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TREE-RING ANALYSIS OF TIMBERS FROM 15 HALTON VILLAGE, NEAR AYLESBURY, BUCKINGHAMSHIRE. HP22 5N5

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Sample HLT-A02 from the north main wall post of truss 2

NTRDL, 20 Hillcrest Grove, Sherwood, Nottingham, NG5 1FT
Telephone 0115 960 3833 (laboratory);
07980 305583 / 07913 427987 (Mobiles)
roberthoward10@hotmail.com
alisonjarnold@hotmail.com

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Summary

Core samples were obtained from ten different oak timbers in this building at Halton Village Buckinghamshire. Analysis undertaken on these samples has resulted in the construction and dating of a single site sequence and the individual dating of a further single sample, HLT-A02.

Site sequence HLTASQ01, of 120 rings, contains five samples and spans the period 1559-1678. Sample HLT-A03, dated within this site sequence, has complete sapwood with a last ring date, and thus a felling date, of 1678/9. Interpretation of the heartwood/sapwood boundary on the other four samples in this site sequence points towards these also representing timbers felled in 1678/9.

Sample HLT-A02 was dated individually to the period 1590-1678. This sample also has complete sapwood and was thus also felled in 1678/9.

Tree-ring analysis has dated timbers of the roof and ceiling frame to 1678/9, with construction of the building likely to have occurred shortly after this date.

Introduction

From the outside, particularly from the front, No.15 Halton Village could, at first glance, be mistaken for a good example of late-Victorian / early-Edwardian model or 'improving' rural English Architecture, there being perhaps a slight nod to the future in its two forward projecting gable bays of the forthcoming 'garden-city' or 'New town' style of the 1920s (Fig 1). To the rear, two further bays project, probably dating to the late-nineteenth century, these being slightly larger than those to the front.

However, anything more than a cursory glance at the building, idyllically set back in a 'English country garden' along side a branch of the Grand Union Canal, will reveal a central range the roof and wall lines of which will suggest a core building of possibly greater antiquity, to which later additions have been made. The true possible age of the building, however, can only be appreciated from the inside, where the remains of a timber-framed structure have recently been more fully revealed.

The building

Judging by the brief survey made at the time of sampling, it seems that No 15 was originally a two-bay structure, formed by three relatively lightweight principal rafter with tiebeam and collar trusses, with a centrally located fireplace and chimney. It was probably always of two floors plus an attic. The principal rafters support single through-purlins to each roof slope, these in turn supporting 10 light, possibly replaced, common rafter pairs to each bay. Given that there are no mortices in the present common rafters it would seem that they never had jointed collars.

There are now straight braces to the purlins from the principal rafters of only the two original end trusses, but none, now, from the principal rafters of the middle truss. On the principal rafters of this middle truss can be found the empty mortices which once probably received the ends of the braces. The purlins do not have mortices for the braces, these being simply pegged to the backs of the purlins. Views of the roof timbers are given in Figure 2a/b.

The roof trusses are supported by main wall posts from which braces may have risen to the tiebeams. Though such braces are no longer visible, there are mortices in the wall posts that may have housed them, and there are certainly straight braces from near the tops of the main wall posts to the wall plates. A view of the wall-framing is given in Figure 3a, with a schematic long section being provided in Figure 4.

There were no carpenter’s or assembly marks seen on any of the timbers. These often take the form of Roman numerals, though simpler marks, and sometimes chisel cuts are used instead. Given that most of the main timbers are covered in paint it was not possible to see any tool marks on them. The backs of the principal rafters, however, do show some evidence of sawing. It is possible that some timbers have been replaced, or possibly reused from an older building. This is particularly so with the purlins of the east bay, between trusses 1 and 2. The purlin to the north, or rear, has mortices which might have taken short ceiling joists, but the south or front purlin has none. Also, as stated above, the purlins do not have mortices for the braces. The rafters here too look slightly more recent than the other timbers in the building. The general impression, therefore, is that the roof might not be a single phase structure.

The first-floor ceiling beam between trusses 2 and 3 might also be reused. Its unsupported west end, with its champher stops, is cut to fit into a dovetail lap mortice of a horizontal beam, such as a tiebeam (see Fig 3b). The fact that the ceiling beam does not reach the tiebeam here, and that in any case the tiebeam does not have a mortice to receive it, suggests a less than cohesive integral structure. Unfortunately, being apparently derived from a fast-grown tree with insufficient rings, this timber was not suitable for tree-ring analysis.

Subsequent alterations, and the late-nineteenth century and possibly later additions, have obscured much of the ground-floor arrangement of the building. It is not at all clear, for example, where the original entrance would have been. This is most likely to have been in the front or rear wall, perhaps near the middle of the building to either side of the central truss (truss 2), close to the centrally-located fireplace. As such it would be a member of the so-called 'lobby entrance' plan form, characteristic of most two-bay post-medieval buildings in the English lowland zone.

It is not certain, either, where the original access to the upper floor might have been. Were the status of the building high enough there may have been stairs, otherwise there might have been something akin to a ladder or steps, perhaps on the far side of the chimney, away from the front door opening. The exact position of some of the original windows is also unknown.

The walls of the original structure, including the internal partition walls between the two bays, appear to have been framed in large square panels, again typical of post-medieval buildings of much of central and southern England. There is no clear evidence, however, as to the original infill of these panels. This may have been of mud plaster applied to wattle and stud, but, given that the intermediate rails and post of the walls are of small size, it may have been simply of cob, that is, thick clay and rough-cut straw clumps, without may other support. It is also just possible that the infill was made up of brick 'noggins'. If at any time the present infill is removed from some of the panels it would be worth noting these rails and posts. If, say, one inch dowel holes and or grooves are found this would suggest wattle and daub.

Thus, in general, the features seen at No.15, that is the plan form of the building, the form of the timber-framing, and the size of the beams, would suggest a late post-medieval structure, possibly reusing some older timbers.

Since its original construction No.15 has been altered and extended. The earliest extension may have been the construction of a third, possibly fully timber-framed, bay to the west, at the canal end, in-line with and extending the original two-bay building. There are timbers in the roof of this third bay but they are fewer in number and slightly smaller than those seen elsewhere. Some of these timbers may be of softwood but even where they are oak they are unsuitable for analysis in that they have insufficient rings for reliable dating. There are also some timbers in the rear wall of this first extension, but they too are small and probably unsuitable for tree-ring analysis. It is unclear if there is any timber in the other, side and front, walls, and they may have been brick from the start. A conjectural phasing plan is given in Figure 5.

As indicated above, the next extension phase probably involved the construction of the two bays to the rear, and then the two bays to the front. Both these additions appear to be in brick.

Sampling

Sampling and analysis by tree-ring dating of timbers within No.15 were commissioned by the owners, Mr and Mrs Pearce out of personal interest and as part of a general enquiry into the background history and development of the site whilst conservation and repairs were underway, this making the timbers especially accessible. It was hoped that tree-ring analysis might indicate the dates at which certain timbers had been felled and, if possible, establish a likely primary construction date for the building as a whole.

Thus, from the material available a total of ten core samples was obtained. Most of the timbers sampled belonged, it was believed to the primary construction phase of the building, though some samples, those from the purlins for example, are possibly of a different phase. Each sample was given the code HLT-A (for Halton, site "A") and numbered 01 – 10, its position, and other relevant information about the timber, being carefully recorded. The position of these samples were marked on sketch plans made at the time of sampling, which were later worked-up to those reproduced here as Figure 6. Details of the samples are given in Table 1. In the figures, and in Table 1, the trusses have been numbered from site east to site west (that is from right, as the building is viewed from the front, to left, towards the canal).

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 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 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 satisfactory analysis.

Analysis

Each of the ten samples obtained from No.15 was prepared by sanding and polishing and their annual growth-ring widths were measured. The growth-ring widths of the ten samples were then compared with each. At a minimum value of t=3.5 five samples had grouped, the individual samples cross-matching with each other at the relative positions as shown in the bar diagram, Figure 7. The five cross-matching samples were combined at these off-set positions to form site chronology HLTASQ01, this having an overall length of 120 rings. Site chronology HLTASQ01 was then satisfactorily dated by repeated and consistent cross-matching with a number of relevant reference chronologies for oak as spanning the years 1559 to 1678. The evidence for this dating is given in the *t*-values of Table 2.

Site chronology HLTASQ01 was then compared with the remaining five ungrouped samples but there was no further satisfactory cross-matching. Each of the five ungrouped samples was then compared individually to the full range of reference chronologies for oak. This resulted in sample HLT-A02 being matched at a first-ring date of AD 1590 and a last-ring date of AD 1678. The evidence for this date is given by the *t*-values in Table 3.

The remaining four samples could not be matched and these remain undated.

Interpretation and Discussion

Tree-ring analysis has resulted in the construction and dating of a single site sequence and the individual dating of one sample. Site sequence HLTASQ01, of 120 rings, contains five samples and spans the period 1559-1678. Sample HLT-A02 has been dated individually to a first-ring date of 1590 and a last-measured ring date of 1678. Two of the dated samples (HLT-A02 and HLT-A03), both from main wall posts, have complete sapwood, that is the last growth ring produced by the tree represented before they were felled, with a last-measured ring date of 1678. In both cases the last-measured ring has the spring and summer growth cells, demonstrating that felling of these timbers would have occurred late in 1678 or early in 1679. Interpretation of the heartwood/sapwood boundary on the other four dated samples, from another wall post, a wallplate, a collar, and a ceiling beam, would suggest that these are also from timbers felled in 1678/9.

It should be noted that the *t*-values with which both HLTASQ01 and HLT-A02 have been matched against the reference material, while statistically satisfactory, are not particularly high. They are, however, consistent and, therefore, considered secure. The lack of high matches against the reference material may be due to the presence on a number of the samples of a series of ‘tight’ growth rings. This denotes a number of years when growth was suppressed for some reason. It may be that the growth of these trees was affected by non-climatic forces, influencing their growth pattern in a way that would not be represented within the reference material.

Conclusion

Dendrochronological analysis of timbers from the earliest, surviving part of this building has dated a number of them to a felling in late 1678/early 1679. It is, therefore, likely that construction of this component of the building occurred in 1678/9 or soon after.

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Table 1: Details of samples from 15 Halton Village, Buckinghamshire

Sample number	Sample location	Total rings	*Sapwood rings	First measured ring date (AD)	Last heartwood ring date (AD)	Last ring date (AD)
HLT-A01	South (front) main wall post, truss 2	49	13	----	----	----
HLT-A02	North (rear) main wall post, truss 2	88	34C	1590	1644	1678
HLT-A03	North main wall post, truss 3	67	20C	1612	1658	1678
HLT-A04	South main wall post, truss 3	57	12	1614	1658	1670
HLT-A05	South wall plate, truss 2 - 3	62	14	1611	1658	1672
HLT-A06	Collar, truss 3	52	--	1612	----	1663
HLT-A07	North purlin, truss 1 - 2	70	h/s	----	----	----
HLT-A08	south purlin, truss 1 - 2	62	06	----	----	----
HLT-A09	North principal rafter, truss 1	47	14	1596	1628	1642
HLT-A10	First floor ceiling beam, truss 1 - 2	109	12	1559	1655	1667

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

Table 2: Results of the cross-matching of site sequence HLTASQ01 when the first-ring date is 1559 and a last-ring date of 1678

Reference chronology	Span of chronology (AD)	*t*-value	Reference
Bolsover Castle (Riding House), Derbys	1494-1744	4.9	Arnold *et al* 2005a
Potterdyke House, Lombard Street, Newark, Notts	1603-1740	4.4	Arnold *et al* 2002
The Wheatsheaf, Cropwell Bishop, Notts	1604-1703	4.3	Howard et al unpubl
12 Chain Lane, Newark, Notts	1608-1684	4.2	Arnold *et al* 2002
Bolsover Castle (Little Castle), Derbys	1532-1749	4.1	Arnold *et al* 2003
Worcester Cathedral, Worcs	1443-1729	4.0	Howard *et al* 2000
Combermere Abbey, Cheshire	1602-1727	3.9	Howard *et al* 2003a
Bringhurst Church (bellframe), Leics	1619-1681	3.6	Arnold *et a*l 2005b
Cheddleton Grange, Staffs	1551-1682	3.5	Howard *et al* unpubl

Table 3: Results of the cross-matching of sample HLT-A02 when the first-ring date is 1590 and the last-ring date is 1678

Reference chronology	Span of chronology (AD)	t-value	Reference
England	401-1981	4.6	Baillie and Pilcher 1982 unpubl
Cheddleton Grange, Staffs	1551-1682	5.0	Howard *et al* unpubl
15-17 St Johns Street, Wirksworth, Derbys	1586-1676	4.9	Howard *et al* 1995
Staircase Café, Stockport, Manchester	1489-1670	4.4	Howard *et al* 2003b
Kibworth Harcourt Mill. Leics	1582-1773	4.3	Arnold *et al* 2004
Coates' Barn, Main St, Cosby, Leics	1642-1734	4.1	Howard *et al* unpubl
37-39 Kirkgate, Newark, Notts	1603-1694	3.8	Arnold *et al* 2002

Figure 1: View of No 15 Halton Village from the front or south

Figure 2a/b: View of the north or rear roof slope of the east bay (above), and the roof of the west bay (below)

Figure 3a/b: View of the rear first-floor wall-frame of the west bay 2 (above); notice the light-weight framing, the braces to the wall-plate and the ceiling beam.
Below, the first-floor ceiling beam in the west bay; notice how it is shaped to fit in to a dovetailed lap mortice in a cross-beam

Figure 4: Simple schematic long-section to show framing of north (rear) upper floor wall and roof slope

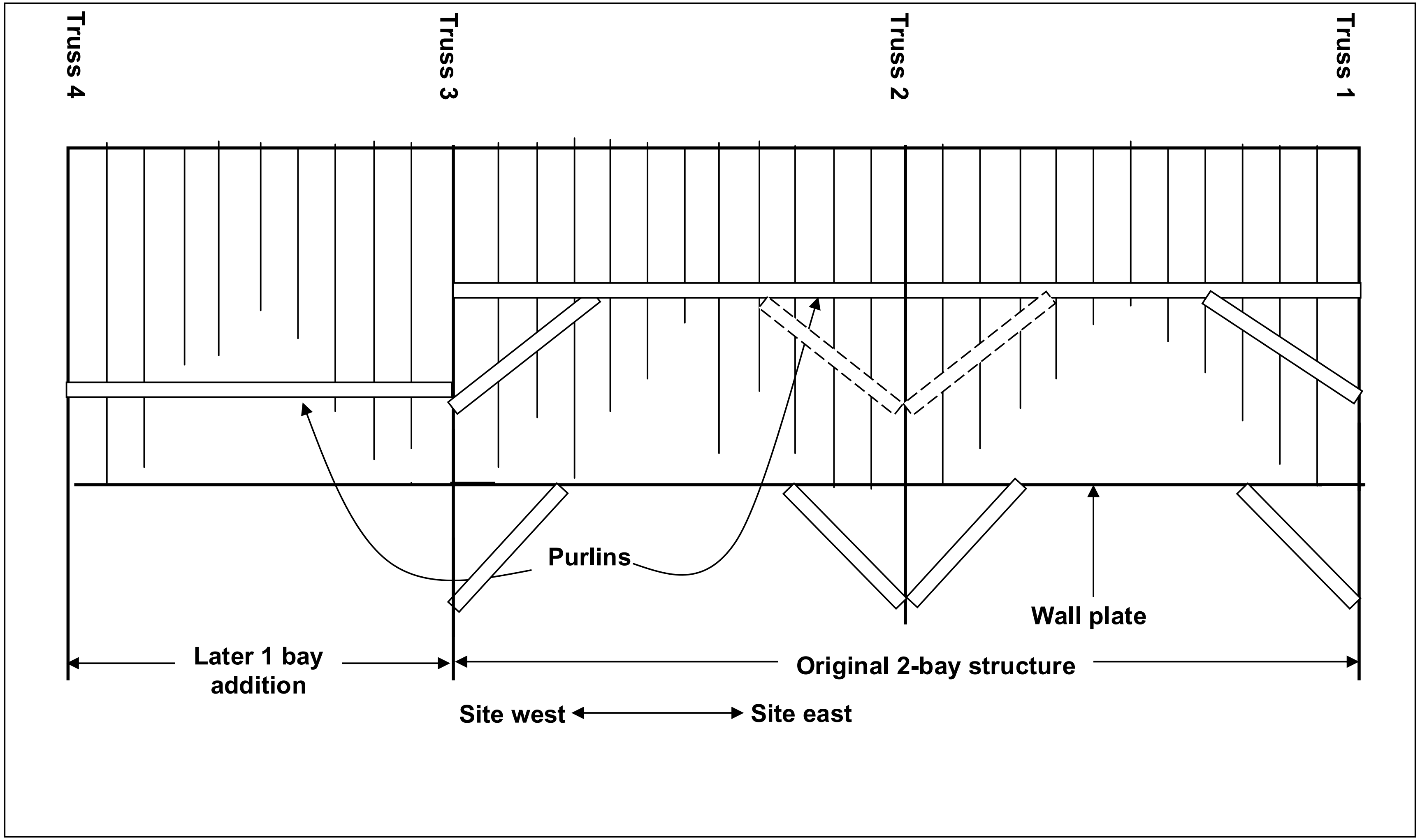


Figure 5: Simple schematic plan to show basic layout of site and conjectural phasing

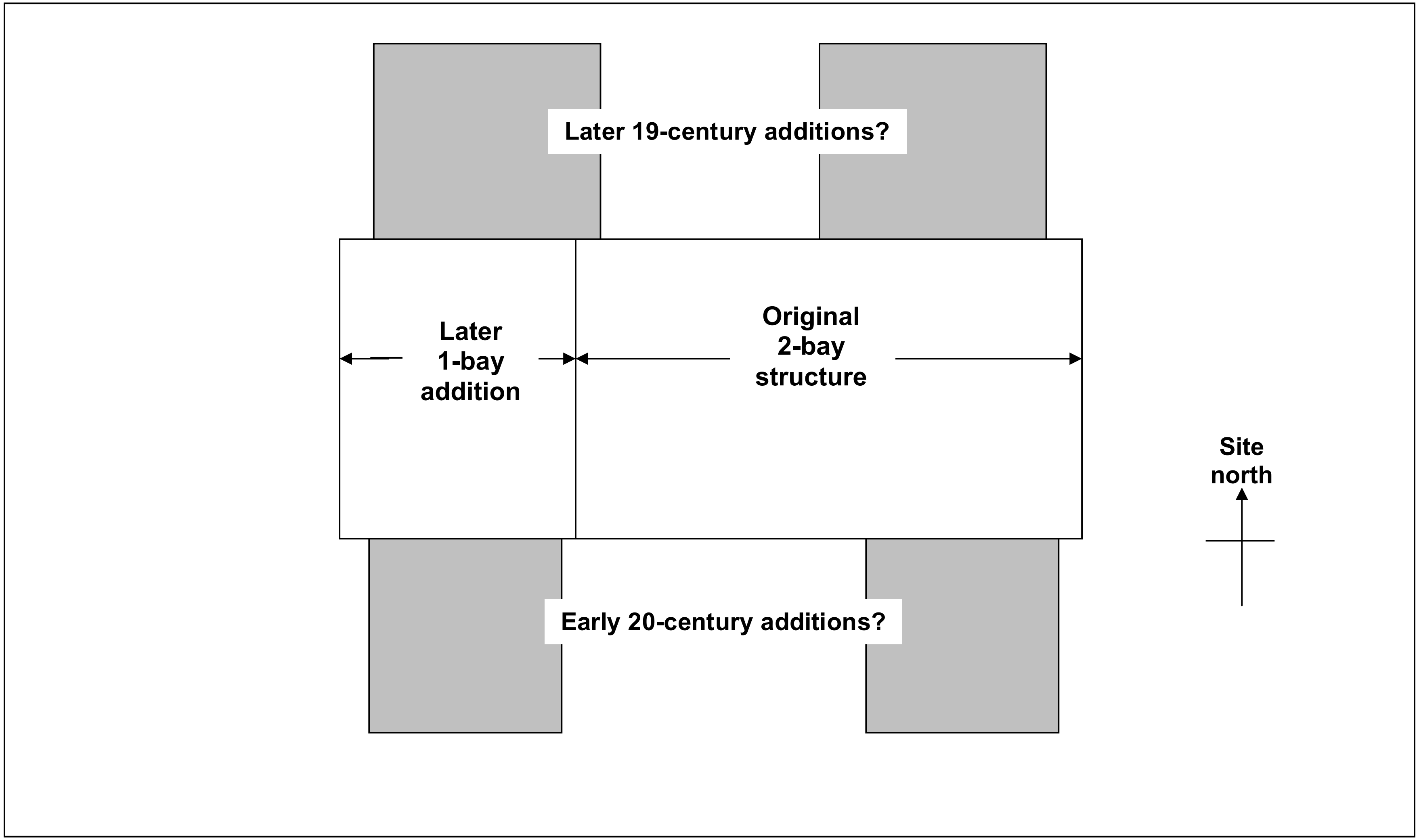


Figure 6: Simple schematic plan of main range to show sample locations and points of note

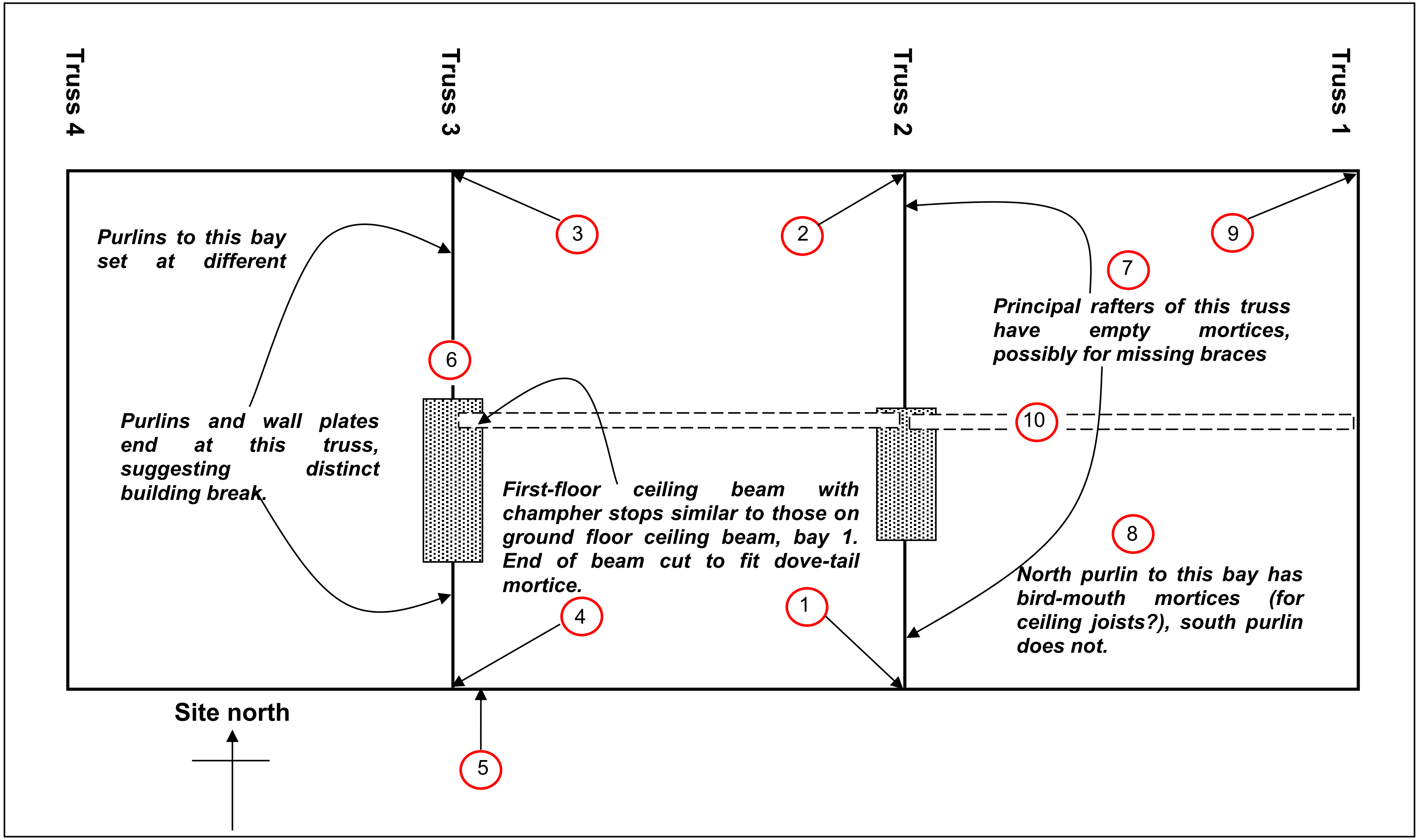
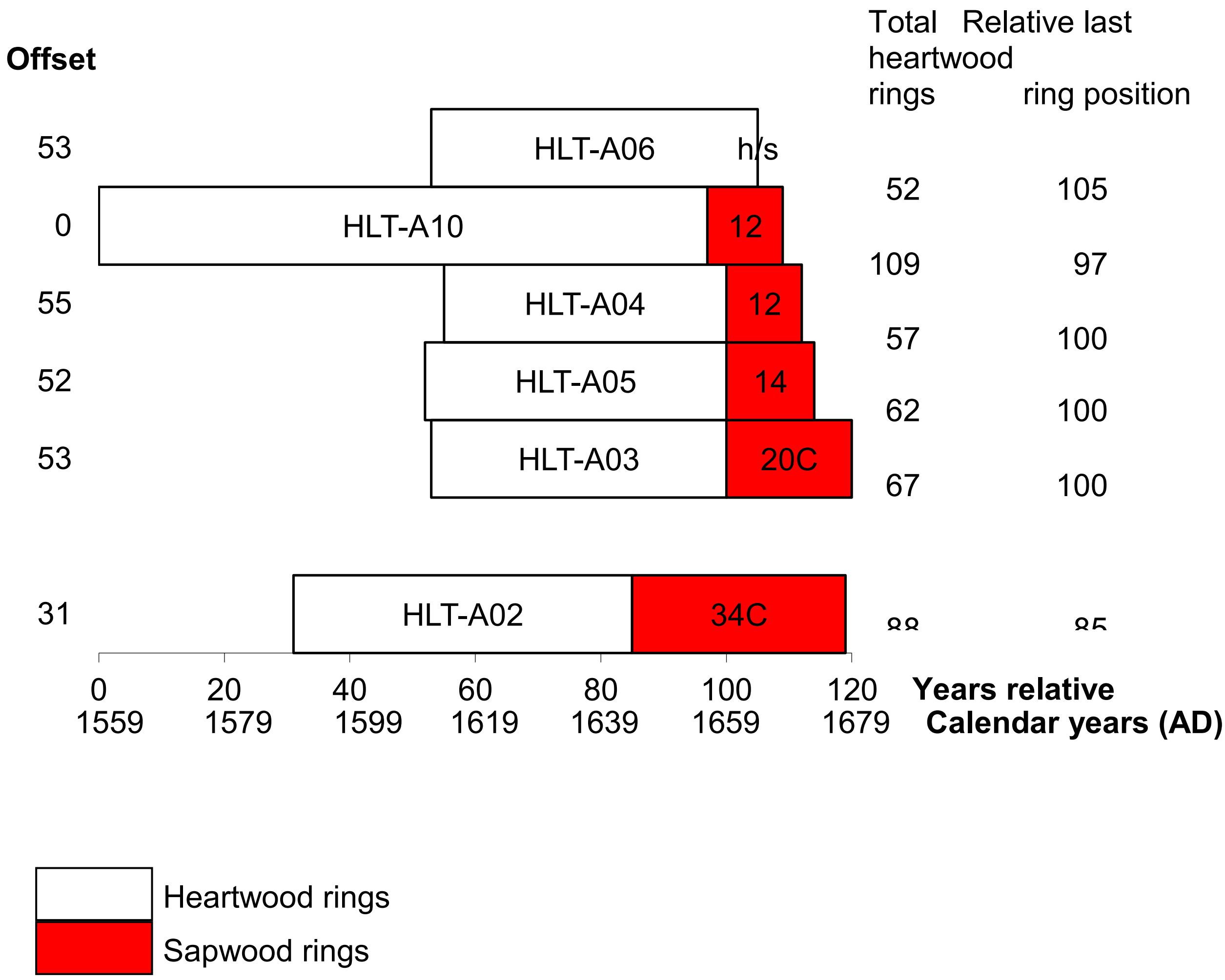


Figure 7: Bar diagram showing samples in site sequence HLTASQ01 and sample HLT-A02, at their relative offset positions



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