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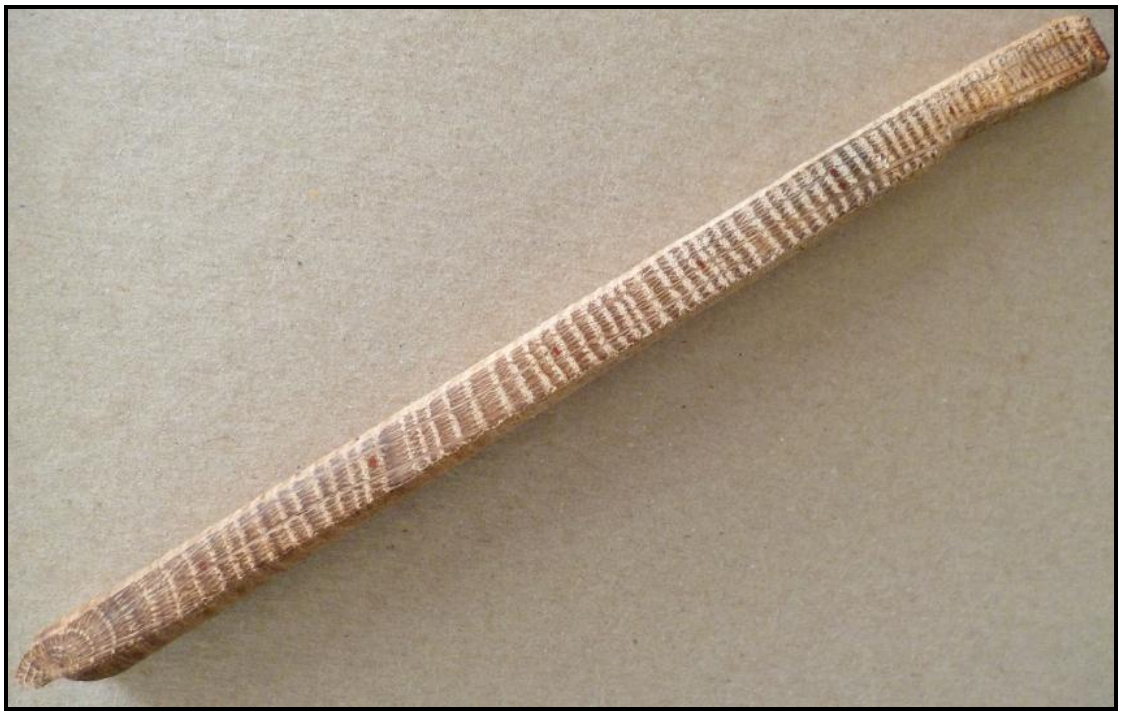

TREE-RING ANALYSIS OF TIMBERS FROM LOWER HOPE FARMHOUSE, ULLINGSWICK, HEREFORDSHIRE

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SUMMARY

Analysis by dendrochronology of cores taken from the suitable timbers of the cruck truss at Lower Hope Farmhouse has resulted in the production of a single site chronology. This site chronology, comprising all four samples obtained, has an overall length of 82 rings, these rings dated as spanning the years 1292–1373. Interpretation of the sapwood on the dated samples would indicate that the trees used for this cruck truss were probably all cut as part of a single episode of felling in the spring of 1374.

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Introduction

Lower Hope Farmhouse stands to the north of the lane running off the A417 trunk road, about a mile west-north-west of the village of Ullingswick, in Herefordshire, itself about midway between the towns of Bromyard and Hereford (SO 582 503, Figs 1a/b). The frontage, or eastern façade, presents a very fine, two storey, brick-built with partial timber frame, building to the former farm courtyard, a large porch having been added to the original front door.

In plan (see Fig 2), this frontage range runs north–south, and probably represents the primary or original (probably at least three-bay) portion of the now enlarged structure. To this, at its southern end, a timber-framed, two-bay, east–west crosswing range, also of two storeys, has been added. A second cross-wing range has been added to the north end of the original building, this second crosswing being in turn extended further westwards.

The timber framing hinted at to the exterior of the building has been retained and conserved on an extensive scale within the house, the framing being found to virtually all walls, floors and ceilings. Interestingly, a very high proportion (but not all) of this timberwork is of elm, a material used extensively in buildings of this area (and neighbouring parts of Worcestershire) in the post medieval period. There is, however, within the main north–south range, a single substantial and impressive oak cruck truss.

This truss comprises two blades, or principal rafters, linked by a collar, with a yoke towards the apex. Of the pair of archbraces between blades and collar which this truss once had, only one now remains, the other having been removed in the distant past. The blades are trenched to take single purlins (removed), and meet at the apex to allow for a ridge beam set ‘diamond’ fashion (also now removed).

Sampling

Sampling and analysis by tree-ring dating of the timbers within Lower Hope Farmhouse were commissioned by the owners, Mr and Mrs Richards. This was conducted as part of a larger and more widespread survey and record of the house undertaken by Mike Napthan, consulting buildings archaeologist. Both programmes of work were undertaken out of personal interest in the history of the buildings. It was hoped that this programme of tree-ring analysis would establish the date for the cruck truss and help determine the date of what appears to be the earliest part of the present buildings

With this aim in mind core samples were obtained from the different suitable timbers available (the only other possible timber, the yoke, having too few rings for reliable dating. Each sample was given the code UWK-A (for Ullingswick, site ‘A’), and numbered 01–04. The sampled timbers were located on a sketch drawing made at the time of sampling, this being given here as Figure 3. Details of the samples are given in Table 1, including the timber sampled and its location, the total number of rings each sample has, and how many of these, if any, are sapwood rings. The individual date span of each dated sample is also given. In this Table, and on the drawings, the trusses, bays, and individual timbers, have been located on a site north–south/east–west basis as appropriate.

The Nottingham Tree-ring Dating Laboratory would like to take this opportunity to thank the owners of Lower Hope Farmhouse, Mr and Mrs Richards, for their enthusiasm, help, and cooperation with this programme of analysis, and particularly for their generous funding of the project. We would also like to thank them for providing the plan used in Figure 2. We would also like to thank Mike Napthan for help and advice concerning the history and development of the house.

Tree-ring dating

Tree-ring dating relies on a few simple, but quite fundamental, principles. Firstly, as is commonly known, trees (particularly oak trees, the timber most commonly found preserved in archaeological excavations) grow by adding one, and only one, growth-ring to their circumference each, and every, year. Each new annual growth-ring is added to the outside of the previous year's growth just below the bark. The width of this annual growth-ring is largely, though not exclusively, determined by the weather conditions during the growth period (roughly March–September). In general, good conditions produce wider rings and poor conditions produce narrower rings. Thus, over the lifetime of a tree, the annual growth-rings display a climatically influenced pattern. Furthermore, and importantly, all trees growing in the same area at the same time will be influenced by the same growing conditions and the annual growth-rings of all of them will respond in a similar, though not identical, way.

Secondly, because the weather over any number of consecutive years is unique, so too is the growth-ring pattern of the tree. The pattern of a short period of growth, 20, 30**,** or even 40 consecutive years, might conceivably be repeated two or even three times in the last one thousand years. A short pattern might also be repeated at different time periods in different parts of the country because of differences in regional micro-climates. It is less likely, however, that such problems would occur with the pattern of a longer period of growth, that is, anything in excess of 54 years or so. In essence, a short period of growth, anything less than 54 rings, is not reliable, and the longer the period of time under comparison the better.

Tree-ring dating relies on obtaining the growth pattern of trees from sample timbers of unknown date by measuring the width of the annual growth-rings. This is done to a tolerance of 1/100 of a millimeter. The growth patterns of these samples of unknown date are then compared with a series of reference patterns or chronologies, the date of each ring of which is known. When the growth-ring sequence of a sample "cross-matches" repeatedly at the same date span against a series of different relevant reference chronologies the sample can be said to be dated. The degree of cross-matching, that is the measure of similarity between sample and reference, is denoted by a "*t*-value"; the higher the value the greater the similarity. The greater the similarity the greater is the probability that the patterns of samples and references have been produced by growing under the same conditions at the same time. The statistically accepted fully reliable minimum *t*-value is 3.5.

However, rather than attempt to date each sample individually it is usual to first compare all the samples from a single building, or phase of a building, with one another, and attempt to cross-match each one with all the others from the same phase or building. When samples

from the same phase do cross-match with each other they are combined at their matching positions to form what is known as a "site chronology". As with any set of data, this has the effect of reducing the anomalies of any one individual (brought about in the case of tree-rings by some non-climatic influence) and enhances the overall climatic signal. As stated above, it is the climate that gives the growth pattern its distinctive pattern. The greater the number of samples in a site chronology the greater is the climatic signal of the group and the weaker is the non-climatic input of any one individual.

Furthermore, combining samples in this way to make a site chronology usually has the effect of increasing the time-span that is under comparison. As also mentioned above, the longer the period of growth under consideration, the greater the certainty of the cross-match. Any site chronology with less than about 55 rings is generally too short for reliable dating.

Having obtained a date for the site chronology as a whole, the date spans of the constituent individual samples can then be found, and from this the felling date of the trees represented may be calculated. Where a sample retains complete sapwood, that is, it has the last or outermost ring produced by the tree before it was cut, the last measured ring date is the felling date of the tree.

Where the sapwood is not complete it is necessary to estimate the likely felling date of the tree. Such an estimate can be made with a high degree of reliability because oak trees generally have between 15 to 40 sapwood rings. For example, if a sample with, say, 12 sapwood rings has a last sapwood ring date of 1400 (and therefore a heartwood/sapwood boundary ring date of 1388), it is 95% certain that the tree represented was felled sometime between 1403 (1400+3 sapwood rings (12+3=15)) and 1428 (1400+28 sapwood rings (12+28=40)).

Analysis

Each of the four samples obtained from the various timbers of the cruck truss were prepared by sanding and polishing, and the annual ring widths of each samples were measured. The data of these measurements were then compared with each other as described in the notes above, this comparative process indicating that all four samples cross-matched with each other at relative positions as shown in the bar diagram, Figure 4. These four samples were combined at their indicated off-set positions to form UWKAQ01, a site chronology with an overall length of 82 rings. This site chronology was then satisfactorily dated by repeated and consistent comparison with a number of relevant reference chronologies for oak as spanning the years 1292 (the date of the earliest ring on any sample (UWK-A01 and A03) to 1373 (the date of the latest ring on any sample (UWK-A02 and A04. The evidence for this dating is given in the *t*-values of Table 2.

Interpretation

Three of the four dated samples (UWK-A02, A03, and A04) in site chronology UWKASQ01, retains complete sapwood. This means that each sample has the last growth ring produced by the tree it represents before it was cut down (this being indicated by upper case 'C' in

Table 1 and the bar diagram Figure 4). In this case, however, although the last *full* growth ring on each of these three samples is dated to 1373, it is possible, under the microscope, to see that the early-cell growth for the following year has started, but there doesn't yet seem to be any late-cell growth. This would suggest that all the trees were in fact felled in the spring of 1374.

Knowing the felling date of the trees, 1374, and given that the inner-most rings on the samples are close to, or actually have, the first growth rings of their respective trees (cover photo), it is possible to say that they must have begun growing in the late thirteenth century, during the reign of Edward I (the Hammer of the Scots). As such, this would make at least the inner parts of these timbers almost 725 years of age!

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Table 1: Details of tree-ring samples from Lower Hope Farmhouse, Ullingswick, Herefordshire

Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Last heartwood ring date (AD)	Last measured ring date (AD)
UWK-A01	East (front) cruck blade	80	19	1292	1352	1371
UWK-A02	West (rear) archbrace	78	28C	1296	1345	1373
UWK-A03	Collar	82	24C	1292	1349	1373
UWK-A04	West (rear) cruck blade	58	19C	1316	1354	1373

* C = complete sapwood is retained on the sample, the last measured ring date (plus any further partial cell growth) is the felling date of the tree represented

Table 2: Results of the cross-matching of site chronology UWKASQ01 and the reference chronologies when the first ring date is 1292 and the last ring date is 1373

Reference chronology	***t*-value**	
Flore's House, Oakham, Rutland	6.9	(Hurford *et al* 2008)
The Old Manor, West Lavington, Wilts	5.8	(Hurford *et al* forthcoming)
Pedagogues' House, Stratford-upon-Avon, Warwicks	5.7	(Arnold *et al* 2006)
Chicksands Priory, Chicksands, Beds	5.6	(Howard *et al* 1998)
Brockworth Court, Brockworth, Glos	5.6	(Howard 2000 unpubl)
Abbey Inn, Burton-upon-Trent, Staffs	5.2	(Howard *et al* 1998 unpubl)
East Midlands Master Chronology	5.2	(Laxton and Litton 1988)
Worcester Cathedral composite working mean	5.1	(Arnold *et al* 2003)

Site chronology UWKASQ01 is a composite of the data of the cross-matching samples (see Fig 4). This composite produces an 'average' tree-ring pattern, where the overall climatic signal of the ring growth is enhanced, and the possible erratic variations of any one individual sample are reduced. This 'average' site chronology is then compared with several hundred reference patterns covering every part of Britain for all time periods. As can be seen here, site chronology UWKASQ01 matches only when its 82 rings span the years 1292–1373, the degree of similarity between site and reference chronology being indicated by the '*t*-values'.

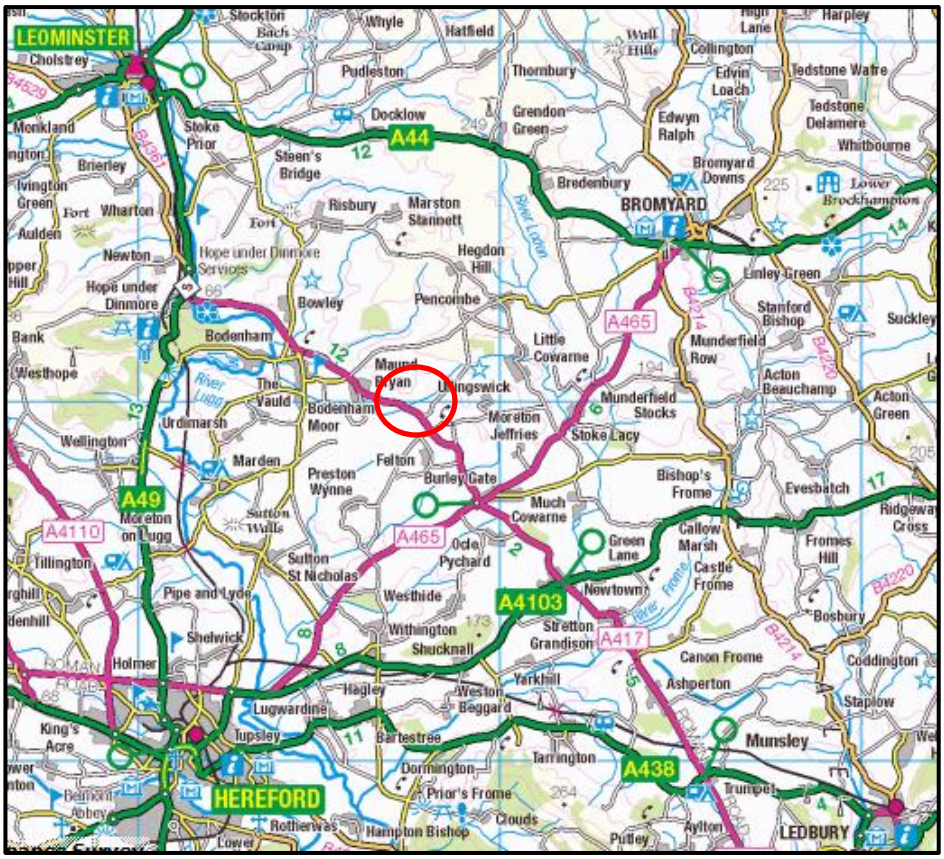


Figure 1a/b: Maps to show location of Ullingswick (top) and Lower Hope Farm (bottom)

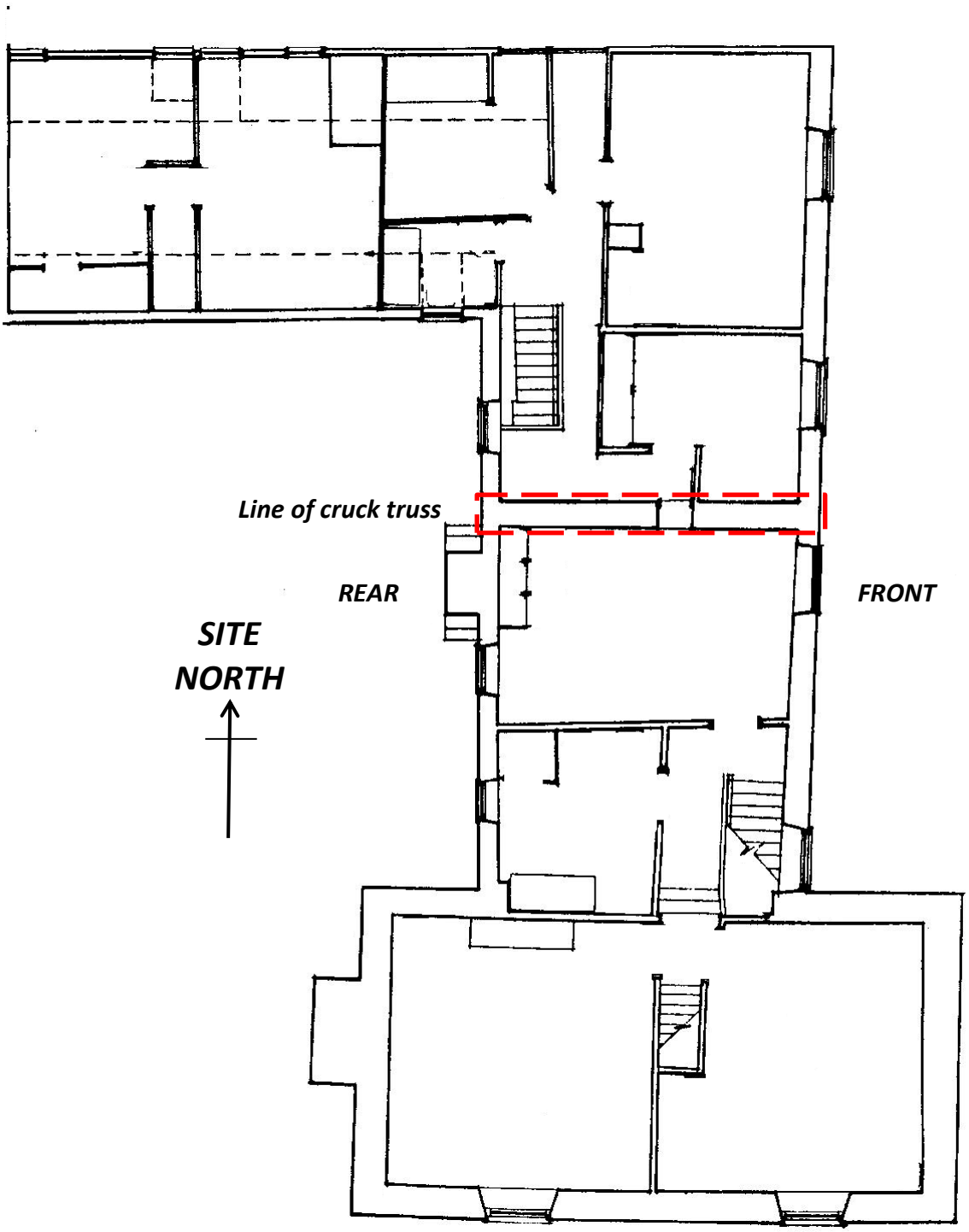


Figure 2: Plan of Lower Hope Farmhouse at first floor level to show position of the cruck truss within the building (courtesy of Mr Clive Richards)

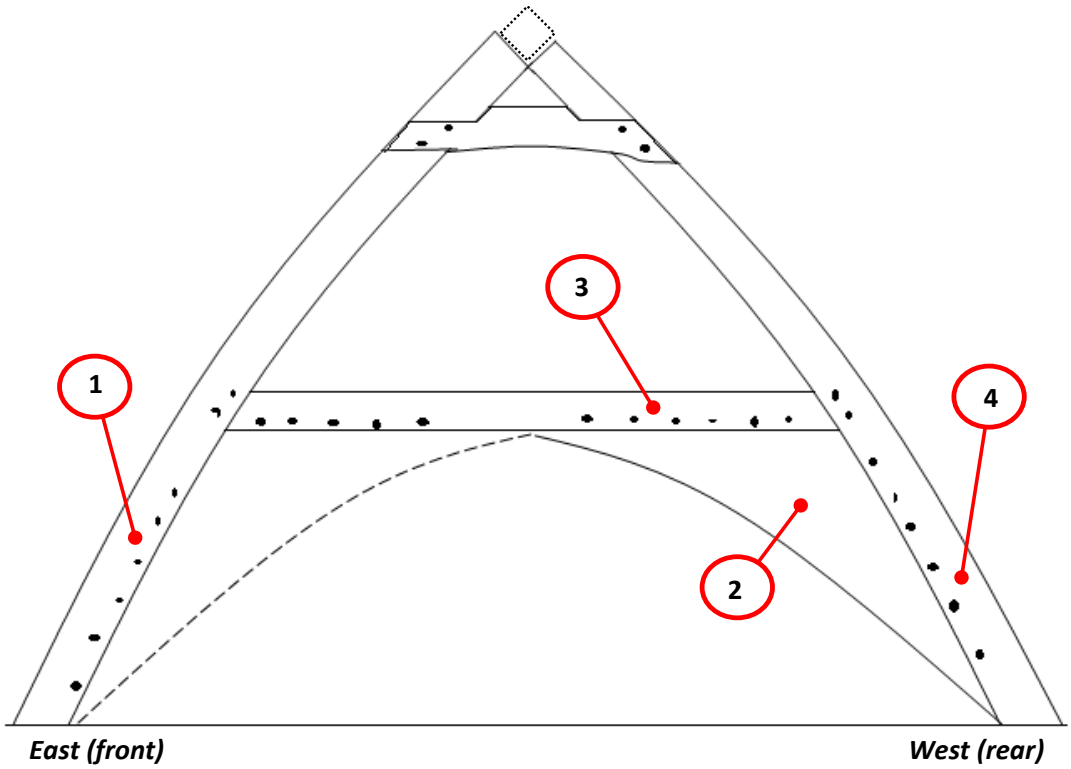
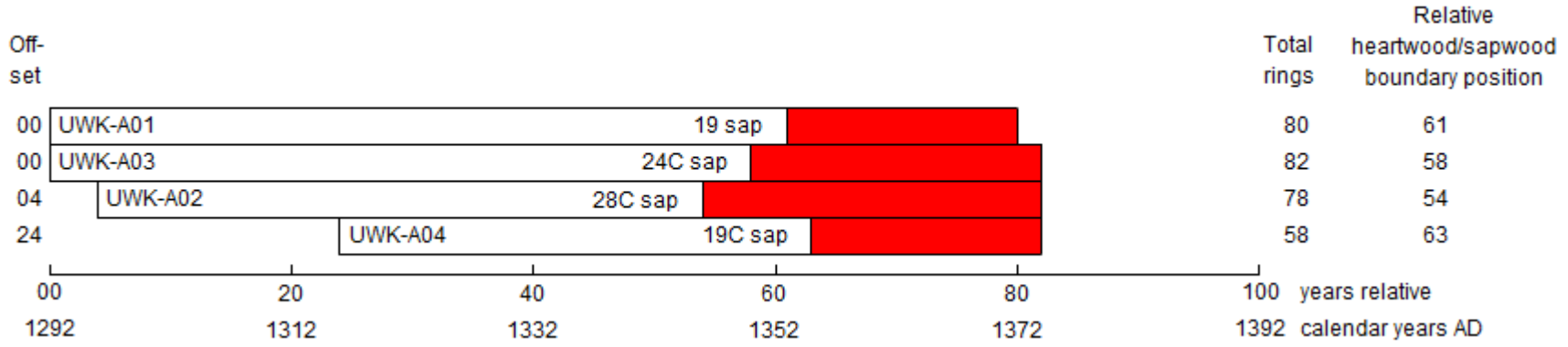


Figure 3: Cross-section through cruck truss to locate sampled timbers



White bars = heartwood rings, shaded bars = sapwood rings
C = complete sapwood is retained on the sample, the last measured ring date (plus any further partial cell growth) is the felling date of the tree

Figure 4: Bar diagram of the samples in site chronologies UWKASQ01

The samples of site chronology UWKASQ01 are shown here in the form of 'bars' at the positions where the variations in the rings cross-match with each other, this similarity being produced by the trees from which the sampled beams were derived all growing in the same place, *at the same time.* The samples are combined to form a 'site chronology', and it is this 'averaged' data which is compared and dated by comparison with the 'reference' chronologies (see Table 2).