Ancient Monuments Laboratory
Report 46/2000

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Summary

The Prior's House at Castle Acre has a low-pitched roof or ceiling with a painted decorative scheme thought to commemorate the wedding of Henry VII and Elizabeth of York in AD 1485. Above this is a roof primarily constructed from rafter couples with scissor bracing. This has hitherto been thought of as later since it covers the chimney associated with thelower roof or ceiling, and there is evidence on the gable ends of modifications associated with the insertion of the steeper pitched scissor-braced roof. Recently, there has been a suggestion that the scissor-braced roof predates the lower roof, which is instead an inserted ceiling. Sampling at this Scheduled Ancient Monument was commissioned to explore this possibility. The results indicate the lower roof or ceiling is late fourteenth century, and assuming the art-historical attribution of the painted ceiling is reliable, it seems likely that this was a later decorative scheme applied to an earlier structure. An alternative possibility is that these timbers are re-used. The upper roof contains timbers of a slightly later date, that is from the later fourteenth or early-fifteenth century. These do show some evidence of re-use. Two additional upper roof trusses of different design and constructed from markedly different timber could not be dated by dendrochronological methods. The presence of water damage on the upper surface of the beams of the decorated low-pitched roof or ceiling, and the absence of visible water damage on the upper roof timbers, may imply that the lower structure was covered by the upper roof at a later date, perhaps as a result of it beginning to leak and thus damage the decoration. The interpretation favoured by this report is that the upper roof is of post-Dissolution date but employing timber salvaged from the priory church or another monastic building.

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Introduction

This document is a technical archive report on the tree-ring analysis of oak timbers from the present roof and ceiling of the Prior's House, Castle Acre Priory, Castle Acre, Norfolk (Figs 1 and 2; NGR TF 815147). 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.

Castle Acre Priory, founded around AD 1089 and dissolved in AD 1537, is thought to be the best preserved Cluniac monastery in England. The site is a Scheduled Ancient Monument, whilst the Prior's House is listed grade 1. The upper floor of this building consists of two unequal sized rooms with a central chimney. There is a low-pitched ceiling common to both rooms that has a painted decorative scheme thought to commemorate the wedding of Henry VII and Elizabeth of York in AD 1485. Above this, and again common to both rooms, is a roof constructed of 36 trusses. Thirty-four of these are rafter couples with scissor bracing (Fig 3), whilst in the western roof there are two trusses with a lower collar and arch-bracing (Fig 4). This roof has hitherto been thought of as later (see Raby and Baillie Reynolds 1952, 19-20) since it covers the chimney apparently associated with the lower ceiling. In addition there is evidence on the gable ends of modifications associated with the insertion of the steeper pitched scissor-braced roof and these appear to incorporate re-used monastic masonry (Fig 5). Recently, there has been a suggestion that the scissor-braced roof predates the lower roof, which is instead an inserted ceiling (English Heritage 1998a, 36).

A tree-ring dating programme of the timbers at this Scheduled Ancient Monument was requested by Glyn Coppack from English Heritage to explore the evidence for these two alternative hypotheses.

Methodology

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

The sampling reported here was undertaken on two separate occasions: an initial group of 22 samples were obtained over a two day period in December AD 1998, which resulted in a date being obtained from the lower roof/ceiling; whilst a second group of 13 samples taken in March AD 2000 resulted, when combined with some of the earlier samples, in a date for some of the upper roof timbers. On both occasions a brief survey identified those oak timbers with the most suitable ring sequences for analysis from the phases and areas of interest. 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 and with due regard to safety on site.

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 filled at the ends which were visible from the floor by dowels made of medieval oak. Upper surface holes and others not visible from the floor were left open in accordance with the conditions of the Scheduled Monument Consent. 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 1999a). The ring sequences were plotted onto semi-log graph paper to enable visual comparisons to be made between sequences. In addition a cross-correlation algorithm (Baillie and Pilcher 1973) was 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 46 annual rings, where these figures indicate the 95% confidence limits of the range (Tyers 1998a). These figures are applicable to oaks from England and Wales. 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.

A further important element of the tree-ring analysis of buildings and archaeological assemblages is the identification of 'same tree' groups within the sampled material. Inspection of timbers, both in buildings and archaeological sites, often suggests that the patterns of knots or branching in timbers are so similar that they appear to be derived from a single tree. Tree-ring analysis is often used to support these suggestions. The identification of 'same tree' groups is based on a combination of high levels of matching between samples, extremely similar longer term growth trends, and individual anatomical anomalies within the timbers. High *t*-values are not by themselves necessarily indicative of two series being derived from a single tree. Conversely low *t*-values do not necessarily exclude the possibility. It is the balance of a range of information that provides the evidence.

Results

Access to the timbers in this building was difficult. The property is open to the public and access had to be arranged for days when working in the Prior's House caused no inconvenience and posed no potential danger to the public. In addition the floor-to-tiebeam height is considerable, and special ladders had to be hired to provide safe access, similarly there is no electric supply in the building so a generator had to be hired to supply power for the coring drills. The number of samples in total from the property was limited by the Scheduled Monument Consent to include no more than 24 samples during the first phase of the work and a limit of an additional 15 samples during the second phase of the work. The consent also required all visible holes to be filled. Thus each visible core site is filled (sometimes at both ends where the coring goes right through a timber) by a 2cm section of doweling cut from sections of medieval oak. These form a good colour match to the historic timber work.

The correct nomenclature to use for the parts of the lower roof or inserted ceiling is a problem, the nomenclature followed here is as if it were a cranked tiebeam roof with central ridge and rafters. This is not meant to pre-judge the correct interpretation of the structure. During sampling no original truss numbers were identified that formed a coherent sequence. The lower roof was therefore assigned truss letters A-E from the east (Table 1; Fig 6). Unfortunately it was subsequently found that there were modern chalked numbers on the upper roof from 1-36 running from the west, these are possibly from the recent survey work. This upper roof numbering sequence was followed for the sampling records in this area (Table 1; Fig 6).

A total of 35 timbers were selected as most suitable for sampling (Table 1; Fig 6). There was an almost complete lack of sapwood throughout the building. The samples were numbered **1-35** inclusive: samples **1-12** are from the lower roof, samples **13-35** from the upper roof.
One of the samples (number **8**) when examined in the laboratory was rejected due to it having too few rings for reliable analysis. A further six samples (**15**, **18**, **19**, **29**, **32**, and **35**) were found when examined

in the laboratory to have less than the normal lowest number of rings considered suitable for reliable analysis, however since these are all from the upper roof and each had 40 or more rings these were measured and analysed with the rest of the upper roof samples. In total therefore 34 samples were measured and the resultant series were then compared with each other. Eleven sequences from the lower roof were found that matched together to form one internally consistent group (Fig 7; Table 2). A 120-year site mean chronology was calculated, named CAP_LOW. A second internally consistent group of fifteen timbers from the upper roof scissor-braced trusses was also found (Fig 7; Table 3). These were combined to form a 132-year site mean chronology named CAP_HIGH. Comparison between CAP_LOW and CAP_HIGH identified a correlation (t = 5.36) indicating CAP_HIGH ends 30 years after CAP_LOW. Two additional groups of three samples were combined to form two more sequences named CAP_HIGH2 and CAP_ARCH, of 70- and 54-years length respectively (Tables 4 and 5). These four site means, and the two remaining unmatched samples were then compared with dated reference chronologies from throughout the British Isles and northern Europe. A single well correlated position was identified for both the CAP_LOW and the CAP_HIGH sequence. Table 6 shows the correlation of both the CAP_LOW and CAP_HIGH mean sequences at their identified dating positions, AD 1237 - 1356 inclusive for CAP_LOW and AD1255 – 1386 for CAP_HIGH. Tables 7 and 8 lists the two dated site mean chronologies. The CAP_HIGH2 and CAP_ARCH sequences and the remaining two measured samples did not match either the rest of the material from Castle Acre nor dated reference chronologies. Tables 9 and 10 list the CAP_HIGH2 and CAP_ARCH sequences. Table 11 lists the sample **33** sequence.

Discussion

The 120-year chronology CAP_LOW is dated AD 1237 to 1356 inclusive. It was created from eleven timbers. None of the dated samples were complete to bark-edge, but all except two of them are definitely or probably complete to the heartwood/sapwood boundary (Table 1). Inspection of the bar diagram (Fig 7) suggests they are derived from a single felling period. Combining the interpretation of these samples suggests they were all felled between AD 1366 and AD 1390 inclusive. The 132-year chronology CAP_HIGH is dated AD 1255 to 1386 inclusive. It was created from fifteen timbers. None of the dated samples were complete to bark-edge, but all but four of them are definitely or probably complete to the heartwood/sapwood boundary (Table 1). Inspection of the bar diagram (Fig 7) suggests they are derived from a single felling period. Combining the interpretation of these samples suggests they were all felled between AD 1396 and AD 1419 inclusive.

This result is unusually difficult to interpret with any degree of reliability. The sampling was undertaken in the expectation that there would be two datable phases. The results obtained have produced dates for two phases which are, just, different in date. There are eleven dated timbers from the lower roof, and there are fifteen dated timbers from the upper roof. The presence of dated later fourteenth-century timbers throughout the surviving part of the lower roof makes it highly probable that the lower roof is late-fourteenth century in origin. There were no obvious features seen during sampling that might indicate the lower roof includes re-used timbers, and I am not aware of any previous suggestion of the presence of re-used timbers in this structure. To place this result in context, the dating obtained suggests that it is a slightly later version of the similar Sacrist's House roof in Ely dated by dendrochronology to AD 1333-6 (Howard *et al* 1993). This is both geographically nearby and of a similar ecclesiastical status. The date obtained inevitably means that, assuming the art-historical attribution of the painted ceiling is reliable, it is likely that the currently visible painting was a later decorative scheme applied to an earlier roof.

In contrast the upper roof contains fewer timbers suitable for dendrochronology. Sample selection was more difficult and, compared with the lower roof, the timbers in it appeared to have fewer rings and faster average growth rates. These impressions are supported by the samples obtained from it, with six of the 23 samples having fewer than 50 rings, and only one sample having more than 100 rings, by comparison only one of the 12 lower roof samples was too short to measure and six have more than 100 rings (Table 1). The dated samples from the upper roof combine to give an original felling date for these timbers of between AD 1396 and AD 1419 which suggests this structure is made of timber felled around 30 years later than those of the lower roof. The dendrochronological results indicate the two structures are not contemporaneous and there is are redundant joints in some of the unsampled upper roof timbers which, if these are the same date as the rest, would imply this roof is somewhat later than the dendrochronological dating evidence obtained for it. There is, in addition, the unresolved issue of the date of the two arch-braced trusses in the upper roof (trusses 3 and 15; Figs 4 and 6). Three of the five samples from these two trusses are combined to form the CAP_ARCH sequence but this is hopelessly short at 54-years length and not surprisingly remains undated (Table 10). The longer individual sequence obtained from the truss 15 collar (sample **33**) which includes sapwood and bark-edge (Table 11) also has proven undatable by current reference data. None of the other timbers in these two trusses appeared suitable for sampling.

Conclusion

The dendrochronological analysis of timbers from Castle Acre clearly identifies the present low ceiling as a late fourteenth-century structure, similar to other low pitched roofs in East Anglia. The present upper roof includes many timbers of later fourteenth- or early fifteenth-century date perhaps originally felled some 30 years after those used in the lower roof. The upper roof is thus definitely later than the lower roof or ceiling and it appears to include some timbers that are clearly re-used, although none of these had sufficient rings for tree-ring analysis. The art-historical attribution of the painted ceiling on the underside of the lower roof to the late-fifteenth century, assuming this to be correct, means that the new dendrochronological results identify this as a later decorative scheme applied to an earlier roof.

The presence of two different but undatable trusses in the upper roof and the likely presence of datable but re-used timbers that are already later than those in the lower roof indicates the upper roof is later than the lower roof and thus replaces it. Further supporting evidence for this conclusion is provided by two other observations: firstly that there is widespread water damage on the upper surfaces of the lower roof that is absent from the roof above it, and secondly that there is the inclusion of re-used masonry on the stone gable ends only above the drip courses. Since these drip lines are an expression of the lower roof line the alternative suggestion requires these to have been added later to the outside of the walls simply to reflect the location of an inserted ceiling.

Acknowledgements

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Figure 1 Location of Castle Acre within England and Wales, based upon Ordnance Survey map

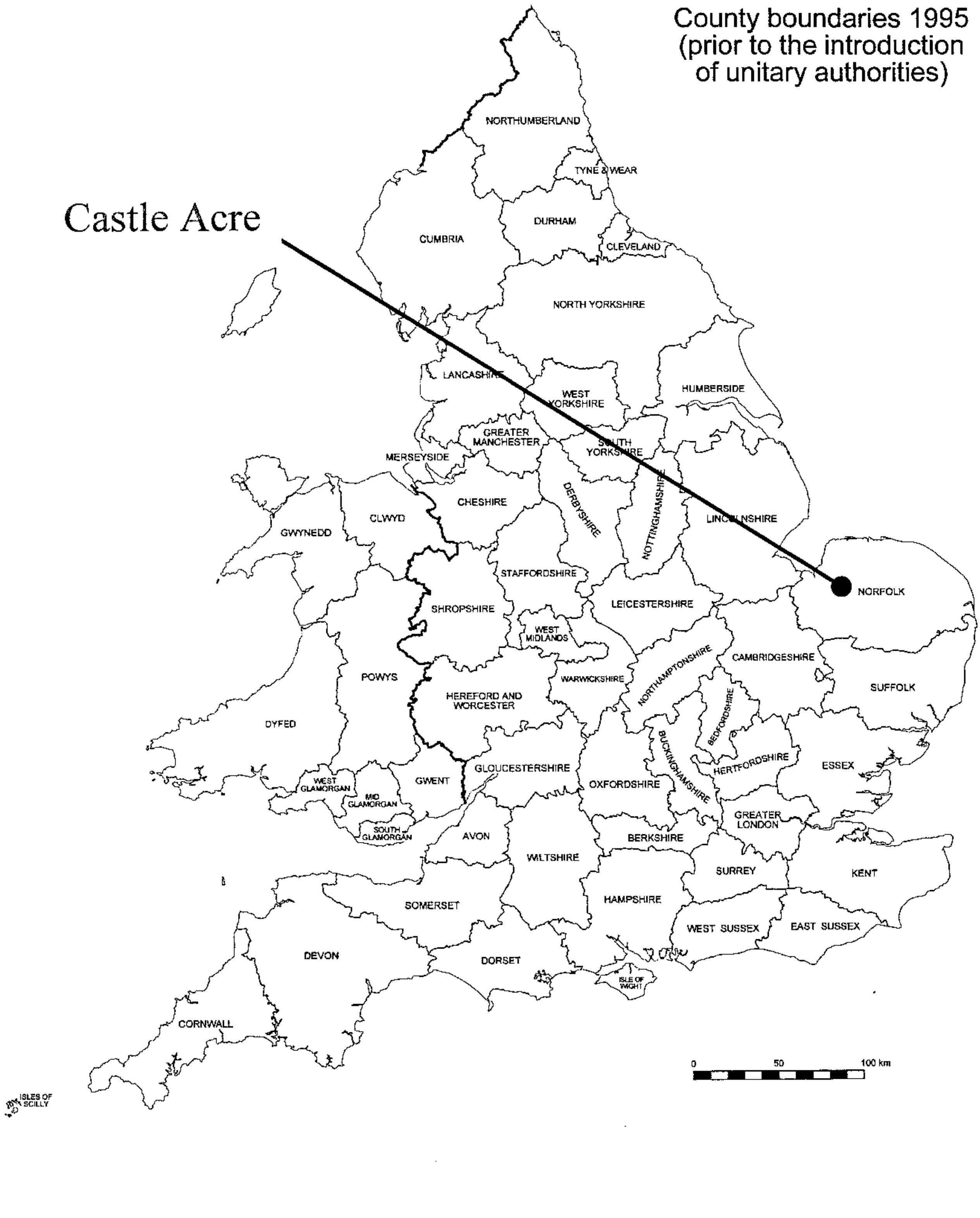

Figure 2 Location of the Prior's House within the site of Castle Acre Priory, after English Heritage (1998a, 21) © English Heritage

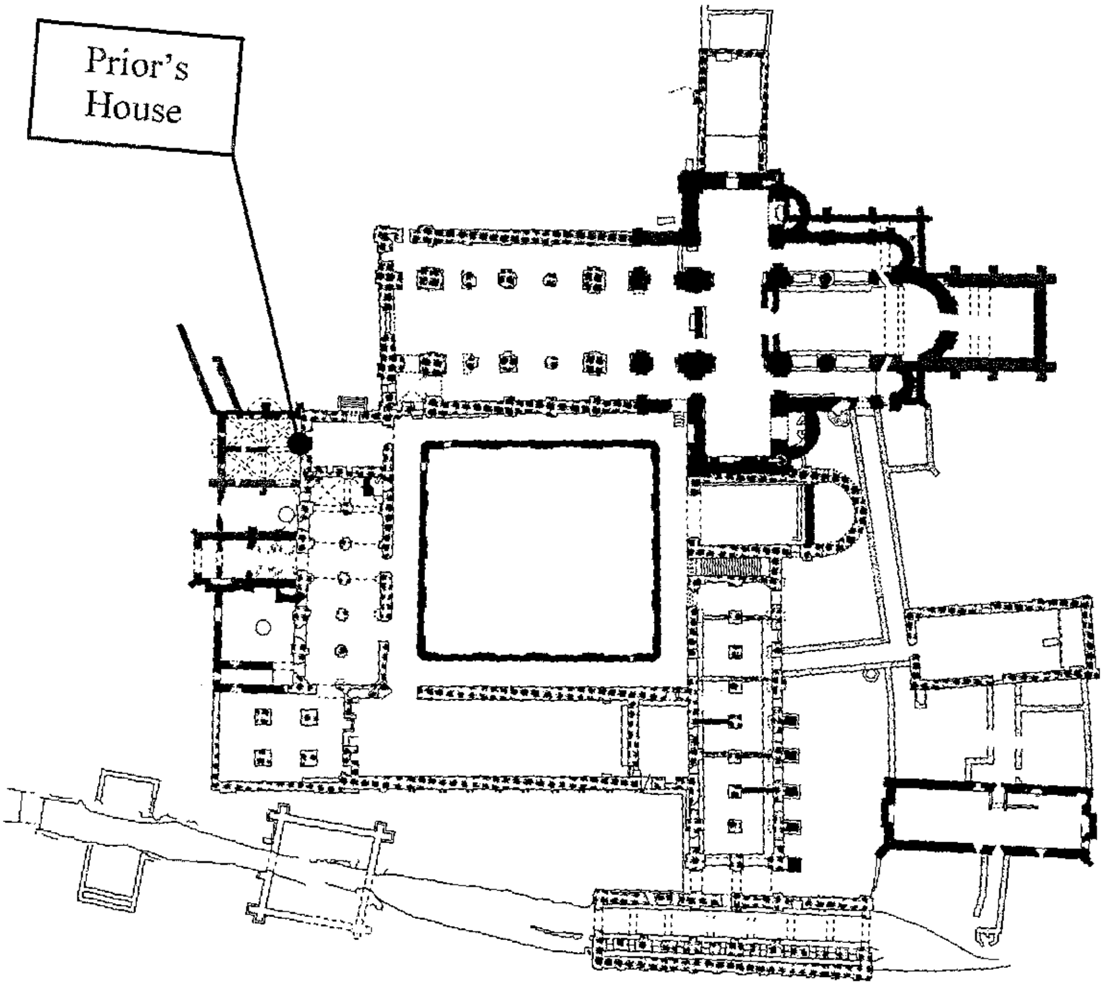

Figure 3

A typical scissor braced truss from the upper roof as seen in trusses 1, 2, 4-14, and 16-36 inclusive, showing the nomenclature used for the timber elements, based on an original by the Ministry of Public Buildings and Works, this figure also shows one of the cranked tiebeams forming the present ceiling

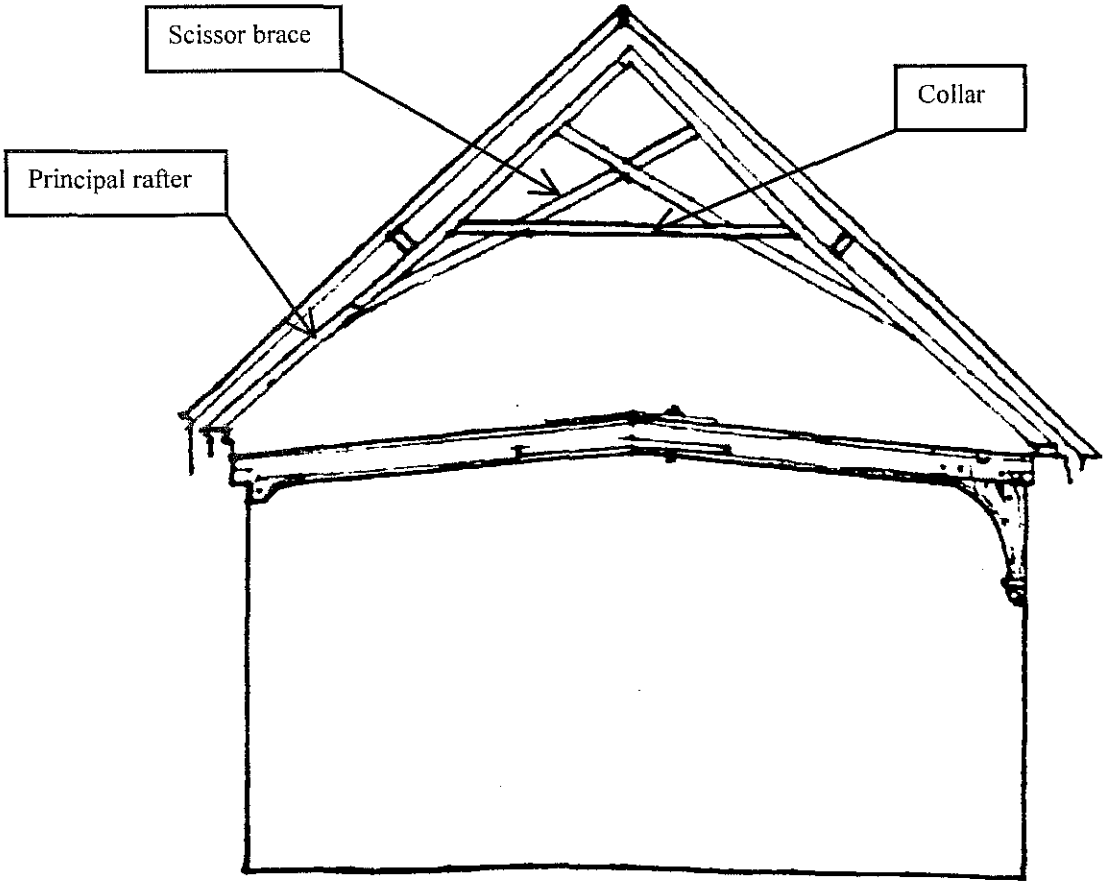

Figure 4

An arch braced truss from the upper roof, trusses 3 and 15, showing the nomenclature used for the timber elements, based on an original by the Ministry of Public Buildings and Works

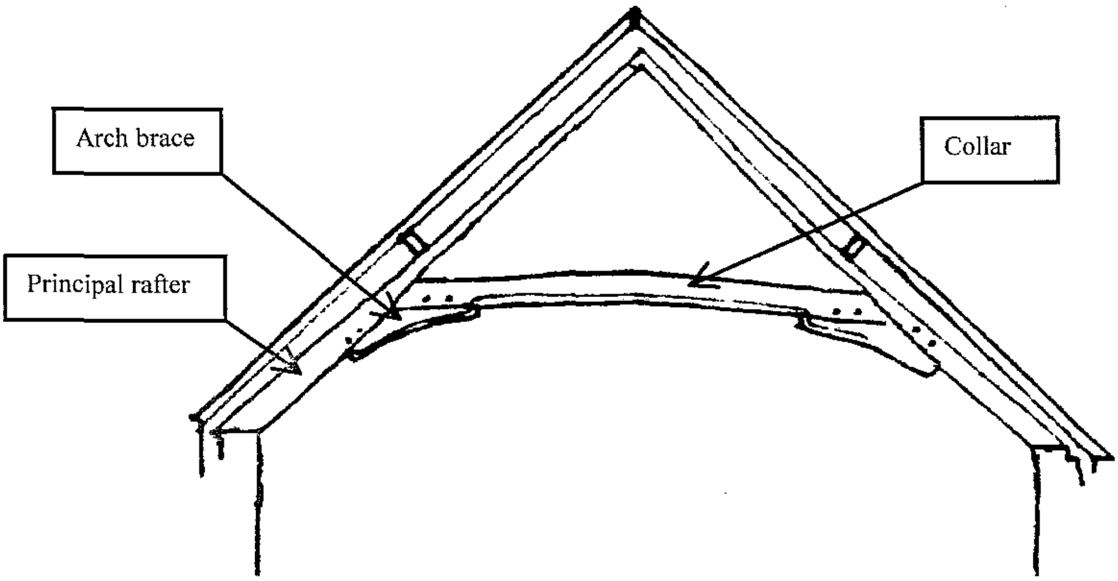

Figure 5

Photograph of the west end of the Prior's House. This shows the drip courses associated with the lower ceiling, the different masonry above these, and also highlights at least one piece of re-used masonry. Photograph English Heritage Photographic Unit © English Heritage

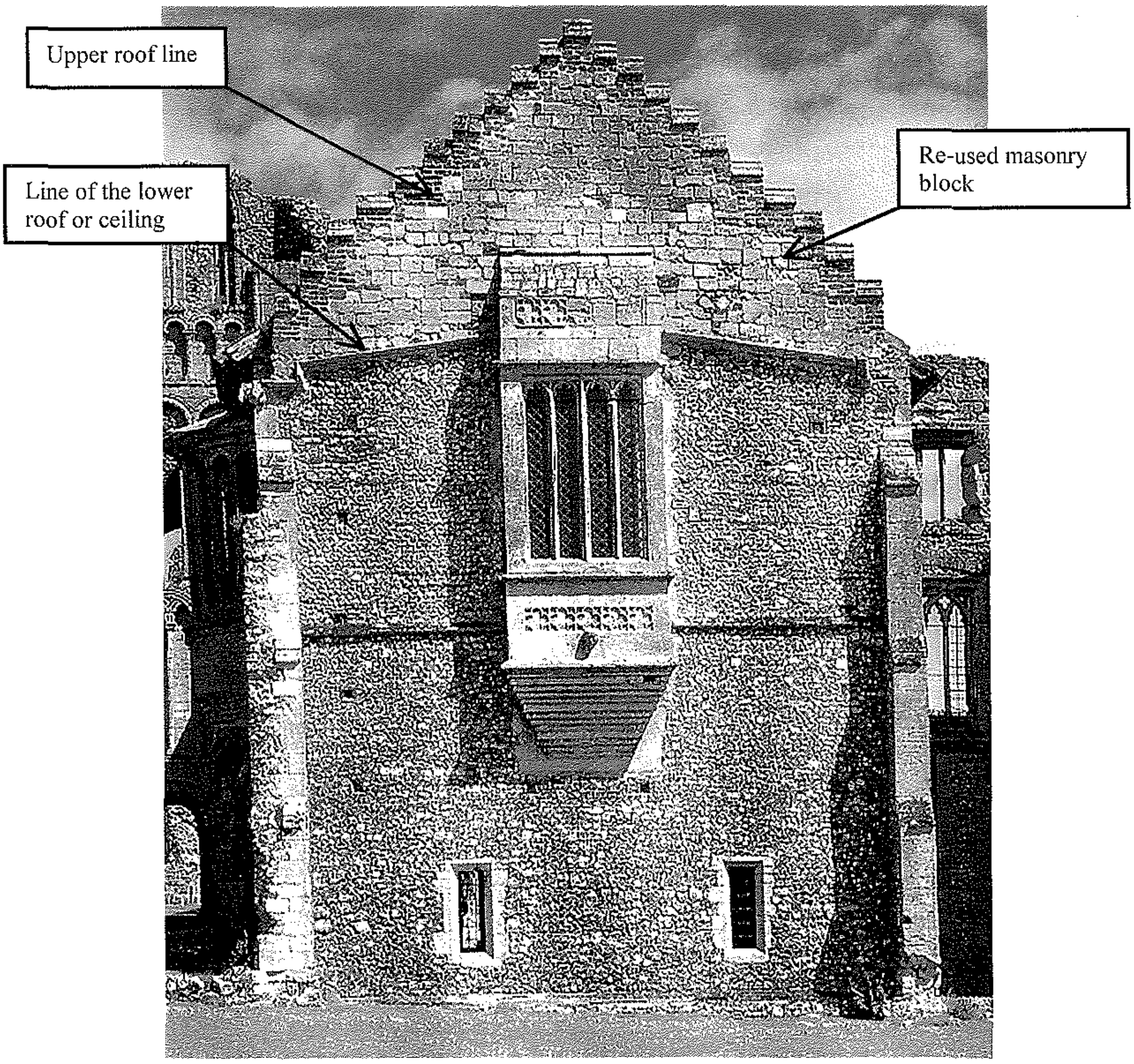

Figure 6

Section of the Prior's House looking north, showing both roofs, the truss numbering scheme adopted, and approximate location of samples **1-35**, based on an English Heritage Survey Services diagram © English Heritage. The timbers from the unseen, but identical southern half of the roof are shown in yellow boxes, those in the northern half are in white boxes

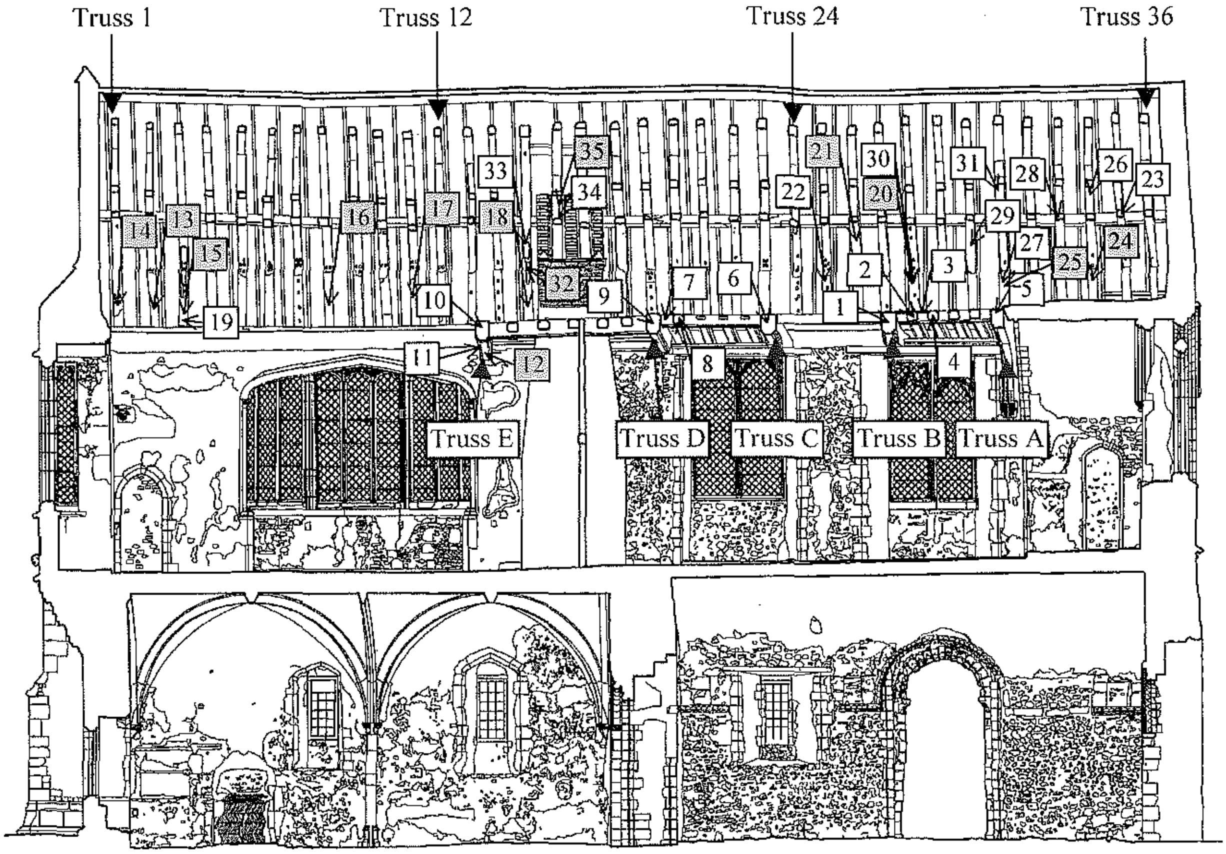

Figure 7

Bar diagram showing the chronological positions of the 26 dated timbers. The felling period for each sequence is also shown

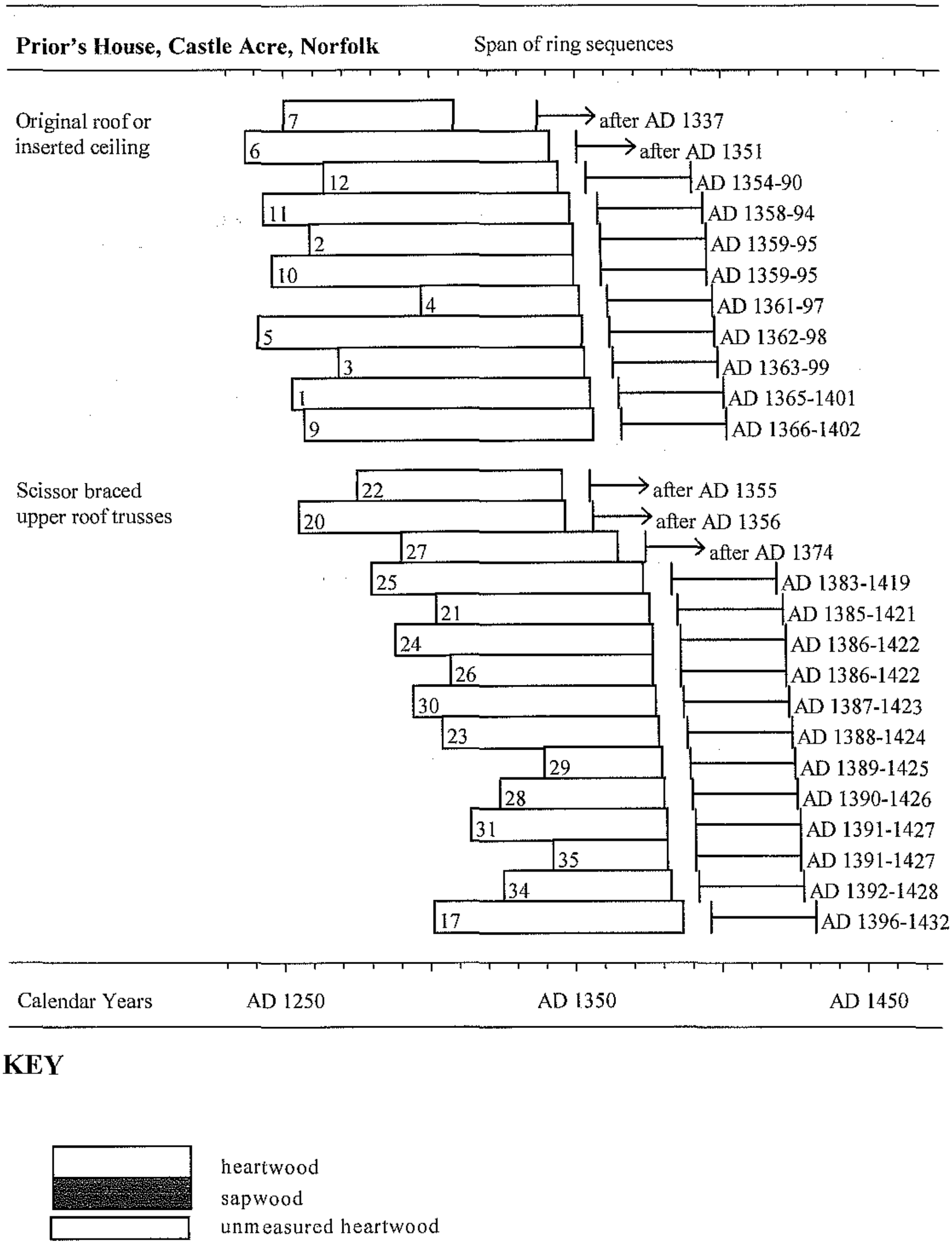

Table 1

List of samples obtained from the Prior's House, Castle Acre

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	Truss B cranked tiebeam	300 x 230	Half	103	h/s	2.73	AD 1253-1355	AD 1365-1401
2	Bay A/B north rafter	160 x 140	Quarter	91	h/s	1.66	AD 1259-1349	AD 1359-95
3	Central ridge bay A/B	240 x 150	Quarter	85	h/s	2.70	AD 1269-1353	AD 1363-99
4	Bay A/B north rafter	160 x 130	Quarter	55	h/s	2.75	AD 1297-1351	AD 1361-97
5	Truss A cranked tiebeam	310 x 200	Quarter	112	h/s	2.09	AD 1241-1352	AD 1362-98
6	Truss C cranked tiebeam	360 x 260	Quarter	105	-	1.80	AD 1237-1341	after AD 1351
7	Central ridge bay C/D	260 x 220	Quarter	59+19h	-	3.37	AD 1250-1308	after AD 1337
8	Bay C/D south rafter	200 x 150	Quarter	-	-	-	Not measured	-
9	Truss D cranked tiebeam	330 x 200	Quarter	100	h/s	2.97	AD 1257-1356	AD 1366-1402
10	Truss E cranked tiebeam	290 x 220	Quarter	104	h/s	2.01	AD 1246-1349	AD 1359-95
11	Truss E north brace	200 x 200	Quarter	106	h/s	2.01	AD 1243-1348	AD 1358-94
12	Truss E south brace	280 x 220	Whole	81	h/s	1.13	AD 1264-1344	AD 1354-90
13	Truss 2 south principal rafter	185 x 120	Quarter	62	-	3.11	-	-
14	Truss 1 south principal rafter	185 x 120	Quarter	57	-	2.98	-	-
15	Truss 3 south principal rafter	185 x 180	Quarter	44	h/s	4.51	-	-
16	Truss 8 south principal rafter	180 x 120	Quarter	58	-	2.55	-	-
17	Truss 11 south principal rafter	180 x 120	Quarter	86	h/s	1.66	AD 1301-1386	AD1396-1432
18	Truss 15 south principal rafter	200 x 180	Quarter	44	h/s	4.08	-	-
19	Truss 3 north principal rafter	180 x 180	Quarter	50	h/s	3.38	-	-
20	Truss 28 south principal rafter	160 x 110	Quarter	92	-	1.61	AD 1255-1346	after AD 1356
21	Truss 26 south scissor brace	160 x 100	Quarter	74	h/s	1.51	AD 1302-1375	AD 1385-1421
22	Truss 25 north principal rafter	180 x 120	Quarter	71	-	2.05	AD 1275-1345	after AD1355
23	Truss 35 collar	160 x 110	Quarter	75	h/s	1.77	AD 1304-1378	AD 1388-1424
24	Truss 34 south principal rafter	170 x 110	Quarter	89	h/s	1.50	AD 1288-1376	AD 1386-1422
25	Truss 31 south principal rafter	170 x 110	Quarter	94	h/s	1.55	AD 1280-1373	AD 1383-1419
26	Truss 34 north scissor brace	165 x 115	Quarter	70	h/s	2.41	AD 1307-1376	AD 1386-1422
27	Truss 31 north principal rafter	180 x 110	Quarter	75	-	2.09	AD 1290-1364	after AD 1374
28	Truss 33 collar	160 x 105	Quarter	57	h/s	2.80	AD 1324-1380	AD 1390-1426
29	Truss 30 north scissor brace	165 x 105	Quarter	41	h/s	3.12	AD 1339-1379	AD 1389-1425
30	Truss 28 north principal rafter	160 x 110	Quarter	84	h/s	1.67	AD 1294-1377	AD 1387-1423
31	Truss 31 north scissor brace	170 x 110	Quarter	68	h/s	1.96	AD 1314-1381	AD 1391-1427
32	Truss 15 south arch brace	260 x 130	Half	50	3	2.55	-	-
33	Truss 15 collar	270 x 130	Half	111	23+Bw	1.77	-	-
34	Truss 16 collar	140 x 110	Quarter	58	h/s	1.71	AD 1325-1382	AD 1392-1428
35	Truss 16 south scissor brace	165 x 115	Quarter	40	h/s	3.37	AD 1342-1381	AD 1391-1427

KEY
Total rings = all measured rings, +(value)h = additional heartwood rings were only counted, the felling period column is calculated using these additional rings.
Sapwood rings: h/s heartwood/sapwood boundary, Bw bark winter felled.
ARW = average ring width of the measured rings

Table 2

t-value matrix for the timbers forming the chronology CAP_LOW, samples **1-12** are from the lower roof or ceiling. KEY: - = *t*-values under 3.0, / = no or short overlap

	2	3	4	5	6	7	9	10	11	12
1	-	-	-	-	6.08	-	-	-	-	-
2		8.82	3.65	5.62	3.02	4.24	5.22	6.65	5.75	3.85
3			4.89	5.35	3.03	6.45	5.47	5.50	6.33	4.14
4				5.01	-	\	3.76	3.13	4.56	-
5					4.92	4.93	7.25	5.05	4.18	3.59
6						-	-	3.13	-	-
7							6.20	3.54	3.07	4.42
9								7.43	6.25	8.38
10									9.50	5.06
11										5.23

Table 3

t-value matrix for the timbers forming the chronology CAP_HIGH, samples **13-35** are from the scissor-braced upper roof trusses (ie not trusses 3 and 15). KEY: - = *t*-values under 3.0, / = no or short overlap

	20	21	22	23	24	25	26	27	28	29	30	31	34	35
17	4.26	4.02	5.23	4.01	5.15	3.72	4.85	4.88	3.85	-	5.58	3.60	-	-
20		3.82	5.61	3.32	4.61	-	3.54	-	4.50	\	7.90	-	-	\
21			-	4.88	3.62	-	5.38	-	-	3.77	3.88	3.59	3.68	3.62
22				3.28	8.85	3.61	-	5.28	4.22	\	3.11	-	-	\
23					4.86	-	5.60	-	3.14	3.39	4.49	3.69	4.99	4.71
24						4.95	3.11	6.32	4.59	-	4.63	-	-	-
25							-	10.41	3.49	-	-	-	-	-
26								-	4.56	3.08	4.08	-	-	-
27									-	-	-	-	-	-
28										4.03	4.98	-	3.62	-
29											-	-	4.64	6.67
30												4.14	4.75	3.11
31													3.70	-
34														6.62

Table 4

t-value matrix for the timbers forming the chronology CAP_HIGH2, these three samples are from the scissor-braced trusses in the upper roof

	14	16
13	4.59	8.41
14		6.78

Table 5

t-value matrix for the timbers forming the chronology CAP_ARCH, these three samples are from the two upper roof trusses with arch braces (trusses 3 and 15)

	18	19
15	8.18	7.46
18		7.60

Table 6

Dating the two mean sequences from the Prior's House, Castle Acre Priory. *t*-values with independent reference chronologies. The two sequences also correlate with a *t*-value of 5.36

Area	**Reference Chronology**	**CAP_LOW** AD 1237 - AD 1356	**CAP_HIGH** AD 1255 – AD 1386
Bedfordshire	Chicksands Priory (Howard *et al* 1998a)	4.98	4.72
Berkshire	Reading (Groves *et al* 1997)	5.38	3.33
Berkshire	Windsor Castle (Tyers *et al* 1997)	4.57	5.24
East Midlands	East Midlands (Laxton and Litton 1988)	4.94	4.31
Essex	Cann Hall Clacton (Tyers 1998b)	7.52	-
Essex	Cressing Temple Church (Tyers 1995)	7.53	3.84
Essex	Navestock Church (Tyers 1999b)	6.01	5.78
Kent	Archbishops Palace, Charing (Howard *et al* 1998b)	4.10	4.59
London	Harmondsworth Tithe Barn (Tyers and Hibberd 1993)	4.96	4.58
London	Hays Wharf (Tyers 1996a; Tyers 1996b)	5.53	4.97
London	Trig Lane (Tyers 1992)	3.81	5.71
Norfolk	Dragon Hall Norwich (Boswijk and Tyers 1998)	6.06	-
Norfolk	Lodge Farm Denton (Groves and Hillam 1993)	7.75	3.14
Norfolk	Marriots Warehouse Kings Lynn (Tyers 1999c)	3.65	5.99
Suffolk	Wingfield College Eye (Bridge 1999)	5.65	-
Surrey	Newdigate (Bridge 1998)	5.30	4.89

Table 7

Ring-width data from site master CAP_LOW dated AD 1237-1356 inclusive

Date	Ring widths (0.01mm)										No of samples									
AD 1237							195	192	164	145							1	1	1	1
	286	306	310	304	355	305	333	206	211	205	2	2	3	3	3	4	4	4	4	5
AD 1251	280	207	331	283	344	236	316	252	309	362	5	5	6	6	6	6	7	7	8	8
	314	352	258	201	200	193	190	249	213	235	8	8	8	9	9	9	9	9	10	10
	317	243	278	242	226	173	288	218	209	254	10	10	10	10	10	10	10	10	10	10
	286	323	267	265	241	227	211	201	316	300	10	10	10	10	10	10	10	10	10	10
	235	245	229	242	225	245	246	184	184	162	10	10	10	10	10	10	11	11	11	11
AD 1301	215	244	206	204	171	174	216	201	237	227	11	11	11	11	11	11	11	11	10	10
	171	179	216	242	251	232	246	214	222	206	10	10	10	10	10	10	10	10	10	10
	233	217	191	156	136	104	167	183	193	136	10	10	10	10	10	10	10	10	10	10
	113	121	139	194	225	200	178	213	247	248	10	10	10	10	10	10	10	10	10	10
	209	212	176	185	267	192	208	182	169	199	10	9	9	9	8	8	8	8	7	5
AD 1351	251	215	240	229	252	329					5	4	3	2	2	1				

Table 8

Ring-width data from site master CAP_HIGH AD 1255-1386 inclusive

Date	Ring widths (0.01mm)										No of samples									
AD 1255					236	378	400	274	297	334					1	1	1	1	1	1
	329	350	254	125	122	178	243	349	305	175	1	1	1	1	1	1	1	1	1	1
	179	114	189	194	200	174	275	194	236	245	1	1	1	1	2	2	2	2	2	3
	236	220	209	205	322	298	226	302	407	339	3	3	3	3	3	3	3	4	4	5
	260	322	319	249	234	279	220	178	239	226	5	5	5	6	6	6	6	6	6	6
AD 1301	219	195	173	213	188	190	251	218	192	154	7	8	8	9	9	9	10	10	10	10
	156	211	204	208	219	205	143	139	139	165	10	10	10	11	11	11	11	11	11	11
	170	139	98	102	138	130	177	187	161	104	11	11	11	12	13	13	13	13	13	13
	97	137	152	228	209	151	124	147	218	204	13	13	13	13	13	13	13	13	14	14
	162	192	165	158	154	129	152	200	197	165	14	15	15	15	15	14	13	13	13	13
AD 1351	248	230	207	252	237	198	156	130	190	262	13	13	13	13	13	13	13	13	13	13
	217	243	249	255	174	176	178	202	195	161	13	13	13	13	12	12	12	12	12	12
	159	172	150	207	225	250	254	240	245	353	12	12	12	11	11	10	8	7	6	5
	354	304	296	226	220	165					4	2	1	1	1	1				

Table 9

Ring-width data from the undated site master CAP_HIGH2

Year	Ring widths (0.01mm)										No of samples									
1	512	587	477	536	545	471	357	367	347	243	1	1	1	1	1	1	2	2	2	2
	321	337	372	427	380	477	287	423	303	299	2	2	2	3	3	3	3	3	3	3
	297	310	183	259	314	238	390	329	177	164	3	3	3	3	3	3	3	3	3	3
	239	323	321	423	252	368	249	327	323	296	3	3	3	3	3	3	3	3	3	3
	278	334	255	362	300	287	301	356	305	250	3	3	3	3	3	3	3	3	3	3
51	159	173	136	171	228	163	115	153	143	206	3	3	3	3	3	3	3	3	3	3
	238	306	289	250	247	244	187	230	209	164	3	3	2	2	1	1	1	1	1	1

Table 10

Ring-width data from the undated site master CAP_ARCH

Year	Ring widths (0.01mm)										No of samples									
1	146	166	134	212	175	205	205	202	205	198	1	1	1	1	1	1	1	1	1	1
	262	238	323	178	304	277	313	392	372	289	3	3	3	3	3	3	3	3	3	3
	404	457	502	575	527	472	379	565	528	409	3	3	3	3	3	3	3	3	3	3
	458	593	396	479	410	454	683	489	455	418	3	3	3	3	3	3	3	3	3	3
	377	519	311	477	422	530	418	320	296	304	3	3	3	3	3	3	3	3	3	3
51	426	460	345	287							2	2	2	2						

Table 11

Ring-width data from the undated sample **33**

Year	Ring widths (0.01mm)									
1	213	274	214	222	161	208	200	415	446	426
	600	715	423	283	440	398	228	258	199	257
	276	205	129	188	181	148	174	120	195	253
	248	458	609	453	255	241	244	165	157	99
	123	92	49	51	65	110	141	110	160	159
51	228	321	187	132	194	158	156	182	237	128
	129	154	159	204	177	99	106	112	96	137
	151	197	114	163	149	119	174	139	109	79
	90	70	65	100	61	79	62	56	58	90
	76	75	83	80	59	71	62	59	74	67
101	83	82	96	101	95	90	83	145	113	96
	60									

Figure 5

Photograph of the west end of the Prior's House. This shows the drip courses associated with the lower ceiling, the different masonry above these, and also highlights at least one piece of re-used masonry. Photograph English Heritage Photographic Unit © English Heritage

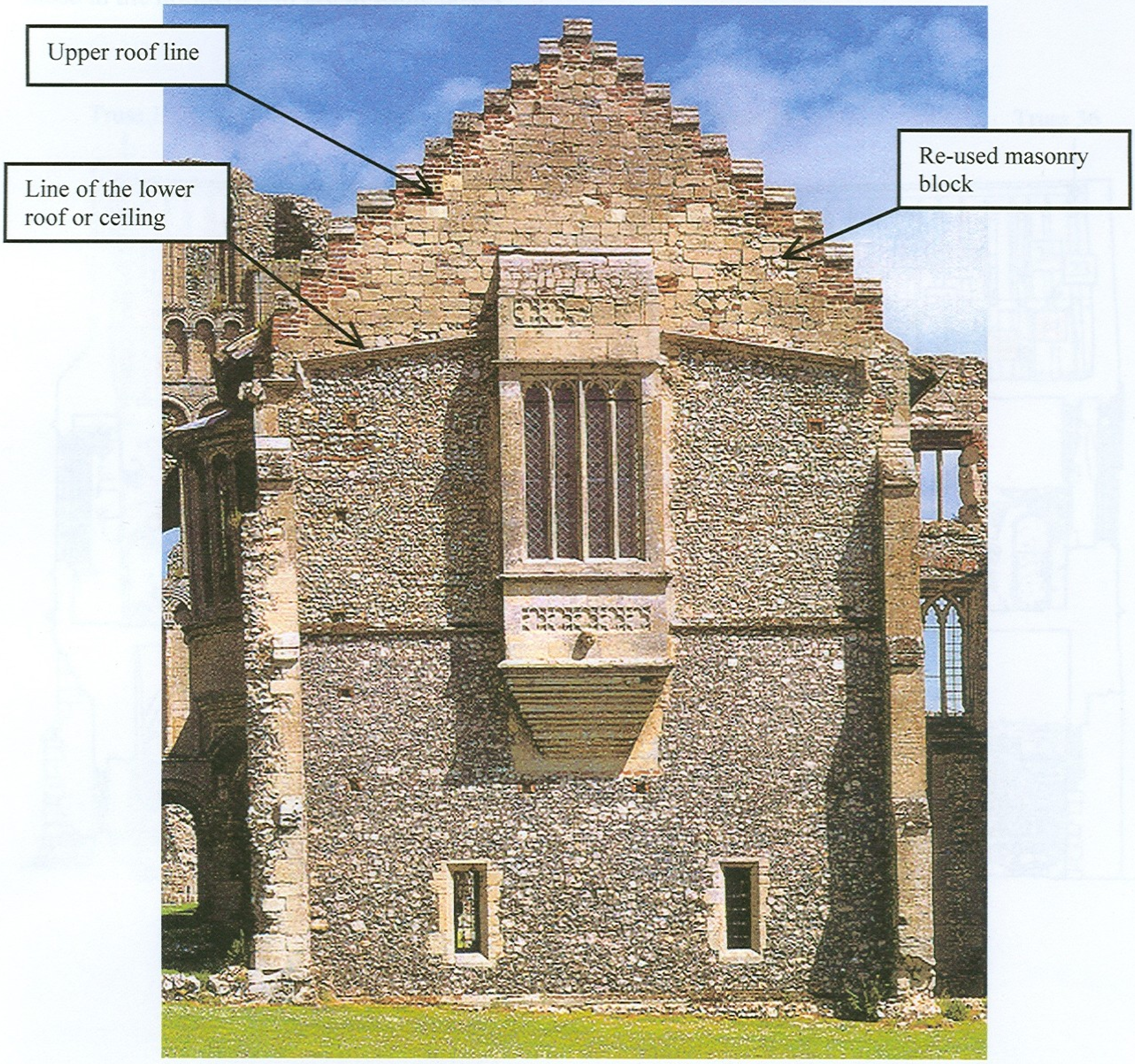

Figure 6

Section of the Prior's House looking north, showing both roofs, the truss numbering scheme adopted, and approximate location of samples **1-35**, based on an English Heritage Survey Services diagram © English Heritage. The timbers from the unseen, but identical southern half of the roof are shown in yellow boxes, those in the northern half are in white boxes