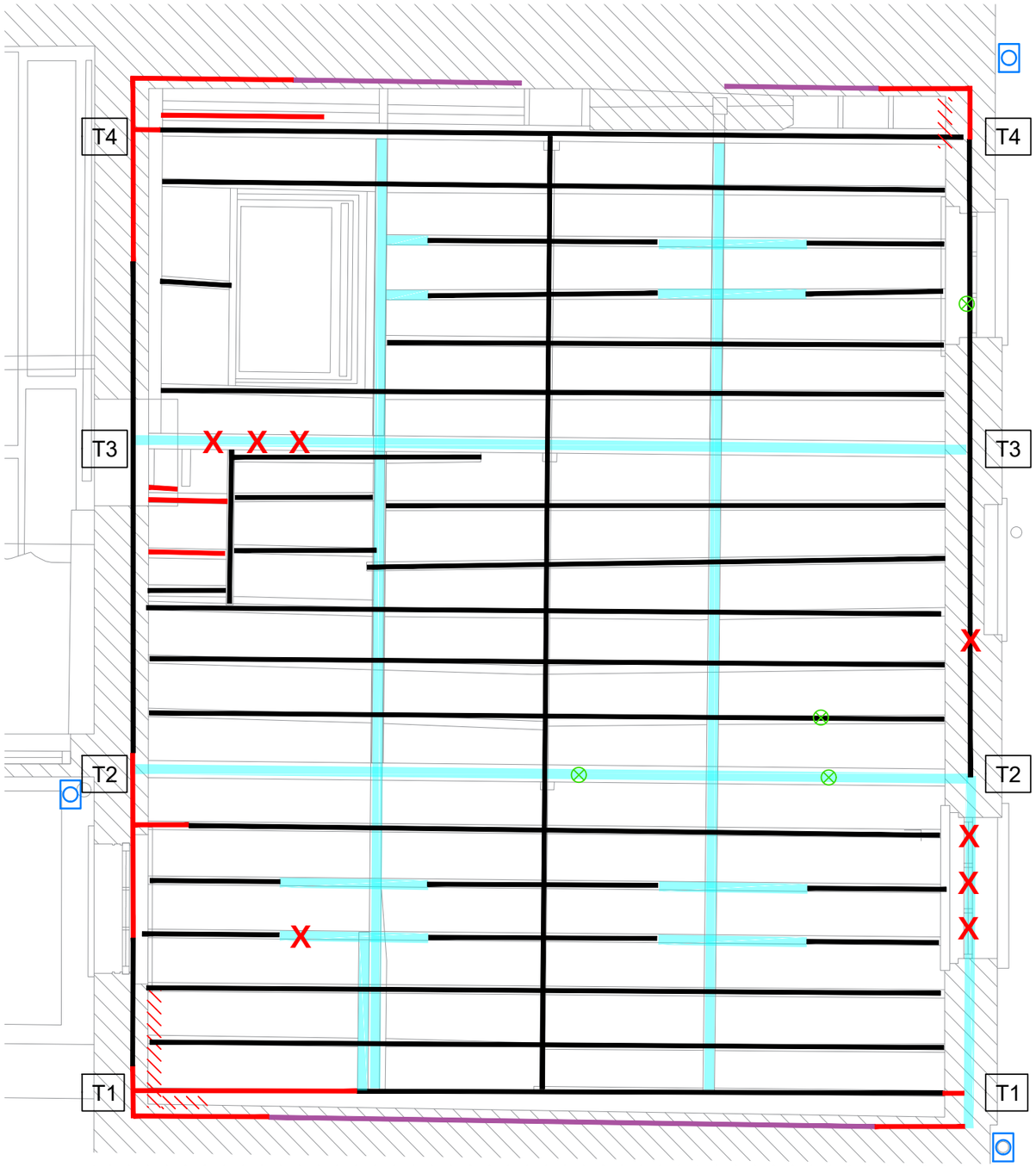
Laboratory image; showing a microscopic radial image of a sample retrieved from a historic floor joist at first floor level

The large window-like openings in the cross-field pitting, and the dentate ray tracheids, are both characteristics associated with relevant literature and library samples relating to European redwood (*Pinus sylvestris*, or Scots Pine)

Attachment B

Code/room no/element	Dimension (mm)	Allocated probable grade	Timber species	Allocated probable strength class	Com
ROOF					
Common rafters	100 x 62mm @ 770mm centres	90%GS 10% UG	ER	C16 UG	
Purlins	265 x 145mm	100% GS	ER	C16	
Truss 1 (T1)					
Tie-beam	215 x 110mm	N/A (excessive paint layers)	ER	-	
Principal rafters	130 x 110mm	50% SS 50% UG (decay)	ER	50% C24 50% UG	
King posts	195 x 120mm <120 x 100mm	N/A (excessive paint layers)	ER	-	
Struts	120 x 110mm	N/A (excessive paint layers)	ER	-	
Truss 2 (T2)					
Tie-beam	215 x 110mm	100% GS	ER	100% C16	
Principal rafters	130 x 110mm	50% SS 50% UG (decay)	ER	50% C24 50% UG	
King posts	195 x 120mm <120 x 100mm	100% SS	ER	100% C24	
Struts	120 x 110mm	100% SS	ER	100% C24	
Truss 3 (T3)					
Tie-beam	215 x 110mm	100% UG	ER	100% UG	
Principal rafters	130 x 110mm	100% UG	ER	100% UG	
King posts	195 x 120mm <120 x 100mm	100% UG	ER	100% UG	
Struts	120 x 110mm	100% UG	ER	100% UG	
Truss 4 (T4)					
Tie-beam	215 x 110mm	100% SS	ER	100% C24	
Principal rafters	130 x 110mm	100% SS	ER	100% C24	
King posts	195 x 120mm <120 x 100mm	100% SS	ER	100% C24	
Struts	120 x 110mm	100% SS	ER	100% C24	

ER = European Redwood
GS = General Structural
SP= Spruce
UG = Ungradable
SS = Special Structural



Key:

- Timber roof element
- Structurally decayed timber element
- Timber roof element scheduled for removal
- Embedded timber plate
- Structurally decayed bonding timber (dado level)
- X Excessively notched timber element
- Approximate location of rainwater hopper
- T1 H+R truss identification number
- Approximate location of species identification sample

H+R

55 Cumberland Terrace, Mews, Roof
Visual Strength Grading Assessment
25 June 2021

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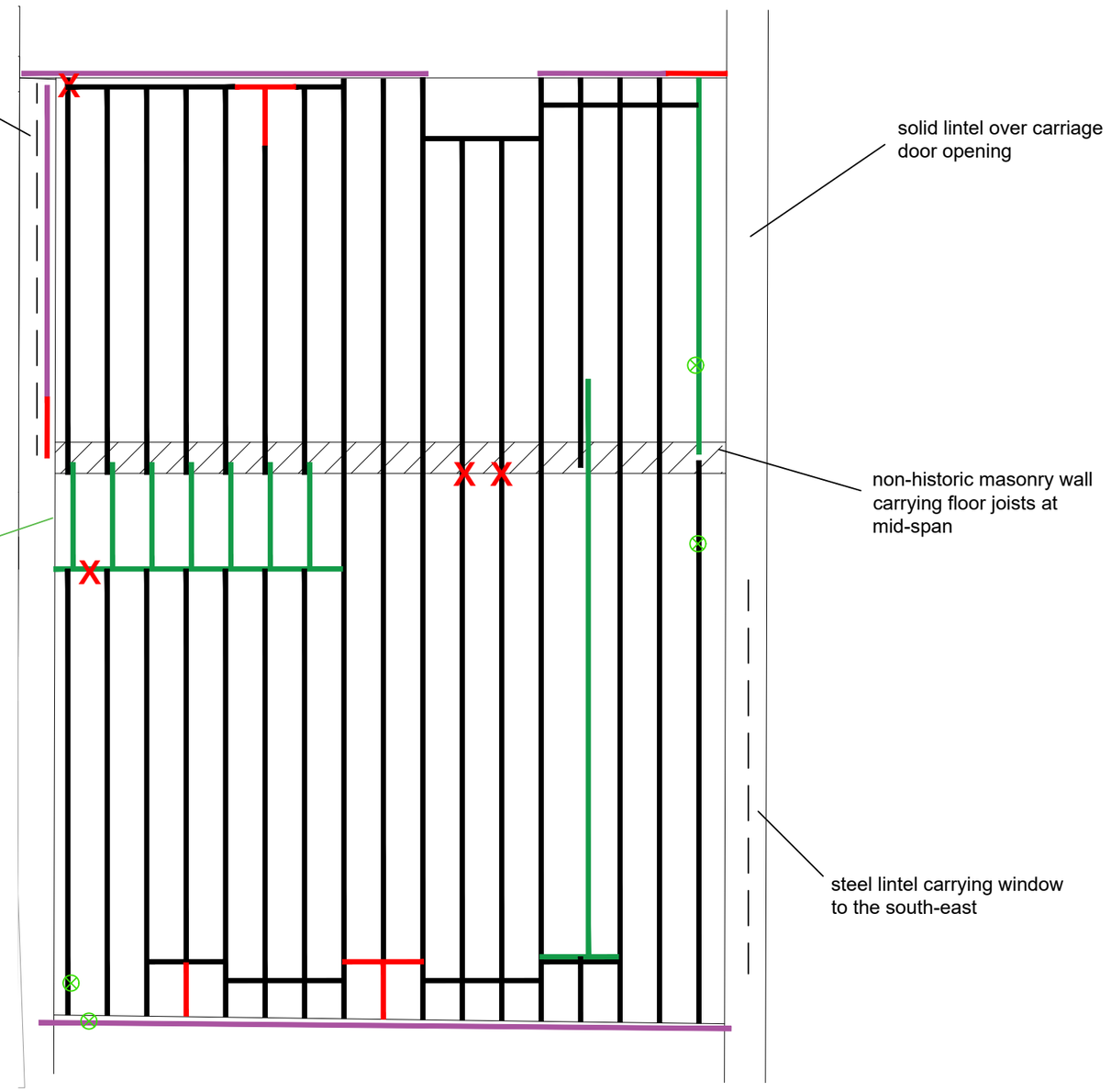
154.11 Site Note 2 -Not to scale-



FIRST FLOOR					
Historic floor joists	190 x 55 mm (Over-sized joists 190 x 75mm	55% UG 45% GS	*ER*	55% UG 45% C16	
Modern floor joists	-	100% GS	*SP*	100% C16	
Plate	100 x N/A mm	-	*ER*	-	

ER = European Redwood
GS = General Structural
SP= Spruce
UG = Ungradable
SS = Special Structural

55 Cumberland Terrace, Mews, First Floor
Visual Strength Grading Assessment
25 June 2021

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

Key:
- Timber roof element
- Structurally decayed timber element
- Timber roof element scheduled for removal
- Embedded timber plate
- Structurally decayed bonding timber (dado level)
- X Excessively notched timber element
- Approximate location of rainwater hopper
- T1 H+R truss identification number
- ⊗ Approximate location of species identification sample