Lower Beanhall Farm,
Bradley Green,
Feckenham,
Worcestershire

Tree Ring Analysis
2005
(WSM 33752)

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Summary

Core samples were obtained from seven different oak timbers at Lower Bean Hall. The analysis by tree-ring dating of these produced two site chronologies. The first site chronology, LBHASQ01, comprises three samples, and has a combined overall length of 147 rings, these rings dated by comparison to a number of reference chronologies as spanning the years 1419 to 1565. Interpretation of the sapwood would suggest that the three timbers represented were all felled sometime between 1580 and 1605.

The second site chronology, LBHASQ02, comprises only two samples, and has an overall length of 126 rings. This site chronology is dated as spanning the years 1530 to 1655. Interpretation of the sapwood would suggest that the two timbers represented were both felled in 1655.

The two remaining individual samples cannot be dated.

The interpretation of the results suggests that two phases of timber felling are represented in this building. Given that there is no structural evidence that timbers have been reused it would appear that two interpretations are possible. Either a late-sixteenth to early-seventeenth century building underwent a major programme of repair in the mid-seventeenth century, this work involving some dismantling and replacement of timbers, or a mid-seventeenth century building was constructed using at least some late-sixteenth to early-seventeenth century timber. Given the nature of the evidence for reuse and insertion found elsewhere at this site, it is probable that this second interpretation is more likely.

Introduction

Lower Bean Hall, Worcestershire (SO 98906040, Figs 1 and 2), presents a relatively simple close-studded single-bay timber framed building, with some diagonal bracing and cross-rails, of two stories with attic space. To this basic structure have been added later phases of building, in brick, to the rear; a second single bay range and an out-shut. At some point in its development, the roof of the timber-framed end has been removed, or at least extensively altered, and incorporated into a new roof covering both the timber and the brick elements of the building. A plan showing the layout and phasing of the building is shown in Figure 3.

Sampling

Sampling and analysis by tree-ring dating of the timbers of Lower Bean Hall were commissioned by Malcolm Hislop of Birmingham Archaeology. The purpose of this was to establish a construction date for the main timber-framed element of the building (phase 2 in plan, Fig 3) in conjunction with a drawn survey and developmental interpretation undertaken by Birmingham Archaeology on behalf of the owners, Mr and Mrs Hands, this work being part of a programme of repair and renovation to the building.

After an examination of the building seven different timbers at first-floor level were sampled by coring. Each of the seven samples obtained was given the code LBH-A (for Lower Bean Hall, site "A") and numbered 01 – 07. All the timbers sampled appeared to be primary and integral with each other, being jointed and pegged. None of the timbers showed any evidence by way of redundant mortices, joint beds, or peg holes, of possible reuse or later insertion. Details of the samples are given in Table 1. In this Table, all timbers are identified on a north - south or east - west basis as appropriate. The positions of these samples are marked on simple schematic plans, Figure 4a-c.

Although there were other timbers available within the building, particularly to the roof space, these were considered to be of a different date to the lower structural framing. Such timbers showed clear evidence for alteration, insertion or repair, and possibly to represent a later re-roofing of the building. The majority of these timbers, furthermore, appeared to be derived from fast grown trees and as such were unlikely to have sufficient rings for reliable dating.

It was further noted at the time of sampling that a number of timbers were of elm rather than oak, elm being less suitable for tree-ring analysis. Such timbers are found not only in the roof space (where it is used for principal rafters, at least one of the upper purlins and some common rafters), but also on the lower floors where it is used for joists, wall posts, and some main beams.

Tree-ring dating

Tree-ring dating relies on a few simple, but quite fundamental, principals. Firstly, as is commonly known, trees (particularly oak trees, the most frequently used building timber in England) 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.

The third principal of tree-ring dating is that, until the early- to mid-nineteenth century, builders of timber-framed houses usually obtained all the wood needed for a given structure by felling the necessary trees in a single operation from one patch of woodland, or from closely adjacent woods. Furthermore, and contrary to popular belief, the timber was used "green" and without seasoning, and there was very little long-term storage as in timber-yards of today. This fact has been well established from a number of studies where tree-ring dating has been undertaken in conjunction with documentary studies. Thus, establishing the felling date for a group of timbers gives a very precise indication of the date of their use in a building.

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 phases 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 satisfactory analysis.

Analysis

In the case of the seven samples from Lower Bean Hall, each one was prepared by sanding and polishing to clearly reveal its annual growth rings. The widths of the annual rings were then measured. It will be seen from Table 1 that the number of rings on all the samples is well above the statistically reliable minimum of 54, the shortest sample being LBH-A09, with 84 rings. Some of the samples have high numbers of rings, 147 on sample LBH-A04 for example. The growth-ring widths of all seven samples were then compared with each other.

This comparative process resulted in two groups of samples being formed. The first group consists of three samples, LBH-A02, A04, and A05, cross-matching with each other at relative positions as shown in the bar diagram, Figure 5. This cross-matching occurs at a minimum *t*-value of 5.3, a figure suggesting that the three timbers represented are derived from different trees which were growing within the same patch of woodland.

These three samples were combined at their indicated cross-matching positions to form site chronology LBHASQ01, this having an overall length of 147 rings. Site chronology LBHASQ01 was then compared with a wide range of reference chronologies for oak, cross-matches with very high *t*-values being found against a series of these when the date of the first ring of the site chronology is 1419 and the date of its last ring is 1565. Evidence for this dating is given in the *t*-values of Table 2.

The second group to form consists of two samples, LBH-A05 and A07, these two cross-matching with each other at relative positions as shown in the bar diagram, Figure 6. These two samples again probably represent timbers derived from two different trees growing within the same wood, matching, as they do, with a value of t=5.7.

These two samples were combined to form site chronology LBHASQ02, this having an overall length of 126 rings. Site chronology LBHASQ02 was then compared with a wide range of reference chronologies for oak, cross-matching with a number of these with satisfactory *t*-values when the date of the first ring of the site chronology is 1530 and the date of its last ring is 1655. Evidence for this dating is given in the *t*-values of Table 3.

The two remaining ungrouped samples, LBH-A01 and A06, were then compared individually with an extensive range of reference chronologies. There was, however, no further cross-matching and these two samples must remain undated.

Interpretation

Analysis by dendrochronology has produced two site chronologies. The first site chronology, LBHASQ01, comprises three samples, its 147 rings dated as spanning the years 1419 to 1565. All three samples in this site chronology, LBH-A02, A04 and A05, retain the heartwood/sapwood transition. Using a 95% confidence limit of 15 - 40 rings for the amount of sapwood the trees might have had would give the timbers an estimated felling date in the range 1580 to 1605.

The second site chronology, LBHASQ02, comprises two samples, its 126 rings dated as spanning the years 1530 to 1655. Both samples in this site chronology, LBH-A05, and A07, retain complete sapwood. This means that they each have the last ring produced by the trees represented before they were felled. For both samples the last measured ring date is the same at, 1655. This is thus the felling date of the two timbers represented.

Conclusion

The interpretation of the results suggests quite clearly that two phases of timber felling are represented in this building, despite the fact that at the time of sampling none of the timbers showed any signs of re-use. Given that there is no structural evidence that timbers have been reused it would appear that two interpretations are possible. Either a building originally constructed in the late-sixteenth to early-seventeenth century has undergone a major programme of repair, involving at least some dismantling and replacement of timber, in the mid-seventeenth century, or a mid-seventeenth century building was constructed using at least some late-sixteenth to early-seventeenth century timber, this earlier material being used in a similar position and form to the original construction.

Given the evidence elsewhere for alterations and for the re-use of material, and for the use of elm timbers (which is more often seen in the very-late post-medieval period), it is perhaps possible that the second interpretation, above, is more likely.

Two samples, LBH-A01 and A03, remain ungrouped and undated. Sample LBH-A01 does displays bands of narrow and compacted rings which might account for the lack of dating. Sample LBH-A03, however, shows no unusual characteristics.

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Table 1: Details of samples from Lower Bean Hall, Bradley Green, Feckenham, Worcestershire

Sample number	Sample location	Total rings	*Sapwood rings	First measured ring date	Last heartwood ring date	Last measured ring date
LBH-A01	North-east corner post	86	11	------	------	------
LBH-A02	North wall, main stud post 1 (from east)	119	h/s	1447	1565	1565
LBH-A03	North wall, main stud post 3 (from east)	127	h/s	1439	1565	1565
LBH-A04	North wall, upper cross-rail, panel 4	147	h/s	1419	1565	1565
LBH-A05	North wall, main stud post 6 (from east)	112	36C	1544	1619	1655
LBH-A06	South-west corner post	84	19C	------	------	------
LBH-A07	South wall, main stud post 5 (from east)	126	23C	1530	1632	1655

C = complete sapwood retained on the sample, the last measured ring date is the felling date of the timber
h/s = the heartwood/sapwood boundary is the last ring on the sample

Table 2: Results of the cross-matching of site chronology LBHASQ01 and relevant reference chronologies when first ring date is 1419 and last ring date is 1565

Reference chronology	Span of chronology	*t*-value	
26 Westgate Street, Gloucester	1399 – 1622	9.9	(Howard *et al* 1998)
East Midlands	882 – 1981	9.8	(Laxton and Litton 1988)
Wales and West Midlands	1341 – 1636	9.4	(Siebenlist-Kerner 1978)
MC10---H	1386 – 1585	9.2	(Fletcher 1978)
Stoneleigh Abbey, Warwicks	1398 – 1658	9.0	(Howard *et al* 2000)
Sinai Park, Burton on Trent, Staffs	1227 – 1750	8.9	(Tyers 1997)
England	401 – 1981	8.1	(Baillie and Pilcher 1982 unpubl)
Lodge Park, Aldsworth, Glos	1324 – 1587	8.1	(Howard *et al* 1995)

Table 3: Results of the cross-matching of site chronology LBHASQ02 and relevant reference chronologies when first ring date is 1530 and last ring date is 1655

Reference chronology	Span of chronology	*t*-value	
East Midlands	882 – 1981	6.7	(Laxton and Litton 1988)
Upper House Farm, Nottfield, Oxon	1431 – 1627	6.5	(Haddon-Rece *et al* 1990)
Stoneleigh Abbey, Warwicks	1398 – 1658	6.4	(Howard *et al* 2000)
Astley Castle, Warwickshire	1495 – 1627	6.4	(Howard *et al* 1997)
26 Westgate Street, Gloucester	1399 – 1622	6.0	(Howard *et al* 1998)
St Andrew's, Owston, Leicestershire	1485 – 1611	5.8	(Howard *et al* 1998)
Worcester Cathedral	1484 – 1772	5.8	(Arnold *et al* 2004)
Sinai Park, Burton on Trent, Staffs	1227 – 1750	5.0	(Tyers 1997)

Figure 1: Map to show general location of Bradley Green

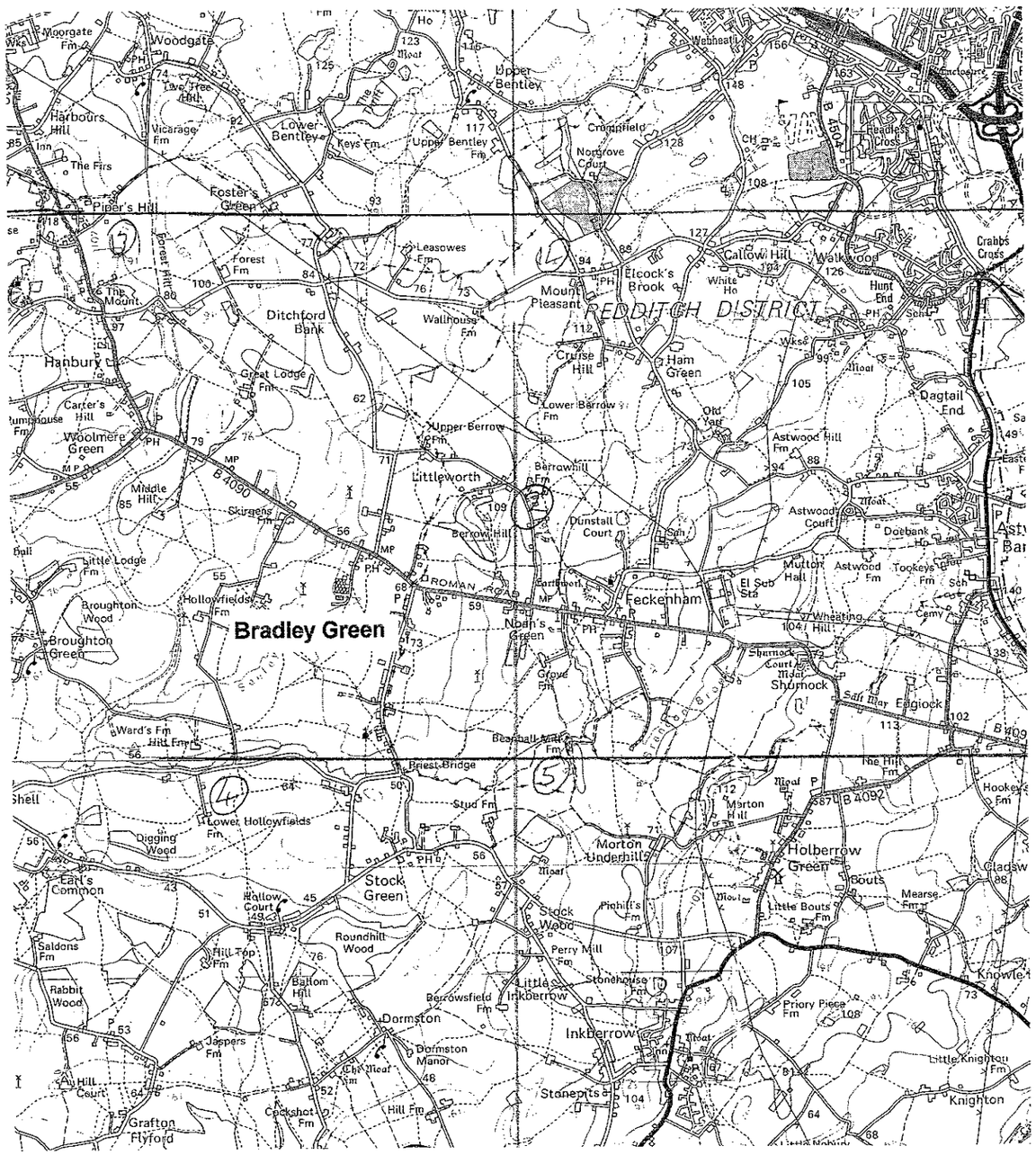
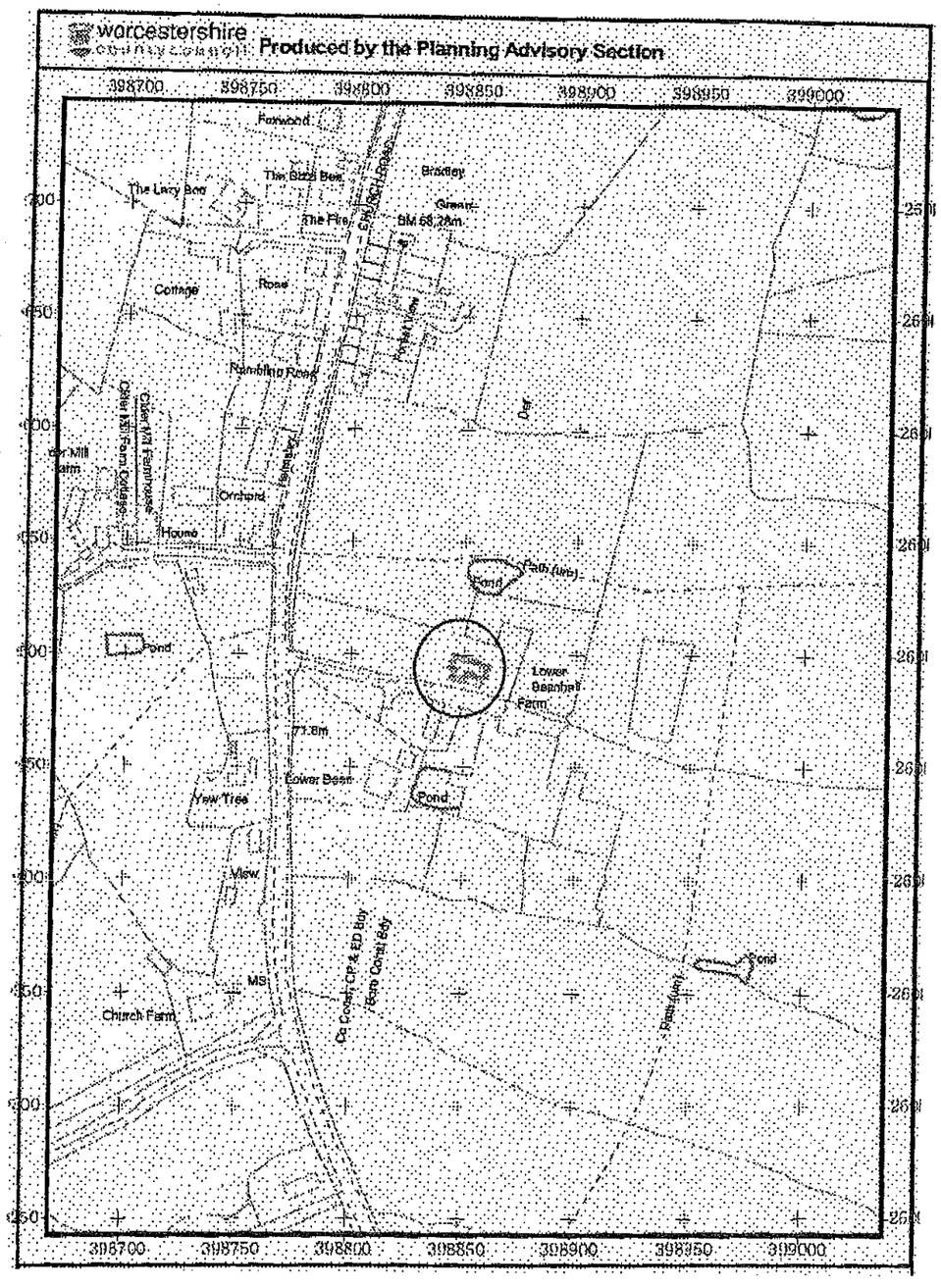


Figure 2: Map to show specific location of Lower Bean Hall
(map from Worcestershire Historic Environment and Archaeology Service)



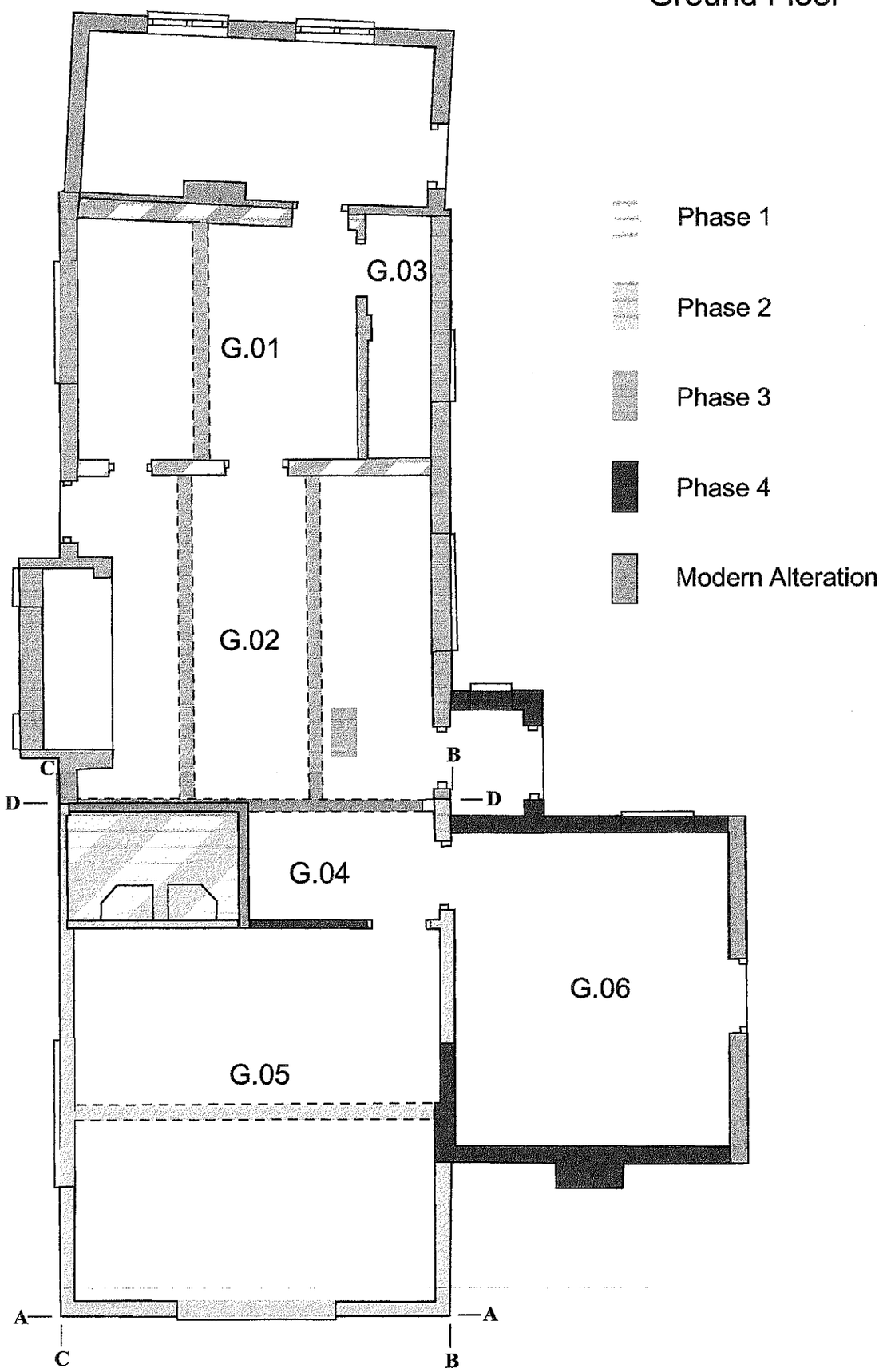


Figure 3: Plan to show basic layout and phasing of Lower Bean Hall (after Christopher Hewitson, Birmingham Archaeology)

Fig.3

Figure 4a: Simple schematic diagram to show position of sampled timbers
North wall viewed from the south looking north

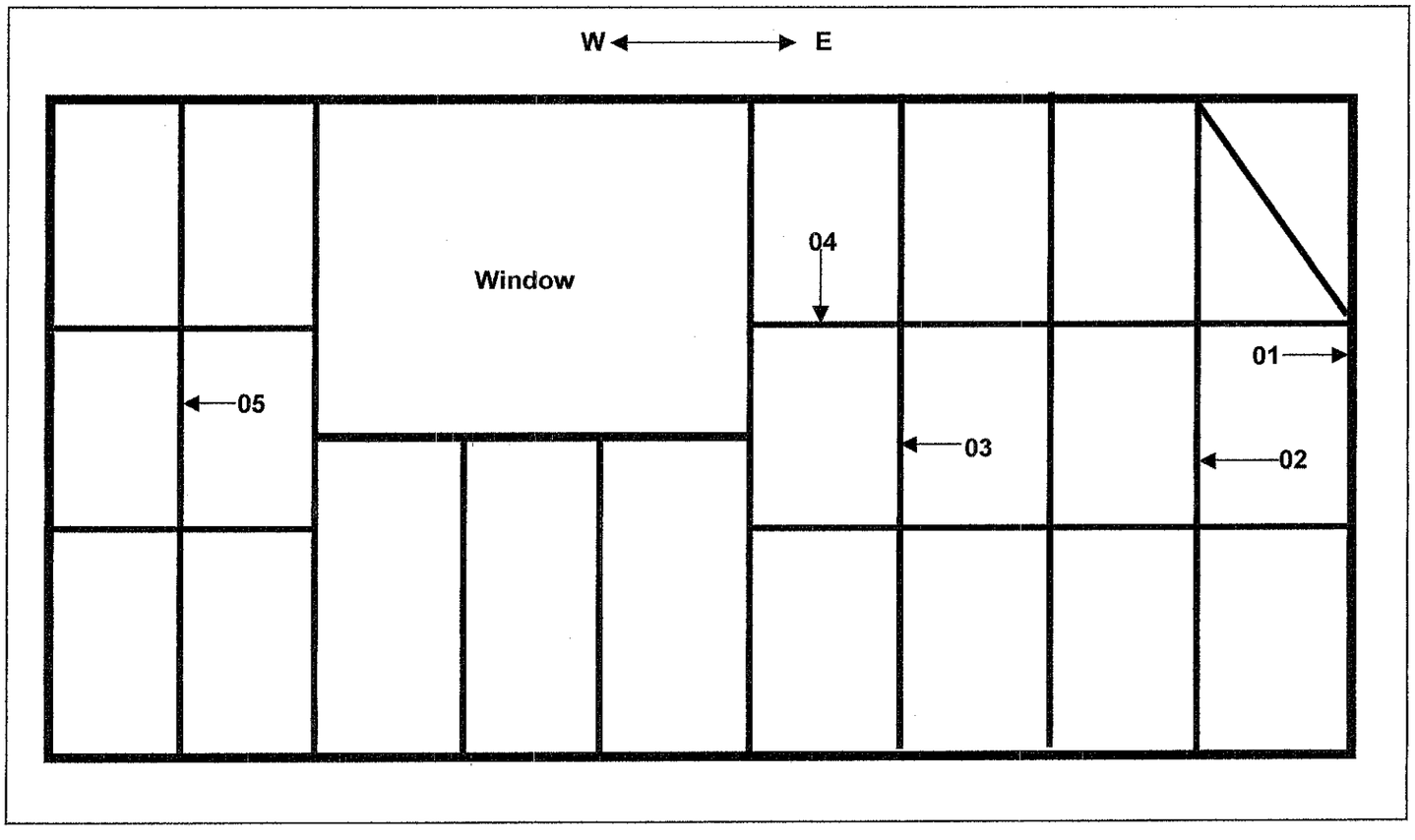


Figure 4b: Simple schematic diagram to show position of sampled timbers
West wall viewed from the east looking west

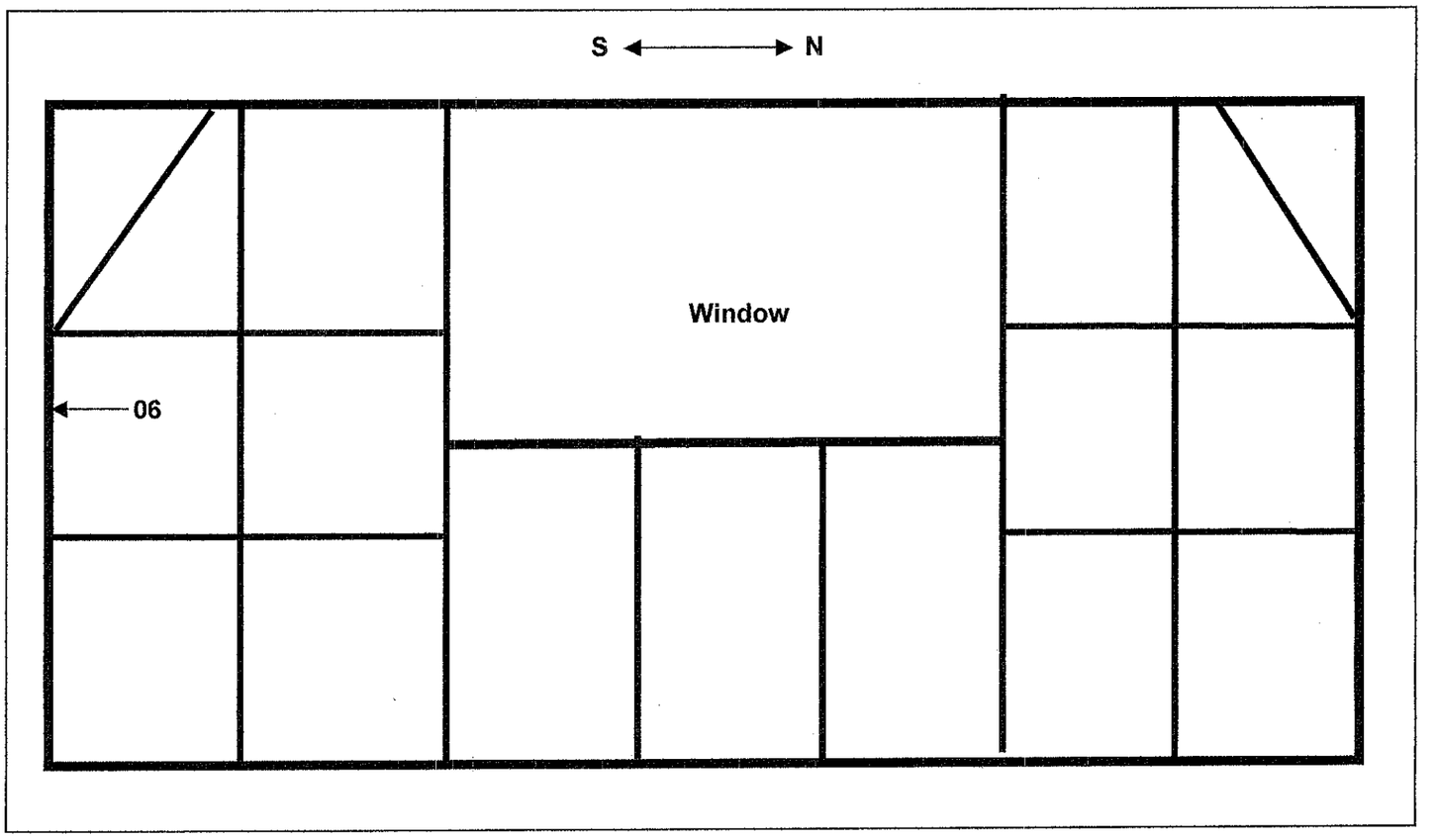


Figure 4c: Simple schematic diagram to show position of sampled timbers
South wall viewed from the north looking south

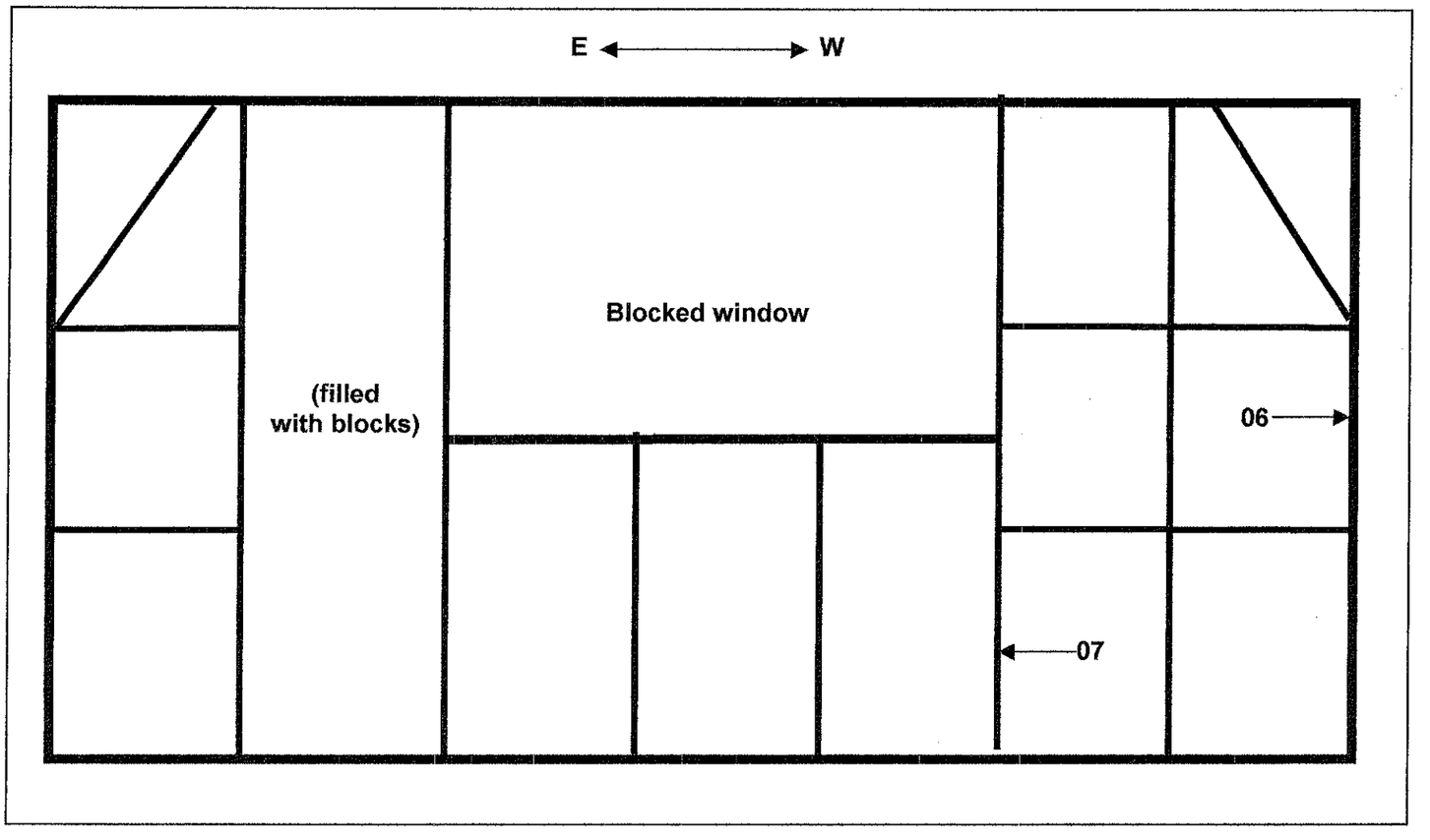


Figure 5: Bar diagram of the samples in site chronology LBHASQ01

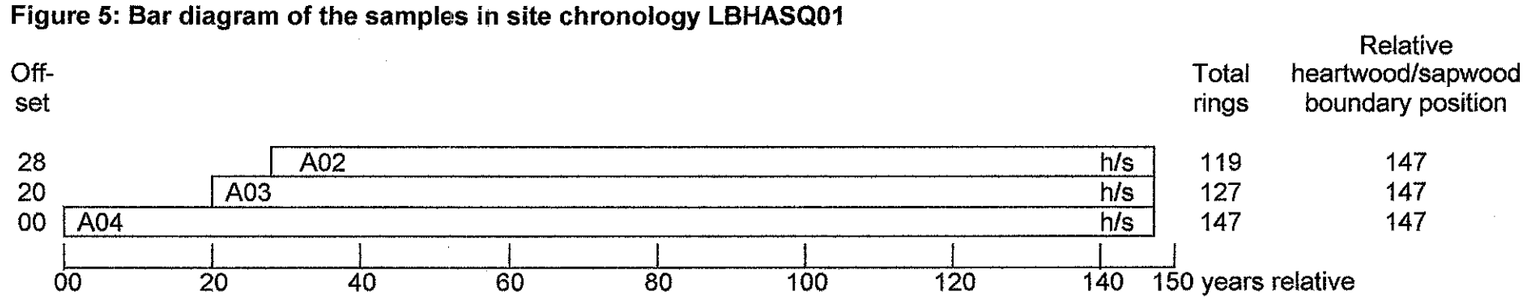
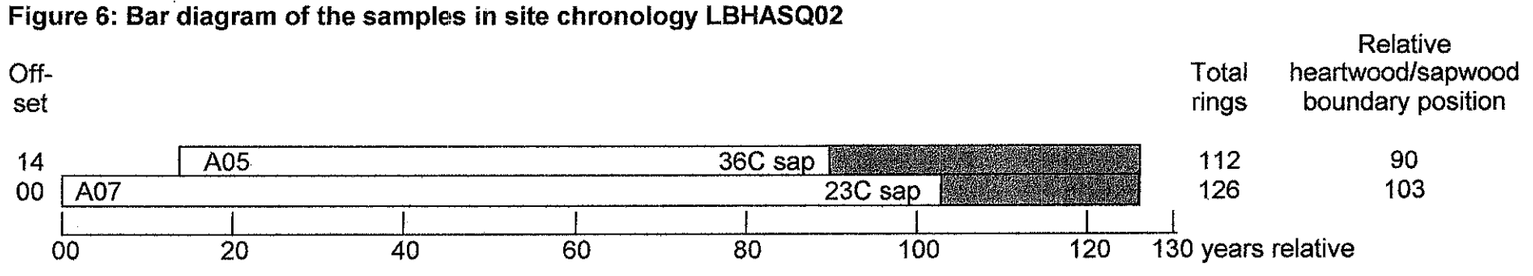


Figure 6: Bar diagram of the samples in site chronology LBHASQ02



white bars = heartwood rings, shaded area = sapwood rings
C = complete sapwood retained on sample, the last measured ring date is the felling date of the timber
h/s = the heartwood/sapwood boundary is the last ring on the sample