2882

Ancient Monuments Laboratory
Report 21/2000

TREE-RING ANALYSIS OF OAK TIMBERS FROM ARCHES COTTAGES, SAWLEY, LANCASHIRE

I Tyers

Ancient Monuments Laboratory Report 21/2000

TREE-RING ANALYSIS OF OAK TIMBERS FROM ARCHES COTTAGES, SAWLEY, LANCASHIRE

I Tyers

Summary

The Arches Cottages, Sawley, have recently undergone remedial repair work and conversion into a single dwelling. Timbers from the original structure were exposed during this and a tree-ring dating programme was commissioned by English Heritage to help inform the ongoing repairs and modifications. The results indicate that some of the timbers date from the second quarter of the sixteenth century.

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 OAK TIMBERS FROM ARCHES COTTAGES, SAWLEY, LANCASHIRE

Introduction

This document is a technical archive report on the tree-ring analysis of oak timbers from Arches Cottages, Sawley, Lancashire (NGR SD 77624651). 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.

Arches Cottages consists of a pair of houses that lie in the village of Sawley across the road from the precinct of Sawley Abbey (Figs 1 and 2). The name derives from their location opposite the entrance arches into the Abbey precinct. At the time of the initiation of this project they were undergoing conversion into a single property. Both former houses are two-storey stone buildings with timber flooring and, now exposed, roof trusses. The pair of trusses in the eastern house are of king-post type, with a diamond set ridge, the single truss in the western house has a short king post from a high collar. The list description suggests the eastern house is the earlier of the two buildings, dated to *c* AD 1600, and that they both include re-used building material derived from Sawley Abbey after the Dissolution. There is an inserted ceiling in the eastern building, whilst both houses include earlier twentieth-century repairs and modifications.

The observation that there were redundant joints on some of the timbers which were not part of any logical structure suggested that some re-used timbers may be present. These may relate to the original construction, or may have been introduced during later repairs. A tree-ring sampling programme of the timbers exposed in the houses was requested by Darren Radcliffe, the local English Heritage Inspector to 'establish whether the timbers in Arches Cottages are likely to be of monastic origin, to inform decisions on their conservation, and potentially to justify further research into the nature and location of the buildings of which they once formed part' (Radcliffe pers comm 1999).

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.

At the start of the visit to the property a brief survey was undertaken to identify the location of any suitable timbers visible in the structure. This survey aimed at identifying 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 timbers in these buildings were generally of small scantling size and relatively low numbers of rings. The short-list of appropriate material was then

compared with the areas and phases of the property selected for analysis in the sampling request documentation. This primarily covered the roof trusses of both houses, the potentially re-used material thought to be present in the roof, and secondarily the inserted floor. Unfortunately the western cottage roof trusses contained no suitable material, and the potentially re-used material in the eastern cottage roof only included one timber suitable for sampling. A series of telephone discussions were then made detailing this lack of suitable material in two of the requested phases. A decision to proceed with the sampling of the eastern cottage roof, including the single potentially re-used timber in this area, was made after consultation with English Heritage. The dendrochronological sampling programme attempted to cover this request by obtaining samples from as broad a range of timbers, in terms of structural element types, scantling sizes, carpentry features, and surface condition 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 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) 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 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 which provides the evidence.

Results

The properties are aligned east-west (Fig 3), the truss labelling scheme and approximate location of the samples is also shown on this diagram. The nomenclature of the truss elements for the eastern trusses is shown on Fig 4.

The initial assessment had identified that there were very few suitable timbers within the properties. The western building contained no suitable material. In the eastern building there was only one timber with both evidence for re-use and adequate numbers of rings, and which could be accessed in the right direction to recover a useful core, and only one of the eastern building first-floor traverse beams was suitable for sampling. A total of 8 timbers were selected as most suitable for sampling (Table 1). The samples were numbered **1-8** inclusive.

Two of the samples (numbers **1** and **3**) when examined in the laboratory were rejected because they had too few rings for reliable analysis. The remaining six samples were measured and the resultant series were then compared with each other. Three sequences were found to match together to form an internally consistent group (Table 2; Fig 5). A 74-year site mean chronology was calculated, named SAWLEY. The site mean, and the three 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 the SAWLEY sequence. Table 3 shows example correlations of the SAWLEY mean sequence at the dating

position identified, AD 1433 - 1506 inclusive, against independent reference chronologies. Table 4 lists the SAWLEY site mean chronology. The remaining three measured samples did not match either the rest of the material from Arches Cottages nor dated reference chronologies.

Discussion

The 74-year chronology SAWLEY is dated AD 1433 to AD 1506 inclusive. It was created from three timbers. All three samples either retain some sapwood or are definitely or probably complete to the heartwood/sapwood boundary (Table 1). Inspection of the bar diagram (Fig 5) suggests they are most likely derived from a single felling period. Sample **2** included a detached piece of sapwood, which contained at least 16 annual rings. Making due allowance for these and for other missing sapwood suggests the felling occurred between AD 1522 and AD 1550.

The three dated samples are all from the trusses of the eastern building. A further undated sample was also derived from these, whilst the remaining two undated samples were the single timbers obtained from the floor girding beams and a clearly re-used timber in the roof, unfortunately neither of these has dated and thus no evidence for either the relative sequence of events within the structure, or the chronology of re-used elements of former Abbey buildings is forthcoming from the analysis.

Conclusion

The dendrochronological analysis of timbers from Sawley identifies the roof trusses from the eastern building as incorporating timbers felled in the second quarter of the sixteenth century. Assuming they are not re-used, and that no unusual delay occurred between felling and first use they indicate that the structure doesn't date from *c* AD 1600 as suggested in the list description but is instead from around the period of the Dissolution. Unfortunately without complete surviving sapwood it is impossible to be certain whether the timbers were felled before or after the period of the suppression of Sawley Abbey.

Acknowledgements

The sampling and analysis programme was funded by English Heritage. Nigel Neil provided a great deal of useful comments whilst on site and provided the original of Figure 4. Mr Derek Clegg of Hamilton Associates should be commended for giving his permission to sample the property amidst his difficult work programme. Sarah Hill from English Heritage put together the request documentation at short notice. Cathy Groves provided useful discussion.

References

Baillie, M G L, 1977 The Belfast oak chronology to AD1001, *Tree Ring Bulletin*, **37**, 1-12

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 *Dendrochronology: guidelines on producing and interpreting dendrochronological dates*, London

Groves, C, 1997 *Dendrochronological analysis of Ightfield Hall Farm Barn, Ightfield, Whitchurch, Shropshire, 1997*, Anc Mon Lab Rep, **91/97**

Groves, C, 1999 *Tree-ring analysis of Hall I' Th' Wood, Bolton, Greater Manchester*, Anc Mon Lab Rep, **12/99**

Groves, C and Hillam, J, 1990 *Tree-ring dating of oak timbers from the Golden Cock, Little Westgate, Wakefield, West Yorkshire*, unpubl rep

Hillam, J, 1984 *Tree-ring analysis of timbers from Elland Old Hall, West Yorkshire*, Anc Mon Lab Rep, **4165**

Morgan, R, 1988 Tree-ring dates for buildings: List 25, *Vernacular Architect*, **19**, 45

Nayling, N, forthcoming *Tree-ring analysis of timbers from Stayley Hall, Stalybridge, Greater Manchester*, Anc Mon Lab Rep

Tyers, I, 1998a *Tree-Ring analysis and wood identification of timbers excavated on the Magistrates Court Site, Kingston upon Hull, East Yorkshire*, ARCUS Rep, **410**

Tyers, I, 1998b *Dendrochronological analysis of timbers from Rupert's Barn, Nether Poppleton, near York*, ARCUS Rep, **420**

Tyers, I, 1999a *Dendro for Windows program guide 2nd edn*, ARCUS Rep, **500**

Tyers, I, 1999b *Tree-ring analysis of timbers in Sizergh Castle, near Kendal, Cumbria*, ARCUS Rep, **479b**

Tyers, I, 1999c *Dendrochronological analysis of timbers from Apethorn Fold Farmhouse, Hyde, Tameside*, Anc Mon Lab Rep, **59/1999**

Table 1

List of core samples from Arches Cottages, Sawley

Core no	Origin of core	Total rings	Sapwood rings	ARW (mm/year)	Date of sequence	Felling period
1	East truss north principal rafter	-	-	-	not measured	-
2	West truss tiebeam	72	2+*16*	2.29	AD 1435-AD 1506	AD 1522-50
3	West truss north principal rafter	-	-	-	not measured	-
4	West truss king post	68	h/s	2.21	AD 1439-AD 1506	AD 1516-52
5	West truss south principal rafter	106	h/s	1.38	not dated	-
6	North-west purlin; reused?	125	-	1.09	not dated	-
7	Central girding beam	107	28+B	1.59	not dated	-
8	East truss south principal rafter	72	h/s?	2.69	AD 1433-AD 1504	AD 1514-50?

KEY

Total rings = all measured rings
Sapwood rings: figures indicate sapwood rings measured, figures in italics indicate detached rings counted for the purposes of felling date calculations, h/s heartwood/sapwood boundary, h/s? possible heartwood/sapwood boundary, B bark edge
ARW = average ring width of the measured rings

Table 2

t-value matrix for the timbers forming the chronology SAWLEY.

	4	**8**
2	4.80	5.87
4		3.20

Table 3

Dating the mean sequence SAWLEY, AD 1433-1506 inclusive. *t*-values with independent reference chronologies

Area	**Reference chronology**	***t*-values**
Cumbria	Sizergh Castle near Kendal (Tyers 1999b)	4.78
Gtr Manchester	Apethorn Fold Farmhouse (Tyers 1999c)	5.46
Gtr Manchester	Hall I' Th' Wood Bolton (Groves 1999)	4.29
Gtr Manchester	Stayley Hall (Nayling forthcoming)	4.68
North Yorkshire	Nether Poppleton Tithe Barn (Tyers 1998b)	4.98
North Yorkshire	Harome (Morgan 1988)	4.93
Northern Ireland	Belfast (Baillie 1977)	4.76
Shropshire	Ightfield (Groves 1997)	4.40
West Yorkshire	Elland Old Hall (Hillam 1984)	4.45
West Yorkshire	Wakefield Golden Cock (Groves and Hillam 1990)	4.29

Table 4

Ring-width data from site master SAWLEY dated AD 1433-1506 inclusive

Date	Ring widths (0.01mm)										No of samples									
AD 1433			183	183	122	145	153	160	362	371			1	1	2	2	2	2	3	3
	356	297	449	413	320	233	318	321	363	337	3	3	3	3	3	3	3	3	3	3
AD 1451	280	327	316	368	278	335	344	257	228	248	3	3	3	3	3	3	3	3	3	3
	220	250	264	275	211	260	253	214	155	217	3	3	3	3	3	3	3	3	3	3
	253	183	280	251	309	306	219	217	222	184	3	3	3	3	3	3	3	3	3	3
	139	70	167	241	240	250	331	189	156	218	3	3	3	3	3	3	3	3	3	3
	178	179	116	155	211	221	152	131	132	142	3	3	3	3	3	3	3	3	3	3
AD 1501	128	176	178	227	207	163					3	3	3	3	2	2				

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

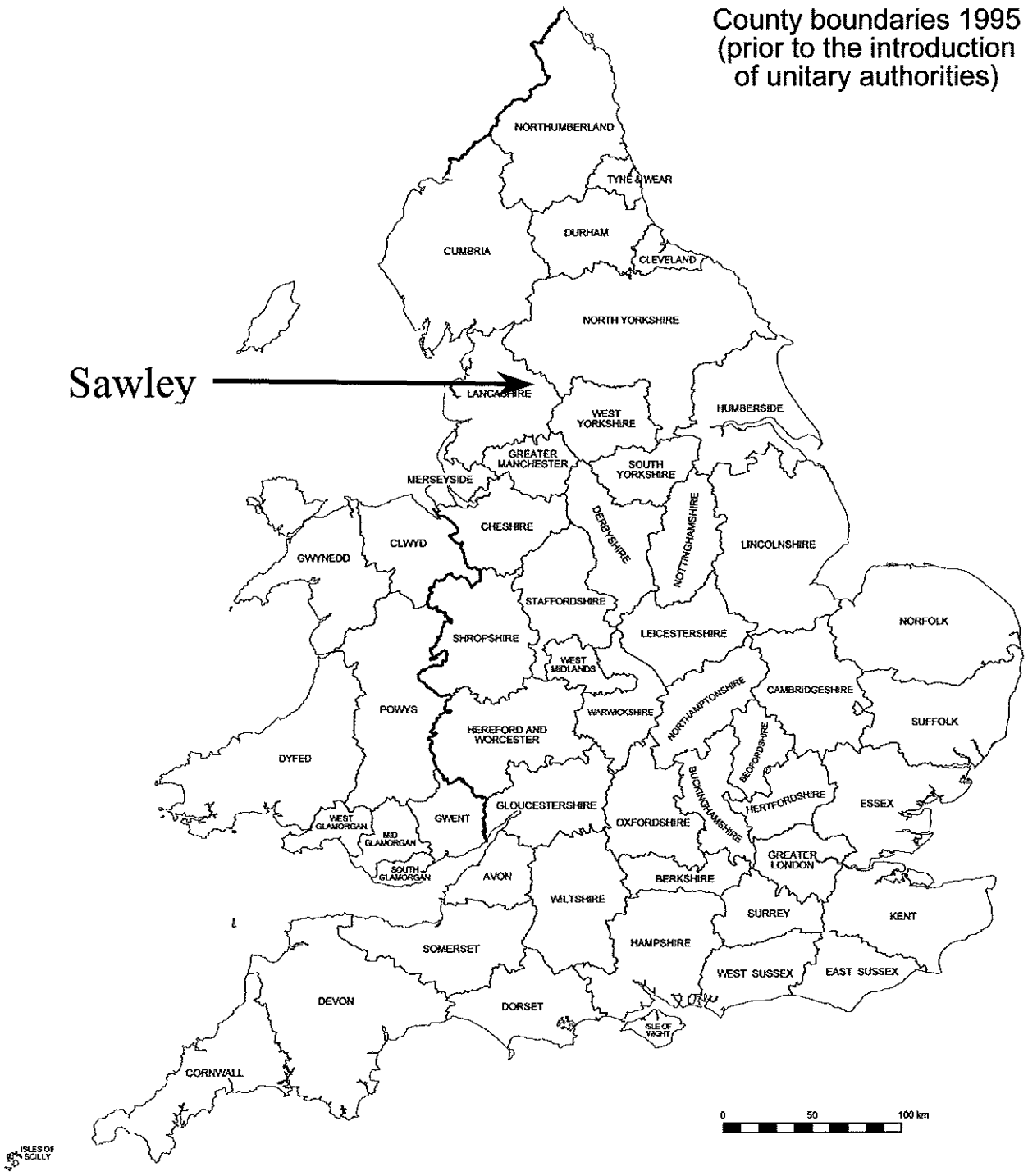

Figure 2 Location of Arches Cottages, Sawley

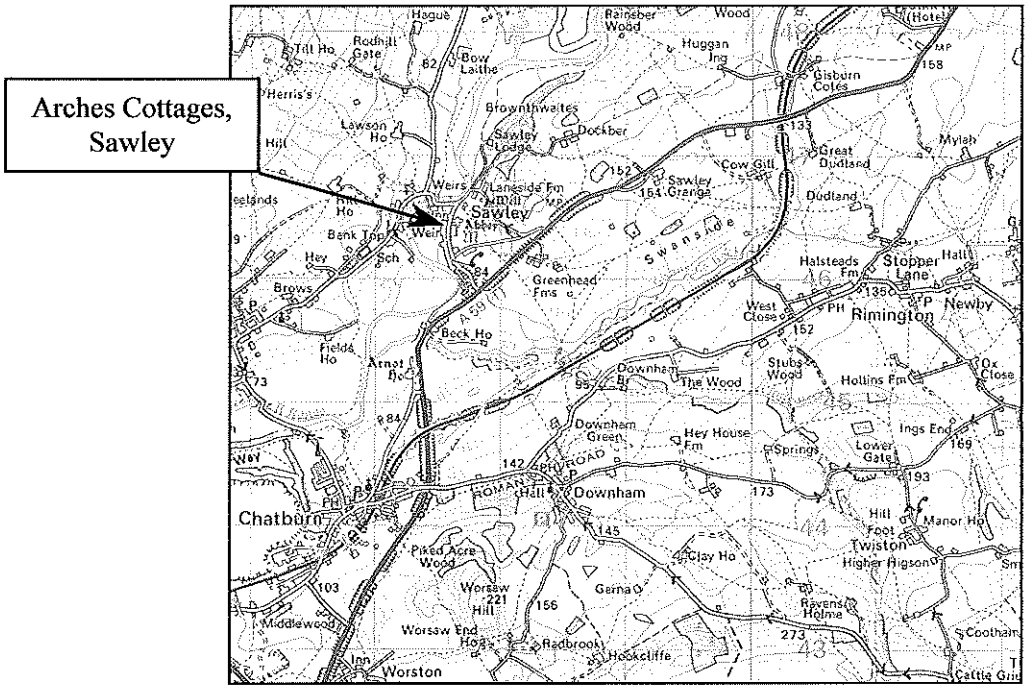

Figure 3 Sketch plan of Arches Cottages, Sawley showing the alignment of the two buildings, the location of the trusses and the approximate location of the sampled timbers

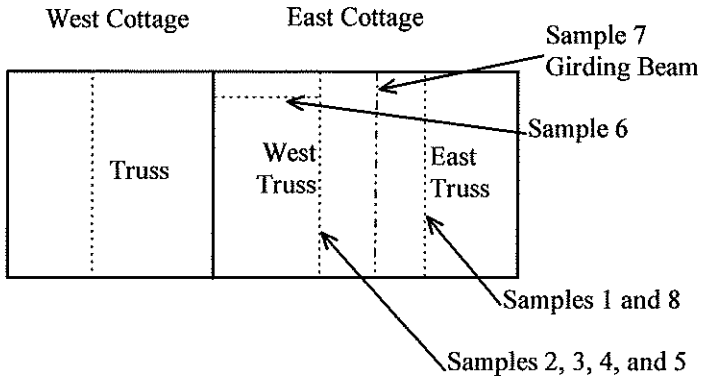

Figure 4 Sketch of the western truss from the eastern building at Arches Cottages, Sawley showing the element nomenclature followed in this report. After Nigel Neil (pers comm), not to scale

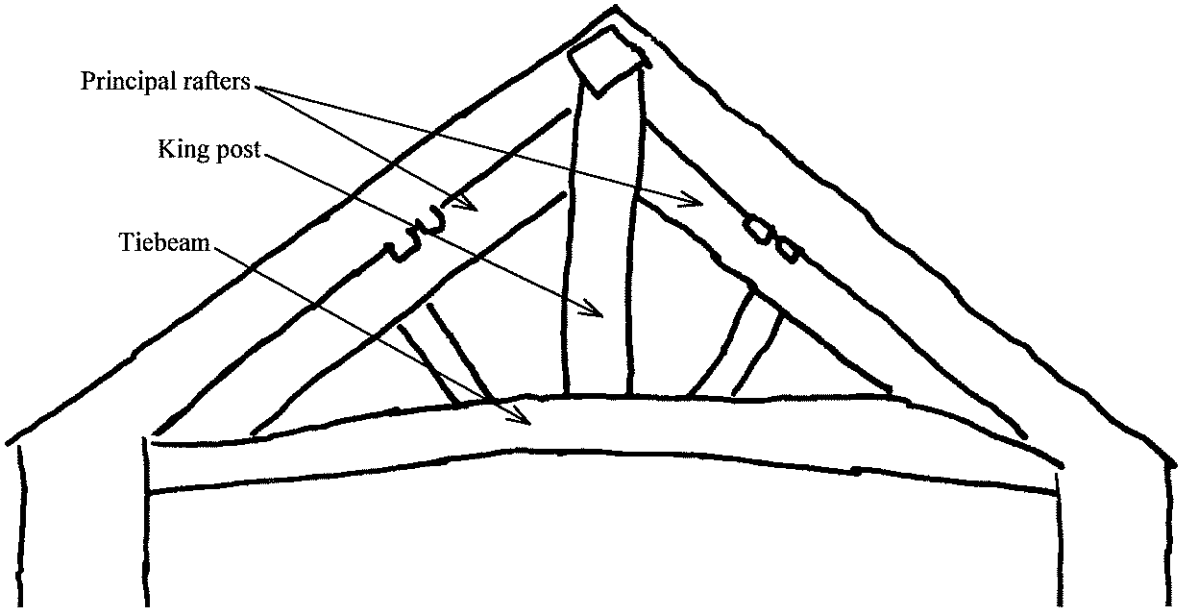

Figure 5 Bar diagram showing the chronological positions of the three dated medieval timbers from the eastern part of Arches Cottages, Sawley. The felling period for each sequence is also shown