

Tree-ring Analysis of Timbers from Gorcott Hall, Warwickshire
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Summary

Tree-ring samples were taken from timbers from a number of areas in this Grade II* listed building, which was on the English Heritage Buildings at Risk register. Seventeen samples were dated, with bark-edge dates of AD 1530 and AD 1531 from the hall roof (season undetermined), winter AD 1531/2 from the porch floor, and winter AD 1530/1 from a single timber in the stair turret roof. The results suggest that these parts of the building are essentially contemporary. A composite felling date range of AD 1520–36 for timbers from the upper cross-wing indicates that this area may also be contemporary.

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Introduction

This document is a technical archive report on the tree-ring analysis of oak timbers from Gorcott Hall, Warwickshire (NGR SP 0882 6821, Fig 1). This Grade II* listed building was also a priority C Building at Risk. The building is a complex one, comprising a central, two-bay hall range, an upper end cross-wing, later extended, and a much altered lower end cross-wing. Analysis was requested by Nick Molyneux of English Heritage while repair works allowed access to the widest range of timbers possible.

Gorcott Hall, having once been the focus of romantic pen and ink sketches by the Midlands artist W A Green (between 1926 and 1944), had fallen into disrepair and been the subject of repeated episodes of theft and vandalism. Under new ownership, extensive repairs were in progress at the time dendrochronological survey and sampling was carried out.

Several areas of dating interest were identified during an inspection of the building by Nick Molyneux and Stephen Price (Fig 2). The upper end cross-wing roof (T1–3), of two unequal bays, has a single tier of tenoned purlins with curved wind braces. The front gable (T1; Fig 3) was jettied but is now under-built in brick. The central truss (T2; Fig 4) was closed above the tie-beam with a collar and inclined struts, but there was no framing below the tie. It has a diagonally set ridge with a triangular yoke immediately below. There is close studding on all four elevations. The pair of round-headed wooden windows in the south elevation appears to be an insertion. A seventeenth-century bay widow with a carved finial at its gabled apex was added to the south elevation between T1 and T2. The cross-wing itself could be dated stylistically to the later fifteenth century.

The hall range roof, apparently dating to the mid-sixteenth century, is almost square (8.2 x 7.1m). The walls of the hall are of diaper brickwork, associated with a gabled porch at the front (Fig 5) and a gabled stair turret at the rear (Fig 6). The rear stair turret appears to have been cut through the main roof of the hall range. The hall roof of collar trusses (T5, T6, T7; Figs 7–9) has two tiers of tenoned purlins with associated curved wind braces at both levels. The tie-beams and collars are cambered. The central truss was open and retains plenty of evidence of taper burn marks. The ceiling below is cambered with the joists extending from a deeply chamfered spine beam and resting on the wall plate.

The close-studding of the side wall of the lower end cross-wing forms the end wall of the hall range. The mutilated lower end cross-wing preserves a single bay of a clasped purlin roof with cranked inclined struts to a former intermediate truss (T8, T9). This is now an external wall and was later cut back with a hipped roof (Fig 2). The west end was of at least two bays. This has been extended westwards by a narrow bay (T10) with external close-studding and tenoned purlins.

A rearward extension of the upper end cross-wing apparently dates to the beginning of the seventeenth century. This extension is represented by a pair of gables projecting from the north-west elevation of the hall (T4; Figs 2, 10). Its framing comprises rectangular or square panels with straight diagonal braces at the first floor and close-studding below.

It was hoped that the tree-ring dating programme would clarify the building sequence. It is beyond the dendrochronological brief to describe the building in detail or to undertake the production of detailed drawings. As part of a multifaceted and multidisciplinary study of the building, elements of this report may be combined with detailed descriptions, drawings, and other technical reports at some point in the future to form either a comprehensive publication or an archive deposition on the building. The conclusions presented therefore may have to be modified in the light of subsequent work.

Methodology

Methods employed at the Lampeter Dendrochronology Laboratory in general follow those described in English Heritage (1998). Details of the methods used for the dating of this building are described below.

The dendrochronological sampling was undertaken in the company of John Meadows of English Heritage who kindly undertook the production of site drawings which have been used here to indicate the location of samples. Timbers with more than 50 annual rings and some survival of the original sapwood or bark-edge were sought. The dendrochronological sampling programme attempted to obtain cores from as broad a range of timbers, in terms of structural element types, scantling sizes, and carpentry features, as was possible within the terms of the request whilst also meeting health and safety requirements.

The complete sequences of growth rings in the samples that were selected for dating purposes were measured to an accuracy of 0.01mm using a micro-computer based travelling stage (Tyers 1999a). The ring sequences were plotted onto semi-log graph paper to enable visual comparisons to be made between sequences. In addition cross-correlation algorithms (Baillie and Pilcher 1973; Munro 1984) were employed to search for positions where the ring sequences were highly correlated. These positions were checked visually using the graphs and, where these were satisfactory, new mean sequences were constructed from the synchronised sequences. The *t*-values reported below are derived from the original CROS algorithm (Baillie and Pilcher 1973). A *t*-value of 3.5 or over is usually indicative of a good match, although this is with the proviso that high *t*-values at the same relative or absolute position must be obtained from a range of independent sequences, and that satisfactory visual matching supports these positions. Timbers originally derived from the same parent tree generally have *t*-values greater than 10.0. Lower values from timbers obviously derived from the same parent tree (eg on morphological grounds) are however quite common. It is the visual similarity in medium-term growth trends of the samples that is the critical factor in determining 'same tree' origin.

All the measured sequences from this assemblage were compared with each other and any found to cross-match were combined to form a site master curve. These and any remaining unmatched ring sequences were tested against a range of reference chronologies, using the same matching criteria of high *t*-values, replicated values against a range of chronologies at the same position, and satisfactory visual matching. Where such positions are found these provide calendar dates for the ring-sequence.

The tree-ring dates produced by this process initially only date the rings present in the timber. The interpretation of these dates relies upon the nature of the final rings in the sequence. If the sample ends in the heartwood of the original tree, a *terminus post quem* (*tpq*) for the felling of the tree is indicated by the date of the last ring plus the minimum expected number of sapwood rings which are missing. This *tpq* may be many decades prior to the real felling date. Where some of the outer sapwood or the heartwood/sapwood boundary survives on the sample, a felling date range can be calculated using the maximum and minimum number of sapwood rings likely to have been present. The sapwood estimates applied throughout this report are a minimum of 10 and maximum of 46 annual rings, where these figures indicate the 95% confidence limits of the range. These figures are applicable to oaks from the British Isles (Bayliss and Tyers 2004). Alternatively, if bark-edge survives, then a felling date can be directly utilised from the date of the last surviving ring. The dates obtained by the technique do not by themselves necessarily indicate the date of the structure from which they are derived. It is necessary to incorporate other specialist evidence concerning the reuse of timbers and the repairs of structures before the dendrochronological dates given here can be reliably interpreted as reflecting the construction date of phases within the structure.

Results

A total of 24 samples was taken (Table 1) comprising seven from the upper end cross-wing roof (Figs 3–4), three from the porch floor (Fig 5), two samples from the stair turret roof (Fig 6), nine samples from three of the roof trusses of the hall range (Figs 7–9), two samples from a tiebeam in an extension to the upper end cross-wing (Fig 10), plus a single sample from a first-floor bressumer beam in the hall range. A paucity of timbers with sufficient rings for analysis limited the number of samples which could be taken from the porch, stair turret roof, and the rearward extension to the upper cross-wing. Absence of suitable timbers in the lower end cross-wing prevented any sampling of that area of the house.

Seventeen of the measured samples cross-matched with significant computer correlations and visually consistent ring-width patterns (Table 2). A 147-year mean calculated from the synchronised ring-width series was found to date against a range of previously independently dated site means from Britain, dating to AD 1385 to AD 1531 inclusive (Table 3). The ring-width data for this mean are presented in Table 4.

Interpretation

The dates for individual samples are given in Table 1 and presented graphically in a bar diagram (Fig 11).

Seven samples from trusses 5, 6, and 7 of the hall range have dated, with felling date ranges all being consistent with the precise felling dates of AD 1530 and AD 1531 from the two principal rafters in truss 5 (samples **14** and **15**). The season of felling of the latter two samples could not be determined. The results suggest construction of the hall range in, or soon after, AD 1531. The high computer correlation (Table 2) and close visual match between samples **18** and **19** from the principal rafters in truss 6 indicate that the timbers derive from the two halves of the same parent tree.

All three of the samples (**8**, **9**, and **10**) taken from the porch floor were dated, with bark edge dating to AD 1531 and two of these exhibiting definitely complete last rings indicating felling in the winter of AD 1531/2. These dates point to construction of the porch as a primary feature of the hall range rather than as a later insertion.

Both of the samples taken from the principal rafters of the southern truss over the stair turret were dated, with the presence of a complete last ring and bark edge on sample **21** indicating felling of its parent tree in the winter of AD 1530/1. Again, this could be interpreted as evidence for the stair turret being a primary structural element in the hall range.

Four samples from the upper end cross-wing have been dated, although none retained bark edge. Combining felling date ranges from two timbers with heartwood/sapwood boundaries and one with partial sapwood suggests felling of the parent trees in the date range AD 1520–36. This could also be taken as evidence for construction of this cross-wing at the same time as the hall range. It clearly demonstrates that the construction of the upper cross-wing is broadly coeval with the hall range.

The results presented here from sampling and analysis of timbers from the hall roof trusses, the first floor of the porch, and the upper end cross-wing suggest these are essentially contemporary. Limited evidence, from two samples taken from the principal rafters of the southern truss over the stair turret, suggest that this feature was also contemporary, even though structural analysis pointed to it possibly being a later insertion.

Acknowledgements

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References

- Baillie, M G L, and Pilcher, J R, 1973 A simple crossdating program for tree-ring research, *Tree Ring Bulletin*, **33**, 7–14
- Bayliss, A, and Tyers, I, 2004 Interpreting radiocarbon dates using evidence from tree rings, *Radiocarbon*, **46(2)**, 957–64
- English Heritage, 1998 *Dendrochronology: guidelines on producing and interpreting dendrochronological dates*, London
- Howard, R E , Laxton , R R, and Litton, C D, 1998a *Tree-Ring Analysis of Timbers from Naas House, Lydney, Gloucestershire*, Anc Mon Lab Rep, **36/1998**
- Howard, R E , Laxton , R R, and Litton, C D, 1998b *Tree-Ring Analysis of Timbers from 26 Westgate Street, Gloucester*, Anc Mon Lab Rep, **43/1998**
- Munro, M A R, 1984 An improved algorithm for crossdating tree-ring series, *Tree Ring Bulletin*, **44**, 17–27
- Nayling, N, 1999 *Tree-ring analysis of timbers from the White House, Vowchurch, Herefordshire*, Anc Mon Lab Rep, **73/1999**
- Tyers, I, 1996 *Tree-ring analysis of six secular buildings from the City of Hereford*, Anc Mon Lab Rep, **17/96**
- Tyers, I, 1997 *Tree-ring analysis of timbers from Sinai Park, Staffordshire*, Anc Mon Lab Rep, **80/97**
- Tyers, I, 1998 *Tree-ring analysis and wood identification of timbers excavated on the Magistrates Court Site, Kingston upon Hull, East Yorkshire*, ARCUS Rep, **410**
- Tyers, I, 1999a *Dendro for Windows program guide 2nd edn*, ARCUS Rep, **500**
- Tyers, I, 1999b *Dendrochronological analysis of timbers from Black Ladies, near Brewood, Staffordshire*, ARCUS Rep, **484**

Table 1

List of samples

Core No	Origin of core	Cross-section of tree	Cross-section size (mm)	Total rings	Sapwood rings	ARW mm/year	Date of sequence	Felling period
01	Upper cross-wing, truss 1, east storey post	Whole	420 x 80+	<50	-	-	Not measured	-
02	Upper cross-wing, truss 1, west storey post	Whole	360+ x 100+	<50	-	-	Not measured	-
03	Upper cross-wing, truss 1, tiebeam	Half	330 x 105	126	12+10s	1.49	AD1385–1510	AD1520–44
04	Upper cross-wing, truss 2, tiebeam. Core fragmented and abandoned	Half	345 x 140	<50	-	-	Not measured	-
05	Upper cross-wing, truss 2, tiebeam	Half	345 x 140	72	+HS	1.86	AD1425–96	AD1506–42
06	Upper cross-wing, truss 2, central strut	Half	205 x 90	96	+HS	1.25	AD1395–1490	AD1500–36
07	Upper cross-wing, truss 2, western strut	Half	215 x 90	65	-	1.32	AD1425–89	after AD1499
08	Porch floor joist	Half	245 x 100	81	21+Bw	1.37	AD1451–1531	AD1531/2 winter
09	Porch floor joist	Half	240 x 100	67	22+Bw	1.51	AD1465–1531	AD1531/2 winter
10	Porch floor joist	Half	235 x 100	86	31+B	1.20	AD1446–1531	AD1531
11	Hall range, truss 7, north principal rafter	Half	265 x 130	97	+?HS	1.87	AD1408–1504	AD1514–50?
12	Hall range, truss 7, collar	Half	265 x 100	83	-	1.77	AD1415–97	after AD1507
13	Hall range, truss 7, tiebeam	Half	320 x 175	105	13	1.68	AD1413–1517	AD1517–50
14	Hall range, truss 5, south principal rafter	Half	265 x 140	122	16+B	1.43	AD1409–1530	AD1530
15	Hall range, truss 5, northern principal rafter	Half	260 x 140	104	17+B	1.48	AD1428–1531	AD1531

Core No	Origin of core	Cross-section of tree	Cross-section size (mm)	Total rings	Sapwood rings	ARW mm /year	Date of sequence	Felling period
16	Hall range, truss 5, purlin	Whole	195 x 100	<50	-	-	Not measured	-
17	Hall range, truss 5, collar	Half	280 x 110	88	+HS	1.66	AD1423–1510	AD1520–56
18	Hall range, truss 6, south principal rafter	Half	265 x 140	102	+HS	1.50	AD1411–1512	AD1522–58
19	Hall range, truss 6, north principal rafter	Half	270 x 150	110	+HS	1.49	AD1395–1504	AD1514–50
20	Stair turret roof, south truss, west principal rafter	Half	190 x 110	74	+HS	1.39	AD1436–1509	AD1519–55
21	Stair turret roof, south truss, eastern principal rafter	Half	190 x 105	65	20+Bw	1.83	AD1466–1530	AD1530/1 winter
22	Hall range, first floor, bressumer beam	Whole	480 x 270	109	+HS	1.97	undated	-
23	Upper cross-wing extension, truss 4, tiebeam	Half	280 x 100	84	24+Bs	1.56	undated	-
24	Upper cross-wing extension, truss 4, tiebeam	Half	250 x 140	39	-	3.32	undated	-

Total rings = all measured rings, +value means additional rings were only counted, the felling period column is calculated using these additional rings. Sapwood rings = +HS heartwood/sapwood boundary, ?HS possible heartwood/sapwood boundary, +Bw = bark-edge winter felled, +Bs = unmeasured spring growth also present. ARW = average ring width of the measured rings

Table 2 *t*-value matrix for samples forming the 147-year, 17-timber site mean **GORC_T17**

- = *t*-values less than 3.00

	05	06	07	08	09	10	11	12	13	14	15	17	18	19	20	21
03	4.17	4.72	-	4.39	6.16	5.43	5.50	4.94	4.70	5.87	5.29	6.04	5.42	4.55	3.80	-
05		5.58	4.48	3.66	5.54	3.11	5.16	4.43	-	3.49	4.46	5.63	3.88	-	-	-
06			6.79	-	-	-	-	3.04	-	-	3.41	3.39	3.37	3.36	-	-
07				-	-	-	-	3.41	-	-	4.04	3.88	-	-	-	-
08					4.73	-	4.84	-	4.42	3.00	3.79	-	3.52	-	-	-
09						5.38	3.20	-	5.76	-	-	-	-	-	-	-
10							-	-	5.25	3.02	-	-	-	-	-	-
11								6.82	3.61	8.43	6.28	6.87	8.54	5.10	4.68	-
12									4.26	5.13	8.14	9.02	4.00	-	-	-
13										3.16	-	3.46	3.54	-	4.02	-
14											5.18	5.46	8.14	5.43	4.35	-
15												7.57	4.70	-	3.44	-
17													4.14	-	-	-
18														12.11	5.23	3.54
19															3.86	-
20																7.76

Table 3 *t*-values for the 147 year, 17-timber site mean **GORC_T17**, dated to AD 1385–1531 inclusive, against a range of site masters

Site Masters	<i>t</i>
Black Ladies, nr Brewood Staffordshire (Tyers 1999)	9.03
Sinai Park, nr Burton, Staffordshire (Tyers 1997)	9.14
Widemarsh St, Hereford Farmers Club (Tyers 1996)	8.37
White House, Vowchurch, Herefordshire (Nayling 1999)	8.06
Naas House, Lydney, Gloucestershire(Howard <i>et al</i> 1998a)	10.04
26 Westgate Street, Gloucester (Howard <i>et al</i> 1998b)	9.40

Table 4 Ring width data for the mean sequence for the 147-year mean sequence **GORC_T17** dated to AD 1385–1531 inclusive

Date	Ring Width (100=1mm)										Number of timbers									
AD1385					128	205	271	184	228	245	1	1	1	1	3	3	3	3	3	3
-	297	291	343	229	170	230	200	255	298	289	1	1	1	1	3	3	3	3	3	3
AD1401	330	215	267	271	211	253	208	212	211	135	3	3	3	3	3	3	3	4	5	5
-	157	173	160	148	145	152	143	186	104	187	6	6	7	7	8	8	8	8	8	8
-	202	141	209	183	201	166	197	216	198	180	8	8	9	9	11	11	11	12	12	12
-	208	268	186	200	188	148	134	108	113	147	12	12	12	12	12	13	13	13	13	13
-	178	127	170	196	153	150	149	148	155	126	13	13	13	13	13	14	14	14	14	14
AD1451	158	136	130	146	154	168	156	154	135	185	15	15	15	15	15	15	15	15	15	15
-	149	162	168	123	161	167	180	168	156	151	15	15	15	15	16	17	17	17	17	17
-	131	140	146	166	202	145	132	121	154	147	17	17	17	17	17	17	17	17	17	17
-	173	158	156	144	122	135	163	137	149	188	17	17	17	17	17	17	17	17	17	16
-	147	127	133	137	156	187	137	115	125	114	15	15	15	15	15	15	14	13	13	13
AD1501	126	133	111	112	126	109	102	117	139	119	13	13	13	13	11	11	11	11	11	10
-	125	134	124	112	106	99	112	128	123	98	8	8	7	7	7	7	7	6	6	6
-	93	103	95	107	102	107	110	119	100	84	6	6	6	6	6	6	6	6	6	6
-	73										4									

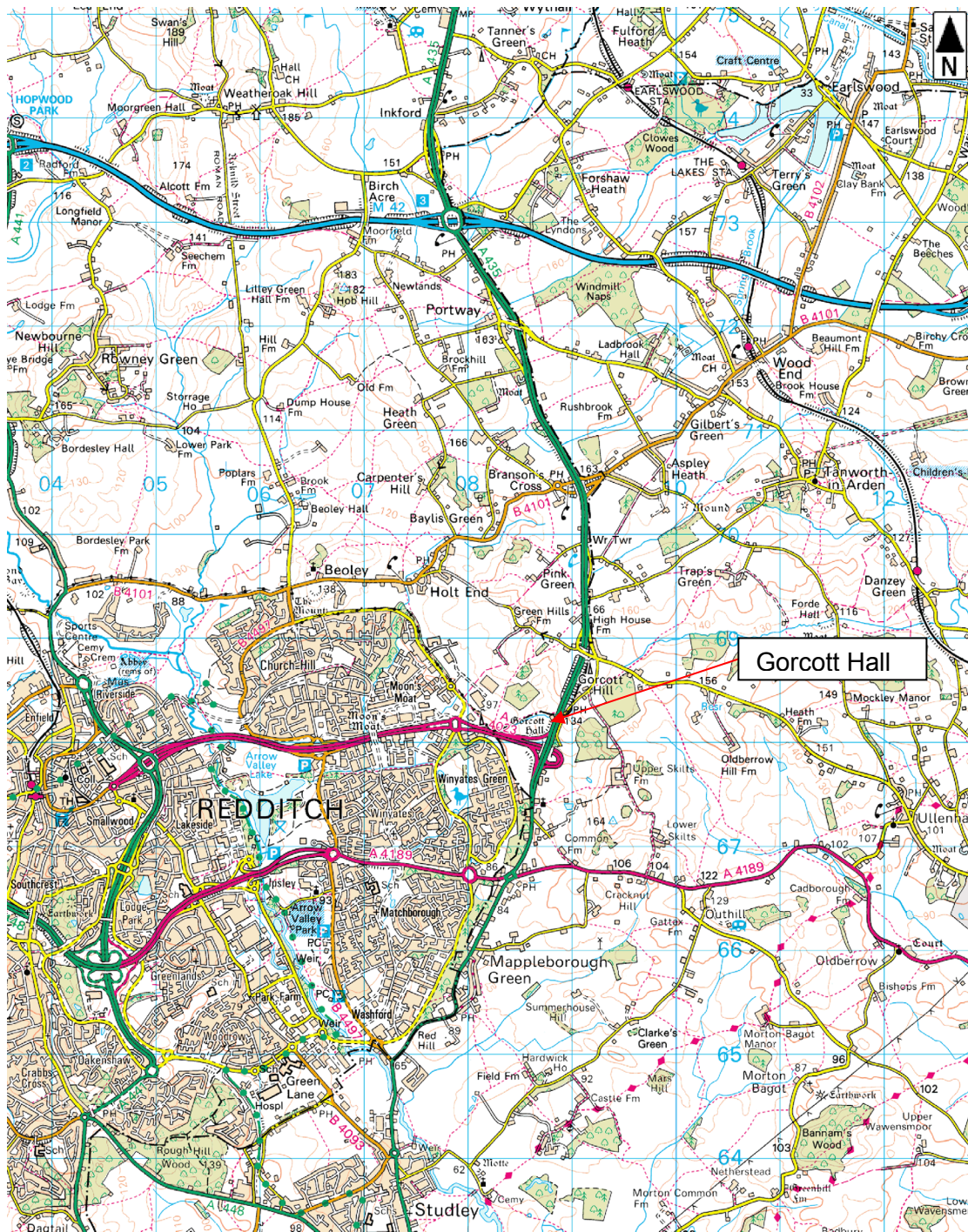


Figure 1 Location of Gorcott Hall.

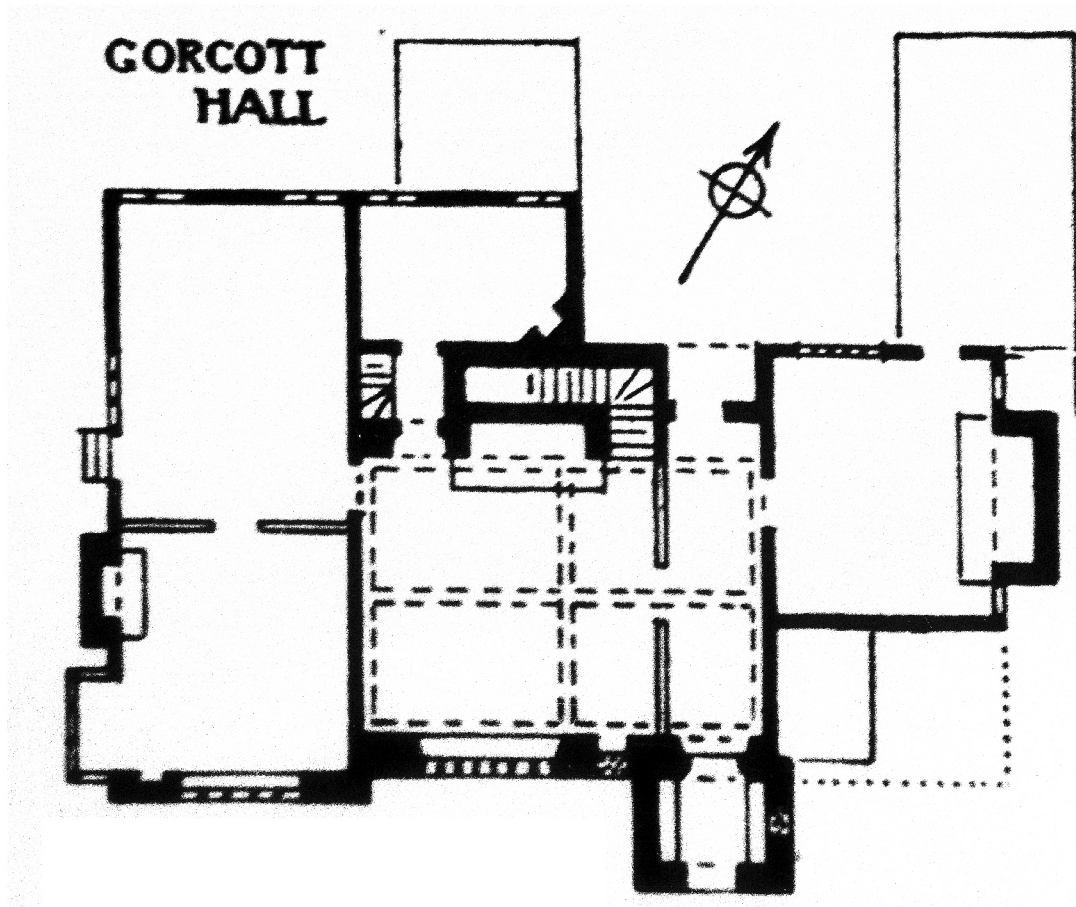
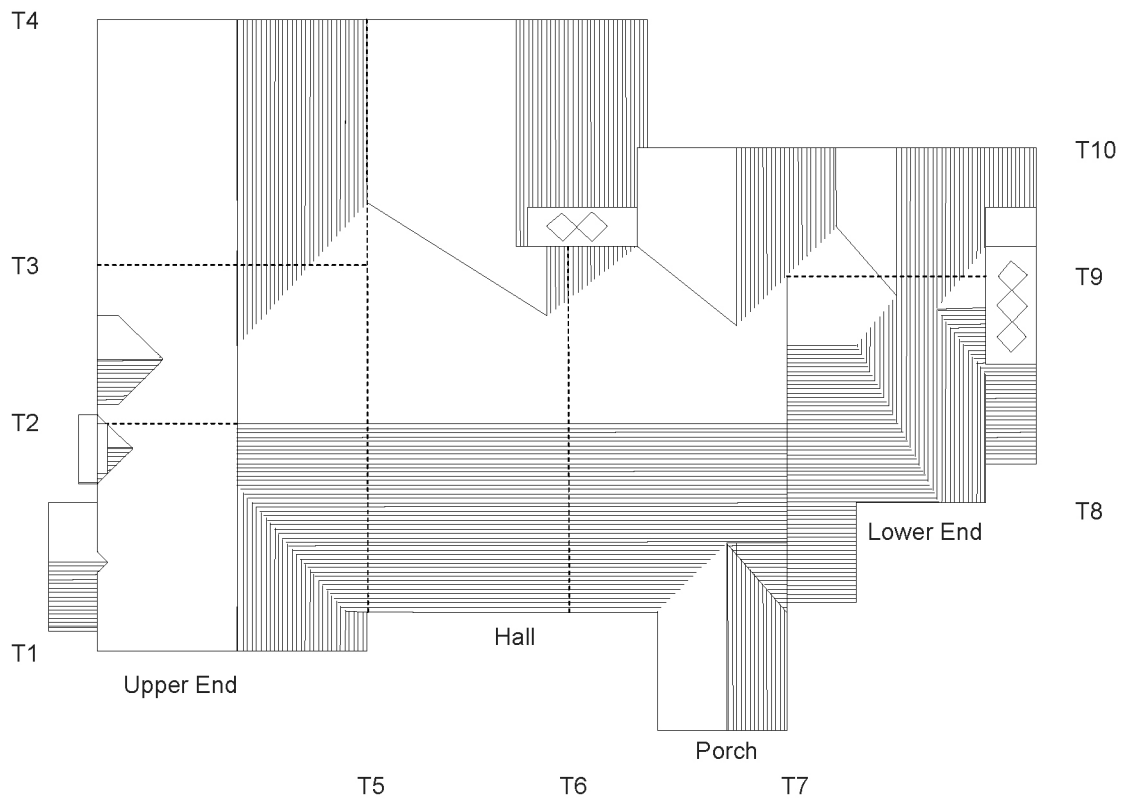


Figure 2 Gorcott Hall. Above: Roof plan showing location of numbered trusses, based on a 2005 drawing by Stephen Price; below: interior layout, recorded in 1956 (© NMR/EH)

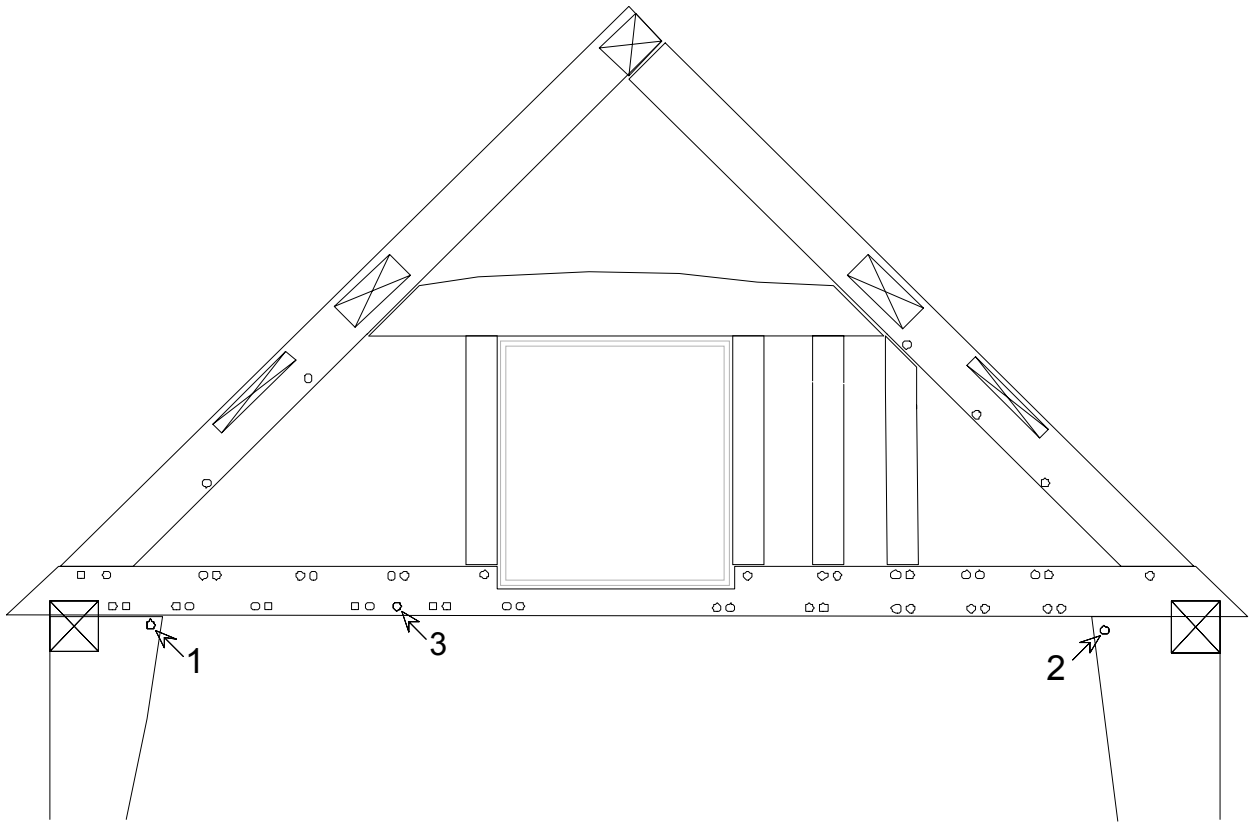


Figure 3 Upper cross-wing, truss 1 view to south. Location of samples 1 – 3

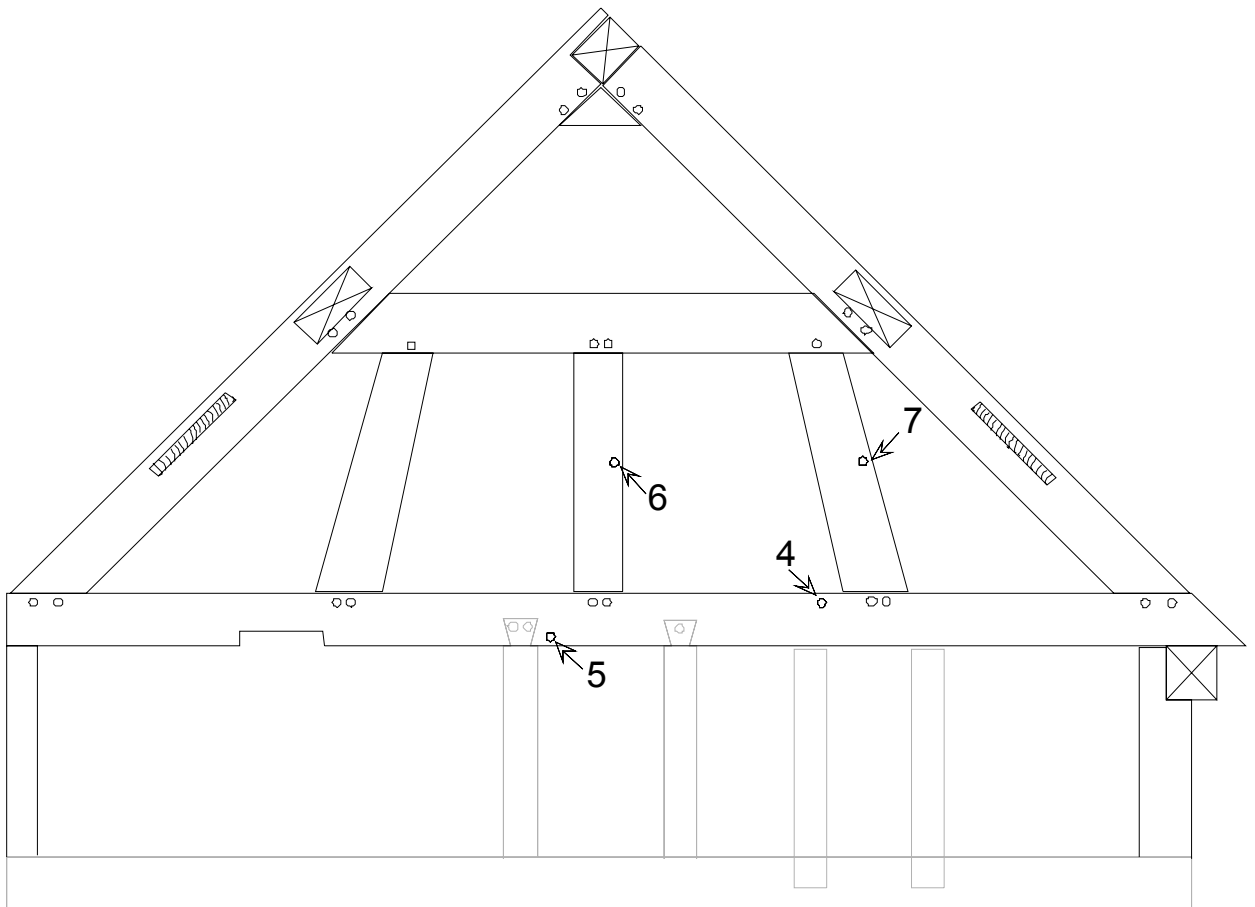


Figure 4 Upper cross-wing, truss 2 view to south. Location of samples 4 – 7

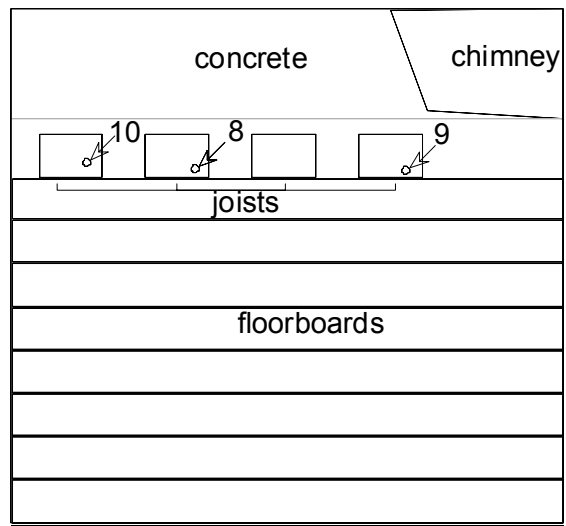


Figure 5 Plan of porch floor. Location of samples 8 – 10

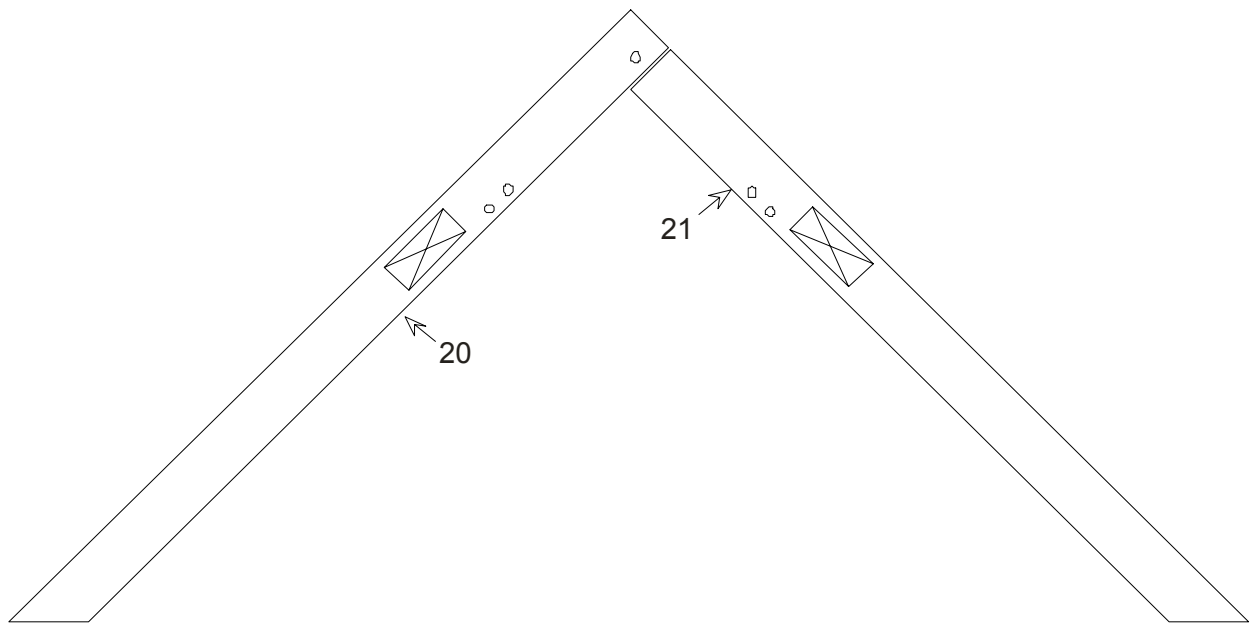


Figure 6 Stair turret roof, southern truss, view towards north. Location of samples 20 – 21

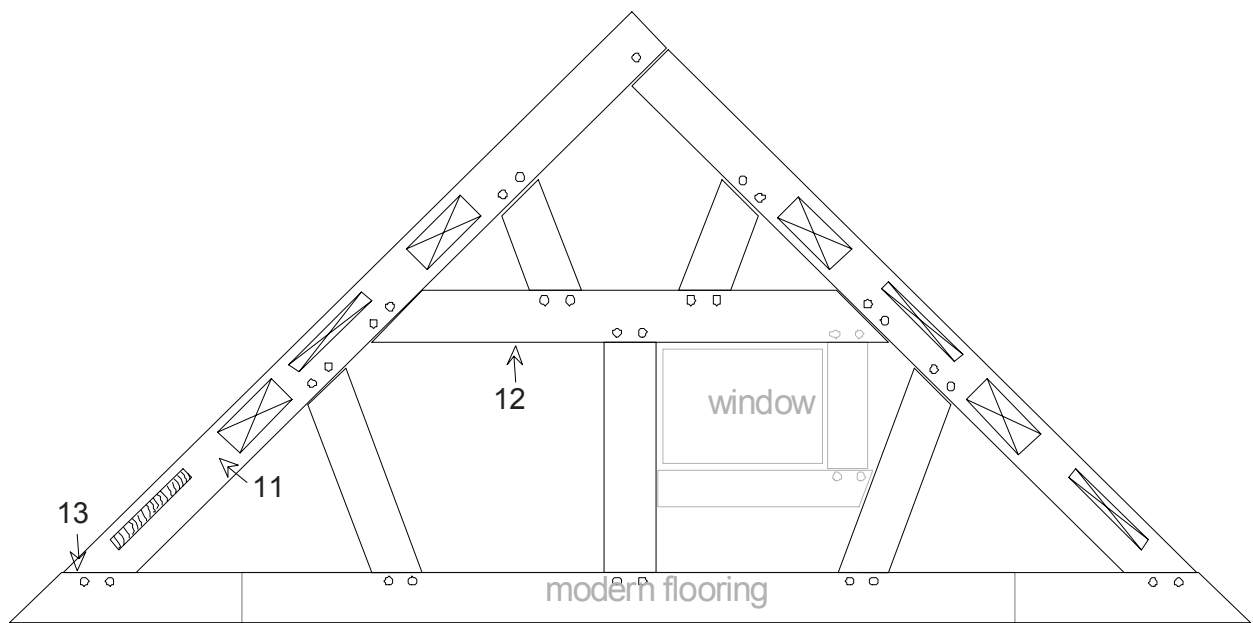


Figure 7 Hall range, truss 7, view towards east. Location of samples 11 – 13

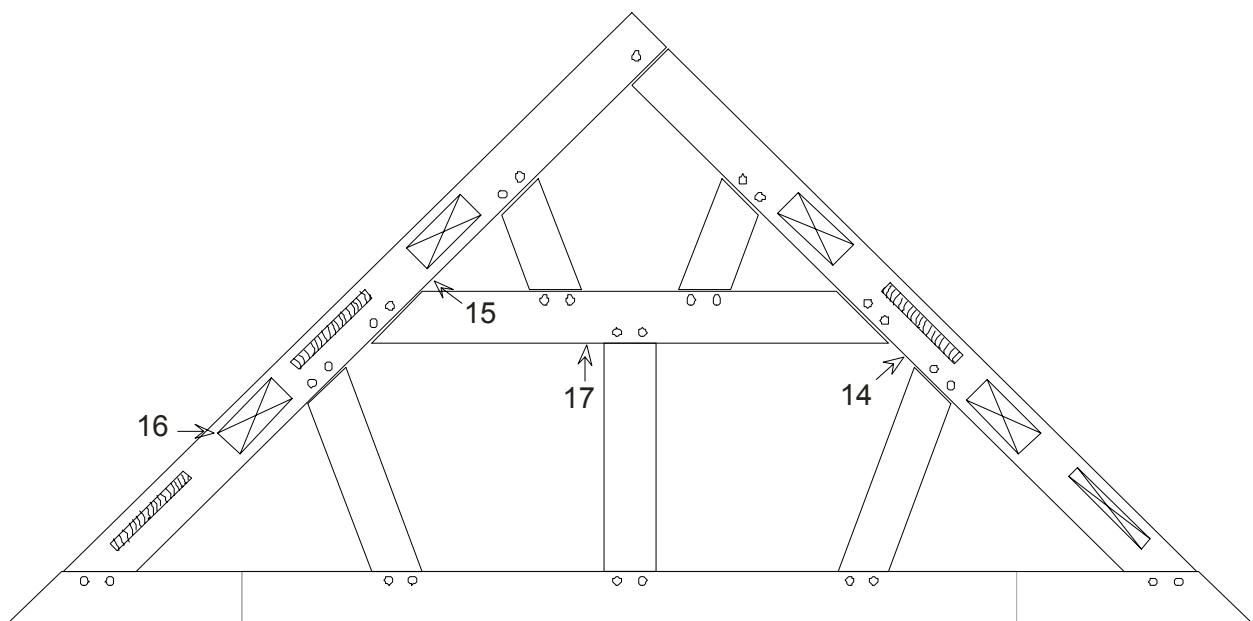


Figure 8 Hall range, truss 5, view towards east. Location of samples 14 – 17

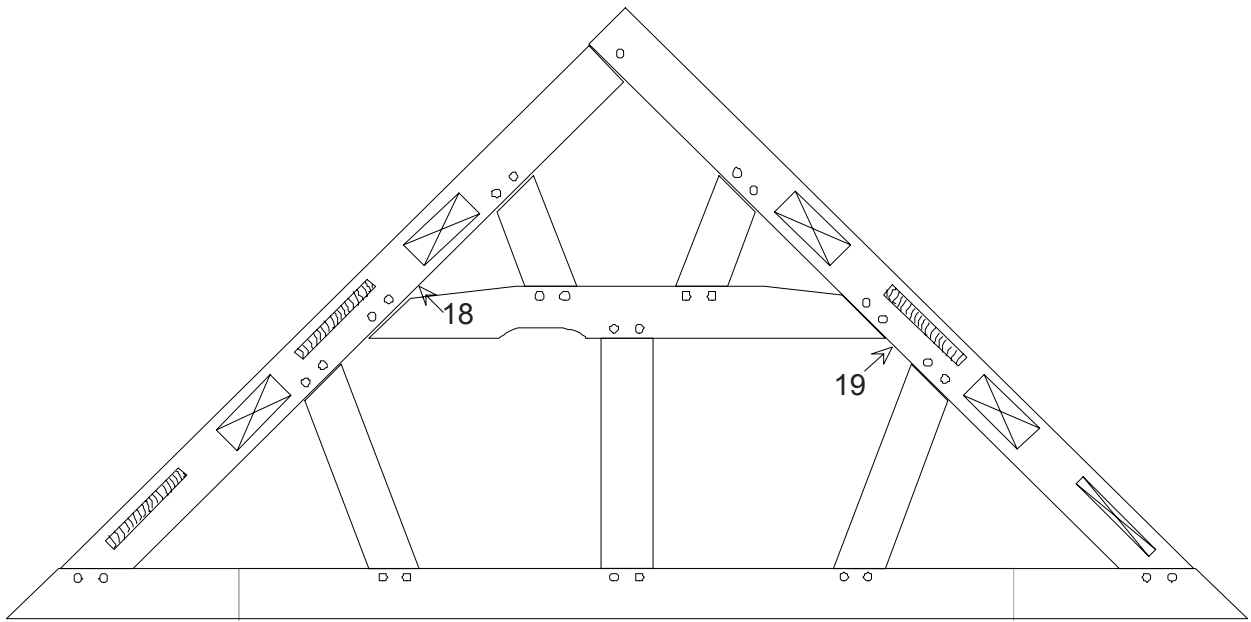


Figure 9 Hall range, truss 6, view towards west. Location of samples 18 – 19

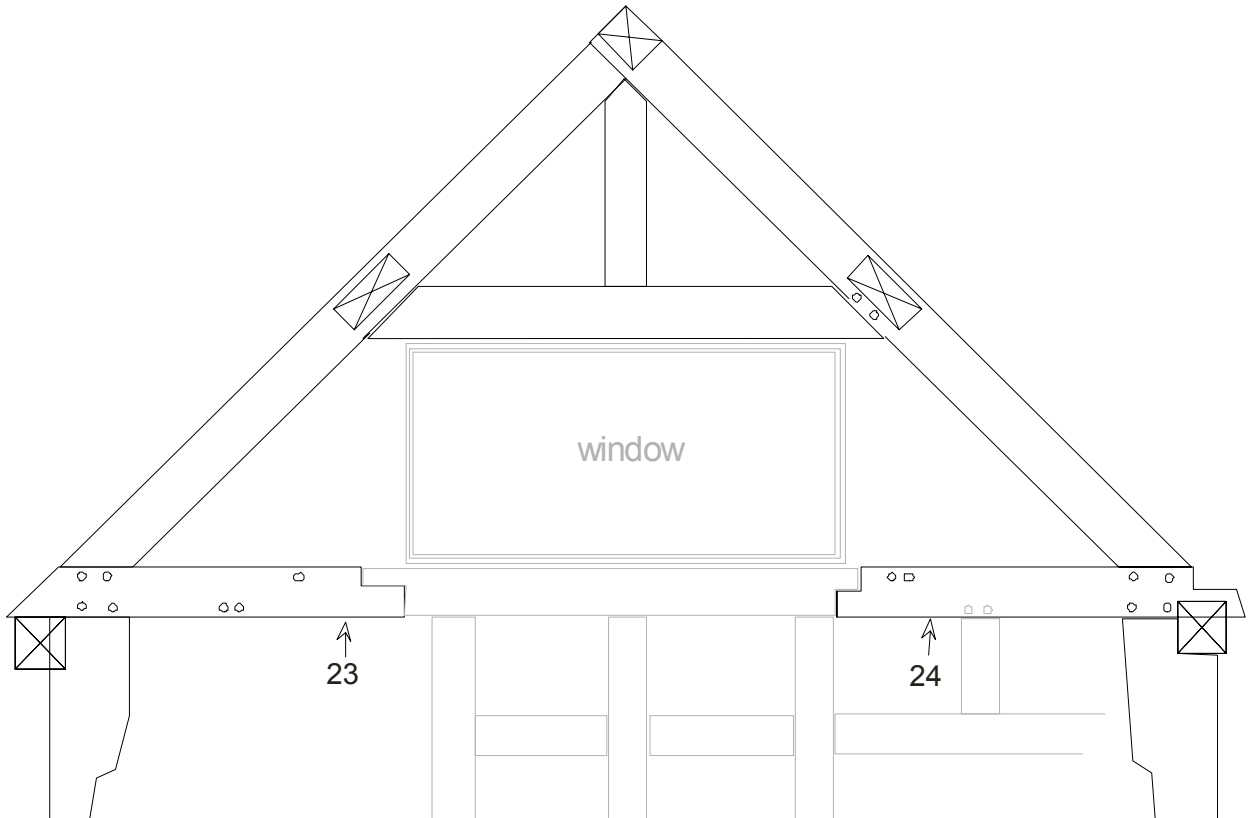


Figure 10 Extension to upper end, eastern part of truss 4, view towards north. Location of samples 23 – 24

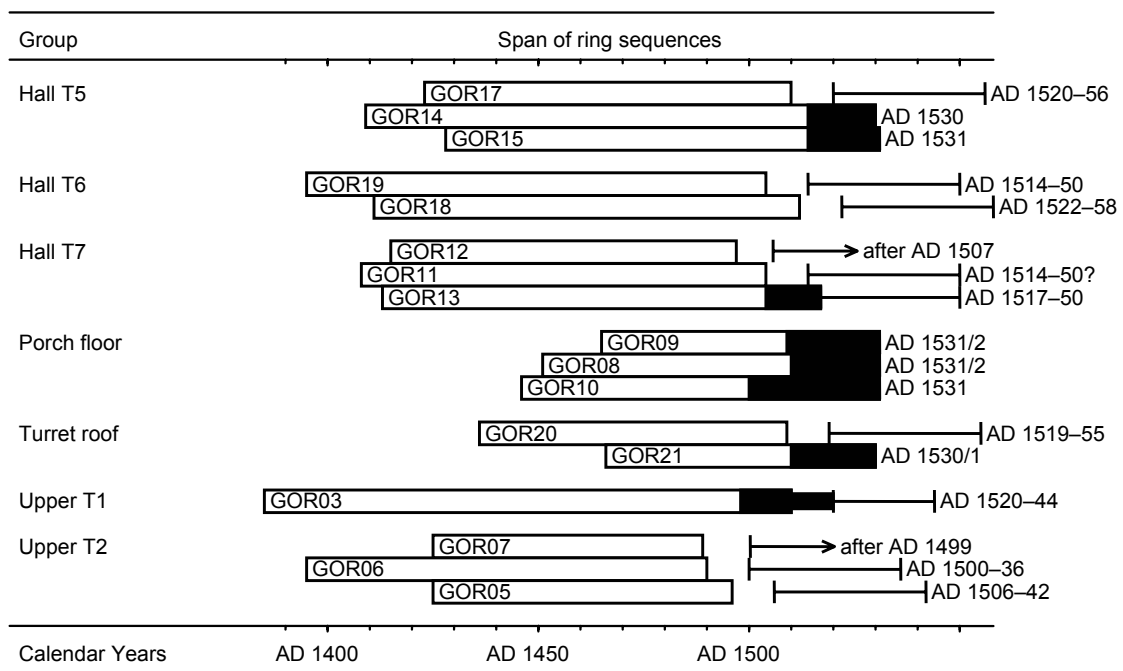


Figure 11 Bar diagram showing relative dating positions of dated tree-ring sequences from individual timbers from the hall range, porch floor, stair turret roof, and upper cross-wing