Ancient Monuments Laboratory
Report 63/98

TREE-RING ANALYSIS OF TIMBERS FROM TABLE HALL, PETERBOROUGH, CAMBRIDGESHIRE

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Summary

Table Hall is a two-storey building situated within the precincts of Peterborough Cathedral. A two-bay, jettied, timber hall is mounted on a masonry ground storey. The building is due to undergo a substantial programme of repair, grant-aided by English Heritage. This report covers the dendrochronological analysis of a series of oak timbers within the roof and from a possibly inserted floor which was undertaken to clarify the dating of the surviving timbers so as to inform repair decisions. The results are consistent with a single phase of construction with both the sling braces of the central truss and moulded beams of the floor being contemporary, dating to the second half of the fifteenth century. One principal retained bark edge giving a felling date of AD 1461.

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Introduction

This document is a technical archive report on the tree-ring analysis of oak timbers from the roof and floor of Table Hall, Peterborough, Cambridgeshire (NGR TL194987). 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 may therefore have to be modified in the light of subsequent work.

Table Hall is a two-storey building located within the precincts of Peterborough Cathedral south-west of the church, built onto the earlier infirmary. It has been dated on stylistic grounds to the mid-fifteenth century and historic references attest its use in the sixteenth century (Hewett 1985, 58). The building is a grade I listed building and has also been scheduled as an Ancient Monument. The building is in need of substantial remedial works to counter-act subsidence and spreading of the roof. The open timber roof is in two bays, each subdivided by minor arch-braced collar trusses. The form of the central truss is more elaborate having a higher arched-braced collar above a collar apparently supported by sling-braces with spur-ties to the wall plate and at the top bearing against a block fixed under the centre of the collar (Dodd 1995, 3; Fig 2).

A tree-ring dating programme of the roof timbers of Table Hall was requested by William Dodd from English Heritage to provide a precise date for its construction, and to identify whether the sling-braces of the central truss and the moulded beams integral with the west-facing jetty were contemporary or later insertions, and hence inform the forthcoming programme of repairs.

Methodology

The general methodology and working practises used at the Sheffield Dendrochronology Laboratory are described in English Heritage (1998). The methodology used for this building was as follows.

A brief survey identified those oak timbers with the most suitable ring sequences for analysis. Those with more than 50 annual rings and some survival of the original sapwood and 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.

The most promising timbers were sampled using a 15mm diameter corer attached to an electric drill. The cores were taken as closely as possible along the radius of the timbers so that the maximum number of

rings could be obtained for subsequent analysis. The core holes were left open. The ring sequences in the cores were revealed by sanding.

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 1997a). 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 these positions are supported by satisfactory visual matching.

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: 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 addition of 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 55 annual rings, where these figures indicate the 95% confidence limits of the range. These figures are applicable to oaks from the British Isles (Hillam *et al* 1987). 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 re-use 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

Timbers with surviving bark or at least partial sapwood survival were preferentially selected for sampling where possible. Disintegration of sapwood during the coring process proved a problem with a number of samples.

A total of 15 timbers were selected as most suitable for sampling (Tables 1 and 2; Figs 2 – 5). The samples were numbered **1-15** inclusive.

Four of the 15 samples when examined in the laboratory were rejected due to their having an insufficient number of rings for reliable analysis, often due to fragmentation of the sapwood (Table 1). The 11 series which were measured were initially compared with each other. Nine sequences were found that matched together to form an internally consistent group (Table 3). A 118-year site mean chronology was calculated, named PET_TAB (Fig 6). The site mean was then compared with dated reference chronologies from throughout British Isles and northern Europe. Table 4 shows the correlation of the mean sequences at the dating position identified for the sequence, AD 1344 - 1461 inclusive. Table 5 lists the site mean chronology.

The two measured samples that did not match the rest of the material to form the PET_TAB sequence were compared with dated reference chronologies from throughout British Isles and northern Europe without any dating being obtained.

Interpretation

The 118-year chronology PET_TAB is dated AD 1344 to 1461 inclusive. It was created from nine timbers, one of which was complete to bark-edge (Fig 6). The surface of the latter sample is somewhat eroded and determining the season of felling with confidence was not possible. Three additional samples from the primary phase of construction (**1**, **3**, and **9**) have either felling ranges or *tpq*'s consistent with this construction date. Both sling braces (samples **6** and **9**) dated, providing a *terminus post quem* of AD 1423 and a range of AD 1453-92 for their felling. Again, both the sampled joists (samples **14** and **15**) that dated successfully have felling ranges in the second half of the fifteenth century.

Discussion

The aim of dendrochronological analysis was threefold: to provide a date for the initial construction and to assess whether either the floor or the sling-braces were later insertions. The dendrochronological results indicate initial construction in the second half of the fifteenth century with survival of bark edge on a single sample implying construction in or soon after AD 1461. The same level of dating precision is not available for the possible insertions. The felling range for sample **6** implies construction in the second half of the fifteenth century. Whilst the dendrochronological results cannot definitively resolve whether the sling-braces are a later insertion or contemporary, the heartwood/sapwood boundaries on both the braces are no later than those of incontrovertibly original timbers (Fig 6). Supporting evidence for their primary origin perhaps derives from the correlation between the sequences which do not indicate different timber sources (Table 2). Similar arguments are applicable to the joists, they appear contemporary within the precision possible with samples lacking sapwood and incontrovertible bark-edge.

Conclusion

The dendrochronological analysis of timbers from Table Hall indicates a date for construction in the second half of the fifteenth century, with a single timber with bark edge pointing to construction of the roof in or soon after AD 1461. The balance of evidence suggests that both the sling-braces of the central truss and the jettied floor form part of this primary phase of construction, or are near contemporary additions rather than significantly later alterations.

Acknowledgements

The sampling and analysis programme was funded by English Heritage. Anthony Richardson and Partners provided site drawings. My colleagues Cathy Groves and Nigel Nayling provided much useful discussion and encouragement. Julian Limentani (Cathedral Architect) and Canon J Higham (Canon Librarian) provided useful discussion, and helped arrange access to the building.

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Figure 1 Plan of Table Hall, Peterborough showing position and orientation of elevations indicating sample locations (after Anthony Richardson and Partners diagram)

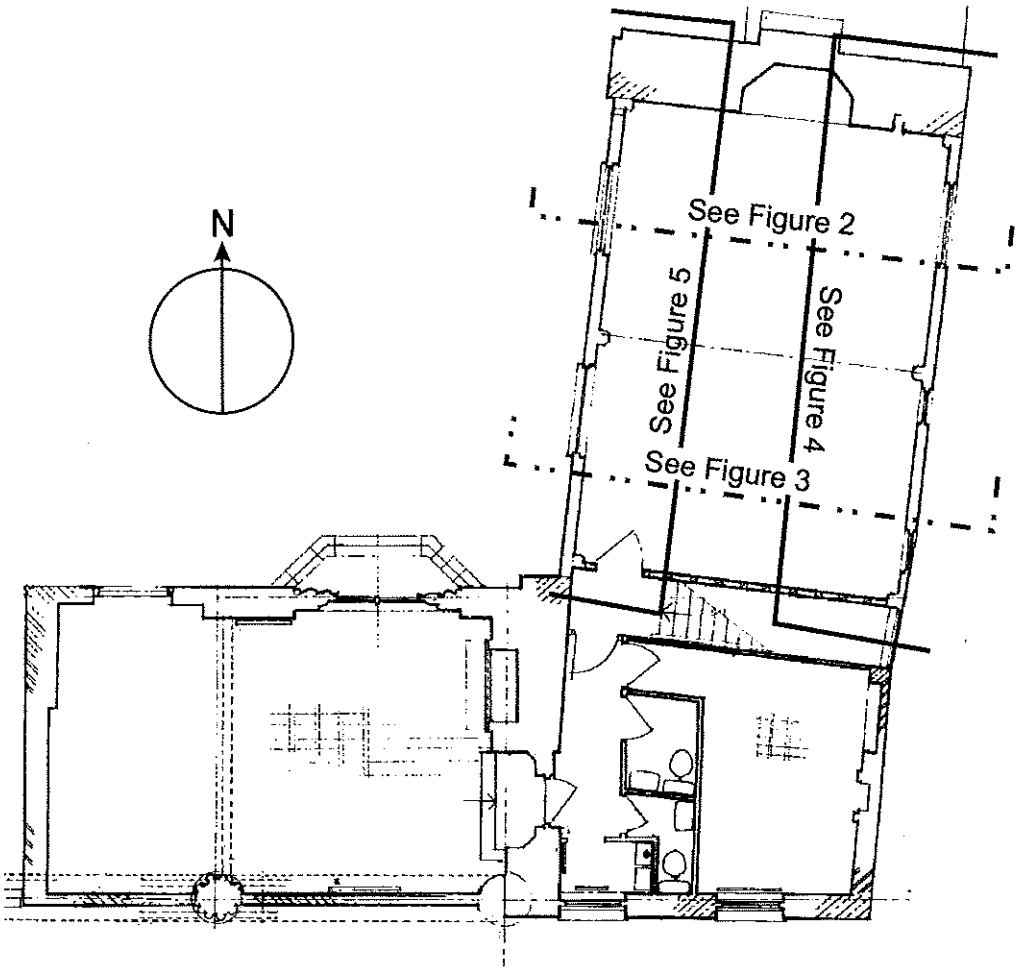


Figure 2 Central truss showing sample locations (after Anthony Richardson and Partners diagram)

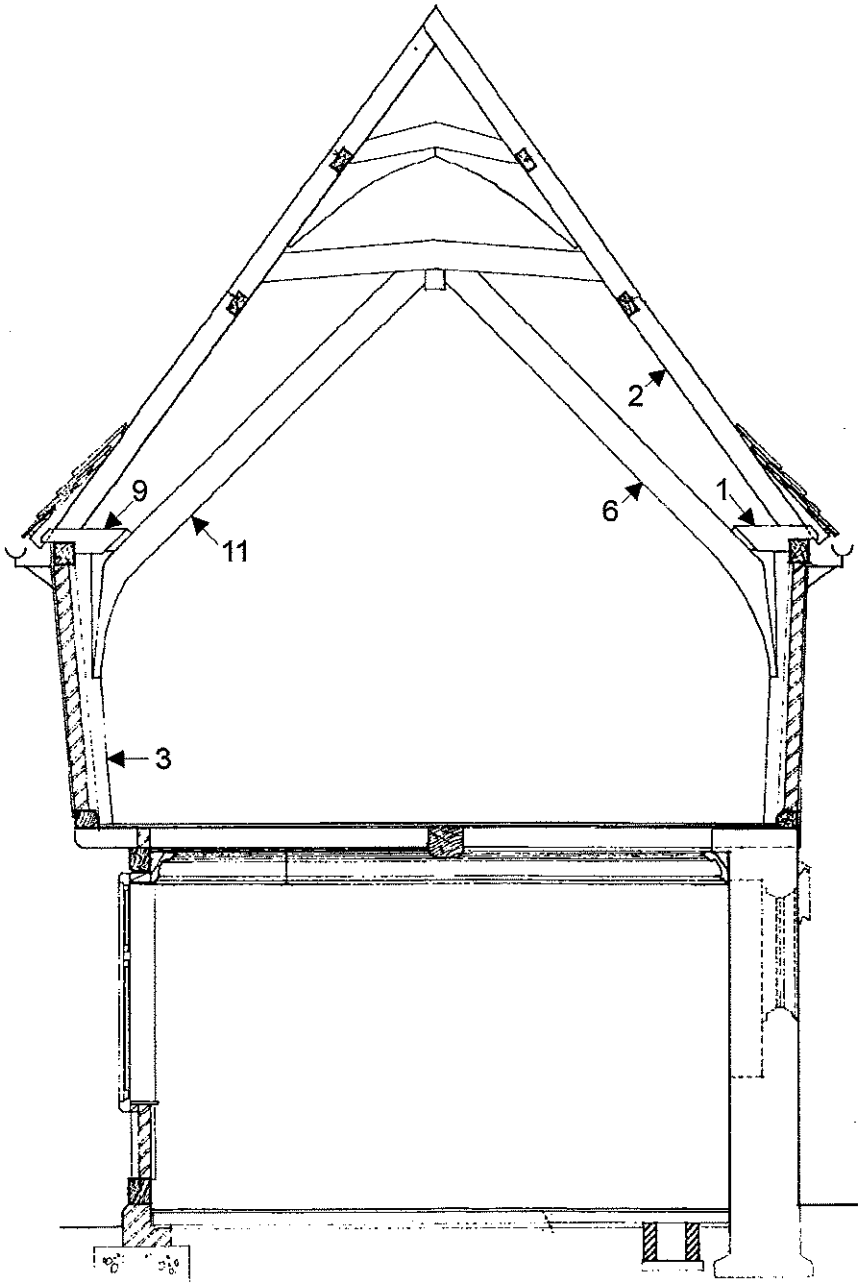


Figure 3 North truss showing sample locations (after Anthony Richardson and Partners diagram)

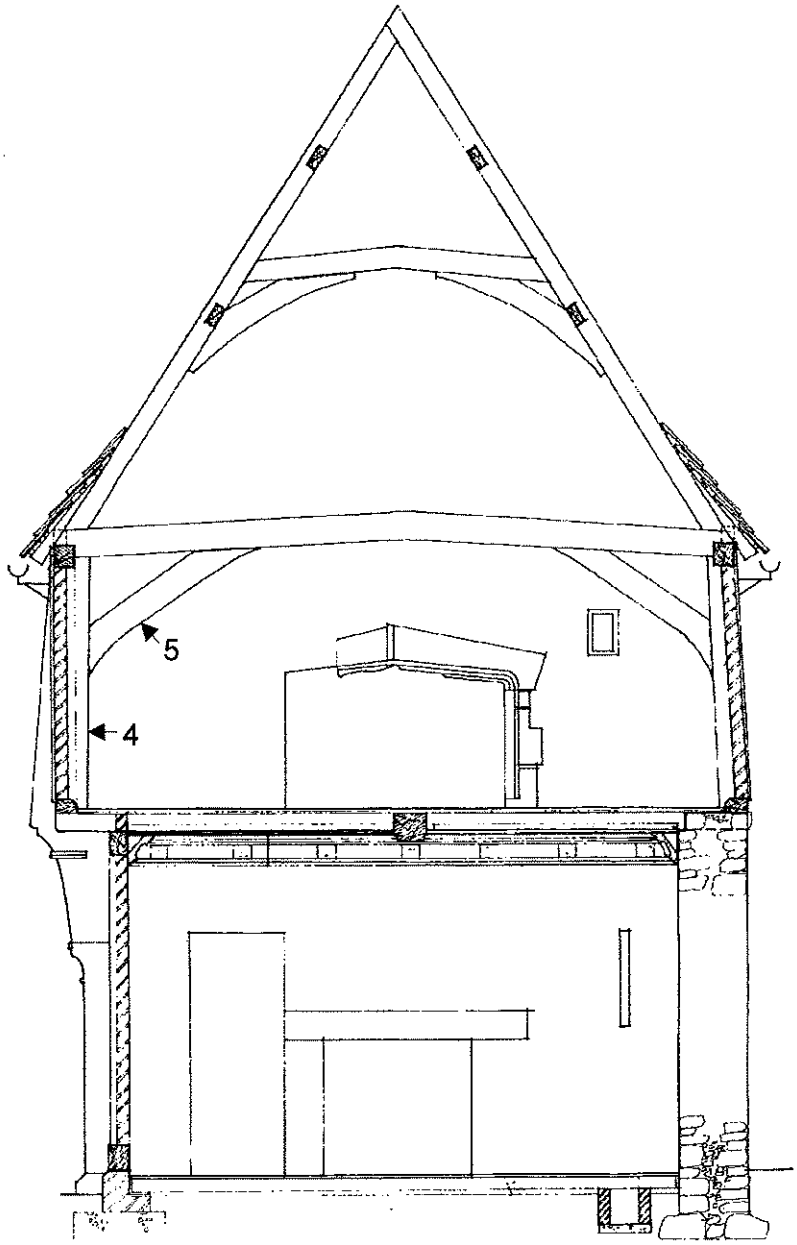


Figure 4 East-facing elevation of roof timbers and the upper storey showing sample locations (after Anthony Richardson and Partners diagram)

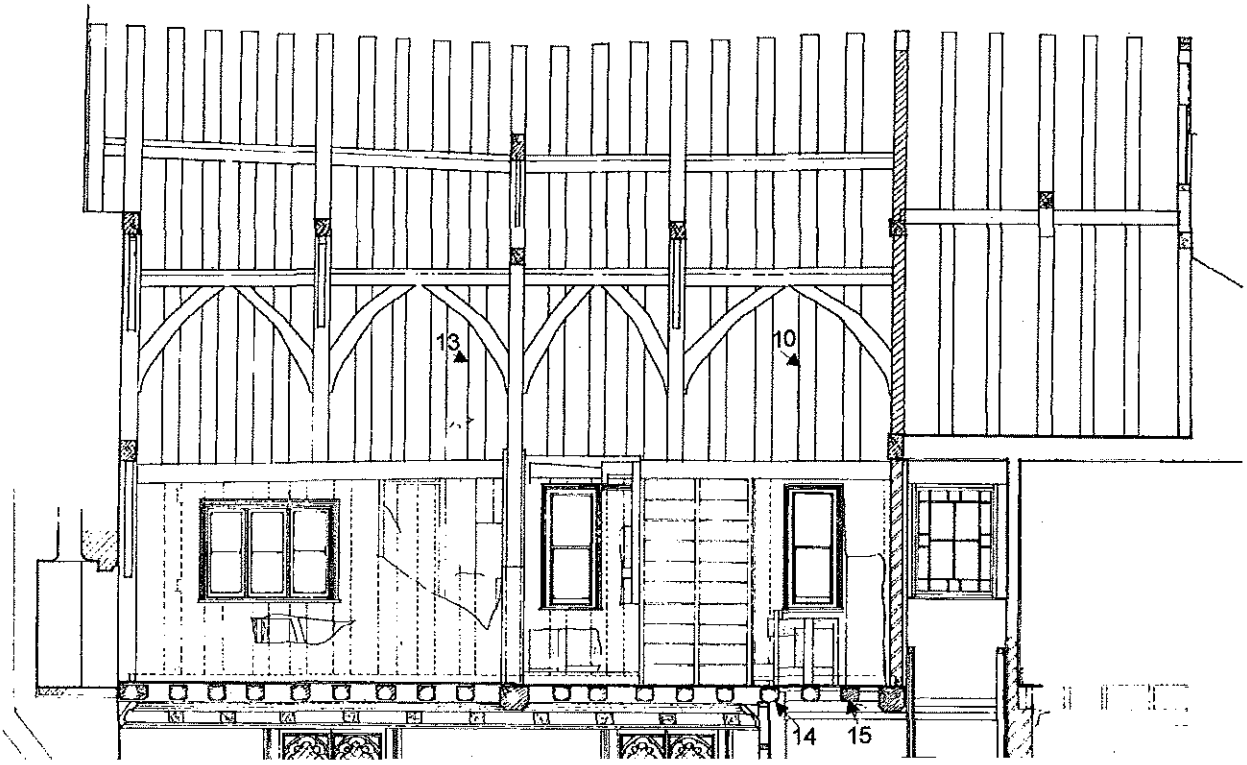


Figure 5 West-facing elevation of roof timbers and the upper storey showing sample locations (after Anthony Richardson and Partners diagram)

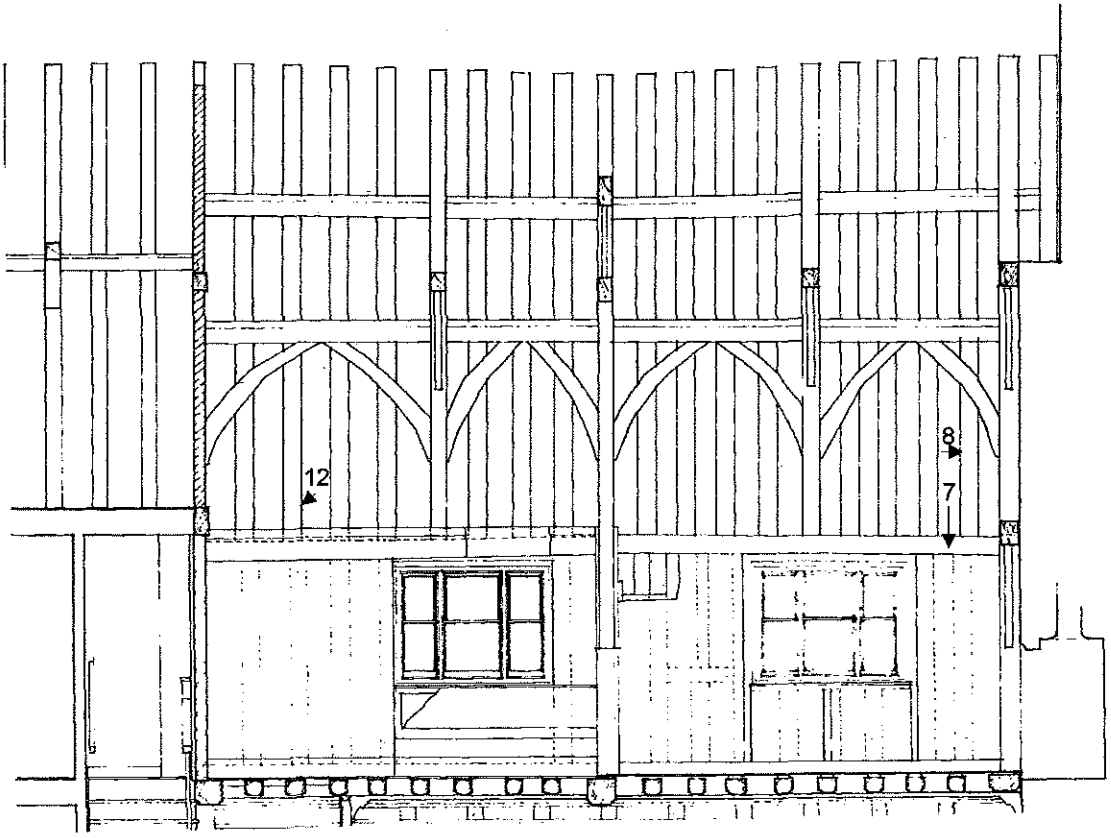
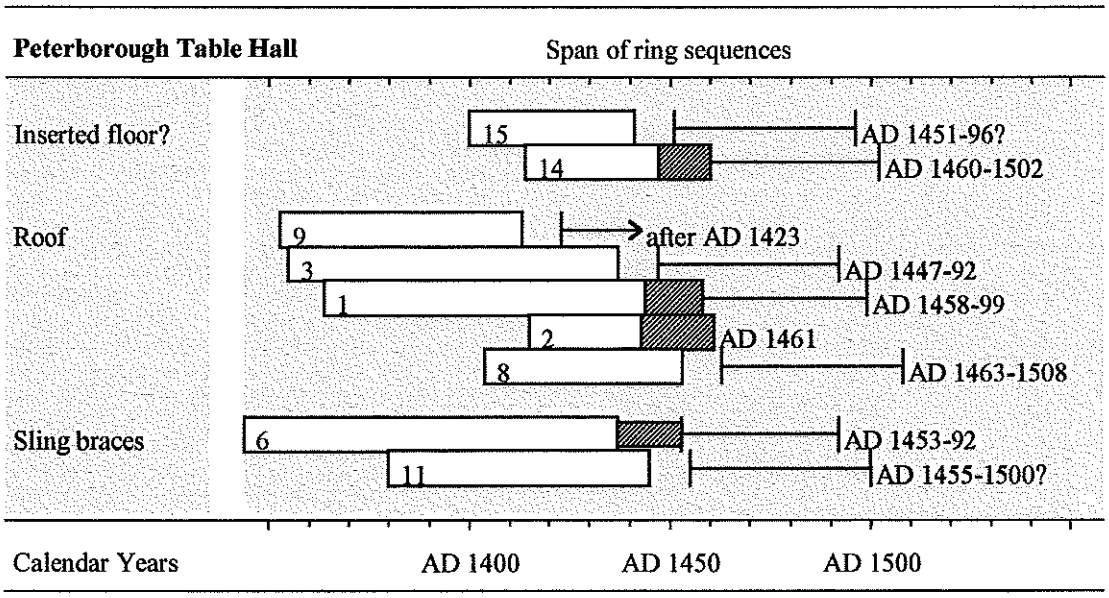


Figure 6 Bar diagram showing the chronological positions of the 9 dated timbers. The felling period for each sequence is also shown



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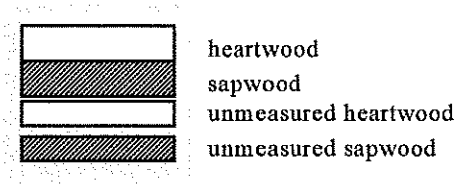

Table 1

List of samples

Core No	Origin of core	Cross-section size (mm)	Cross-section of tree	Total rings	Sapwood rings	ARW mm/year	Date of sequence	Felling period
1	Central truss, east side: truncated tiebeam	210 x 200	Whole	95	14	1.53	AD 1364-1458	AD 1458-99
2	Central truss, east side: principal	215 x 180	Whole	47	18+b	2.58	AD 1415-61	AD 1461
3	Central truss, west side: storey post	200 x 190	Whole	83	-	1.55	AD 1355-1437	AD 1447-92
4	North truss, west side: storey post	240 x 240	Whole	55	-	1.67	undated	
5	North truss, west side: brace	230 x 80	Quarter	*c* 34	-		unmeasured	
6	Central truss, east side: sling brace	215 x 160	Quarter	94+16	16	1.17	AD 1344-1437	AD 1453-92
7	West side: wall plate	200 x 180	Quarter	*c* 38	-		unmeasured	
8	West side: rafter 2	170 x 80	Quarter	50	h/s	1.73	AD 1404-53	AD 1463-1508
9	Central truss, west side: truncated tiebeam	210 x 210	Whole	61	-	1.86	AD 1353-1413	after AD 1423
10	East side: rafter 18	180 x 110	Quarter	*c* 28	-		unmeasured	
11	Central truss, west side: sling brace	215 x 180	Whole	66	h/s?	1.68	AD 1380-1445	AD 1455-1500?
12	West side: rafter 18	185 x 85	Quarter	*c* 31	-		unmeasured	
13	East side: rafter 10	180 x 90	Quarter	47	h/s?	2.70	undated	
14	Inserted floor: joist 16	170 x 90	Half	47	13	2.00	AD 1414-60	AD 1460-1502
15	Inserted floor: joist 18	175 x 90	Half	42	h/s?	2.08	AD 1400-41	AD 1451-96?

Total rings = all measured rings, +value means additional rings were only counted, the felling period column is calculated using these additional rings.
sapwood rings: h/s heartwood/sapwood boundary, h/s? possible heartwood/sapwood boundary, +b = bark-edge
ARW = average ring width of the measured rings

Table 2

Summary showing the structural function of the sampled timbers

Structural element	Sample numbers	Description
Braces	**5**	One brace from the north truss (Fig 3)
Floor joists	**14** and **15**	Two of the timbers forming part of the possibly inserted floor towards the north end of the building (Fig 4)
Plates	**7**	The western wall plate (Fig 5)
Principal rafters	**2**	One core from the principal on the eastern side of the central truss (Fig 2)
Rafters	**8, 10, 12,** and **13**	Four other rafters were sampled (Figs 4 and 5)
Sling braces	**6** and **11**	Both of the possibly later braces of the central truss (Fig 2)
Spur-ties	**1** and **9**	Both of the spur-ties of the central truss (possibly the two ends of a truncated tiebeam) (Fig 2)
Storey posts	**3** and **4**	A post from each of the trusses (Figs 2 and 3)

Table 3

t-value matrix for the timbers forming the chronology PET_TAB.
KEY: - = *t*-values under 3.0, \ = no overlap

	2	**3**	**6**	**8**	**9**	**11**	**14**	**15**
1	4.24	5.80	-	3.79	11.4	7.70	4.80	-
2		-	-	3.71	\	3.10	3.48	-
3			5.83	6.73	4.52	4.60	5.90	-
6				3.35	-	4.75	-	3.08
8					\	3.09	9.17	3.69
9						4.05	\	\
11							-	5.01
14								3.21

Table 4
Dating the mean sequence PET_TAB, AD 1344-1461 inclusive. *t*-values with independent reference chronologies

Area	Reference chronology	*t*-values
Bedfordshire	Chicksands Priory (Howard *et al* 1998)	5.59
Devon	Prowse Barn (Groves pers comm)	4.31
East Midlands	East Midlands (Laxton and Litton 1988)	4.64
Essex	Netteswellbury Barn (Tyers 1997b)	5.84
Essex	Nether Hall (author unpubl)	4.96
Essex	Thaxted Church (author unpubl)	5.84
Gloucestershire	Twyning Bellframe (Tyers 1996)	4.64
Kent	Kent (Laxton and Litton 1989)	4.00
London	Sutton House (Tyers 1991)	5.96
Yorkshire	Nostell Priory (Tyers 1998)	5.67

Table 5
Ring-width data from site master PET_TAB, dated AD 1344-1461 inclusive

Date	Ring widths (0.01mm)										No of samples									
AD 1344				162	325	242	136	116	60	54				1	1	1	1	1	1	1
AD 1351	77	69	207	208	175	268	219	167	206	208	1	1	2	2	3	3	3	3	3	3
	117	320	343	393	295	273	324	205	168	198	3	3	3	4	4	4	4	4	4	4
	133	160	215	136	180	184	235	206	194	237	4	4	4	4	4	4	4	4	4	5
	188	298	224	158	159	165	225	201	162	99	5	5	5	5	5	5	5	5	5	5
	76	54	80	115	124	161	102	141	160	162	5	5	5	5	5	5	5	5	5	6
AD 1401	177	192	148	144	171	262	172	202	163	142	6	6	6	7	7	7	7	7	7	7
	169	169	156	145	171	159	219	297	191	225	7	7	7	7	8	8	8	8	8	8
	166	152	253	216	147	112	164	182	195	168	8	8	8	8	8	8	8	8	8	8
	174	215	160	114	135	105	134	118	93	115	8	8	8	8	8	8	8	6	6	6
	147	129	170	138	95	122	149	141	144	108	6	5	5	5	5	4	4	4	4	4
AD 1451	112	140	130	113	110	128	107	111	96	92	4	4	4	3	3	3	3	3	2	2
	103																			