Ancient Monuments Laboratory
Report 6/99

TREE-RING ANALYSIS OF TIMBERS FROM TIPTOFTS, NEAR WIMBISH, ESSEX

I Tyers

Ancient Monuments Laboratory Report 6/99

TREE-RING ANALYSIS OF TIMBERS FROM TIPTOFTS, NEAR WIMBISH, ESSEX

I Tyers

Summary

Tiptofts is a grade I listed building, on the site of a Scheduled Ancient Monument. The timber-framed aisled hall has a hammerbeam roof thought to date from the fourteenth century, whilst the cross-wing to the south was thought to be the remnant of an earlier phase. This report covers the dendrochronological analysis of timbers from both the aisled hall and the cross-wing. The results indicate both sections are probably late-thirteenth century in date, and may be contemporaneous.

Author's address :-

I Tyers
SHEFFIELD DENDROCHRONOLOGY LABORATORY
Archaeology Research School
University of Sheffield West Ct 2 Mappin St
Sheffield
S1 4DT

TREE-RING ANALYSIS OF TIMBERS FROM TIPTOFTS, near WIMBISH, ESSEX

Introduction

This document is a technical archive report on the tree-ring analysis of oak timbers from the aisled hall and southern cross-wing of Tiptofts, near Wimbish, Essex (NGR TL57023737). 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.

The aisled hall at Tiptofts is an exceptional structure with quatrefoil aisle posts, decorated capitals, and a hammerbeam roof. The importance of the building has long been recognised, Pevsner (1954, 359-60) reports it as 'one of the most valuable survivals of medieval domestic architecture in Essex'. Hewett (1980, 126-8) in discussing the cross-wing reports it as 'among the few demonstrably experimental examples of jettied timber buildings'. The main areas of interest are in the southern cross-wing (Fig 1), identified as the service end from the survival of the decorated doorways that must have lead to the buttery, kitchen, and pantry. This appears more humble in conception than the aisled hall and it has frequently been assumed this is the survivor of an original hall, the main part of which was replaced during the aggrandisement of the building following the return of Sir John Tiptoft from the Hundred Years War after *c* AD 1348. The southern end of the aisled hall is perhaps most remarkable for the absence of a later inserted floor, this building is thus one of the few where the full impact of an open hall is still plain. Before the insertion of the stack in the middle it must have been a most impressive structure. The north cross-wing may be a significantly later addition.

A tree-ring dating programme of the timbers of the hall and service range was requested by Deborah Priddy from English Heritage primarily in the hope of providing a series of dates to assist with the interpretation of recent archaeological excavations under the floors in advance of underpinning and other remedial works.

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 thorough 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

Almost all the timbers in the structure are of oak (*Quercus* spp.). Timbers with some evidence of surviving sapwood were selected for sampling wherever possible.

A total of 13 timbers were selected as most suitable for sampling (Table 1, Figs 2-5). The samples were numbered **1-13** inclusive. Seven samples were obtained from joists and storey posts in the cross-wing (samples **1-7**; Figs 2 and 3), whilst six samples were obtained from the hall. Samples **8-11** were from the area of the south west aisle post and include a wall-plate and two braces (Fig 4), whilst **12** and **13** were obtained from the roof at the north end of the hall (Fig 5).

Only six samples when examined in the laboratory were found to include enough rings for reliable analysis (Table 1). The other seven cores either had too few rings for reliable analysis, or had fragmented too badly to be reconstructed, or in one case included a ring sequence which could not be reliably resolved. The six usable cores were measured and the resultant six series were initially compared with each other. Four sequences were found that matched together to form an internally consistent group (Table 2), three of these were samples from the cross-wing and one is from the hall. A 68-year mean chronology was calculated from the three cross-wing samples. This mean and the other sequences were then compared with dated reference chronologies from throughout the British Isles and northern Europe. Table 3 shows the correlation of sample **10** from the hall, and the mean sequence of the three correlated cross-wing samples at the dating positions identified. Table 4a lists the data from sample **10**, Table 4b lists the cross-wing mean chronology.

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

Interpretation

Four timbers from the building were dated by the analysis, all were complete to either the heartwood/sapwood boundary or retained some sapwood (Fig 6). Applying an estimate for the lost sapwood to indicate the felling period of the timbers, and assuming the material is contemporary within each structure indicates felling of the three dated timbers from the cross-wing between AD 1287 and AD 1329, whilst the single dated timber from the hall was probably felled between AD 1282 and AD 1327. In all likelihood the phases are contemporaneous. Given the skewed nature of the distribution of the number of sapwood rings found in British oaks (Hillam *et al* 1987) they are more likely felled in the late thirteenth-century than the early fourteenth-century.

Discussion

The sampling programme undertaken on the building was intended to assist the interpretation of this complex building. The phasing has been the subject of intense speculation amongst historians of vernacular architecture. The results appear to indicate that the principal structural elements of the hall and cross-wing are contemporaneous. The service end appears later than predicted, whilst the hall is earlier than had been anticipated. This conclusion must remain tentative given the small number of timbers that were suitable for analysis, and the even smaller number that dated. The absence of well replicated results from the hall is of some concern. The hall timbers were re-examined, in the company of David Andrews,

John Walker, and Mr and Mrs Johnson after completion of the analysis in order to assess whether there were any signs of re-use on the single dated timber, and whether there were any other timbers that could assist with the dating of the hall. This examination provided independent confirmation of the presence of the heartwood/sapwood boundary recorded at the outer edge of sample **10**, and failed to provide any convincing evidence for re-use of this timber. Overall the hall timbers are typically derived from large fast growing trees and the only structural elements identified that may be suitable for tree-ring analysis are a pair of currently inaccessible tiebeams, and an inaccessible post. Some of the moulded panels associated with the service end door frames contain long tree-ring sequences but these would be at risk of disfigurement and in any case could be later insertions. Some of these timbers may become accessible in the future if any major refurbishment works are undertaken, it is to be hoped that their potential for clarifying the dendrochronological results will be considered in this event.

Conclusion

The dendrochronological analysis of timbers from Tiptofts sheds some light on the relative phasing of the two early parts of the hall. Despite only small numbers of usable timbers being present in the structure dates were obtained from both parts and appear to suggest they are contemporary, with the cross-wing later than expected and the hall slightly earlier than expected. The results are remarkable for two reasons, the cross-wing may be the earliest currently dated example if its type, whilst the hammerbeam roof may also be the earliest dated example of its type (John Walker, Dave Stenning, and David Andrews pers comm).

Acknowledgements

The sampling and analysis programme was funded by English Heritage. Mr and Mrs Johnson kindly allowed access to their house and coped with the noise and debris. David Andrews, Dave Stenning, Adrian Gibson and John Walker all gave me the benefit of their thoughts on the interpretation of the structure. John Walker kindly provided the drafts of figures used as the basis of Figures 1-5. My colleagues Cathy Groves and Nigel Nayling provided useful discussion and encouragement. David Andrews and John Walker kindly made themselves available for a subsequent visit, and Mr and Mrs Johnson again kindly allowed access, all contributed to useful discussion of the results and their implications.

References

Baillie, M G L, 1982 *Tree-Ring Dating and Archaeology*, London

Baillie, M G L, and Pilcher, J R, 1973 A simple crossdating program for tree-ring research, *Tree Ring Bulletin*, **33**, 7-14

English Heritage, 1998 *Guidelines on producing and interpreting dendrochronological dates*, London

Groves, C, and Hillam, J, 1993 *Tree-ring dating of oak timbers from Lodge Farm, Denton, Norfolk*, Anc Mon Lab Rep, **83/93**

Groves, C, and Hillam, J, 1994 *Tree-ring analysis of Englishcombe Tithe Barn, near Bath, Avon, 1993*, Anc Mon Lab Rep, **64/94**

Groves, C, Hillam, J, and Pelling-Fulford, F, 1997 Dendrochronology, in *Excavations on Reading Waterfront sites, 1979-1988* (eds J W Hawkes and P J Fasham), Wessex Archaeological Reports, **5** , 64-70

Hewett, C A, 1980, *English Historic Carpentry*, Chicester

Hillam, J, 1991 *Tree-ring dating of oak cores from the Tithe Barn at Winterbourne, near Bristol, Avon*, Anc Mon Lab Rep, **46/91**

Hillam, J, Morgan, R A, and Tyers, I, 1987 Sapwood estimates and the dating of short ring sequences, in *Applications of tree-ring studies: current research in dendrochronology and related areas* (ed R G W Ward), BAR Int Ser, **333**, 165-85

Howard, R E, Laxton, R R, and Litton, C D, 1997 *Tree-ring analysis of timbers from Ware Priory, High Street, Ware, Hertfordshire*, Anc Mon Lab Rep, **84/97**

Howard, R E, Laxton, R R, and Litton, C D, 1998a *Tree-ring analysis of timbers from Chicksands Priory, Chicksands, Bedfordshire*, Anc Mon Lab Rep, **30/98**

Howard, R E, Laxton, R R, and Litton, C D, 1998b *Tree-ring analysis of timbers from the Manor House, Abbey Green, Burton upon Trent, Staffordshire*, Anc Mon Lab Rep, **11/98**

Laxton, R R, and Litton, C D, 1988 *An East Midlands master tree-ring chronology and its use for dating vernacular buildings*, University of Nottingham, Dept of Classical and Archaeological Studies, Monograph Series, **III**

Laxton, R R, and Litton, C D 1989 Construction of a Kent master chronological sequence for oak, 1158-1540 AD, *Med Archaeol*, **33**, 90-98

Munro, M A R, 1984 An improved algorithm for crossdating tree-ring series, *Tree Ring Bulletin*, **44**, 17-27

Pevsner, N, 1954, *The buildings of England: Essex*, Harmondsworth

Rackham, O, 1990 *Trees and woodland in the British Landscape*, 2nd edn, London

Tyers, I, 1997a *Dendro for Windows program guide*, ARCUS Rep, **340**

Tyers, I, 1997b *Tree-ring analysis of seven buildings in Essex*, ARCUS Rep, **292**

Tyers, I, Groves, C, Hillam, J, and Boswijk, G, 1997 List 80 - Tree-ring dates from Sheffield University, *Vernacular Architect*, **28**, 138-158

Figure 1 Plan of Tiptofts (after John Walker pers comm)

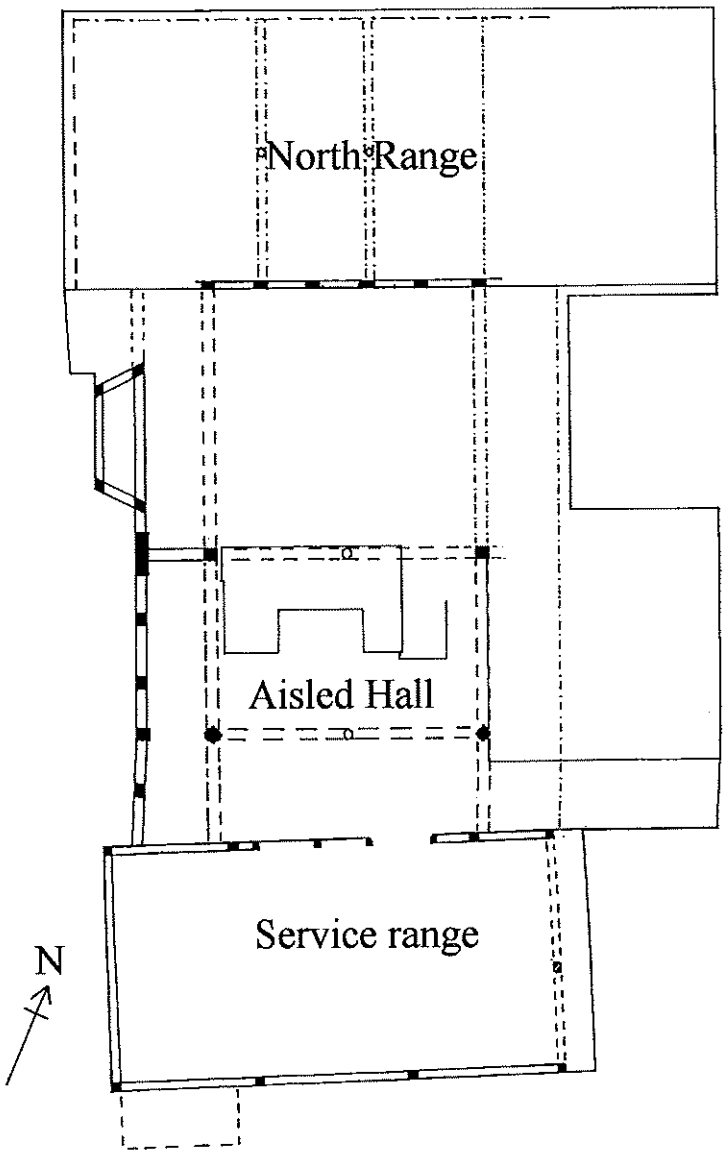


Figure 2 Plan of ground floor of the service wing showing location of samples **1-4** (after John Walker pers comm)

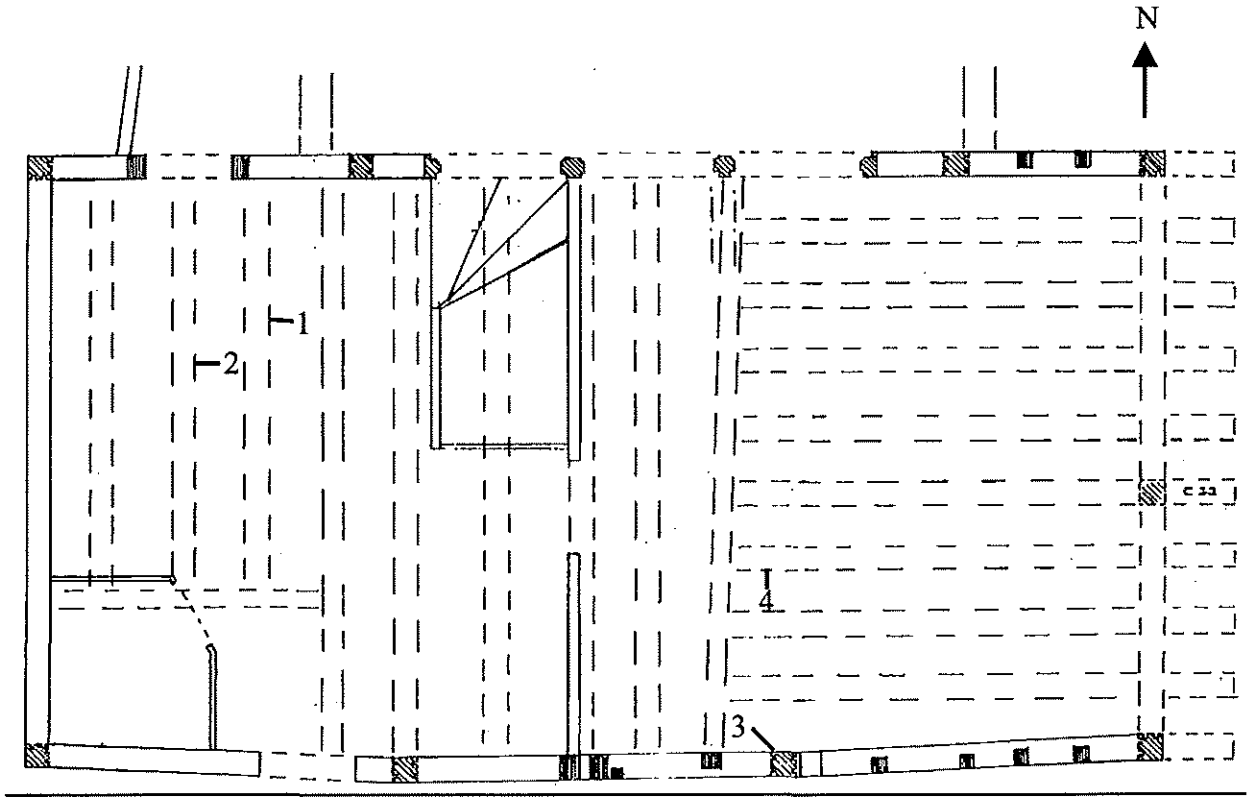


Figure 3 Plan of first floor of service wing showing location of samples **5-7** (after John Walker pers comm)

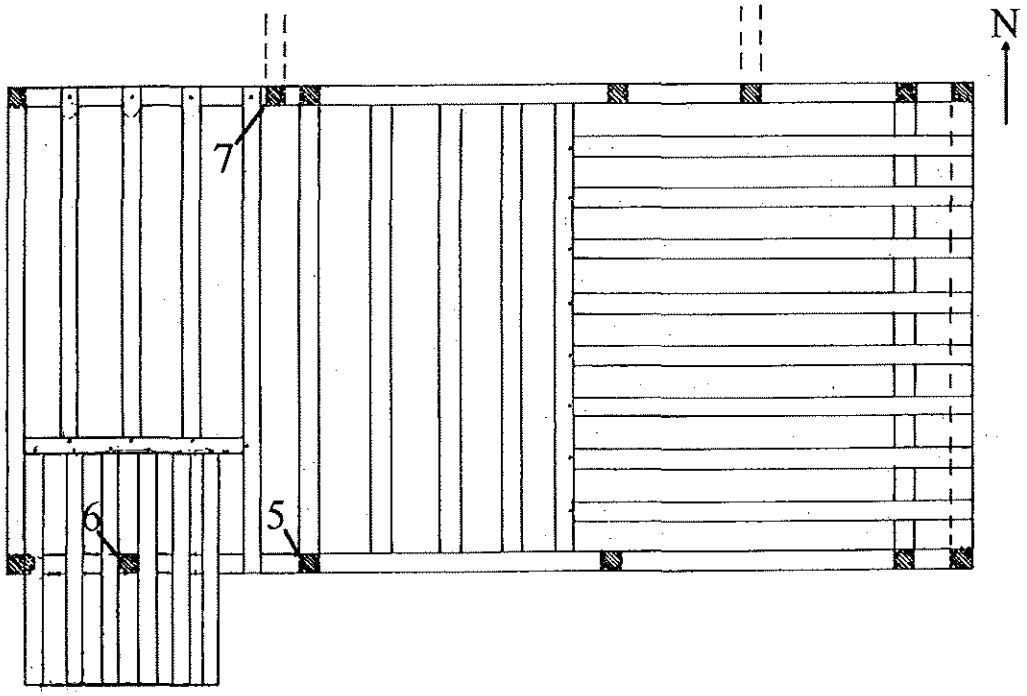


Figure 4 North-south section of the aisled hall, looking west, showing location of samples **8-13** (after John Walker pers comm)

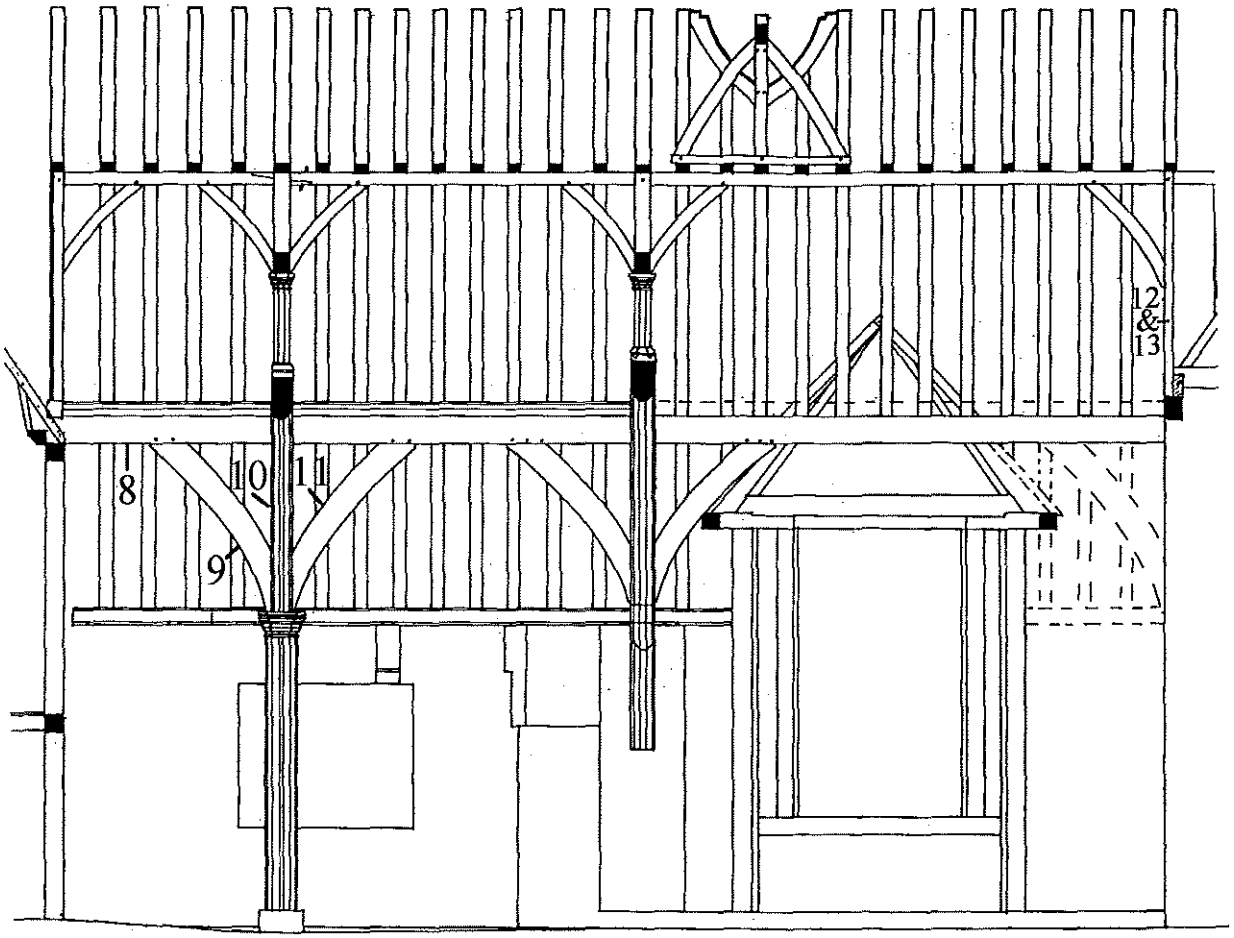


Figure 5 East-west section of north end of the aisled hall, looking north, showing location of samples **12-13** (after John Walker pers comm)

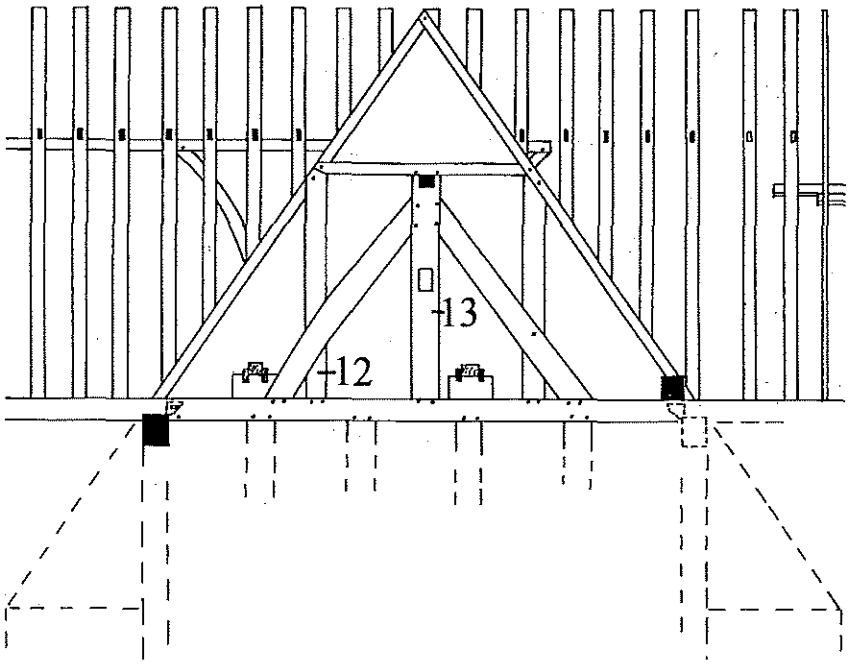
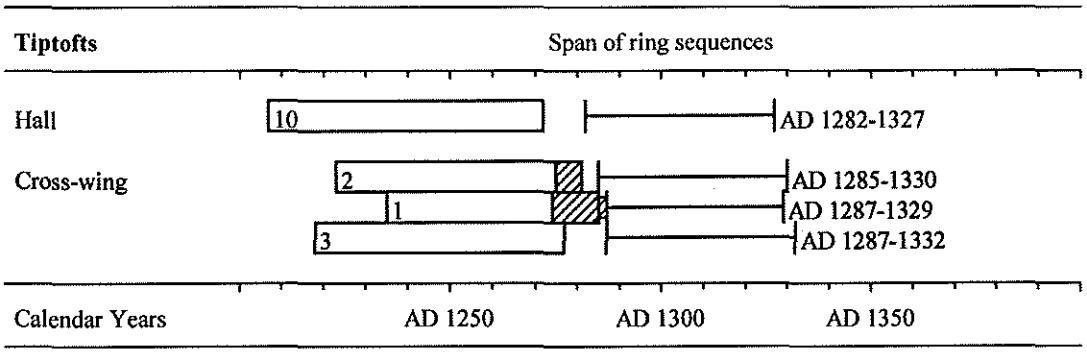
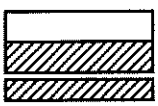


Figure 6 Bar diagram showing the chronological positions of the four dated timbers. The felling period for each sequence is also shown



KEY



heartwood
sapwood
unmeasured sapwood

Table 1

List of samples, grouped by area of sampling

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	Cross-wing joist	190 x 165	Quarter	51	11+2	2.55	AD 1235-1285	AD 1287-1329
2	Cross-wing joist	230 x 170	Quarter	59	6	2.54	AD 1223-1281	AD 1285-1330
3	Cross-wing post	200 x 170	Quarter	60	h/s	2.33	AD 1218-1277	AD 1287-1332
4	Cross-wing joist	185 x 160	Whole	*c* 25	-	-	not measured	-
5	Cross-wing storey post	190 x 180	Quarter	*c* 28	-	-	not measured	-
6	Cross-wing storey post	195 x 180	Quarter	*c* 27	-	-	not measured	-
7	Cross-wing/Hall partition storey post	195 x 180	Whole	*c* 23	-	-	not measured	-
8	Hall wall plate	250 x 250	Whole	64	-	2.15	undated	-
9	Hall post south brace	270 x 250	Whole	*c* 60 *	-	-	not measured	-
10	Hall post above the moulding	270 x 260	Whole	66	h/s	2.71	AD 1207-1272	AD 1282-1327
11	Hall post north brace	260 x 250	Whole	78	h/s	1.68	undated	-
12	Hall north end roof post	230 x 100	Half	*c* 32	-	-	not measured	-
13	Hall north end crown post	310 x 115	Half	*c* 37	-	-	not measured	-

Key:
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,
ARW = average ring width of the measured rings
* this sample includes an unresolvable ring sequence within it

Table 2

t-value matrix for the dated timbers from Tiptofts.
KEY: - = *t*-values under 3.0, \ = no overlap

	2	**3**	**11**
1	3.53	3.73	-
2		3.98	3.09
3			-

Table 3

Dating the sequence from sample **10**, AD 1207-1272 inclusive, and the cross-wing samples **1-3** mean sequence AD1218-1285 inclusive. *t*-values with independent reference chronologies, - = *t*-values under 3.0

Area	**Reference chronology**	**Hall** sample **10** *t*-values AD1207-1272	**Cross-wing** samples **1-3** *t*-values AD1218-1285
Avon	Englishcombe Tithe Barn (Groves and Hillam 1994)	5.01	-
Avon	Winterbourne Tithe Barn (Hillam 1991)	3.60	3.44
Bedfordshire	Chicksands Priory (Howard *et al* 1998a)	-	3.44
Berkshire	Reading (Groves *et al* 1997)	3.81	-
East Midlands	East Midlands master (Laxton and Litton 1988)	-	4.70
Essex	Essex master* (author unpubl)	5.93	4.21
Essex	The Bury, Clavering (Tyers *et al* 1997)	5.19	5.16
Essex	Riven Hall, Roydon (author unpubl)	4.47	-
Essex	Southchurch Hall (Tyers 1997b)	4.86	4.74
Hertfordshire	Ware Priory (Howard *et al* 1997)	-	5.05
Kent	Kent master (Laxton and Litton 1989)	4.62	3.65
Norfolk	Lodge Farm, Denton (Groves and Hillam 1993)	-	3.66
Staffordshire	Abbey Green, Burton (Howard *et al* 1998b)	3.26	4.34

* NB this is not independent of the other Essex data

Table 4a

Ring-width data from sample **10**, dated AD 1207-1272 inclusive

Date	Ring widths (0.01mm)									
AD 1207							184	234	353	275
	233	242	263	213	330	268	165	171	240	278
	354	259	311	311	270	372	338	340	379	347
	252	163	264	251	254	167	272	262	235	226
	183	175	173	202	356	308	421	198	263	229
AD 1251	315	278	389	438	328	436	417	214	218	290
	309	341	196	143	285	269	231	294	193	177
	295	275								

Table 4b

Ring-width data from the samples **1-3** mean sequence, dated AD 1218-1285 inclusive

Date	Ring widths (0.01mm)										No of samples									
AD 1218								138	180	195								1	1	1
	112	109	194	290	197	250	280	309	334	401	1	1	2	2	2	2	2	2	2	2
	285	215	235	191	202	187	327	292	285	400	2	2	2	2	3	3	3	3	3	3
	351	301	423	285	311	304	330	202	229	292	3	3	3	3	3	3	3	3	3	3
AD 1251	352	231	367	286	314	278	264	137	125	129	3	3	3	3	3	3	3	3	3	3
	166	269	210	210	200	193	211	226	288	245	3	3	3	3	3	3	3	3	3	3
	221	178	186	183	167	218	248	189	186	253	3	3	3	3	3	3	3	2	2	2
	183	206	228	209	125						2	1	1	1	1					