



**TREE-RING ANALYSIS OF TIMBERS FROM  
STONELOWE HALL,  
LONGSDON,  
NEAR LEEK,  
STAFFORDSHIRE**

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**Sample STL-A13 from the tiebeam of truss E in the hall range**



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## SUMMARY

Tree-ring analysis was undertaken of 29 samples from what an archaeological building survey has shown to be three separate phases of Stonelowe Hall. The results demonstrate that all the timbers used in phase 2 of the building (the Hall range) are likely to have been felled in 1569, whilst all the timbers used in phase 3, (the cross passage), are likely to have been felled a few years later in 1577. None of the 12 timbers of phase 1 which were sampled have been dated, and the date of this part of the building thus cannot be proven by tree-ring dating.

From the material analysed a single site chronology was created, STLASQ01, this comprising 14 of the 17 samples obtained from phases 2 and 3. This site chronology has an overall length of 138 rings, these dated as spanning the years 1440 – 1577.

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## Introduction

Stonelowe Hall is a large stone farmhouse which, outwardly (see Fig 1), appears to be of seventeenth century date. It has recently been sold and is now undergoing much needed repair and conservation, the new owner going to considerable expense to ensure, for example, that local stone is used for new windows. The Building is listed Grade II.

Prior to repair work the interior was the subject of a detailed archaeological survey by Faith Cleverdon, this clearly illustrating that substantial parts of three distinct structural phases of timber framing remain within. On the basis of scant stylistic evidence and the form of the framing it is possible that the phase 1 building dates to the fifteenth century, whilst phases 2 and 3 are later.

The timber-framed components of Stonelowe comprise three elements (see simple plan, Fig 2). Firstly there is a two-bay, east-west, cross-wing, formed by three trusses, 'A', 'B', and 'C'. This wing contains what appears to be a primary first-floor frame consisting of three lateral bridging beams from which run smaller common joists (for the purposes of this description the building is taken to align north – south, although in reality it runs north-west to south-east (with the front facing south-west)). The trusses are slightly varied, but are generally formed of principal rafters frames with cambered tiebeams and collars (except for truss 'C'), there being vertical queen posts between tiebeam and collar, and diagonal struts from collar to principals. There is a single purlin to each roof slope, with originally, it would appear, wind braces from principal rafters to the purlins. It would also appear that arched braces (now lost) originally sprang from near the tops of the jowled wall post to the tiebeam. Illustrations of trusses 'B' and 'C' are given in Figures 3a and 3b respectively. Structurally this element represents the phase 1 construction and appears to be the earliest extant building on the site.

To the north of this primary cross-wing, and detached or separate from it, was then built the phase 2 element, a north-south hall range of two bays formed by trusses 'E', 'F', (see Figs 3d/e) and 'H', truss 'H' now being lost (truss 'G' appears only as relatively modern inserted beams in the upper floor and roof). The three main frames again have principal rafters with straight, or only slightly cambered, tiebeams but no collars, there being longer diagonal (truss 'E') or vertical (truss 'F') struts between tiebeam and principals. There are two purlins to each roof slope. Wind braces run both up and down from the upper purlins only to the principal rafters. There are no wind braces between the lower purlins and the principal rafters (*Faith, is there a long-section drawing showing this – I don't have a photo – perhaps I could call in to take one?*).

The lower frame is composed of vertical studs forming rectangular panels with, in the case of truss 'F', mid-rails on the upper floor (the lower portion of this truss has been lost). There are straight, or only very slightly curved, braces from the wall posts, which are slightly expanded at their heads, to the tiebeam, and, in the case of truss 'E', from wall posts to wall plate.

The first-floor frame of the hall range, integral and primary with its construction, is again composed of lateral main bridging beams from which run smaller common joists.

The gap between the phase 1 cross-wing and the phase 2 Hall range appears to have been subsequently closed by the phase 3 construction. This consisted of the insertion of an additional frame, truss 'D' (see Fig 3f) abutting the north wall of the cross-wing. The gap between the phase 1 cross-wing and the phase 2 Hall was then roofed and the walls in-

filled to form a cross passage. Truss 'D' comprises principal rafters with a 'tiebeam', the 'tiebeam' running on past the foot of the west rafter in the form of a wall plate to end on the same line at the west wall of the cross-wing range, the effect being to form a 'porched' entrance on the west side. The west end of this tie/wallplate was supported by a main post (now lost). There are slightly inclined struts between tiebeam and principal rafters, the principal in turn supporting two purlins to each roof slope.

There appears to have been subsequent further alterations to the frames, consisting mostly of removing studs and braces, or inserting beams and infilling walls. In the seventeenth century the timber-framed structure was encased in stone with, it would appear likely, additional ranges or portions of building being added at this time.

## **Sampling**

Sampling of timbers from Stonelowe Hall was commissioned by Faith Cleverdon, for Staffordshire Moorlands District Council. This was undertaken during an early stage of redevelopment, as part of a full survey and research into the site whilst conservation and repair work was being carried out. It was hoped that tree-ring analysis would establish the date of the primary part of the building i.e. the cross-wing, and determine when the second and third phases, the Hall range and the infill cross passage addition were constructed.

Thus, from the timbers available a total of 29 core samples was obtained. Each sample was given the code STL-A (for Stonelowe, site "A") and numbered 01 – 29. From the phase 1 cross-wing range were obtained 12 samples, STL-A01 – A12. These samples were taken from the roof timbers and from the beams of the ground-floor ceiling frame, including main bridging beams as well as common joists. Ten samples, STL-A13 – A22, were obtained from the phase 2 Hall range timbers, mostly from the roof, but with some wall and ground-floor ceiling beams also being cored. Finally, seven samples, STL-A23 – A29, were obtained from the smaller number of timbers available in the phase 3 cross passage structure.

The positions of these samples were marked on plans made and provided by Faith Cleverdon, these being reproduced here as Figures 3a-g. Details of the samples are given in Table 1. In this Table, all trusses and the individual timbers have been numbered and/or identified following the schema of the drawings provided.

The Nottingham Tree-ring Dating Laboratory would like to take this opportunity to thank the new owner of Stonelowe Hall, John Trigg, for his enthusiasm for this programme of tree-ring analysis and for his help and cooperation during sampling. We would also like to thank Faith Cleverdon for her help and advice and for the use of her drawings. Sampling was generously funded by Staffordshire Moorlands District Council.

## **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 principle 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 reliable dating.

### **Analysis**

Each of the 29 samples obtained from Stonelowe Hall was prepared by sanding and polishing and their annual growth-ring widths were measured. The growth-ring widths of the 29 samples were then compared with each.

At a minimum value of  $t=4.0$  a single group comprising 14 samples could be formed, cross-matching with each other at the positions indicated in the bar diagram Figure 4. These 14 cross-matching samples were combined at these indicated off-set positions to form STLASQ01, a site chronology of 138 rings. Site chronology STLASQ01 was then satisfactorily dated by comparison with a number of relevant reference chronologies for oak as spanning the years 1440 to 1577. The evidence for this dating is given in the  $t$ -values of Table 2.

Site chronology STLASQ01 was then compared with the 15 remaining ungrouped samples, but there was no further satisfactory cross-matching. The 15 ungrouped samples were then compared individually with the full range of reference chronologies but, again, there was no further cross-matching. These samples must, therefore, remain undated.

### **Interpretation and results**

Analysis by dendrochronology of 29 samples from the three elements of Stonelowe Hall, the hall, the cross-wing, and the cross passage, has resulted in 14 of these samples, all from 2 elements of the building only, being combined to form a single site chronology, STLASQ01. This site chronology is 138 rings long, these rings being satisfactorily dated as spanning the years 1440 – 1577.

One of the dated samples in site chronology STLASQ01, from the phase 2 building, STL-A22, retains complete sapwood. This means that it has the last ring produced by the tree it represents before it was felled. The last ring on this sample is dated 1569. This is thus the felling date of the timber represented. The relative position of the heartwood/sapwood boundary on the other eight dated samples from this portion of the building indicates that they represent timbers which were all felled at the same time. This position varies by 12 years, from relative position 104 (1543) on sample STL-A16, to relative position 116 (1555) on sample STL-A17. It is very likely, therefore, that all the timbers from this part of the building were felled in 1569 as well.

Another of the dated samples in site chronology STLASQ01, this time from the phase 3 building, STL-A27, also complete sapwood. This again means that it has the last ring produced by the tree before it was felled. In this case the last ring on the sample, and thus the felling of the timber, is dated 1577.

Only one other dated sample from this part of the building, STL-A24, retains the heartwood/sapwood boundary, this being at relative position 115 (1554). Although the three other dated samples from phase 3 do not have the heartwood/sapwood boundary there is no reason to suspect that they are not of the same date. It is thus likely that all the phase 3 timbers were felled in 1577.

## **Conclusion**

It would appear, therefore, that Stonelowe Hall contains two phases which can be dated by dendrochronology. The phase demonstrated by the buildings archaeology survey as being the earlier is constructed of timber felled in 1569. The phase seen to be later structurally is constructed of timber felled a few years later in 1577. None of the phase shown by the survey to be the earliest, phase 1, can be dated by dendrochronology. It must, however, be earlier than 1569.

The lack of dating of the phase 1 samples, STL-A01 – A12, is unfortunate, but not altogether uncommon in dendrochronology. However, as will be seen from Table, six of the 12 samples obtained from this phase are below the minimum of 54 rings required for satisfactory dating, and that 2 other samples only just have this minimum. Only four samples, therefore, are truly satisfactory. It is quite likely, therefore, that these low numbers of rings is a major factor in the lack of cross-matching and dating.

It is not certain where the trees used at Stonelowe were originally growing. However, as indicated by Table 2, which shows the reference chronologies against which site chronology STLASQ01 has been dated, the highest *t*-values are found against material from buildings north and east of Stonelowe. This might indicate that the trees are from woodlands in this direction rather than anywhere else. It is likely that the trees used for phase 1 are from different woodland to those which supplied the timbers for phases 2 and 3. As may be noted from Table 1, the samples used in phase 1 have lower numbers of rings than do the samples from the other two phases; the timbers of phase 1, however, are slightly smaller than those of phases 2 and 3 which in turn are all approximately the same size.

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**Table 1:** Details of tree-ring samples from Stonelowe Hall, Longsdon, Staffordshire

| Sample number        | Sample location                             | Total rings | Sapwood rings* | First measured ring date (AD) | Last heartwood ring date (AD) | Last measured ring date (AD) |
|----------------------|---|-------------|----------------|-------------------------------|-------------------------------|------------------------------|
| Phase 1 (cross-wing) |   |             |                |                               |                               |                              |
| STL-A01              | South principal rafter, truss A             | 37          | h/s            | -----                         | -----                         | -----                        |
| STL-A02              | Collar, truss A                             | 38          | h/s            | -----                         | -----                         | -----                        |
| STL-A03              | Tiebeam, truss B (middle)                   | 54          | h/s            | -----                         | -----                         | -----                        |
| STL-A04              | Collar, truss B (middle)                    | 87          | h/s            | -----                         | -----                         | -----                        |
| STL-A05              | North principal rafter truss B (middle)     | 54          | h/s            | -----                         | -----                         | -----                        |
| STL-A06              | South principal rafter truss B (middle)     | 48          | h/s            | -----                         | -----                         | -----                        |
| STL-A07              | South principal rafter, Truss C             | 28          | h/s            | -----                         | -----                         | -----                        |
| STL-A08              | Tiebeam, truss C                            | 63          | h/s            | -----                         | -----                         | -----                        |
| STL-A09              | Ground-floor ceiling, main east beam        | 49          | h/s            | -----                         | -----                         | -----                        |
| STL-A10              | Ground-floor ceiling, main middle beam      | 74          | 35             | -----                         | -----                         | -----                        |
| STL-A11              | Ground-floor ceiling, main west beam        | 30          | 5              | -----                         | -----                         | -----                        |
| STL-A12              | Ground-floor ceiling, west joist 5 (from N) | 110         | 30             | -----                         | -----                         | -----                        |
| Phase 2 (hall range) |   |             |                |                               |                               |                              |
| STL-A13              | Tiebeam truss E                             | 110         | h/s            | 1441                          | 1550                          | 1550                         |
| STL-A14              | East principal rafter, truss E              | 97          | h/s            | 1449                          | 1545                          | 1545                         |
| STL-A15              | West principal rafter, truss E              | 96          | h/s            | 1443                          | 1547                          | 1547                         |
| STL-A16              | West queen strut, truss E                   | 64          | h/s            | 1480                          | 1549                          | 1543                         |
| STL-A17              | Tiebeam truss F                             | 116         | h/s            | 1440                          | 1555                          | 1555                         |
| STL-A18              | East principal rafter, truss F              | 57          | h/s            | 1498                          | 1554                          | 1554                         |
| STL-A19              | East wall post, truss F                     | 74          | h/s            | 1478                          | 1551                          | 1551                         |
| STL-A20              | West principal rafter, truss F              | 60          | h/s            | 1495                          | 1554                          | 1554                         |
| STL-A21              | Ground floor bridging beam, truss F         | 49          | h/s            | -----                         | -----                         | -----                        |
| STL-A22              | Ground floor, west plate, truss E – F       | 80          | 16C            | 1490                          | 1553                          | 1569                         |

**Table 1:** continued

| Sample number | Sample location                  | Total rings | Sapwood rings* | First measured ring date (AD) | Last heartwood ring date (AD) | Last measured ring date (AD) |
|---------------|----------------------------------|-------------|----------------|-------------------------------|-------------------------------|------------------------------|
|               | Phase 3 (cross-passage)          |             |                |                               |                               |                              |
| STL-A23       | East main wall post truss D      | 35          | h/s            | -----                         | -----                         | -----                        |
| STL-A24       | East principal rafter, truss D   | 101         | h/s            | 1454                          | 1554                          | 1554                         |
| STL-A25       | Tiebeam, truss D                 | 69          | 23C            | -----                         | -----                         | -----                        |
| STL-A26       | West main wall post, truss D     | 68          | no h/s         | 1451                          | -----                         | 1526                         |
| STL-A27       | West principal rafter, truss D   | 122         | 22C            | 1456                          | 1555                          | 1577                         |
| STL-A28       | West eaves plate, truss D (to E) | 73          | no h/s         | 1454                          | -----                         | 1526                         |
| STL-A29       | West post adjoining truss E      | 77          | no h/s         | 1449                          | -----                         | 1525                         |

**Table 2:** Results of the cross-matching of site chronology STLASQ01 and relevant reference chronologies when the first-ring date is 1440 and the last-ring date is 1577

| Reference chronology                       | <i>t</i> -value | Reference                           |
|--|-----------------|-------------------------------------|
| Unthank Hall, Holmesfield, Derbys          | 8.4             | ( Howard <i>et al</i> 1993 )        |
| Dilston Castle, Corbridge, Northumberland  | 7.0             | ( Arnold <i>et al</i> 2003 )        |
| Well Bank Farm, Bradfield, South Yorkshire | 6.6             | ( Howard <i>et al</i> 1994 )        |
| England                                    | 6.0             | ( Baillie and Pilcher 1982 unpubl ) |
| Mousley Bottom, New Mills, Derbys          | 5.8             | ( Esling <i>et al</i> 1990 )        |
| Offerton Hall, Offerton, Derbys            | 5.6             | ( Howard <i>et al</i> 1995 )        |
| East Midlands                              | 4.8             | ( Laxton and Litton 1988 )          |
| Wales and West Midlands                    | 4.6             | ( Siebenlist-Kerner 1978 )          |