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A J Arnold[1], R E Howard[1], Dr C D Litton[1] and G Dawson[2]

Summary

The timbers of 18 bellframes were assessed for their dendrochronological potential resulting in 12 being selected for analysis. Eleven of these produced dated timbers, although one bellframe is represented by only a single dated timber. With the exception of the late fifteenth-century timbers at Knipton and Shenton, the rest of the timbers proved to be of seventeenth-and eighteen-century date. These effectively divide into two groups, one dating to the early-mid seventeenth century, followed by an apparent gap in felling in the third quarter of the seventeenth century, and the second group dating to the late seventeenth-mid eighteenth century.

In general the standard typology has been supported by the tree-ring dates, however, this project has identified two examples where a successful bellframes type has continued for longer than previously believed.

The timber exploited for these structures has been shown to vary in character, whether short-lived or long-lived, fast or slow grown, with various sources being used. This project has demonstrated the potential dendrochronology has to increase our understanding and future protection of bellframes. Additionally, in the light of these results, there is an argument that the conventional typology might need revising.

Keywords

Dendrochronology
Standing Building

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Table of Contents

1. Introduction

This report presents the results of a research programme jointly commissioned by English Heritage and Leicestershire County Council, Heritage and Resources Team, to date a number of church bellframes in Leicestershire (Fig 1). With bellframes possibly being the least studied aspect of historic churches, due in part to the fact they are not immediately visible, their importance has not always been recognised. This and the fact that they actually need to work have put them at high risk. In the past it has been felt more cost effective to remove old and decaying frames rather than having them repaired. The dearth of experienced people with the necessary skills, with which to carry out work on these structures, has also added to the focus on removal rather than repair. The survival rate of old bellframes in the East Midlands, is particularly poor.

Happily, this threat has now been recognised and in recent years there has been a move towards conservation. With this has come the acknowledgement that much more can be learnt about these structures. Although there already exists a comprehensive typology for dating bellframes the limitations of this had been recognised (Pickford 1993, 1). As well as the obvious aim of dating and understanding the individual bellframes investigated, and identifying historic timbers which might potentially be at risk, the production of a relatively large number of tree-ring dated examples from Leicestershire would allow comparison of dates obtained by the standard typology and dendrochronologically dated examples from other areas. In this way a greater understanding of the development of bellframe design could be obtained.

It is hoped that by increasing our understanding of these bellframes any potential threats to their survival can be more usefully evaluated. The results of this project could be added to those already gained through similar projects to help form mitigation strategies, influence future planning decisions, and develop an effective policy to combat this threat, not just in Leicestershire but in the country as a whole.

Some important work has already been undertaken on bellframes, such as Chris Pickford's guide to inspection and recording (1993). It is within this publication that the bellframe classification used to distinguish the examples investigated appears, ie, the bellframe in the church at Chadwell is of Pickford type 6.D. Any dates gained from this project could be added to the growing corpus of tree-ring dated bellframes from around the country. Ian Tyers of the Sheffield Dendrochronology Laboratory has previously undertaken a similar project to the one being reported on here in Essex, (Tyers 1995a; 1996) commissioned as part of a wide-ranging survey of surviving bellframes and belfries in that county. The Nottingham University Tree-Ring Dating Laboratory has also already carried out tree-ring analysis on a number of church bellframes around the country, including two in Leicestershire, Stathern and Saltby. The bellframe at Stathern Church (Fig 2) was built from timbers felled in AD 1599-1619 (Howard *et al* 1992a unpubl). The timbers of the frame at Saltby Church have a felling date of AD 1625 (Howard *et al* 1995a unpubl). Both of these bellframes have been removed from their churches. The timbers from Stathern bellframe have unfortunately been disposed of, but Saltby bellframe has since been re-erected in the grounds of Beaumanor Park, Woodhouse, Leicestershire.

The earliest bells in churches were not large and were only intended to be swung through a small arc, thus a frame as such was not required. However, by the fourteenth century actual bellframes were necessary to combat the increased stresses produced by the more rigorous ringing of larger bells. These early bellframes would consist of a set of trusses, which would have a sill, king post, braces, and a short head, and be tied together with transoms (Fig 3a). The queen post variant seen at Knipton is a peculiarity of the East Midlands. Although the short-headed bellframe continued until the sixteenth century, from the fifteenth century onwards it began to give way to the stronger and sturdier long-headed version (Fig 3b). It is clear that the shift towards change-ringing of bells in the early seventeenth century had a profound effect on bellframe design. This type of bell ringing requires a strong frame with well-designed fittings, in addition to a minimum (usually) of five bells. One way around this was to convert the medieval short-headed frame to a long-headed type, with the frame also being extended or adapted to take any extra bells. In other churches the old short-headed frame was removed and a new frame put in its place (Pickford 1993).

Unlike the Essex project, which concentrated on a single bellframe type in a limited area, the Leicestershire bellframes investigated as a result of this project are distributed throughout the county and were included for a number of reasons. The example at Knipton church is thought to be the earliest surviving frame in Leicestershire, whilst Gaulby bellframe is an early example of a six-bell frame. Other bellframes displayed certain design aspects that made the successful dating of them of extra importance, such as Chadwell, Muston, Goadby Marwood, and Bringhurst. The frame at Orton-on-the-Hill is currently at risk from demolition, gaining a date for this frame could potentially have great bearing on its survival. The frames at Ashby Parva, Twycross, and Welham are of typical south Leicestershire jack-braced type, dating of the group as a whole would prove of interest and helpful in refining the typology of bellframes. Then we come to Aston Flamville, which are clearly a reused pair of timbers, finding a date for them would possibly give us an idea of their history prior to their current use. Both Grimston and Shenton were thought to be partially rebuilt and by dating their various phases a greater understanding of these bellframes could be gained. At Knossington there had been disagreements as to the construction date of the frame and it was hoped that dendrochronology would settle this. Finally, Norton-juxta-Twycross, Rearsby, and Stoneby are examples of frames of a later date than the main group. All of the chosen bellframes, which date to the medieval or post-medieval period, are under some threat of alteration or loss.

Sampling and analysis was carried out by the Nottingham University Tree-Ring Dating Laboratory. George Dawson and Dr Christopher Brooke compiled the original list of bellframes assessed for their dendrochronological potential and undertook detailed surveys of all of these whether they were sampled or not.

Figure 1: Map of *Leicestershire* showing the location of all bellframes

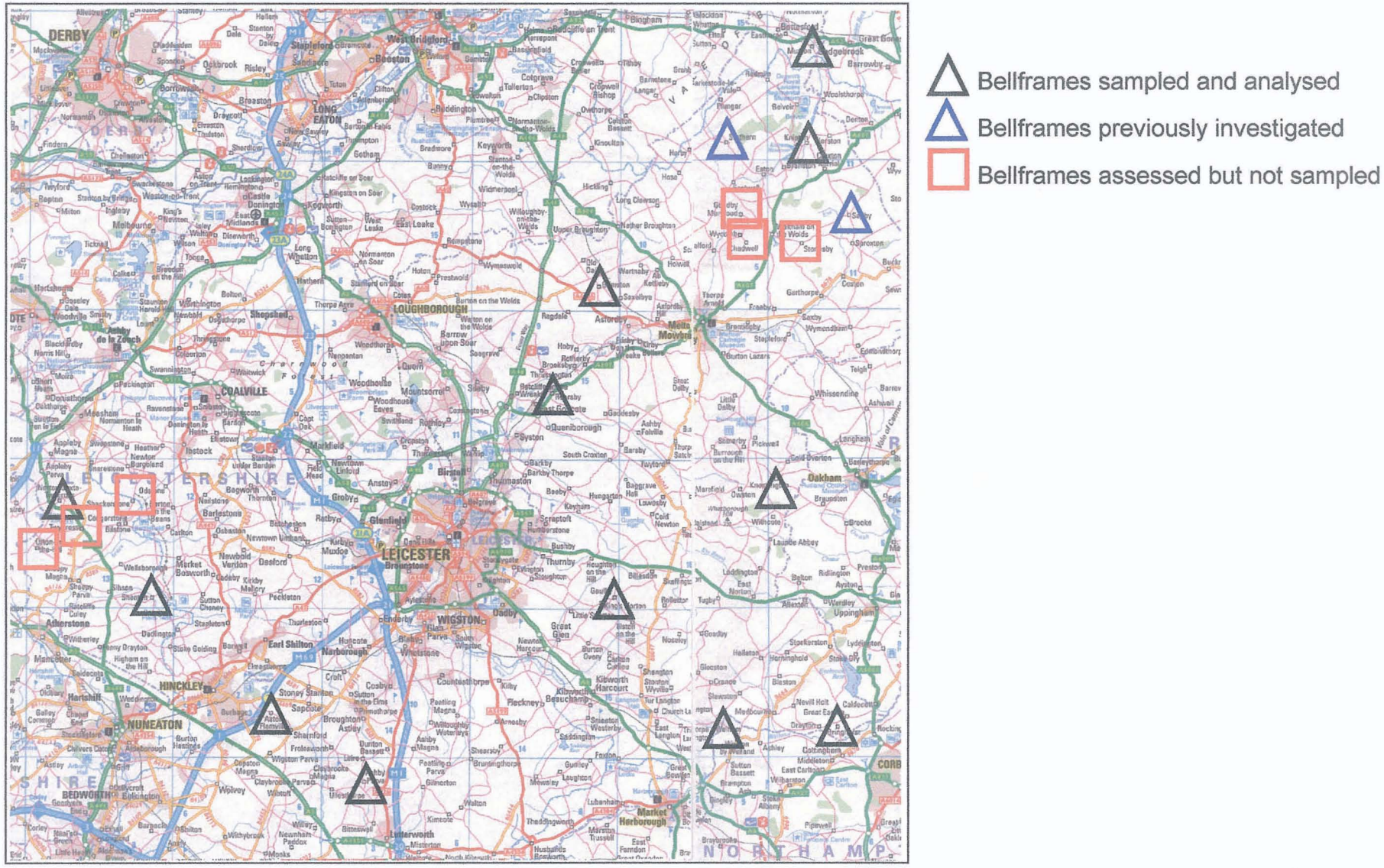
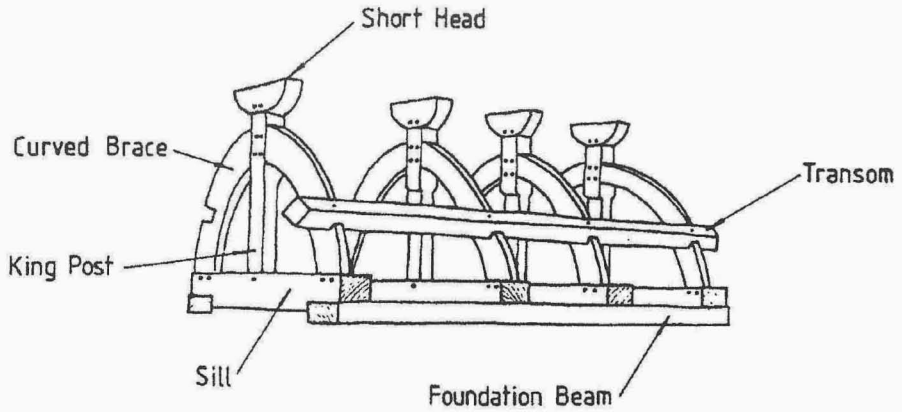
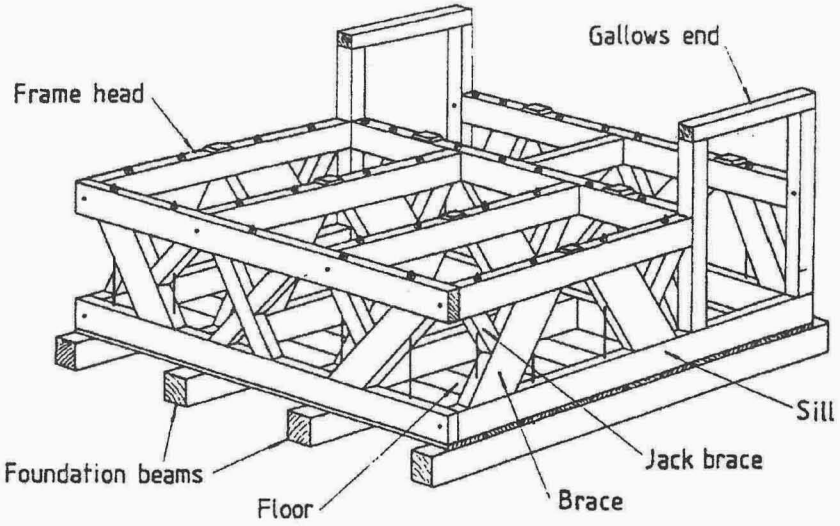


Figure 2: Stathern Church bellframe (George Dawson)

Figure 3: Components of a bellframe a) short-headed frame and b) long-headed frame (Pickford 1993)



a)



b)

2. Methodology

Sampling Programme. Initially a list of 18 bellframes was compiled by George Dawson, who also produced a series of drawings for each bellframe, whether it was eventually sampled or not, and provided a detailed description of the frame and its bells. Unlike the Essex project which concentrated on a single bellframe type from a fairly restricted geographical area, it can be seen that these 18 bellframes are distributed throughout the county (Fig 1). All of these bellframes were visited and an assessment made on their suitability for tree-ring dating. The assessment involved attempting to identify numbers and accessibility of suitable oak timbers. This was decided on whether the beams showed signs of reuse or replacement, had sapwood, and were thought suitable for tree-ring analysis (ie that they had the required minimum number of 54 rings for successful dating). In this way they were graded as to whether there was a reasonable chance that the sampled timbers would date and whether this would give a construction date or date a significant phase. On the basis of this a set of recommendations were drawn up and a programme of sampling initiated, with the 12 bellframes thought most likely to produce dated timbers being chosen for tree-ring analysis. The methods of sampling, preparation, analysing, and dating used here are described in the Appendix.

In the absence of complete sapwood the felling date ranges given here are the 95% confidence intervals; these are discussed in detail in the Appendix but suffice it to say here that for British timber from the East Midlands this is 15-35 rings. This is used to give an estimated felling date range for a group of similarly dated timbers in a bellframe. The usual assumption is that the timber was used green, giving an estimated date range for construction.

Samples were taken from timbers of the original construction phase, and also from timbers representing repairs or alterations when thought appropriate. In this way it was hoped to provide dates, not only of construction but also for any major alterations the bellframe might have undergone, thereby allowing a greater understanding of the development of individual bellframes.

The English Heritage Dendrochronology Guidelines (1998) state that for a simple single-phase building or structure 8-10 timbers should ideally be sampled, with further timbers being sampled if suspected of being reused, inserted, or representing another phase. It will be seen that in a number of the bellframes more than 10 timbers per phase were sampled. This was usually done when, after the first cores had been produced, it could be seen that potentially a number of them were not going to be suitable for measurement (whether through not having the minimum required number of rings, being too broken, or perhaps having a distorted ring pattern). By taking extra samples it was hoped to maximise the number of viable samples. Additionally, as Ian Tyers discovered in his project (1996), bellframes are often constructed from relatively few trees. By sampling more timbers it was hoped to increase the chance of obtaining sequences from more than one tree, thereby increasing the possibility of getting a date.

When each bellframe was sampled it was given the code LBF, followed by a letter denoting the bellframe (ie LBF-L refers to samples from the bellframe at Aston

Flamville), and each timber sampled a number. The location of each sample was marked on drawings provided by George Dawson. Some photographs were taken by Dr Christopher Brooke, and where suitable these have also been included. All samples were taken using a 15mm diameter corer attached to an electric drill, with the resulting core holes left unplugged.

A general discussion of the methods of dendrochronology can be found in English Heritage's Dendrochronology Guidelines (1998) and the more particular methods used by the Nottingham Laboratory in the Appendix, including the Litton-Zainoden Grouping Procedure used to cross-match groups of sequences of ring widths.

3. Bellframes assessed but not sampled

Initially 17 of the 18 bellframes originally suggested by George Dawson were assessed for their tree-ring dating potential. On the basis of these inspections a list was drawn up in order of suitability. Agreement was given for the best 12 bellframes to be sampled, thus leaving six bellframes unsampled. Of these six, three were dismissed as not having any timbers with the minimum required number of rings for successful tree-ring analysis. Two of the remaining three, Goadby Marwood and Chadwell, contained some timbers which may just have enough rings. Problems with access to the sixth unsampled bellframe, at Shackerstone Church delayed this being undertaken at the same time as the others. However, this has subsequently been carried out and this bellframe is thought suitable for sampling should the opportunity arise in the future. George Dawson undertook a programme of detailed recording and documentary research for each of these six bellframes. Individual site descriptions below are based on his survey, the drawings have been reproduced and appear in the relevant sections, and information on the bells can be found in section 10. Anyone wishing to see the original reports should contact Leicestershire County Council or George Dawson directly (george@dawson112.freeserve.co.uk).

3.1
Church of St Mary, Chadwell
(SK 782 246; Figs 4-9)

Description
This pegged oak frame for three bells is of double jack-braced design, Pickford type 6.D. All four trusses are similar in design and the frame is of one build, probably dating from the early eighteenth century.

The bell fittings (headstock, wheel, bearings, and floor roller pulleys) date from the late eighteenth or early nineteenth century.

Dendrochronological assessment
Within the bellframe are a number of reused timbers. These reused timbers have a very wide ring width pattern and are not thought to have enough rings for successful dating. Some of the timbers which show no sign of reuse might just have enough rings, however, this would be marginal, and overall this bellframe is not thought a suitable candidate for further dendrochronological investigation.

Figure 4: Church of St Mary, Chadwell (Dr C J Brooke)

Figure 5: Church of St Mary, Chadwell; centre pit. The truss between bells 2 and 3, similar to truss B-B (Fig 9) is nearest to the camera (Dr C J Brooke)

Figure 6: Church of St Mary, Chadwell; tenor pit, showing the left hand side of end frame, A-A (Dr C J Brooke)

Figure 7: Church of St Mary, Chadwell; Plan at frame head level (George Dawson)

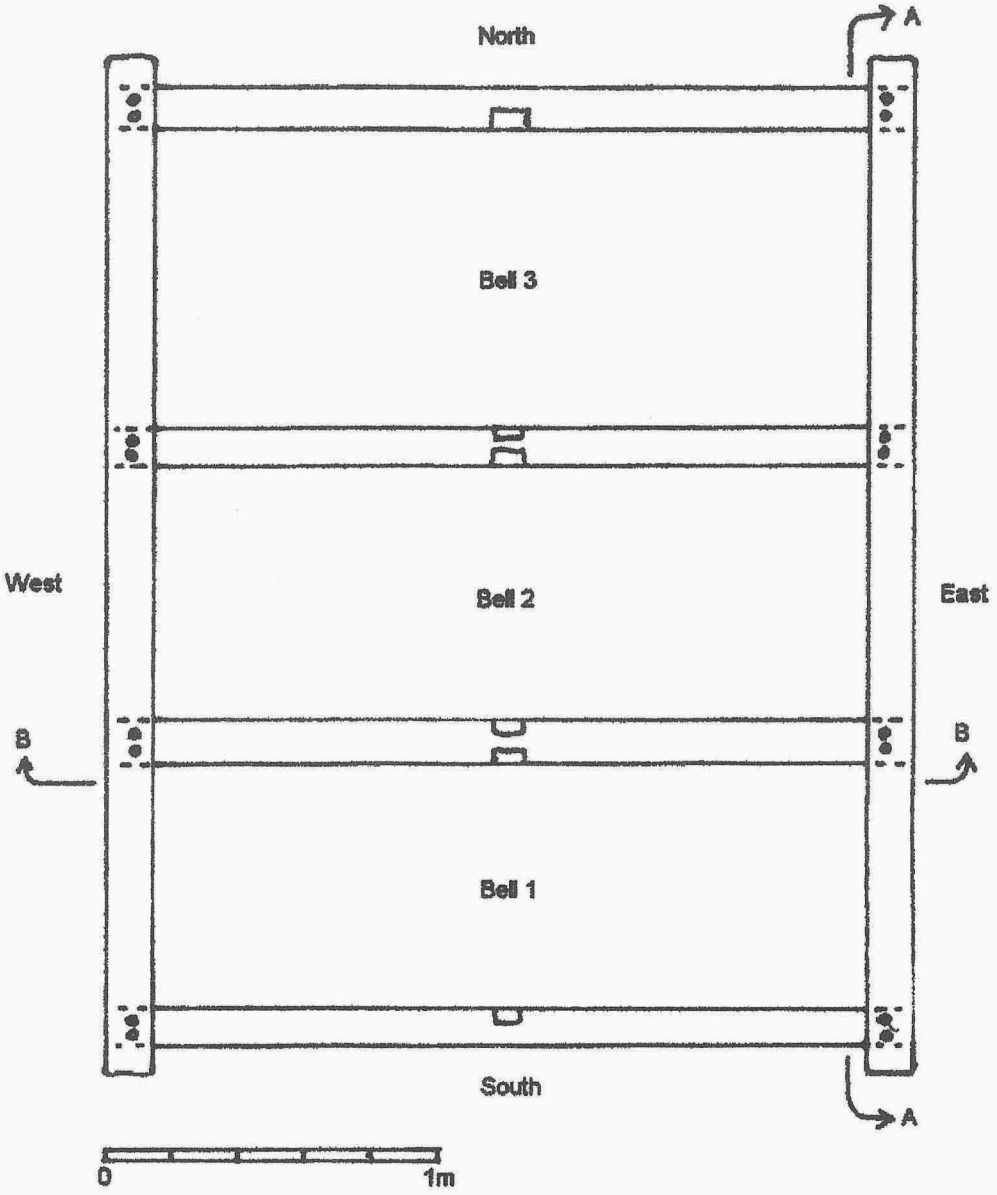


Figure 8: Church of St Mary, Chadwell, section A-A; end frame (George Dawson)

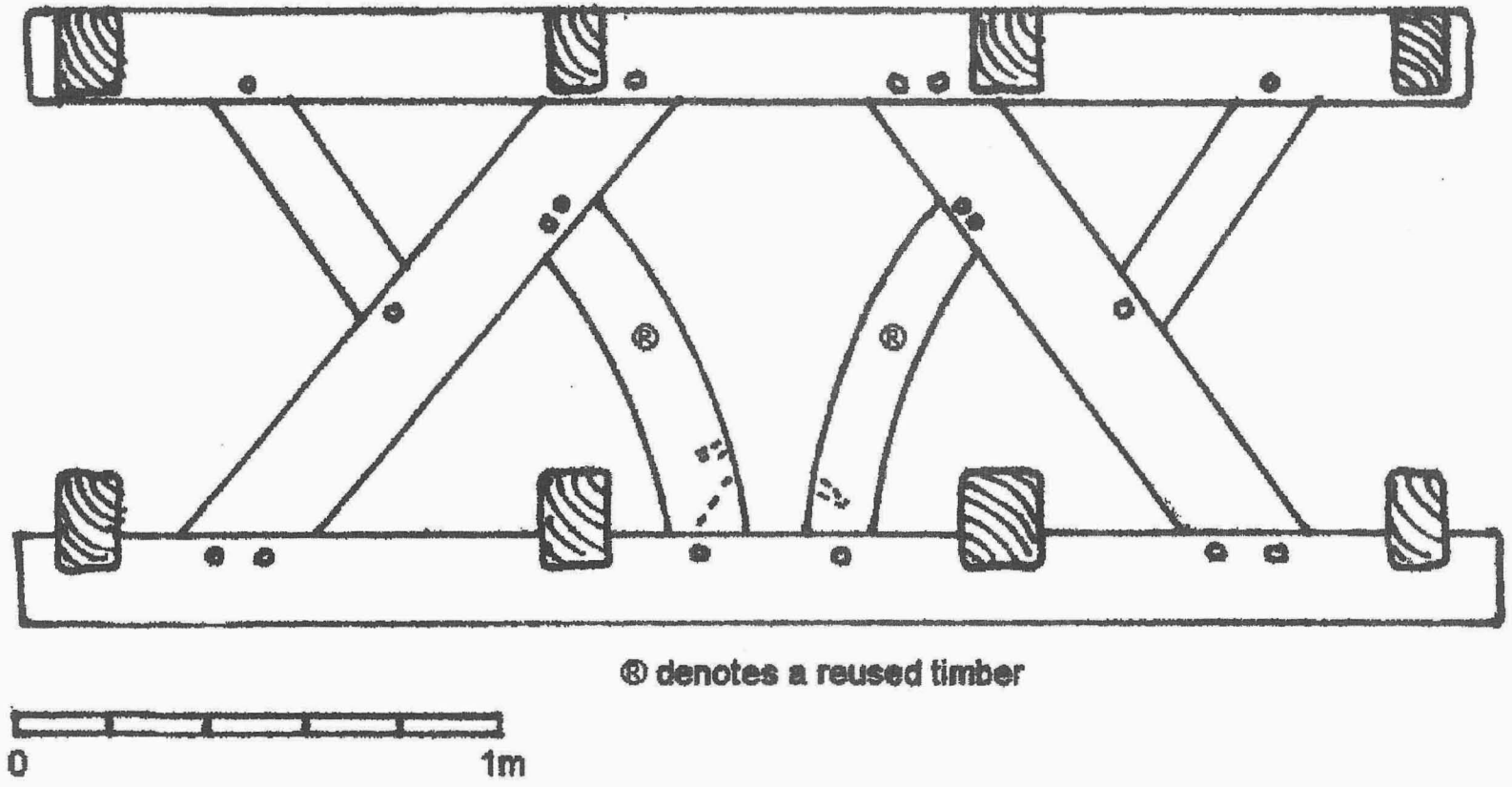
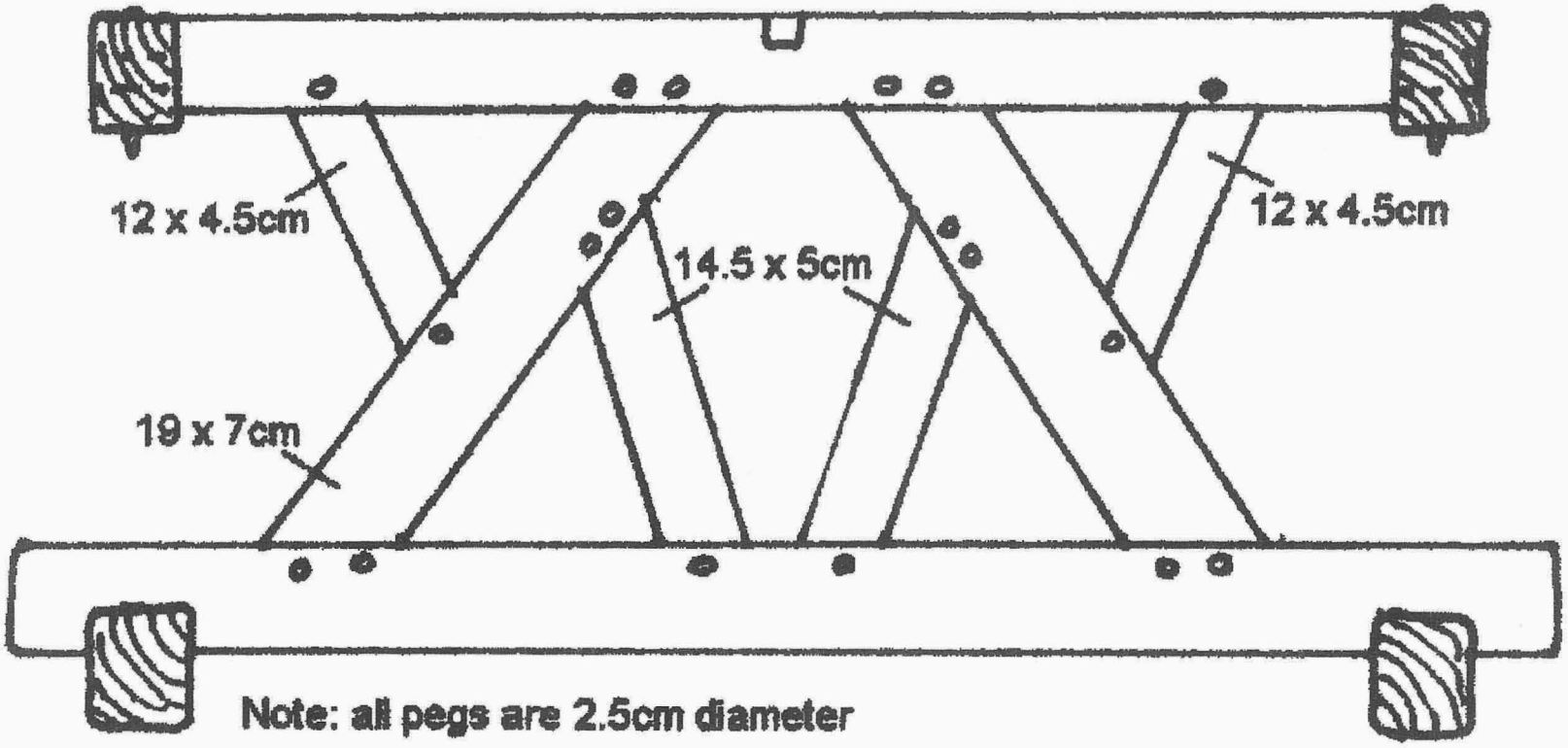


Figure 9: Church of St Mary, Chadwell, section B-B (George Dawson)



3.2
Church of St Denys, Goadby Marwood
(SK 779 264; Figs 10-16)

Description
This oak frame for three bells is an unusual queen post frame (a queen-post equivalent of Pickford type 5.A) dating from the late-sixteenth century. Each truss has curved braces and end-posts. In some of these braces there are holes for pegs and this implies that the frame once had transoms (and therefore short heads). However, there is no sign of cut-outs for these transoms, nor are there areas of less eroded timber which one would expect where the transom would cover and protect the brace.

Each of the head frames are cut back to allow the bells to swing through the pit (Pickford Variant I, type 3) through an angle of greater than 180 degrees. Puzzlingly the outer side of the north truss is also cut away. There are some heavily eroded incised marks on the frame head of the eastern end frame. One possible interpretation of these is: 1557 SS

Dendrochronological assessment
Unfortunately the majority of these timbers have a wide ring-width pattern consistent with fast grown trees. However, the frame heads are marginal, and along with a couple of the supporting beams might just have the sufficient number of rings for successful dating. This bellframe is an interesting early survival and should another phase of sampling be commissioned this could be a possibility.

Figure 10: Church of St Denys, Goadby Marwood (Dr C J Brooke)

Figure 11: Church of St Denys, Goadby Marwood, showing the outer face of the northernmost truss, and bell 3 behind it (Dr C J Brooke)

Figure 12: Church of St Denys, Goadby Marwood, showing truss A-A (Dr C J Brooke)

Figure 13: Church of St Denys, Goadby Marwood, looking down on the frame with bells 1 (top), 2 (middle), and 3 (bottom) (Dr C J Brooke)

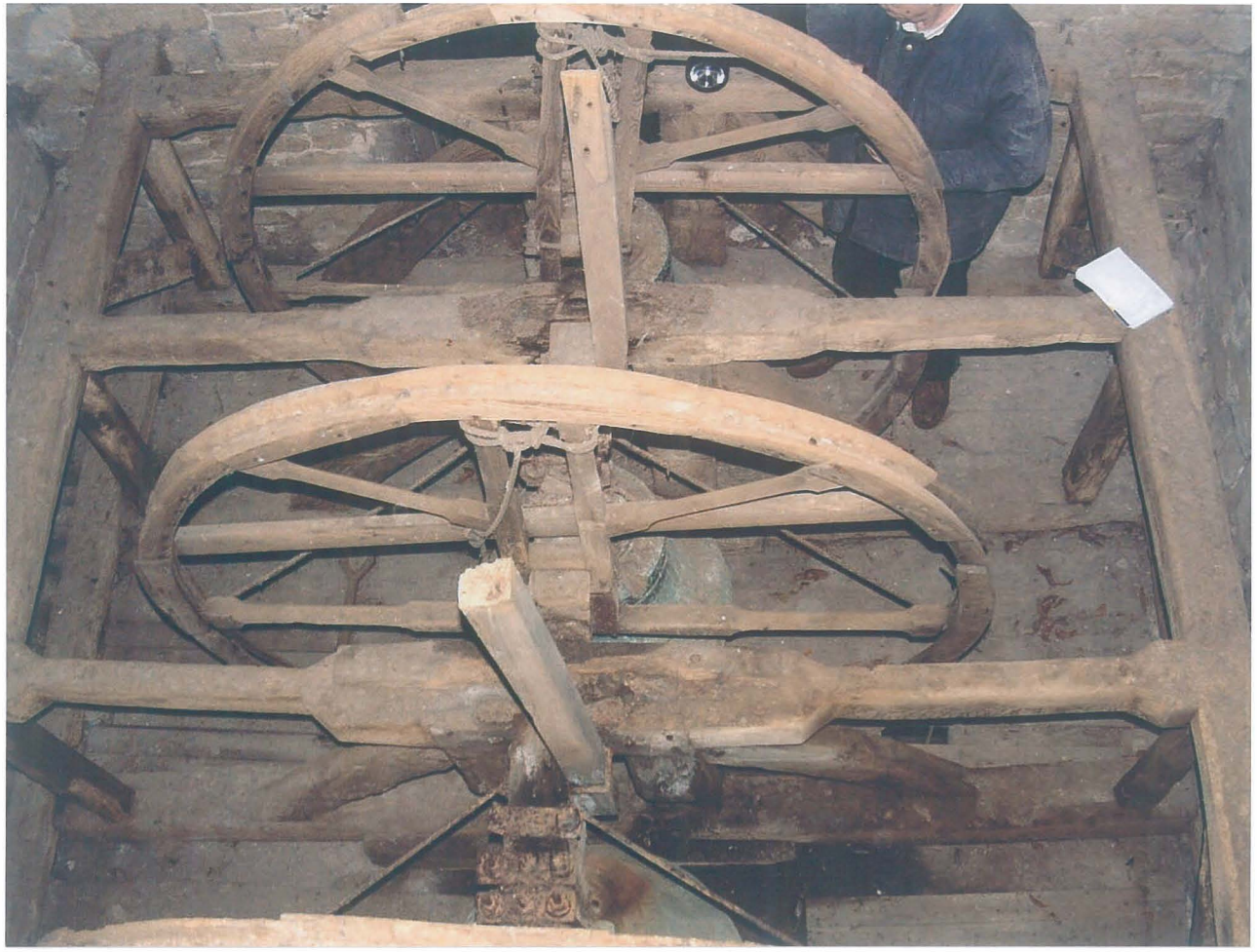


Figure 14: Church of St Denys, Goadby Marwood; plan at frame head level (George Dawson)

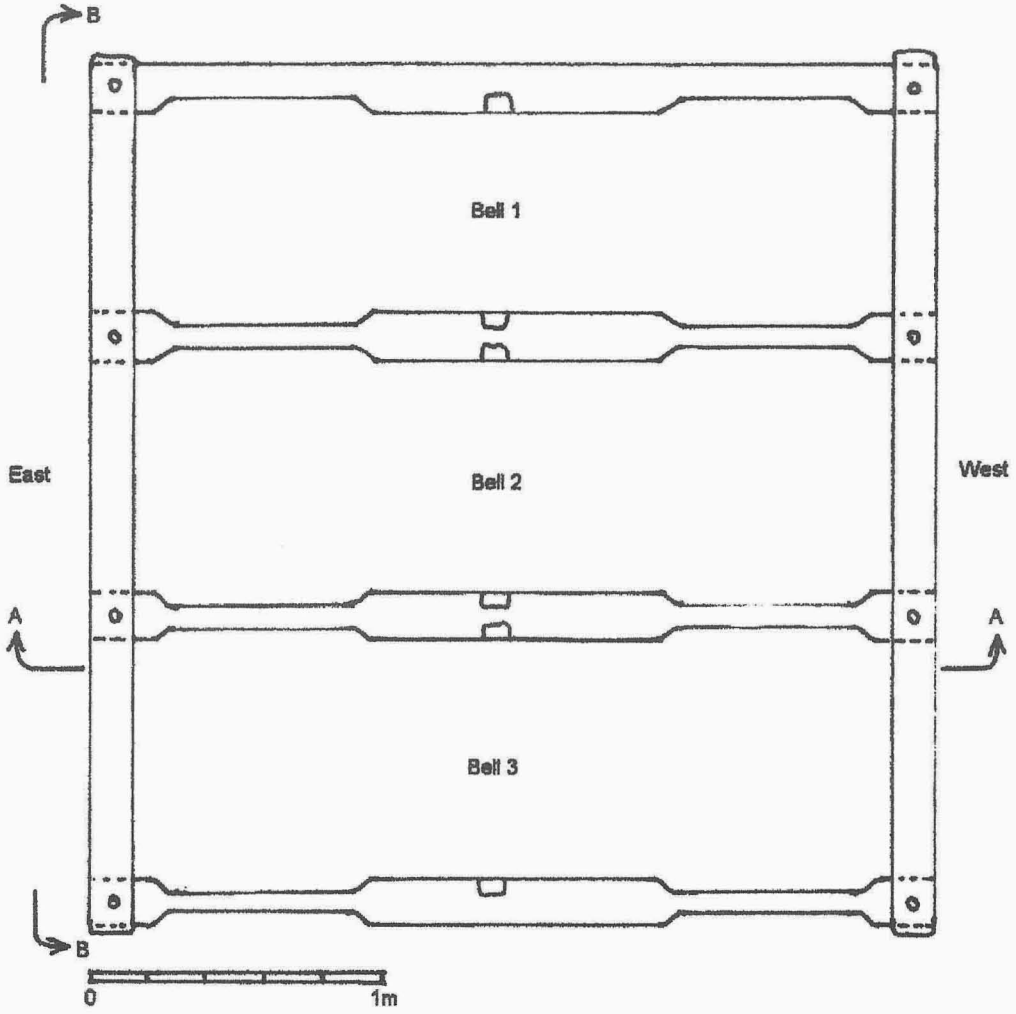


Figure 15: Church of St Denys, Goadby Marwood; section A-A (George Dawson)

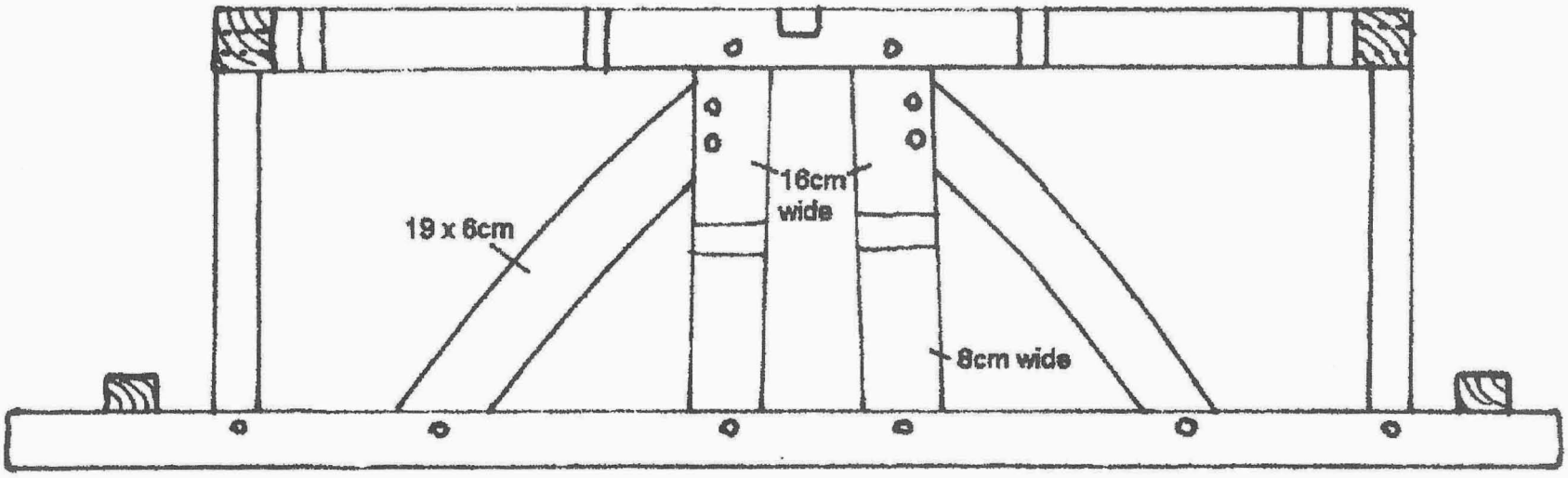
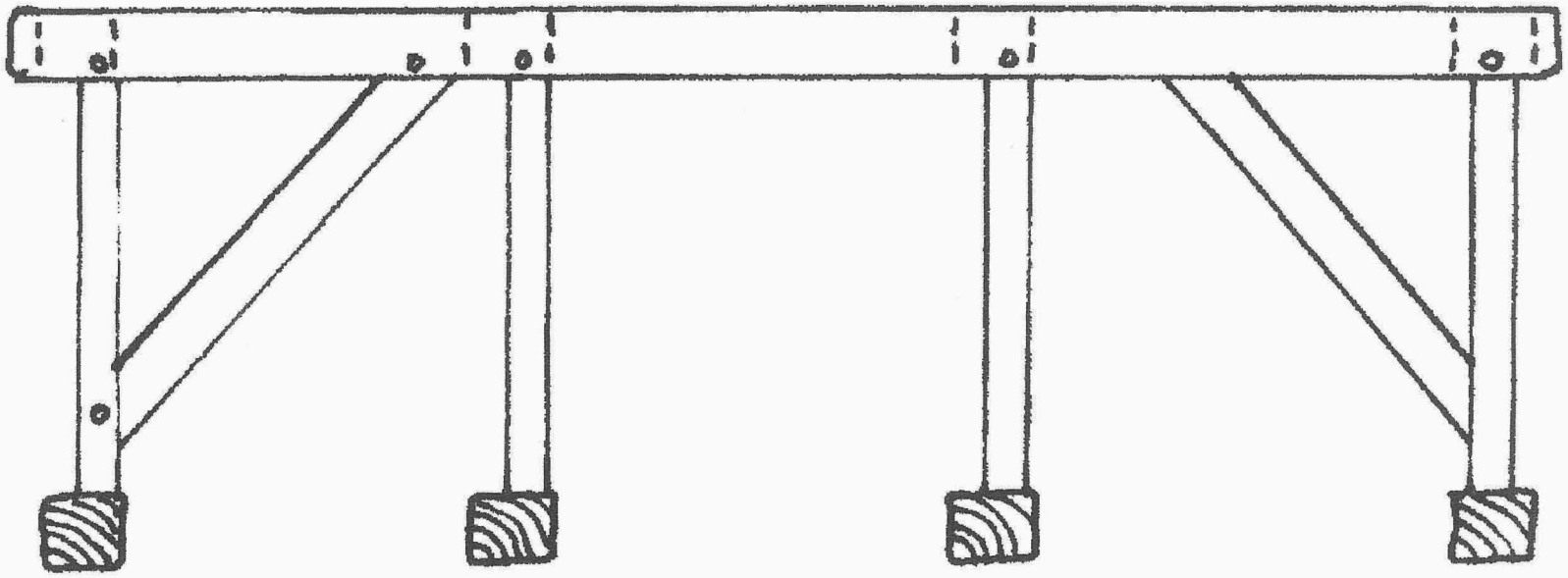


Figure 16: Church of St Denys, Goadby Marwood; section B-B, view from outside (George Dawson)



3.3
Church of St Peter, Stonesby
(SK 822 247; Figs 17-19)

Description
This pegged oak bellframe for three bells is of jack-braced design, Pickford type 6.B. It has four similar trusses, which sit on the sills of the end frames. The frame has weathered badly and, to tighten the joints, iron straps have been added at all frame head joints. At a rehanging new timbers have been set into the top sills of the frame to provide a firm surface for the new bearings.

The frame can be dated stylistically to the early-seventeenth century.

Dendrochronological assessment
When inspected for their suitability for tree-ring analysis, the timbers of the bellframe were seen to vary greatly. Overall they were not thought suitable, generally displaying a wide ring-width sequence, with it thought unlikely that many would have enough rings for successful tree-ring analysis.

Figure 17: Church of St Peter, Stonesby, plan (George Dawson)

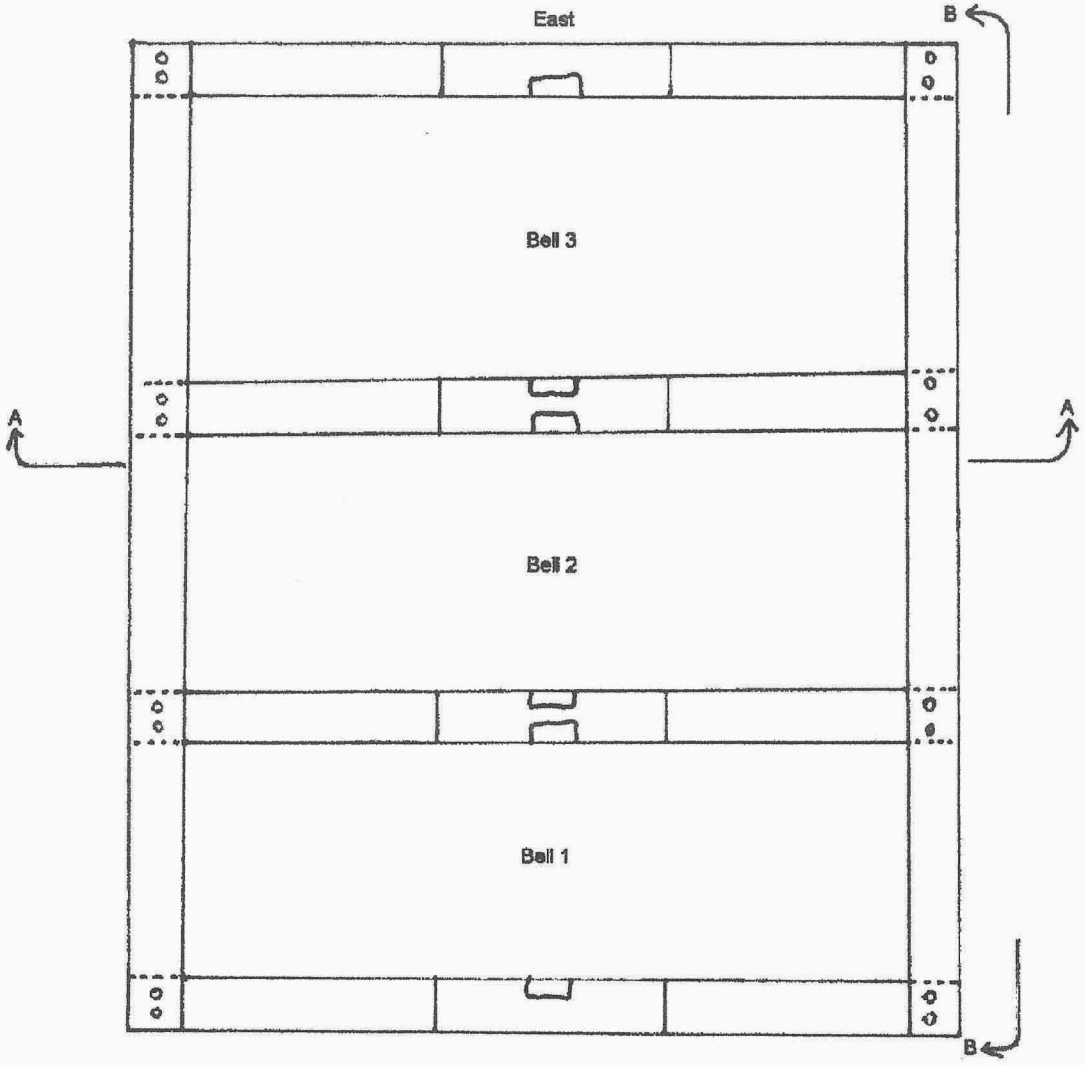


Figure 18: Church of St Peter, Stonesby, section A-A (George Dawson)

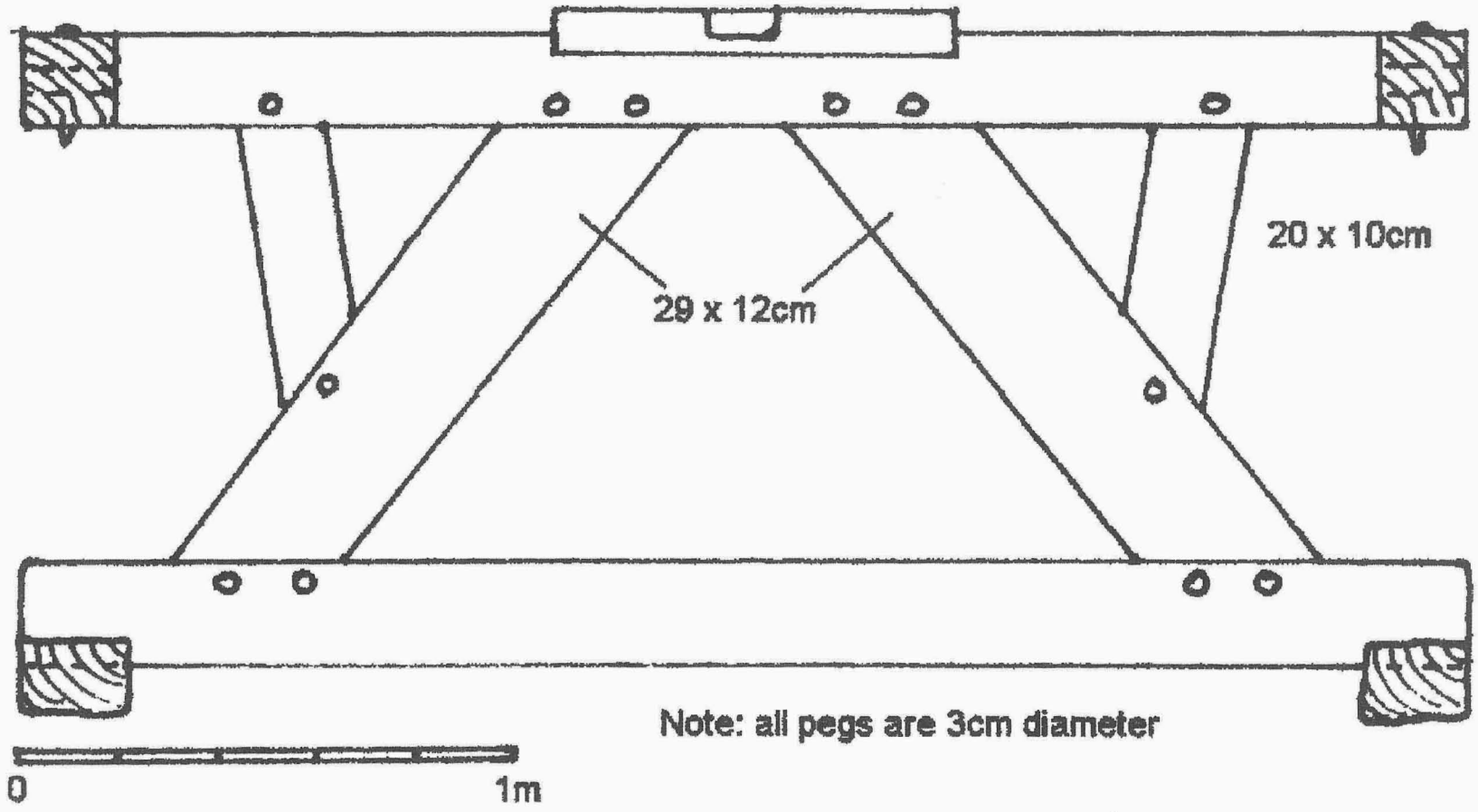
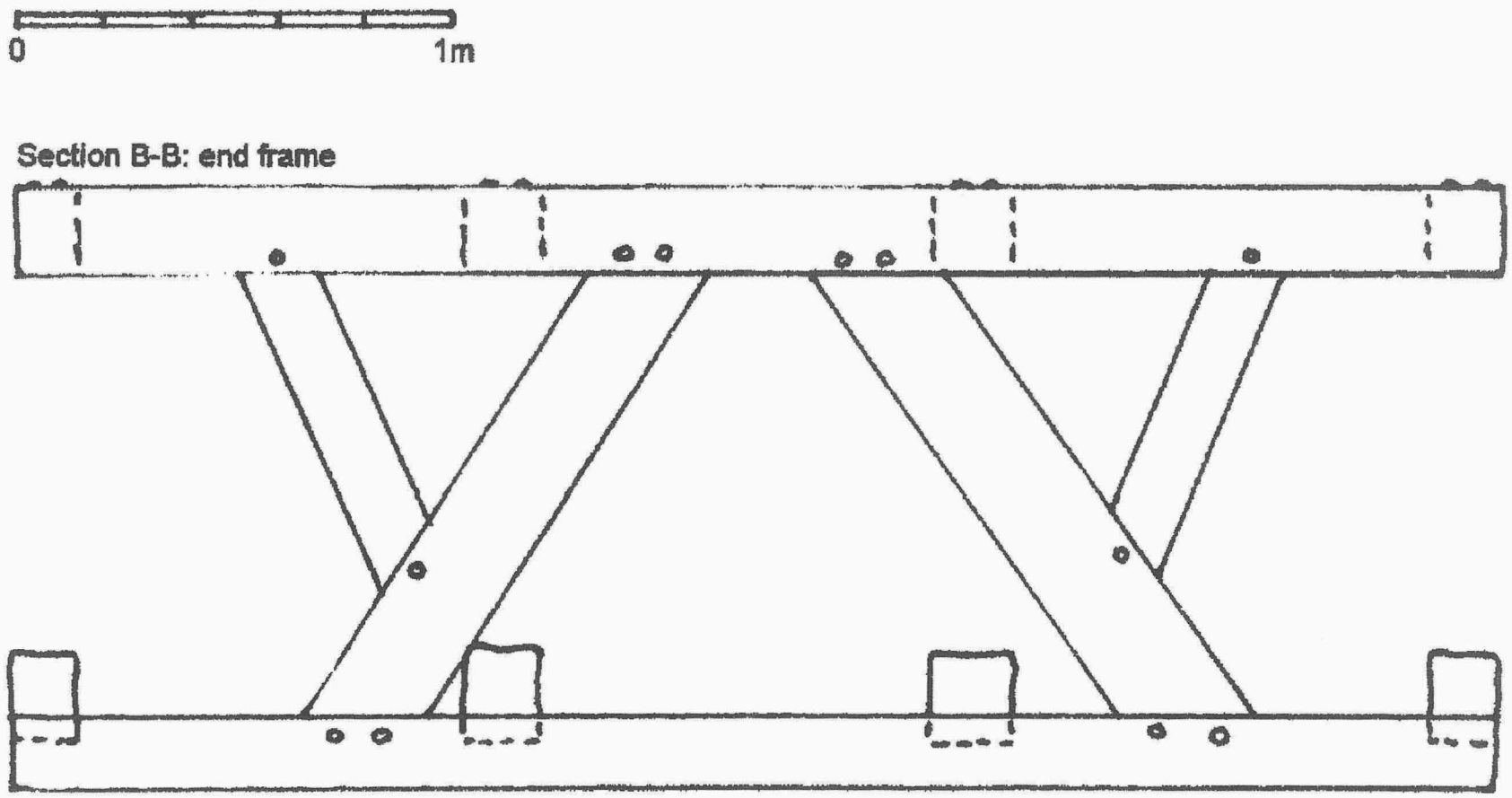


Figure 19: Church of St Peter, Stonesby, section B-B end frame (George Dawson)



3.4
Church of St James, Twycross
(SK 339 049; Figs 20-4)

Description
This three-bell frame is a typical south Leicestershire oak jack-braced frame (Pickford type 6.B). An unusual feature of this frame is that the sills of the trusses are mortised into the end frame sills (Pickford variant A.1 position 3, A.2 method 3). The end frame on the west side is similar in style to the trusses, but that on the east has no braces at all, consisting of the frame head and sills only. Some of the timbers have suffered from damage due to dampness and fabric has been lost. The bells are now not rung.

All trusses are similar in design and the frame is of one build and stylistically probably dates from the AD 1630s.

Dendrochronological assessment
Unfortunately the ring width sequence of the timber contained within the bellframe was that of fast grown trees, therefore, the timbers have an insufficient number of rings to make successful dating a possibility.

Figure 20: Church of St James, Twycross (Dr C J Brooke)

Figure 21: Church of St James, Twycross; bellframe top sills, with bell 1 in the foreground and bell 2 in the background (Dr C J Brooke)

Figure 22: Church of St James, Twycross; viewed from underneath, showing bell 3 and its trusses (Dr C J Brooke)

Figure 23: Church of St James, Twycross; plan view at frame head level (George Dawson)

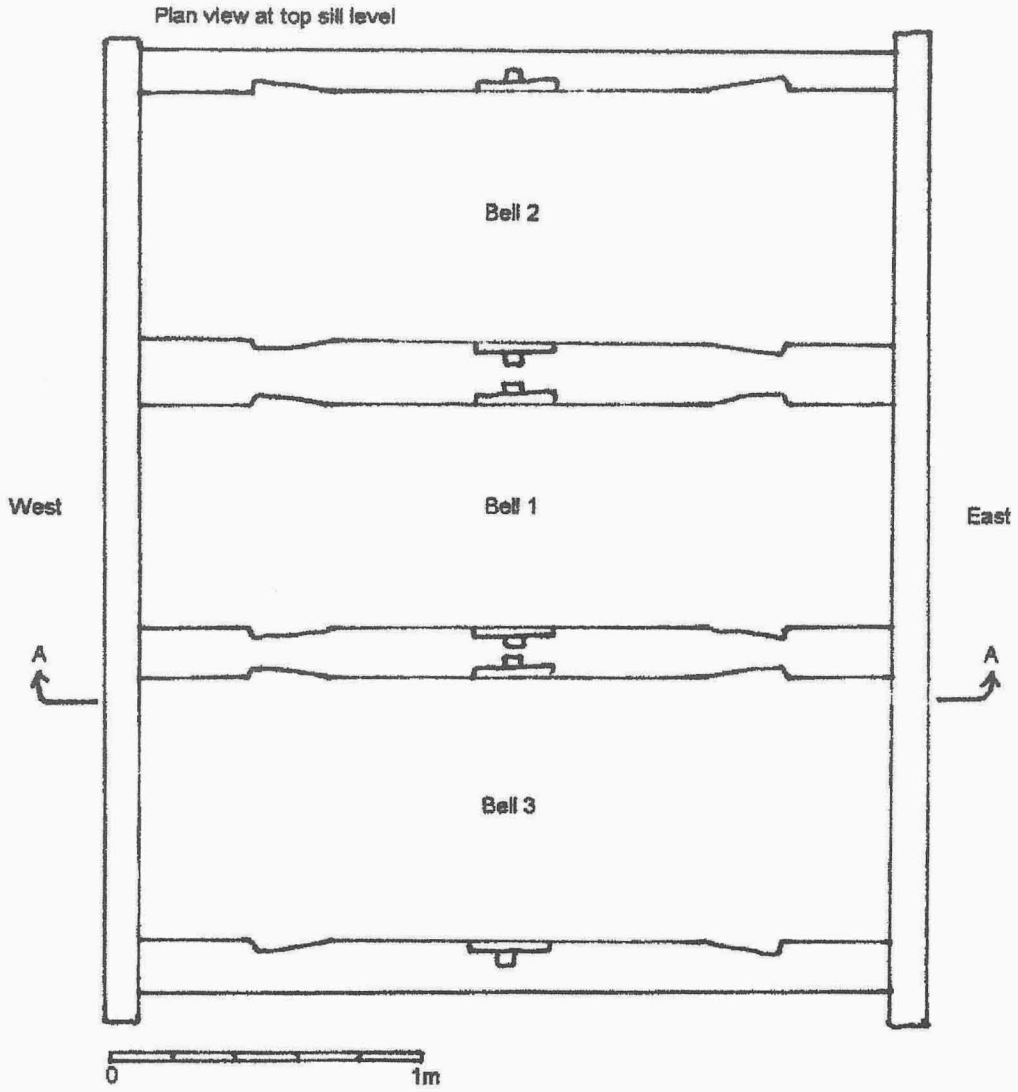
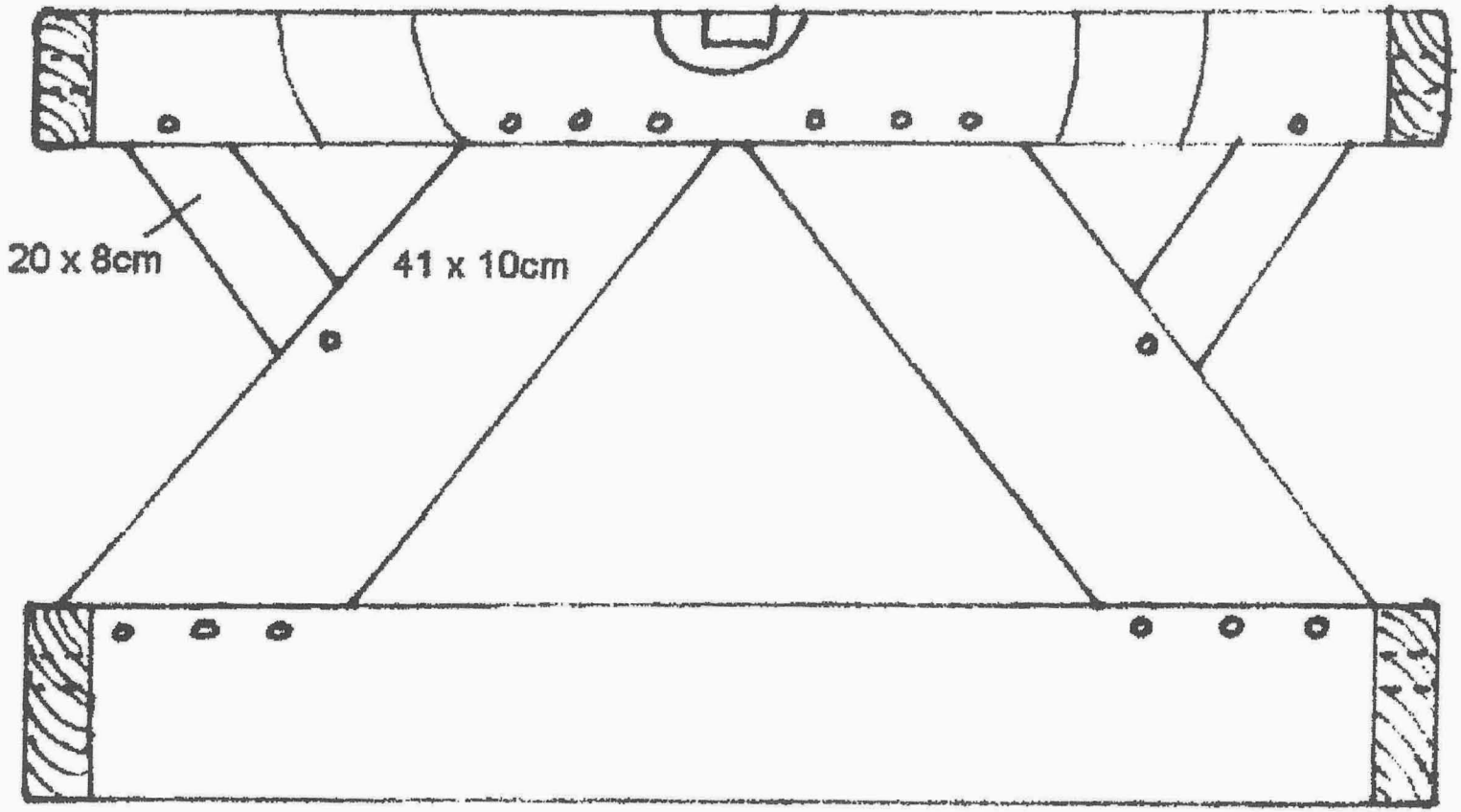


Figure 24: Church of St James, Twycross, section A-A (George Dawson)



3.5
Church of St Peter, Shackerstone
(SK 374 067; Figs 25-8)

Description
The oak bellframe for three bells is of simple braced design, Pickford type 6.A. The trusses are not substantial and unusually are pegged together with single pegs. The braces of the end frame are substantial and are probably reused as one brace has a redundant mortise in it.

Overall it is likely that the frame dates from the period when the two tenors were cast, *c* AD 1664.

Dendrochronological assessment
This bellframe appears to be of one build with no obvious use of reused or inserted timbers. From inspection of the timbers most of them are thought likely to have the minimum number of required rings needed for successful tree-ring analysis. Should a further phase of investigation be commissioned this bellframe would be amongst those recommended for sampling.

Figure 25: Church of St Peter, Shackerstone, plan (George Dawson)

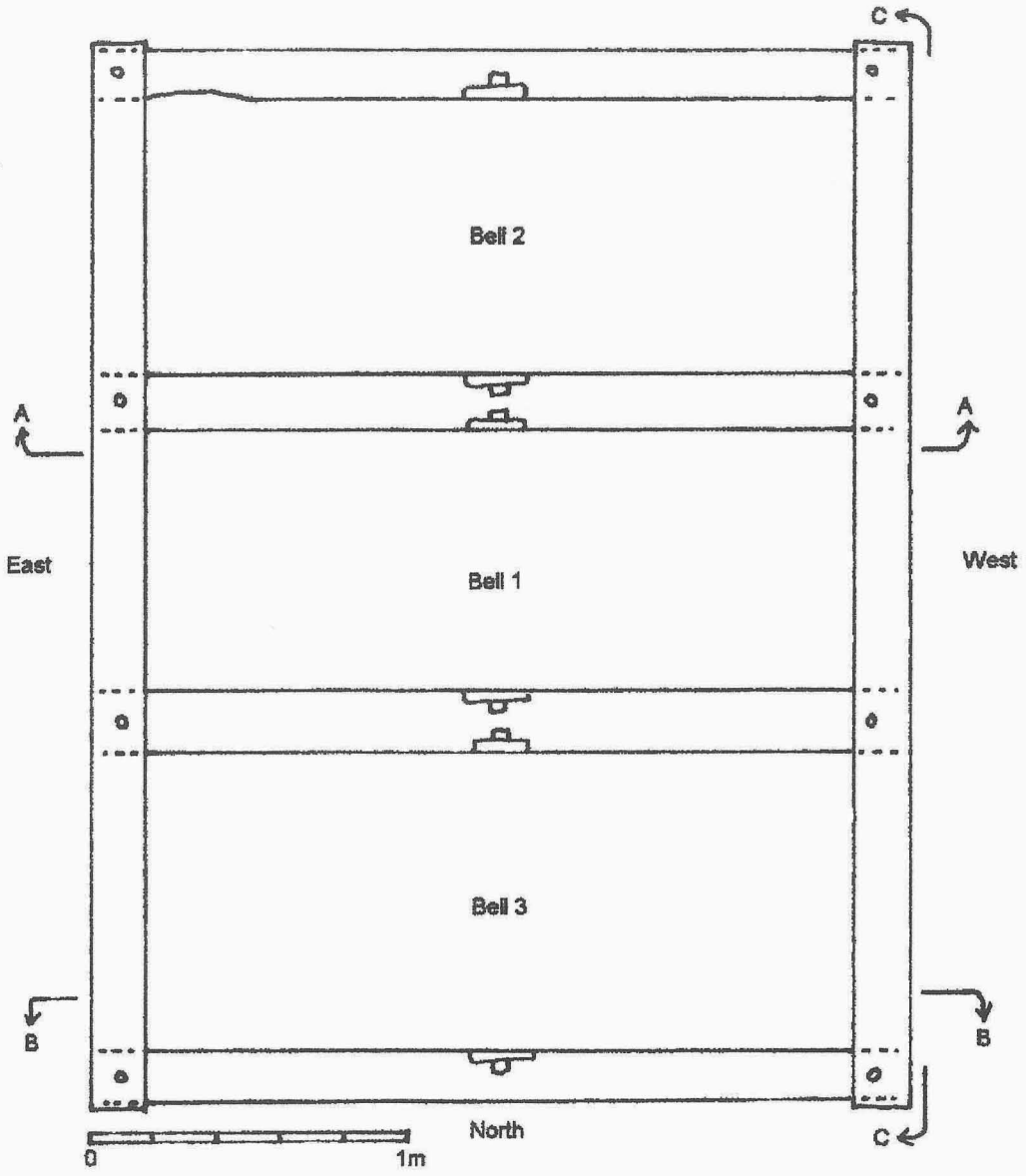


Figure 26: Church of St Peter, Shackerstone, section A-A (George Dawson)

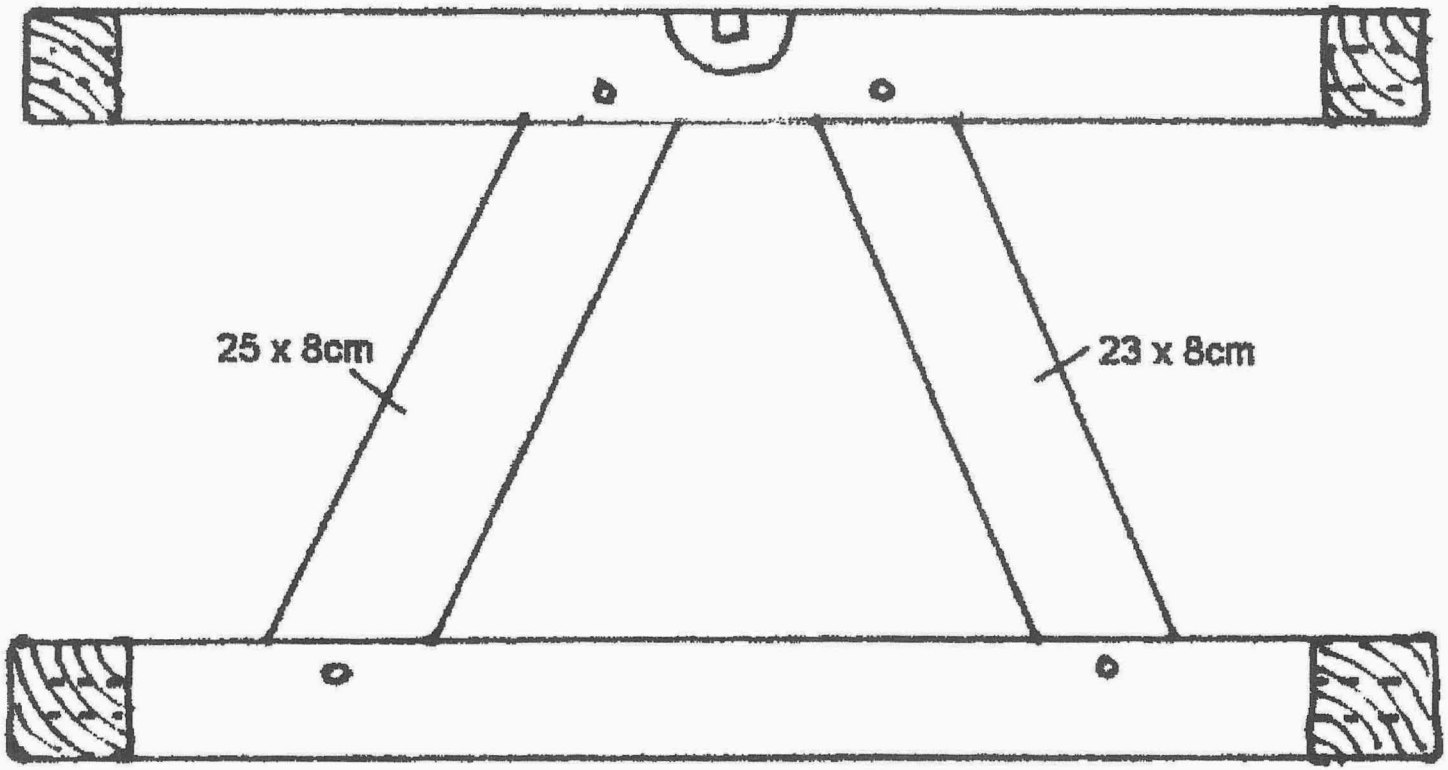


Figure 27: Church of St Peter, Shackerstone, section B-B (George Dawson)

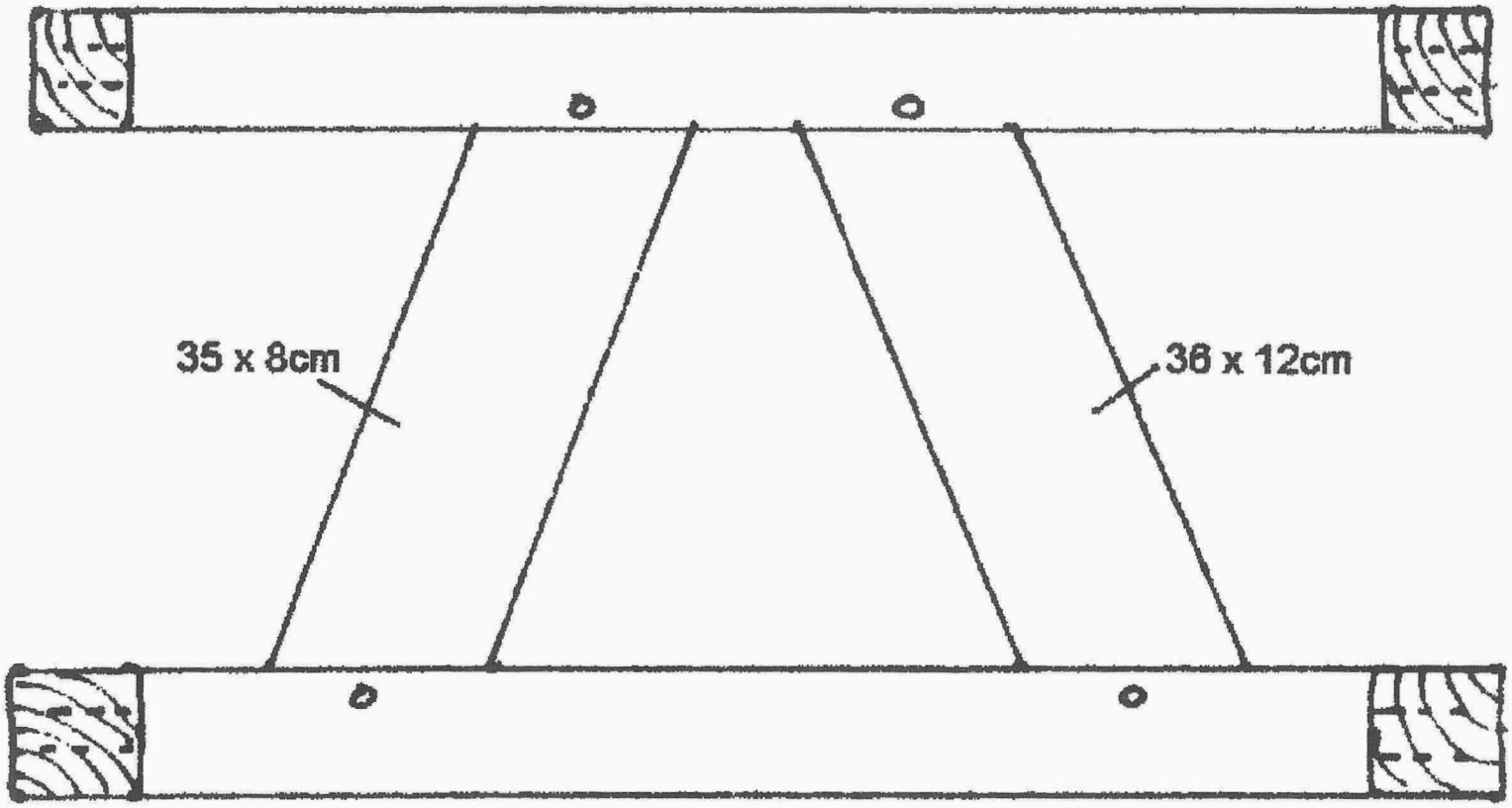
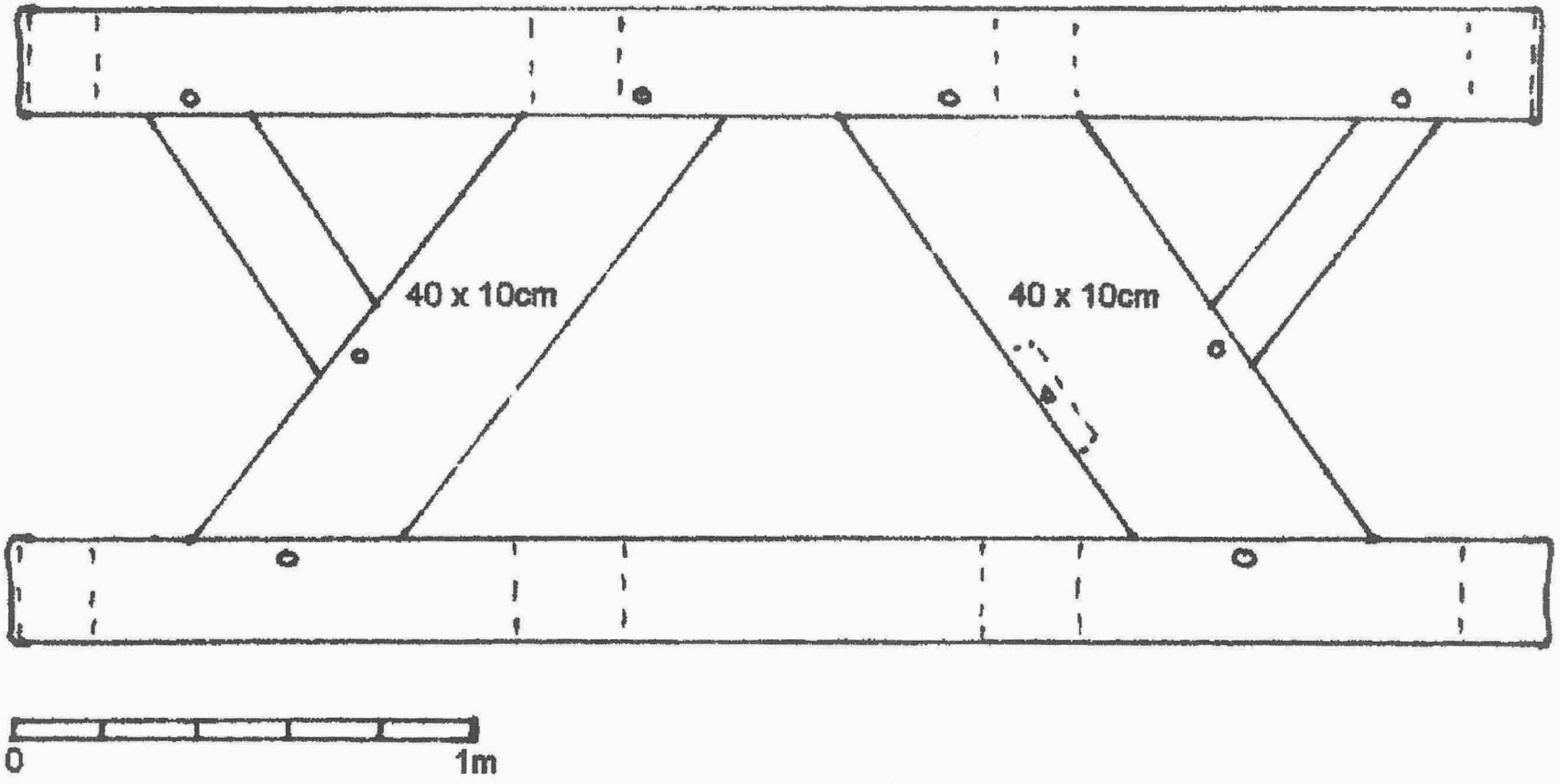


Figure 28: Church of St Peter, Shackerstone, section C-C (George Dawson)



3.6
St Edith of Polesworth Church, Orton on the Hill
(SK 303 039; Figs 29-32)

Description
The oak bellframe for four bells is of composite design, Pickford types 6.A and 6.B. There are three parallel pits orientated east-west, with a transverse pit across the east ends of the other pits. The outer trusses and end-frames are type 6.A and the two trusses between bells 2 and 3, and 3 and 4 are type 6.B. The frame is in poor condition and now disused. There are various poor quality repairs to the frame, probably dating from the nineteenth century. As the result of decay in important frame members the bells were removed from the frame in the 1960s for safety reasons.

It is likely that the frame dates from the time that three of the bells were cast, namely *c* AD 1700.

Dendrochronological assessment
Although it was difficult to see the growth pattern of these timbers they were thought to be wide ringed, with insufficient numbers for successful dating.

Figure 29: St Ediths of Polesworth Church, Orton, sketch plan (not to scale) (George Dawson)

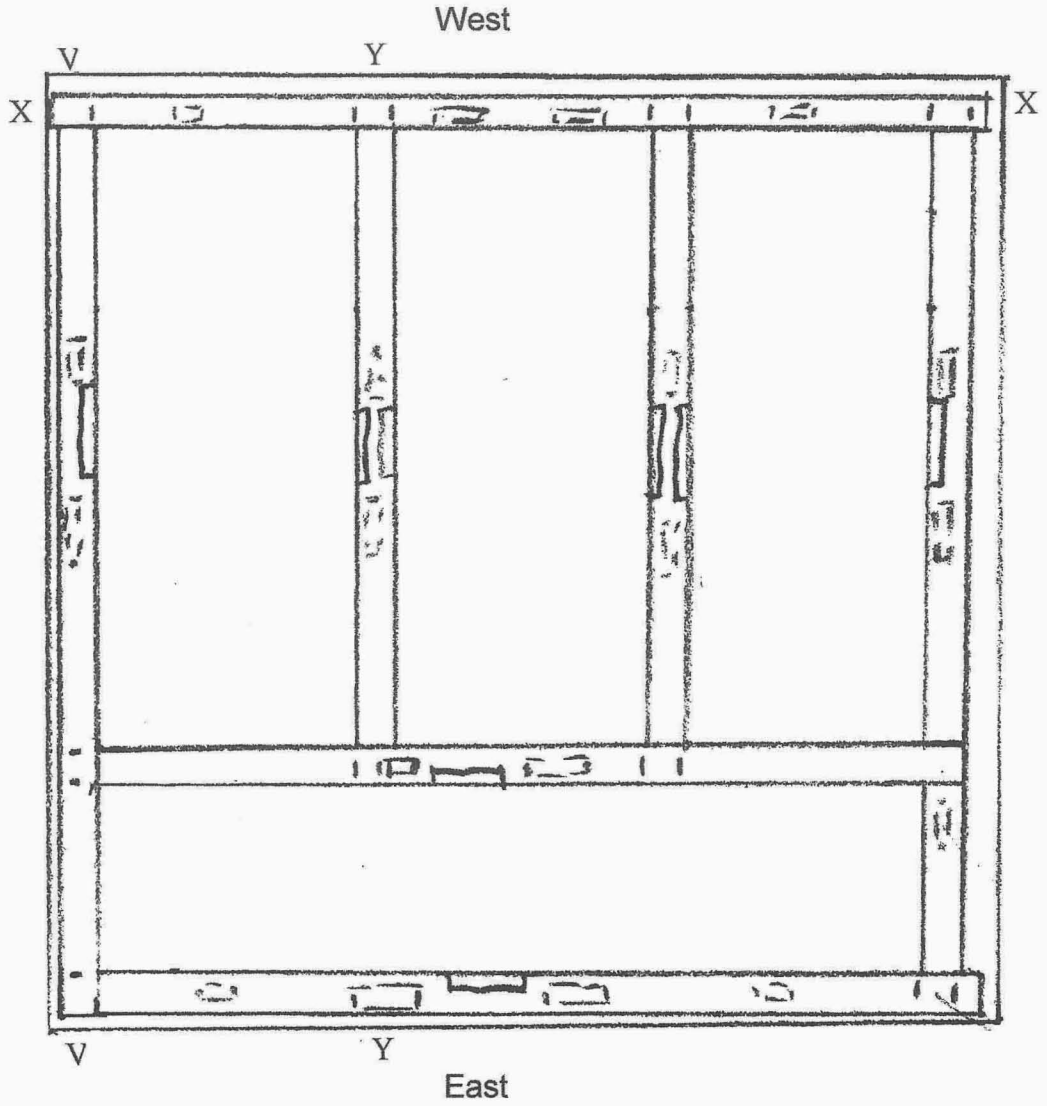


Figure 30: St Edith of Polesworth Church, Orton-on-the-Hill, section X-X (not to scale) (George Dawson)

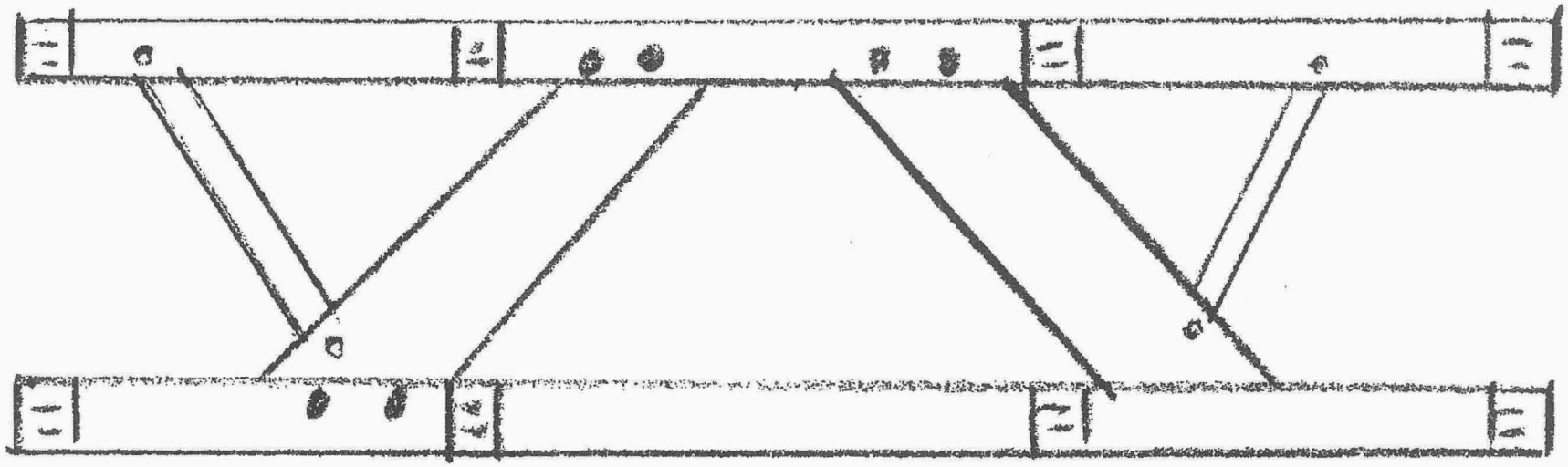


Figure 31: St Edith of Polesworth Church, Orton-on-the-Hill, section V-V (not to scale) (George Dawson)

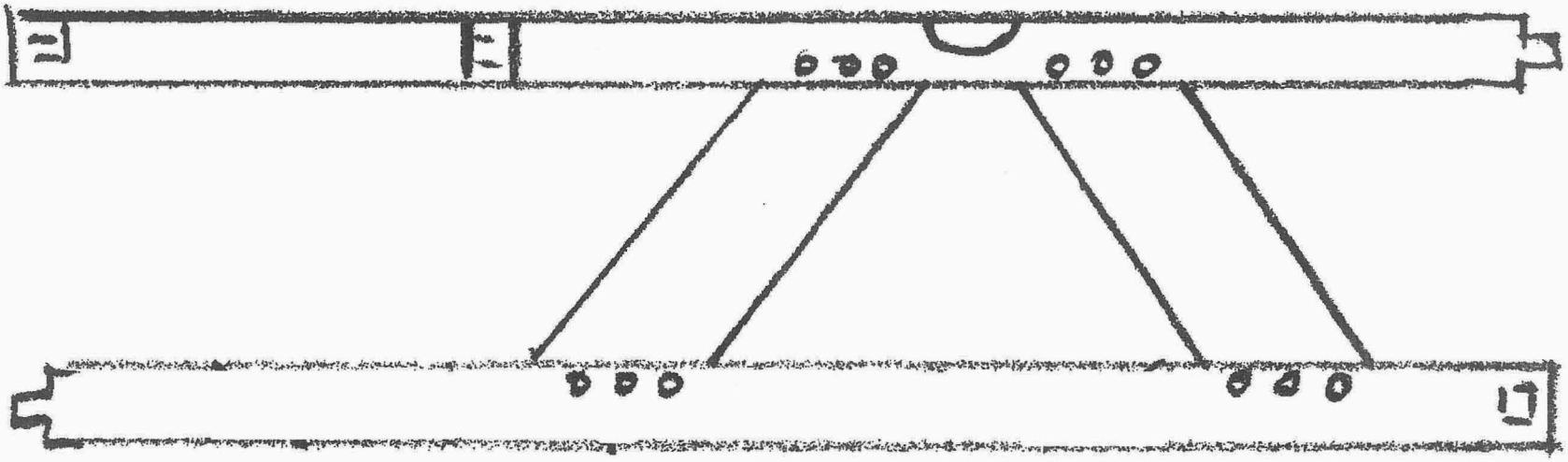
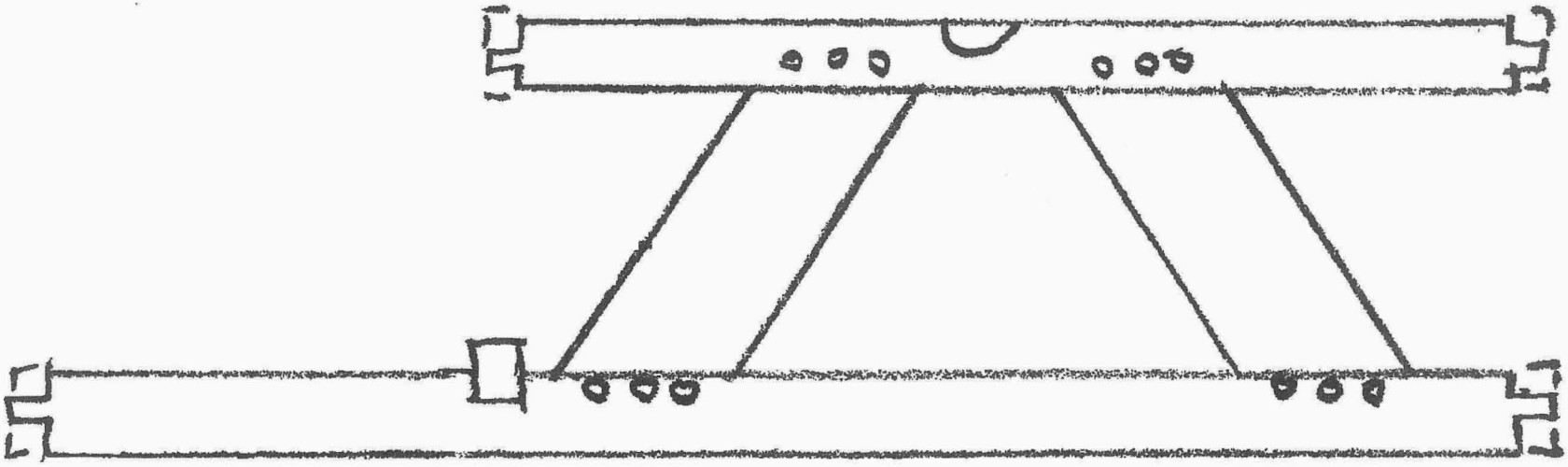


Figure 32: St Ediths of Polesworth Church, Orton-on-the-Hill, section Y-Y (not to scale) (George Dawson)



4. Analysis

On the grounds outlined in the introduction all assessed bellframes were graded on their suitability for tree-ring analysis. The 12 frames thought most likely to produce relevant and useful dates were then sampled. Each section begins with a description of the bellframe, including the expected date on stylistic or documentary grounds. This is followed by information relating to the sampling undertaken, the analysis, and results gained. Drawings on which the timbers sampled have been marked and further details of all samples are to be found in the relevant tables and figures in each site section. The location of all churches can be found on Figure 1, the map of Leicestershire. The data of all measured samples can be found at the end of the report (Section 8). The bellframe description is based on information provided by George Dawson, who also produced the drawings. Information on the bells can be found in section 10.

4.1
Church of St Andrew, Welham (LBF-A)
(SPP 477 293; Figs 33-9)

Description
The bell chamber contains two bells hung in a pegged frame of jack-braced design, Pickford type 6.B. It has three trusses, referred to here as A, B, and C (with B the northernmost and C the southernmost). The eastern end frame is clearly cut down from a wider unit. There were originally three bells so the implication is that there were three parallel pits, the southern most one of which has been removed. The western end frame is similar in general design, but there are extra timbers. The frame head of the frame has been partially cut away to allow the bells to swing up.

Stylistically the frame has been dated to the early-seventeenth century.

Sampling, Analysis, and Results
Fifteen core samples were taken from frame heads, sills, braces, and jack braces (Table 1; Figs 34-8). Truss B (Fig 35) does not have any jack braces. At a least value of t=4.5 all 15 samples grouped and site sequence LBFASQ01, of 191 rings, was constructed containing these samples at the offsets shown in the bar diagram (Fig 39). This site sequence was successfully matched against the relevant reference chronologies for oak at a first-ring date of AD 1443 and a last-ring date of AD 1633. The evidence for this dating is given by the t-values in Table 2.

Interpretation
Analysis of samples from the timbers of this bellframe has resulted in the production of one dated site sequence, containing all 15 samples. This site sequence, of 191 rings, was dated to the period AD 1443-1633. One of the samples, LBF-A05 has complete sapwood and a last-ring date of AD 1633. When this sample is looked at closely under the microscope it is possible to see the start of the spring growth cells of the following year. Therefore, the timber from which this sample is taken was felled in spring AD 1634. Thirteen

other samples in this site sequence have the heartwood/sapwood boundary ring, the average of which is AD 1608. Allowing for sample LBF-A08 having the last ring date of AD 1630, it is possible to calculate an estimated felling date for the timbers represented to within the range AD 1631-43, also consistent with an AD 1634 felling. The final sample in this site sequence, LBF-A15, does not have the heartwood/sapwood boundary ring, but with a last measured ring date of AD 1560 this is estimated to be AD 1576 at the earliest, again not inconsistent with a felling of AD 1634.

Discussion

Tree-ring analysis has resulted in the successful dating of 15 timbers of the bellframe. It is now known that one timber used in the construction of this structure was felled early in AD 1634, with at least a further 13 (and probably 14) also being quite likely to have been felled at this time.

The high degree of matching that occurs between many of these samples suggests that, in the main, trees from a single source were utilised. In some cases the *t*-values between samples are so high as to suggest that a number of beams come from the same tree; LBF-A10 matches LBF-A15 at t=14.4, and LBF-A02 at t=14.1 (the overlap between LBF-A02 and LBF-A15 is not great which is possibly why they do not match each other highly).

Table 1: Details of tree-ring samples from timbers of the bellframe of the Church of St Andrew, Main Street, Welham, Leicestershire

Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Last heartwood ring date (AD)	Last measured ring date (AD)
LBF-A01	Frame head, truss C-C	130	h/s	1479	1608	1608
LBF-A02	South jack brace, west end frame (E-E)	63	h/s	1545	1607	1607
LBF-A03	Sill, truss B-B	68	h/s	1542	1609	1609
LBF-A04	East brace, truss B-B	101	h/s	1509	1609	1609
LBF-A05	Frame head, east end frame (D-D)	170	22C	1464	1611	1633
LBF-A06	East jack brace, truss C-C	49	01	1559	1606	1607
LBF-A07	Sill, west end frame (E-E)	178	11	1443	1609	1620
LBF-A08	West brace, truss B-B	82	23	1549	1607	1630
LBF-A09	North jack brace, west end frame (E-E)	77	17	1548	1607	1624
LBF-A10	Frame head, truss A-A	150	16	1474	1607	1623
LBF-A11	Sill, truss A-A	140	09	1477	1607	1616
LBF-A12	Sill, truss C-C	139	22	1490	1606	1628
LBF-A13	South brace, west end frame (E-E)	64	18	1566	1611	1629
LBF-A14	East brace, truss A-A	92	h/s	1521	1612	1612
LBF-A15	West brace, truss C-C	106	--	1455	----	1560

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

Table 2: Results of the cross-matching of site sequence LBFASQ01 and relevant reference chronologies when the first-ring date is AD 1443 and the last-ring date is AD 1633

Reference chronology	*t*-value	Span of chronology	Reference
East Midlands	10.0	AD 882-1981	Laxton and Litton 1988
England	7.8	AD 404-1981	Baillie and Pilcher 1982 unpubl
Nun Appleton Hall, Tadcaster, Yorks	10.9	AD 1478-1657	Howard *et al* 1995b unpubl
Bolsover Castle (riding house), Derbyshire	10.2	AD 1494-1744	Arnold *et al* forthcoming
Frith Hall Farm, Brampton, Derbys	8.8	AD 1480-1602	Howard *et al* 1993
Manor House, Alford, Lincs	8.4	AD 1500-1611	Arnold *et al* 2003a
Staunton Harold (church pews), Leics	8.3	AD 1508-1661	Howard *et al* 1996a

Figure 33: Church of St Andrew, Welham, Bellframe; plan (George Dawson)

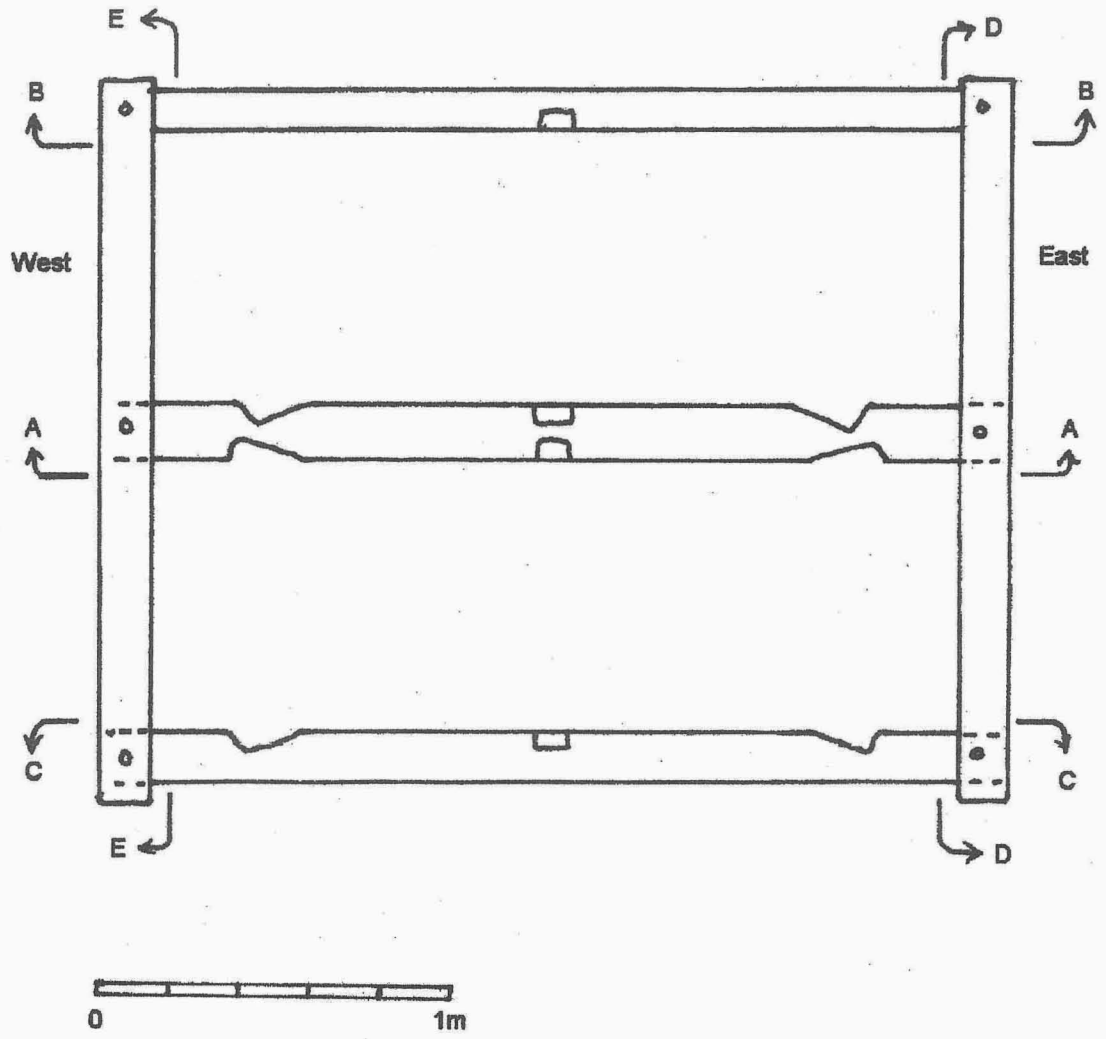


Figure 34: Church of St Andrew, Welham, bellf-frame; truss A-A, showing the location of samples LBF-10-11, and LBF-14 (George Dawson)

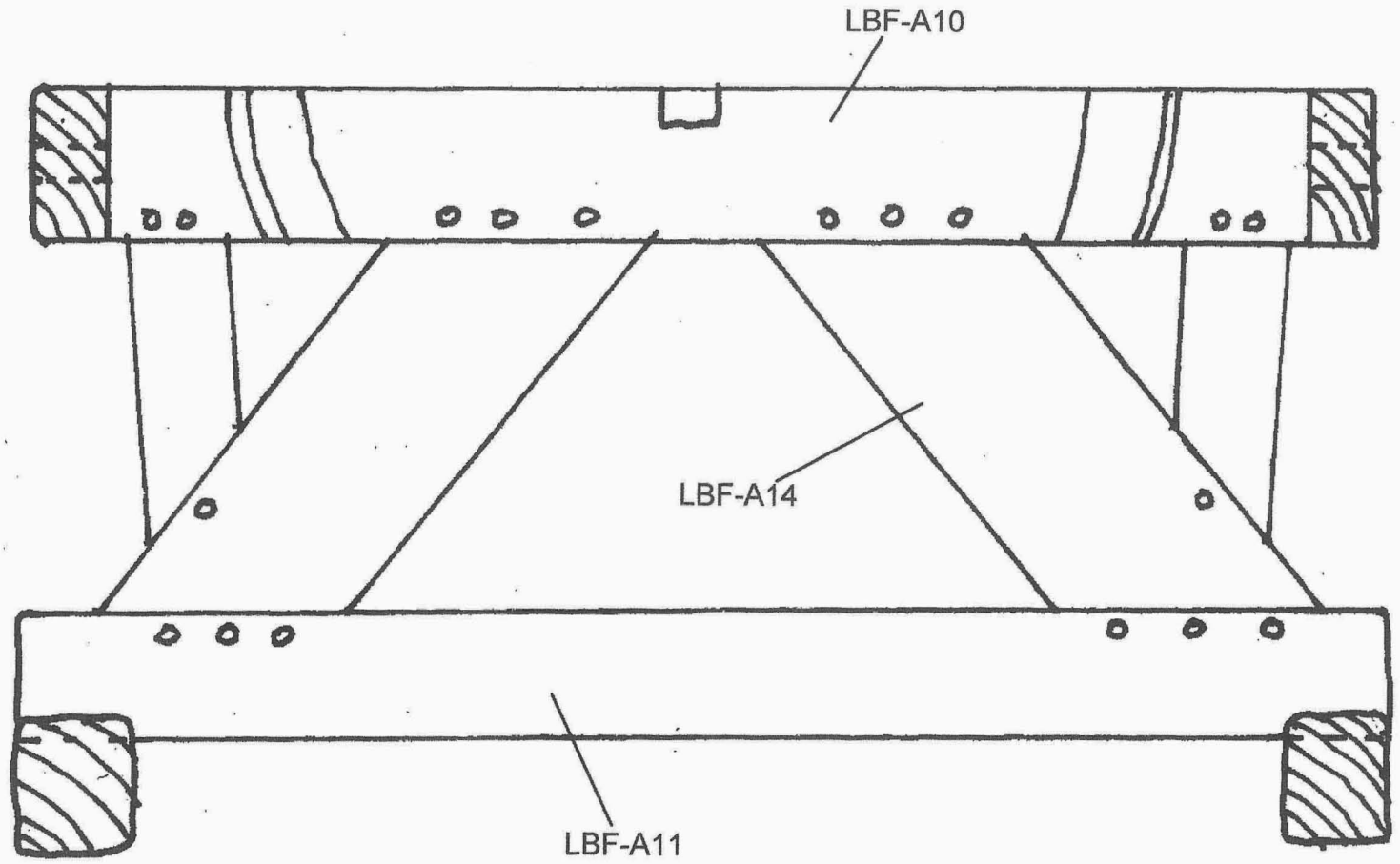


Figure 35: Church of St Andrew, Welham, bellframe; truss B-B, showing the location of samples LBF-A03-04, and LBF-A08 (George Dawson)

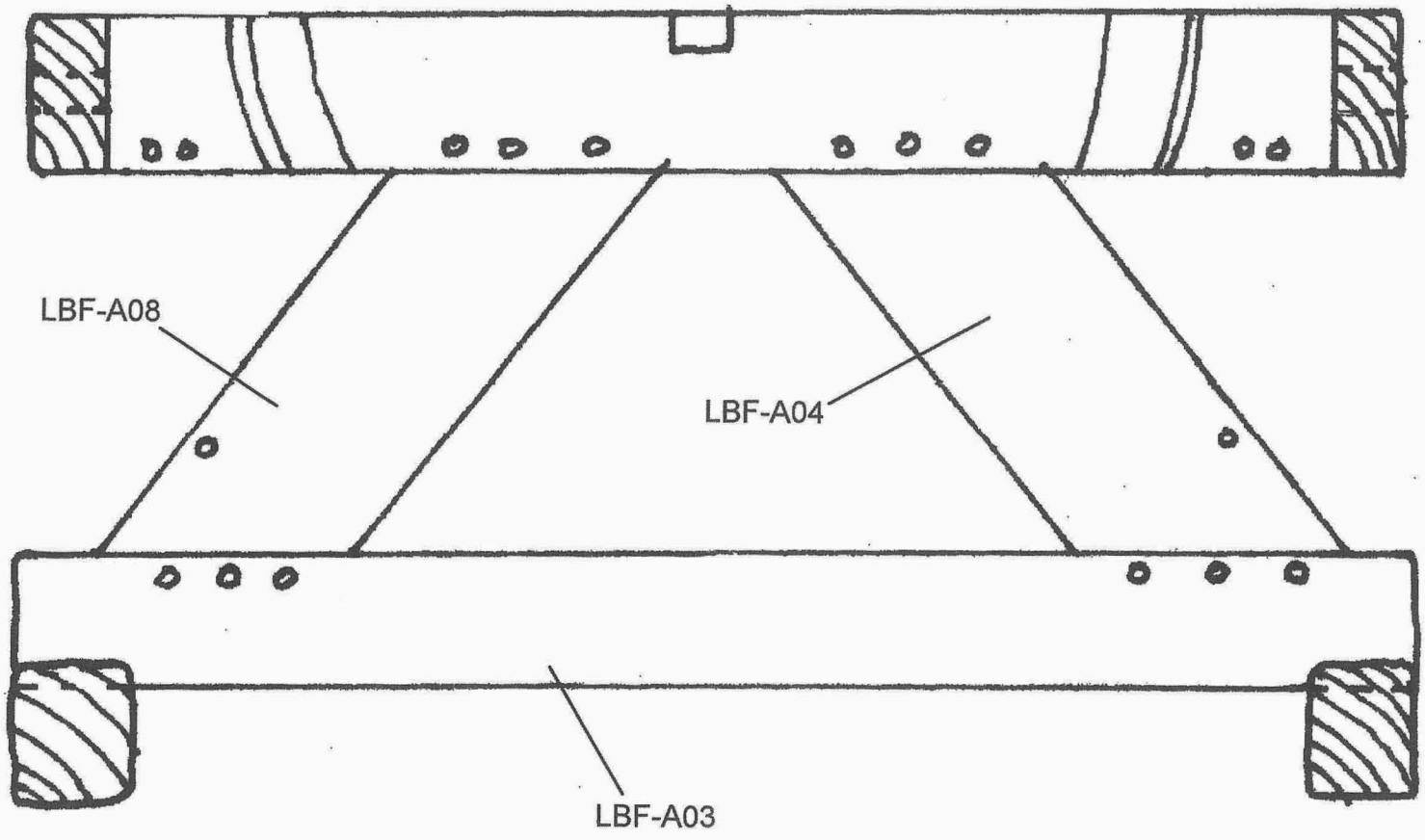


Figure 36: Church of St Andrew, Welham, bellframe; truss C-C, showing the location of samples LBF-A01, LBF-A06, LBF-A12, and LBF-A15 (George Dawson)

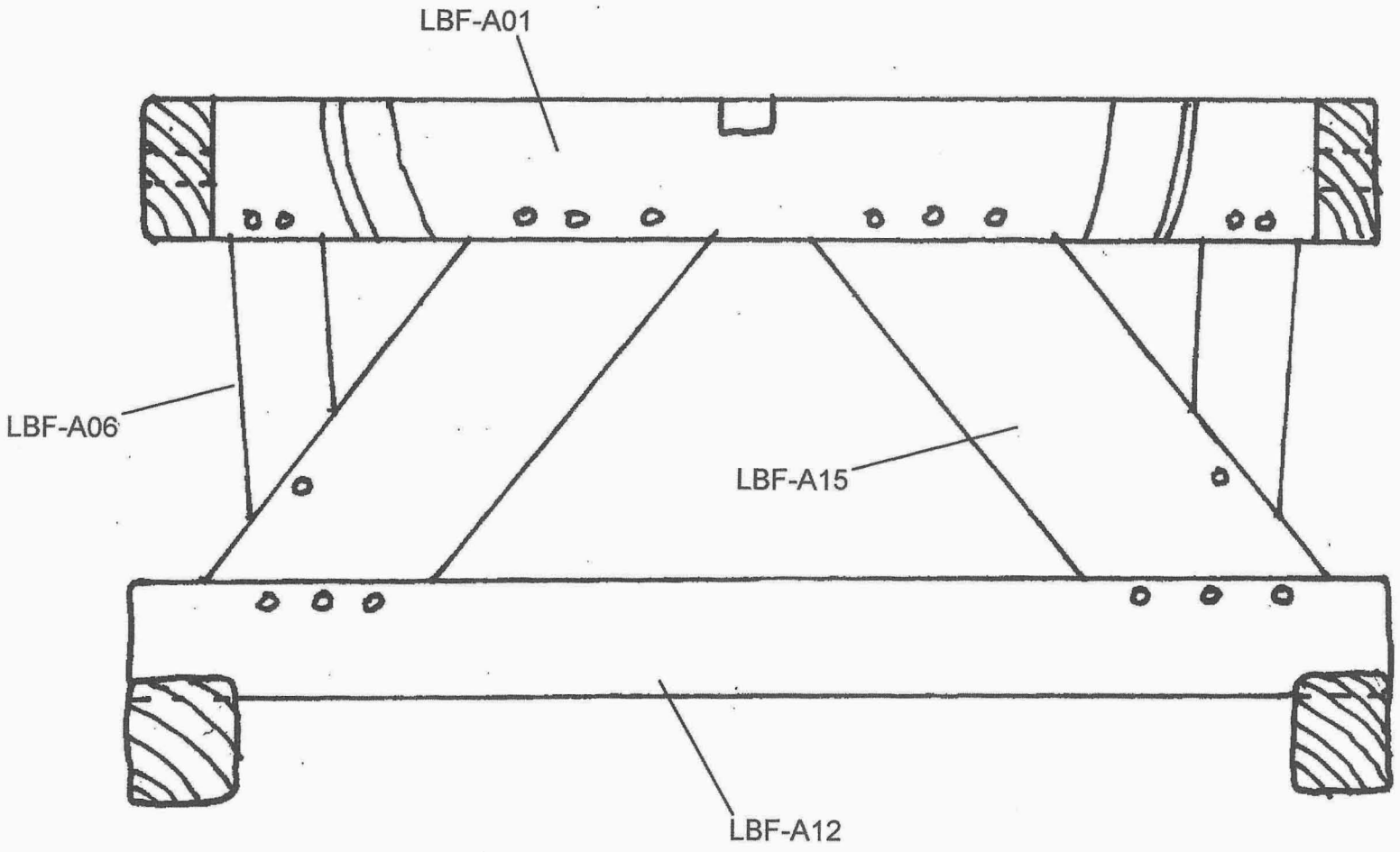


Figure 37: Church of St Andrew, Welham, bellframe; east end frame, showing the location of sample LBF-A05 (George Dawson)

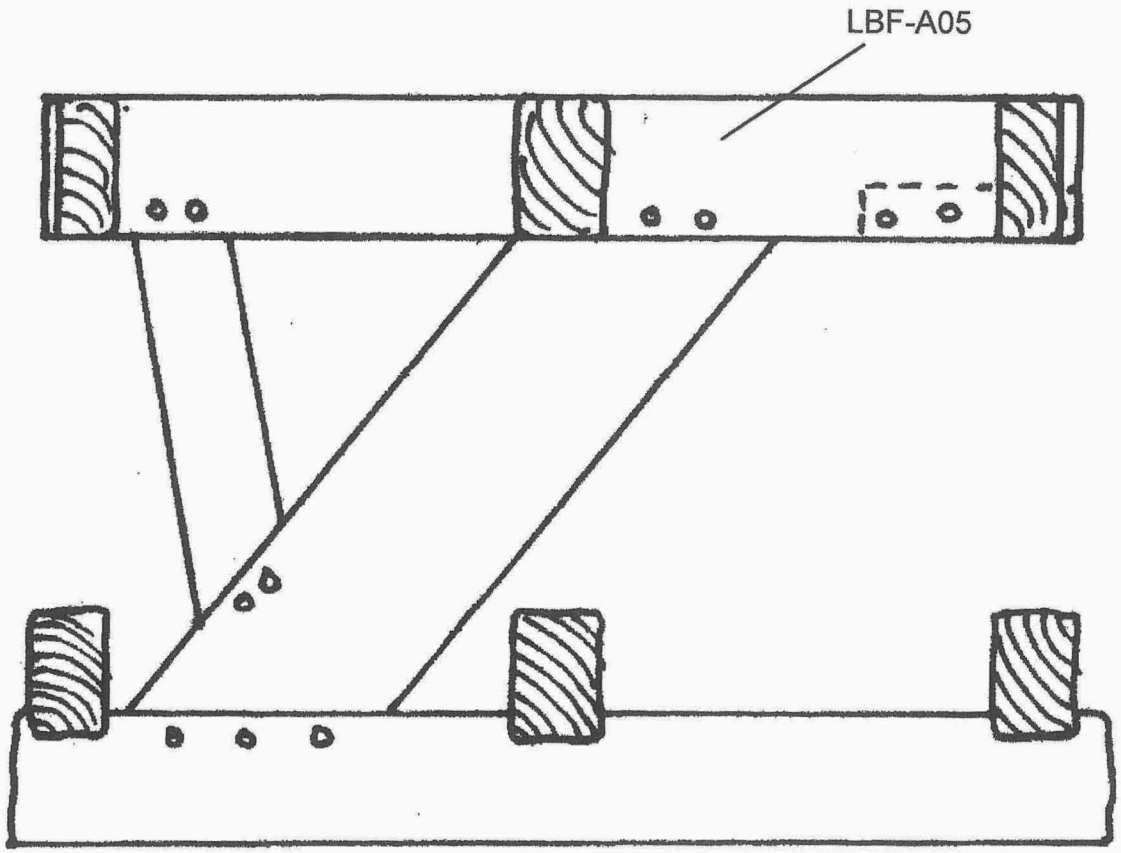


Figure 38: Church of St Andrew, Welham, bellframe; west end frame, showing the location of samples LBF-A02, LBF-A07, LBF-A09, and LBF-A13 (George Dawson)

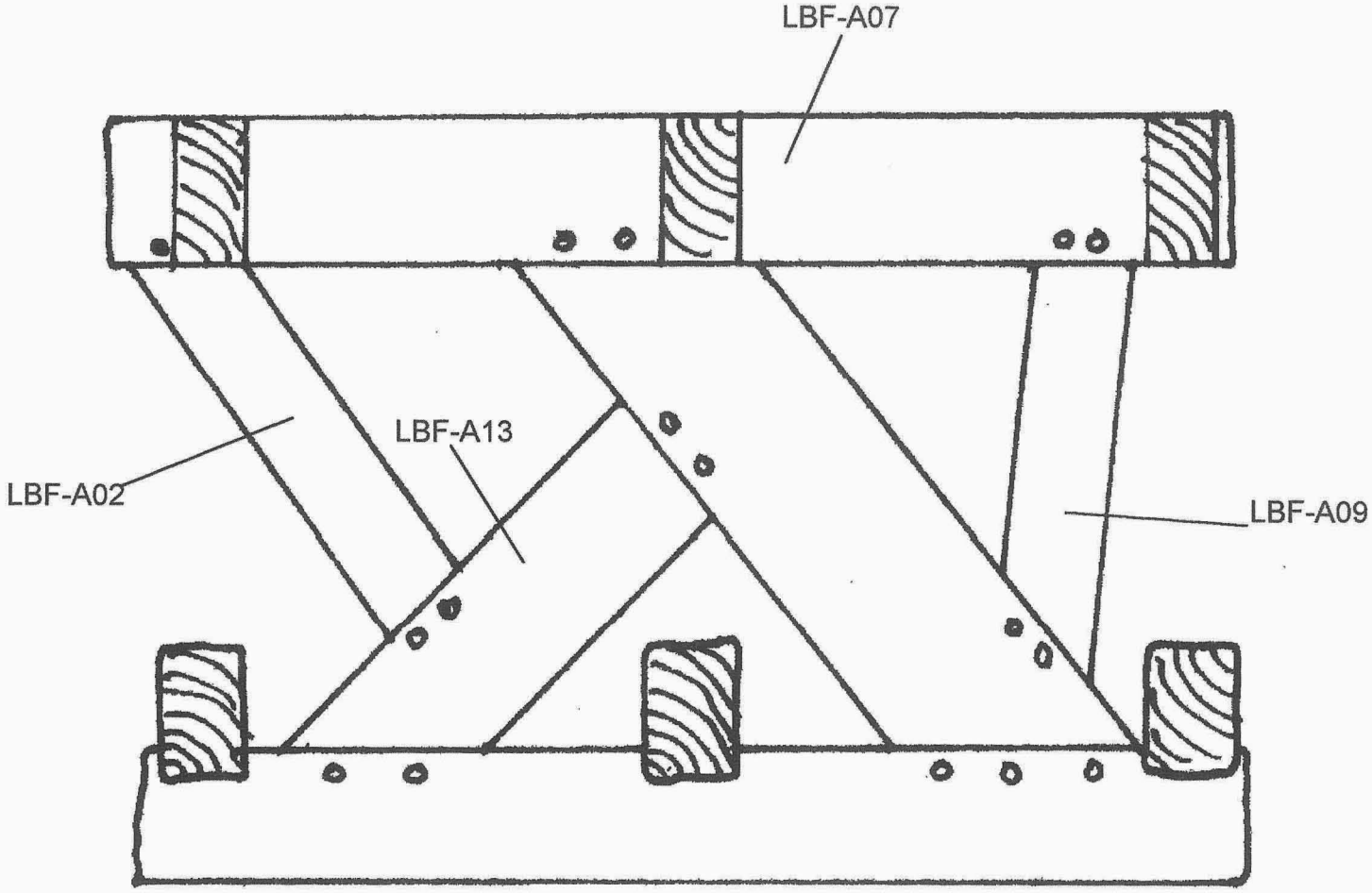
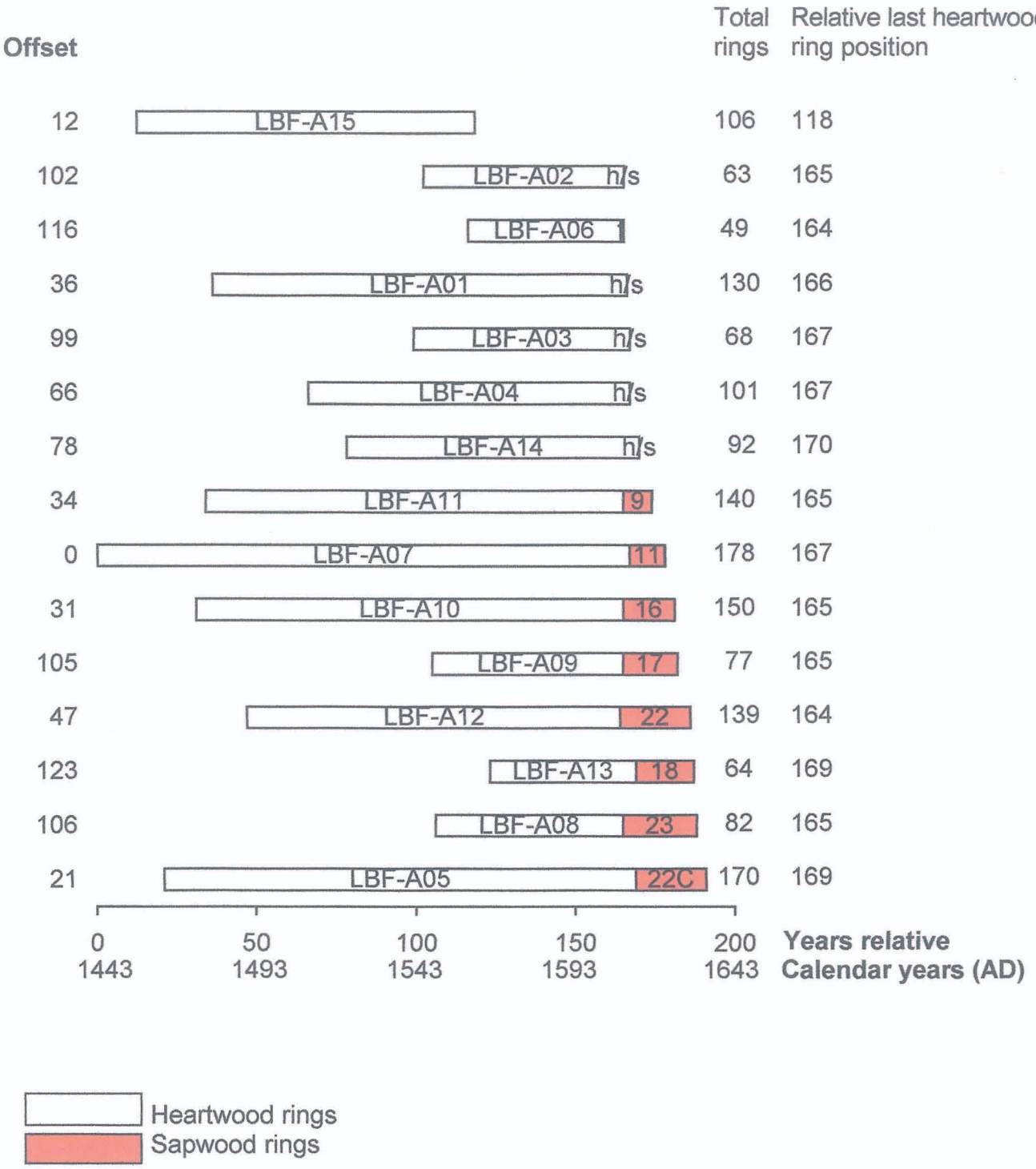


Figure 39: Bar diagram of samples in site sequence LBFASQ01



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

4.2
Church of St Michael, Rearsby (LBF-B)
(SK 651 145; Figs 41-8)

Description
This oak frame for three bells has four trusses, and is of jack-braced design, Pickford type 6.B. The two outer trusses are similar, and are joined to the end frames at both frame head and sill with mortise and tenons. The two central truss sills are lap jointed to the bottom end gate sills. All trusses have carpenters marks, all joints on the south truss being marked I, those on the adjacent truss II, and so on. The marking out for joints is also clearly discernible. These trusses are referred to here as F, E, B, and A (from north to south).

The braces are less substantial than on some frames, which lead to the conclusion it was built in the early-to-mid eighteenth century.

Sampling, Analysis, and Results
Core samples were taken from fifteen different timbers, from frame heads, sill, braces, and jack braces (Table 3; Figs 41-6). Two of the samples (LBF-B08 and LBF-B09) were seen to have too few rings for secure dating. Analysis of the remaining 13 samples resulted in eight samples forming three groups.

Three samples matched and site sequence LBFBSQ01, of 88 rings, was constructed containing these samples at the offsets shown in the bar diagram (Fig 47). This site sequence was successfully matched against the relevant reference chronologies for oak at a first-ring date of AD 1606 and a last-ring date of AD 1693. The evidence for this dating appears in Table 4.

A further three samples matched and site sequence LBFBSQ02, of 62 rings, was constructed containing these samples at the offsets shown in the bar diagram (Fig 47). This site sequence was successfully matched against the relevant reference chronologies for oak at the first-ring date of AD 1631 and a last-ring date of AD 1692. The evidence for this dating is given by the *t*-values in Table 5.

Finally, two samples matched and site sequence LBFBSQ03, of 57 rings, was constructed containing these samples at the offsets shown in the bar diagram (Fig 48). Attempts to date this site sequence proved unsuccessful and therefore these samples remain undated.

Attempts to date the remaining samples individually resulted in the successful dating of sample LBF-B01 to the period AD 1428-1531. The evidence for this dating is given by the *t*-values in Table 6.

Interpretation
Analysis of samples from the timbers of this bellframe has resulted in the production of two dated site sequence and one individually dated sample.

Site sequence LBFBSQ01, of 88 rings, was dated to the period AD 1606-93. Two of the samples contained in this site sequence have the heartwood/sapwood boundary ring. The average of this is AD 1689, which allows an estimated felling, date to be calculated for the two timbers represented to within the range AD 1704-24. The third sample, LBF-B05, does not have the heartwood/sapwood boundary ring and so an estimated felling date cannot be calculated for the timber represented, except to say that with a last measured ring date of AD 1657 this is estimated to be AD 1673 at the earliest, therefore not inconsistent with a felling of AD 1704-24 as well.

Site sequence LBFBSQ02, of 62 rings, was dated to the period AD 1631-92. Two of the three samples contained within this site sequence have the heartwood/sapwood boundary ring. The average of this is AD 1692, which allows an estimated felling, date range to be calculated for the two timbers represented to within the range AD 1707-27. The third sample does not have the heartwood/sapwood transition ring but, with a last measured ring date of AD 1687, this is estimated to be AD 1703 at the earliest.

The felling date ranges as outlined above are consistent with a single felling for the four samples. The average heartwood/sapwood boundary ring for the four samples that have this ring is AD 1690, giving an average estimated felling date for the timbers represented to AD 1705-25.

Sample LBF-B01 was dated individually to the period AD 1428-1531. This sample does not have the heartwood/sapwood boundary ring and, therefore, an estimated felling date cannot be calculated for it except to say that with a last measured ring date of AD 1531 this would be AD 1547 at the earliest, but could equally be much later.

Discussion
Tree-ring analysis has resulted in the successful dating of seven timbers of the bellframe. The estimated felling date of four of these timbers is AD 1705-25. An estimated felling date cannot be calculated for the other three dated samples but all have last measured ring dates which do not rule out them having also come from trees felled in AD 1705-25.

The values at which these samples have dated are not as high as would be preferred, however, they are consistent.

Table 3: Details of tree-ring samples from timbers of the bellframe of the Church of St Michael, Church Lane, Rearsby, Leicestershire

Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Last heartwood ring date (AD)	Last measured ring date (AD)
LBF-B01	South jack brace, west end frame	105	--	1428	----	1531
LBF-B02	Frame head, east end frame	84	h/s	1606	1689	1689
LBF-B03	Frame head, west end frame	71	04	1623	1689	1693
LBF-B04	North jack brace, east end frame	54	24C	----	----	----
LBF-B05	Frame head, truss B-B	52	--	1606	----	1657
LBF-B06	South brace, west end frame	54	16	----	----	----
LBF-B07	Frame head, truss F-F	60	h/s	1633	1692	1692
LBF-B08	West brace, truss A-A	NM	--	----	----	----
LBF-B09	North jack brace, west end frame	NM	--	----	----	----
LBF-B10	East jack brace, truss A-A	78	--	----	----	----
LBF-B11	Sill, truss E-E	57	h/s	1635	1691	1691
LBF-B12	Frame head, truss E-E	55	--	----	----	----
LBF-B13	Frame head, truss A-A	57	--	1631	----	1687
LBF-B14	East brace, truss E-E	49	h/s	----	----	----
LBF-B15	South brace, truss E-E	56	h/s	----	----	----

*NM = not measured
h/s = the heartwood/sapwood boundary is the last ring on the sample
C = complete sapwood retained on sample, last measured ring is the felling date

Table 4: Results of the cross-matching of site sequence LBFBSQ01 and relevant reference chronologies when the first-ring date is AD 1606 and the last-ring date is AD 1693

Reference chronology	*t*-value	Span of chronology	Reference
East Midlands	4.8	AD 882-1981	Laxton and Litton 1988
Church Farm, Hayton, Notts	5.4	AD 1622-1721	Howard and Litton forthcoming (a)
Blidworth Church, Blidworth, Notts	5.0	AD 1621-1713	Laxton and Litton 1988
37-39 Kirkgate, Newark, Notts	5.0	AD 1603-1694	Arnold *et al* 2002a
Southwell Minster (aisle roof), Notts	5.2	AD 1573-1716	Howard *et al* 1996b
Bolsover Castle (riding house), Derbys	5.2	AD 1494-1744	Arnold *et al* forthcoming
Cheddleton Grange, Staffs	4.3	AD 1551-1682	Howard *et al* 1995c unpubl

Table 5: Results of the cross-matching of site sequence LBFBSQ02 and relevant reference chronologies when the first-ring date is AD 1631 and the last-ring date is AD 1692

Reference chronology	*t*-value	Span of chronology	Reference
East Midlands	4.2	AD 882-1981	Laxton and Litton 1988
London	4.2	AD 413-1728	Tyers 1999 unpubl
Blidworth Church, Blidworth, Notts	5.6	AD 1625-1717	Laxton and Litton 1988
Old Barn, Stratford on Avon, Warwicks	4.9	AD 1591-1735	Howard *et al* 1996b
Claydon House, Bucks	4.5	AD 1613-1756	Tyers 1995b
Southwell Minster (aisle roof), Notts	4.4	AD 1573-1716	Howard *et al* 1996b
Bolsover Castle (riding house), Derbys	4.2	AD 1494-1744	Arnold *et al* forthcoming

Table 6: Results of the cross-matching of site sequence LBF-B01 and relevant reference chronologies when the first-ring date is AD 1428 and the last-ring date is AD 1531

Reference chronology	*t*-value	Span of chronology	Reference
East Midlands	5.7	AD 882-1981	Laxton and Litton 1988
England	5.3	AD 401-1981	Baillie and Pilcher 1982 unpubl
Hagworthingham Church, Lincs	5.5	AD 1336-1533	Laxton and Litton 1988
Thatched Cottage, High Street, Melbourne, Derbys	5.2	AD 1372-1530	Howard *et al* 1997a
Ughill Manor, Tinker Bottom, Bradfield, S Yorks	5.2	AD 1349-1504	Howard *et al* 1994a
Woodseat Hall Farm, Barlow, Derbys	4.8	AD 1417-1535	Howard *et al* 1996c
Seaton Holme, Easington, Durham	4.7	AD 1375-1489	Howard *et al* 1988 unpubl

Figure 40: Church of St Michael bellframe: plan (George Dawson)

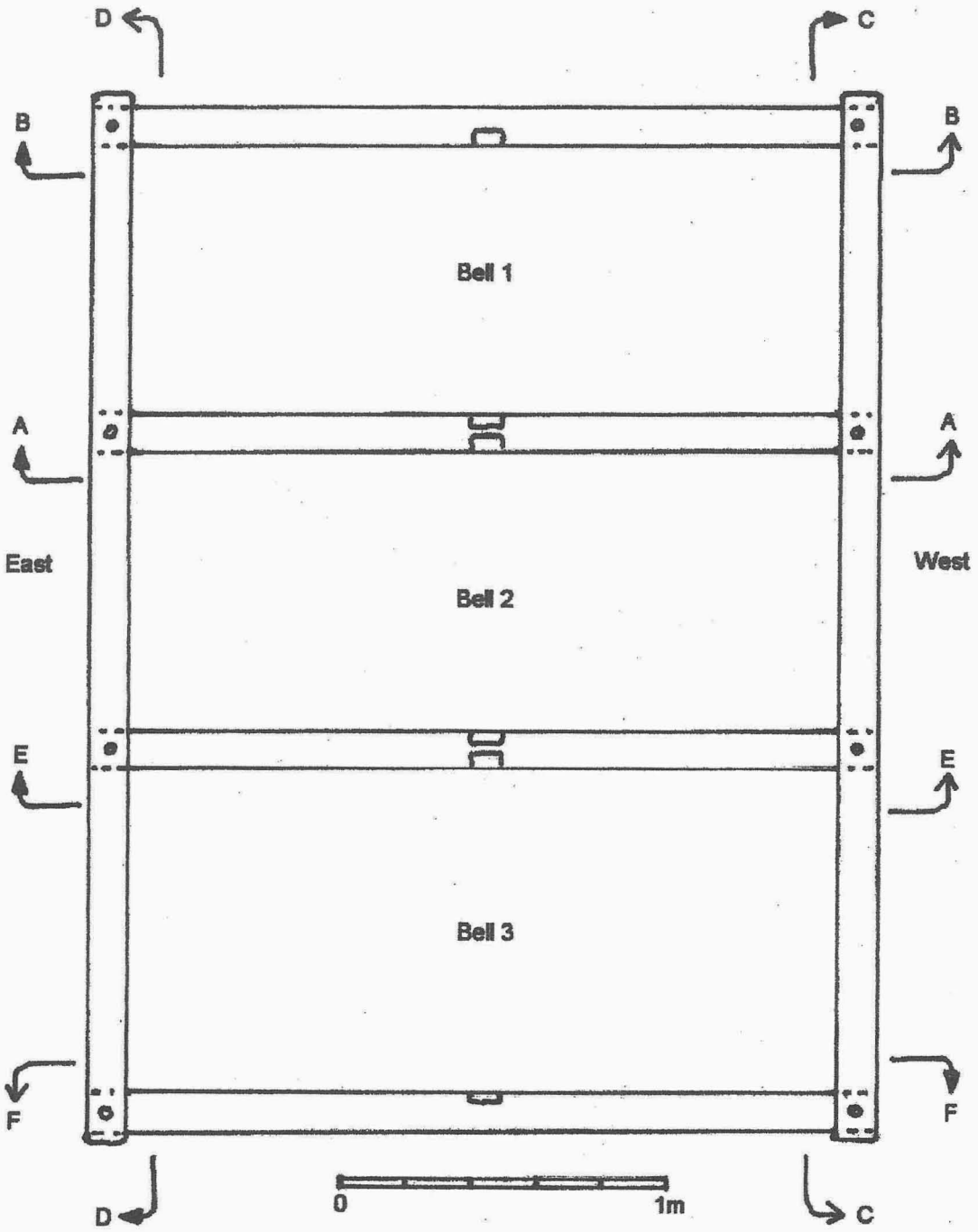


Figure 41: Church of St Michael, Rearsby, bellframe: section A-A, showing the location of samples LBF-B08, LBF-B10, and LBF-B13 (George Dawson)

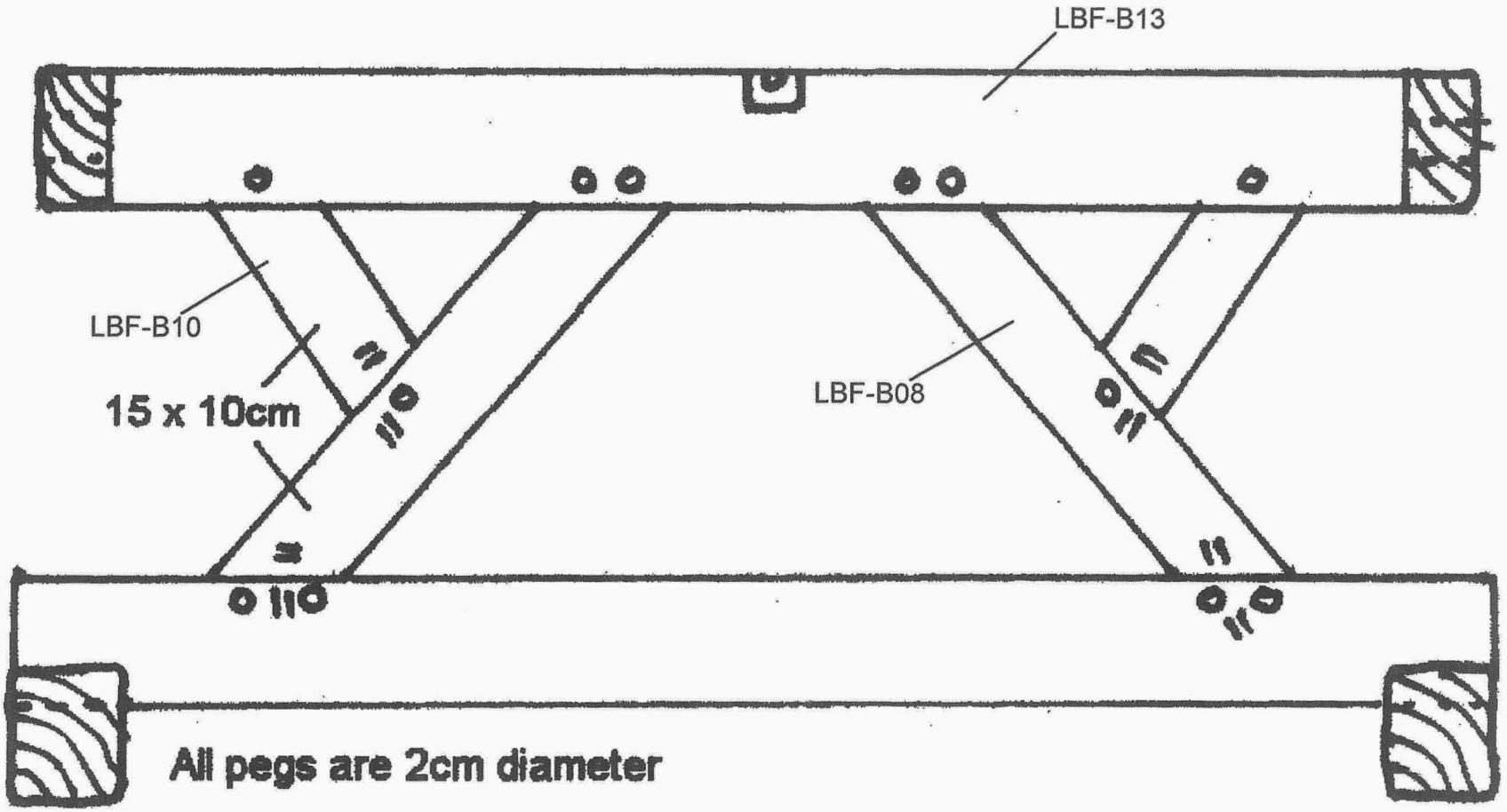


Figure 42: Church of St Michael, Rearsby, bellframe: section B-B, showing the location of sample LBF-B05 (George Dawson)

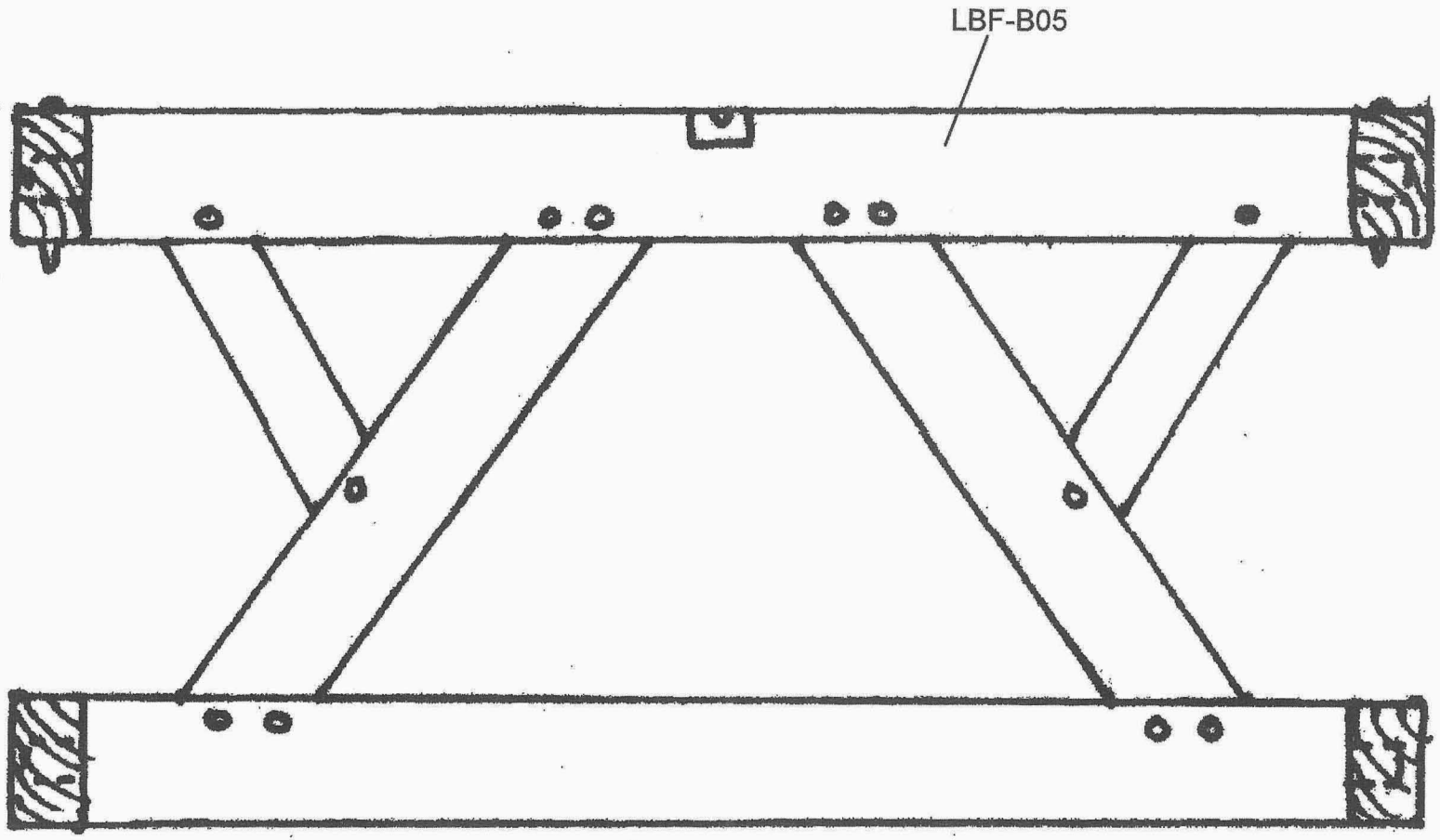


Figure 43: Church of St Michael, Rearsby, bellframe: west end frame (C-C), showing the location of samples LBF-B01, LBF-B03, LBF-B06, and LBF-B09 (George Dawson)

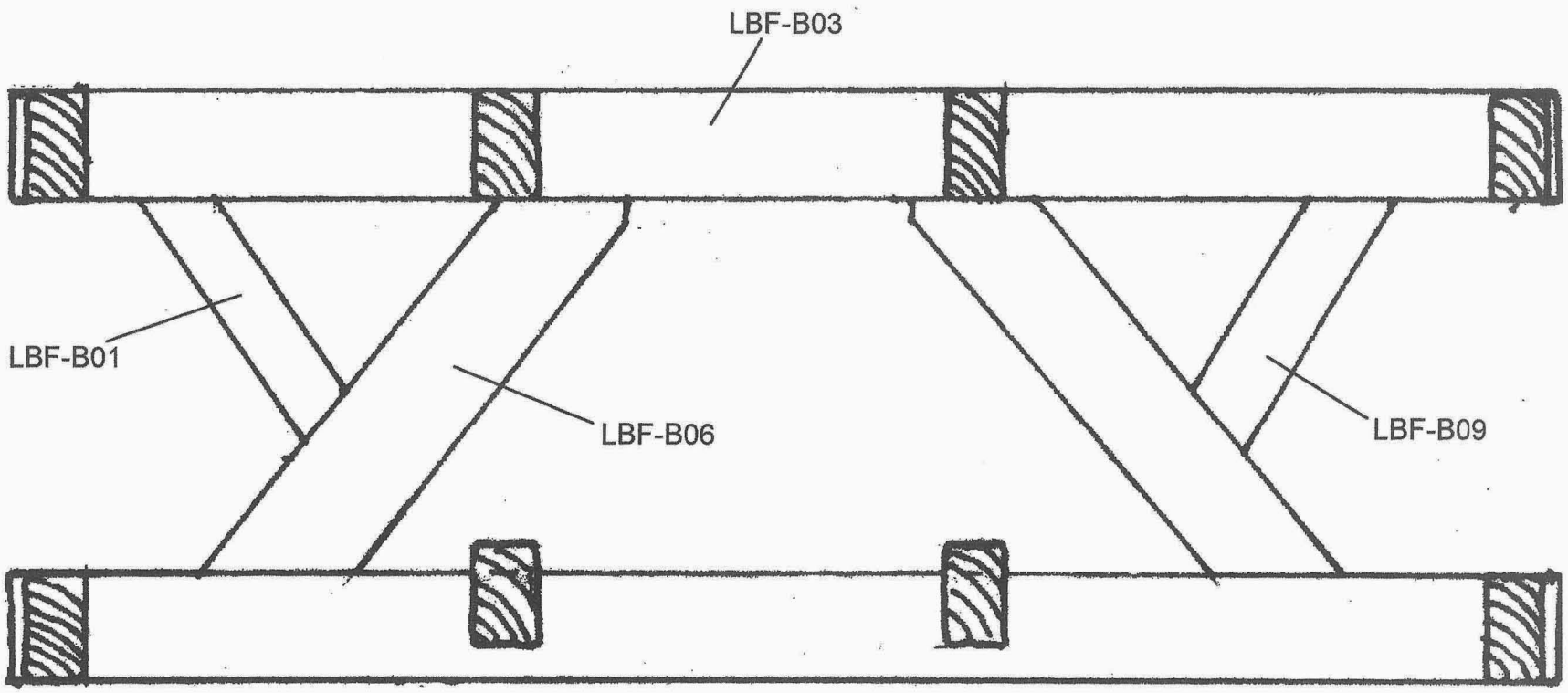


Figure 44: Church of St Michael, Rearsby, bellframe: east end frame (D-D), showing the location of samples LBF-B02, and LBF-B04 (George Dawson)

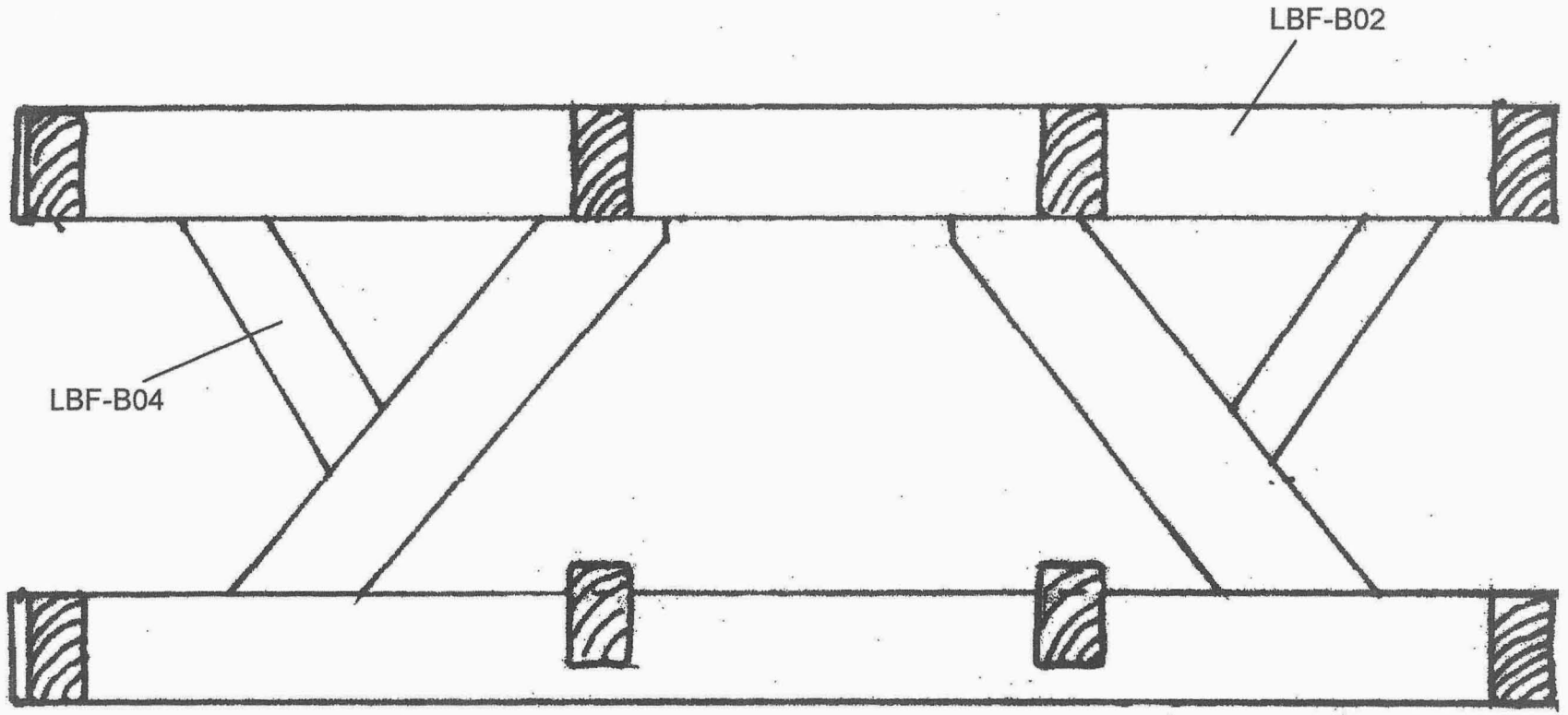


Figure 45: Church of St Michael, Rearsby, bellframe: section E-E, showing the location of samples LBF-B11-12, and LBF-B14-15 (George Dawson)

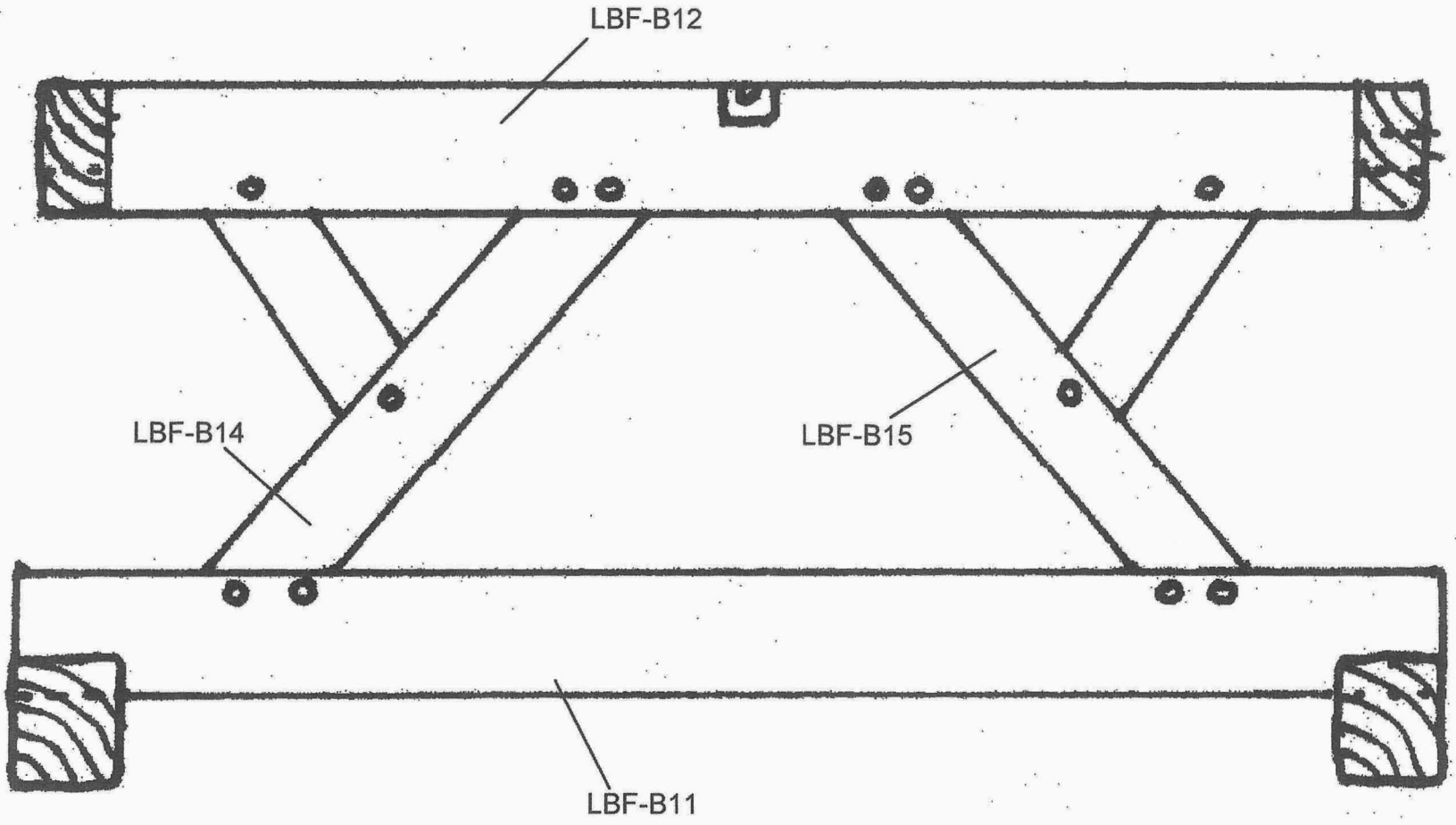


Figure 46: Church of St Michael, Rearsby, bellframe: section F-F, showing the location of sample LBF-B07 (George Dawson)

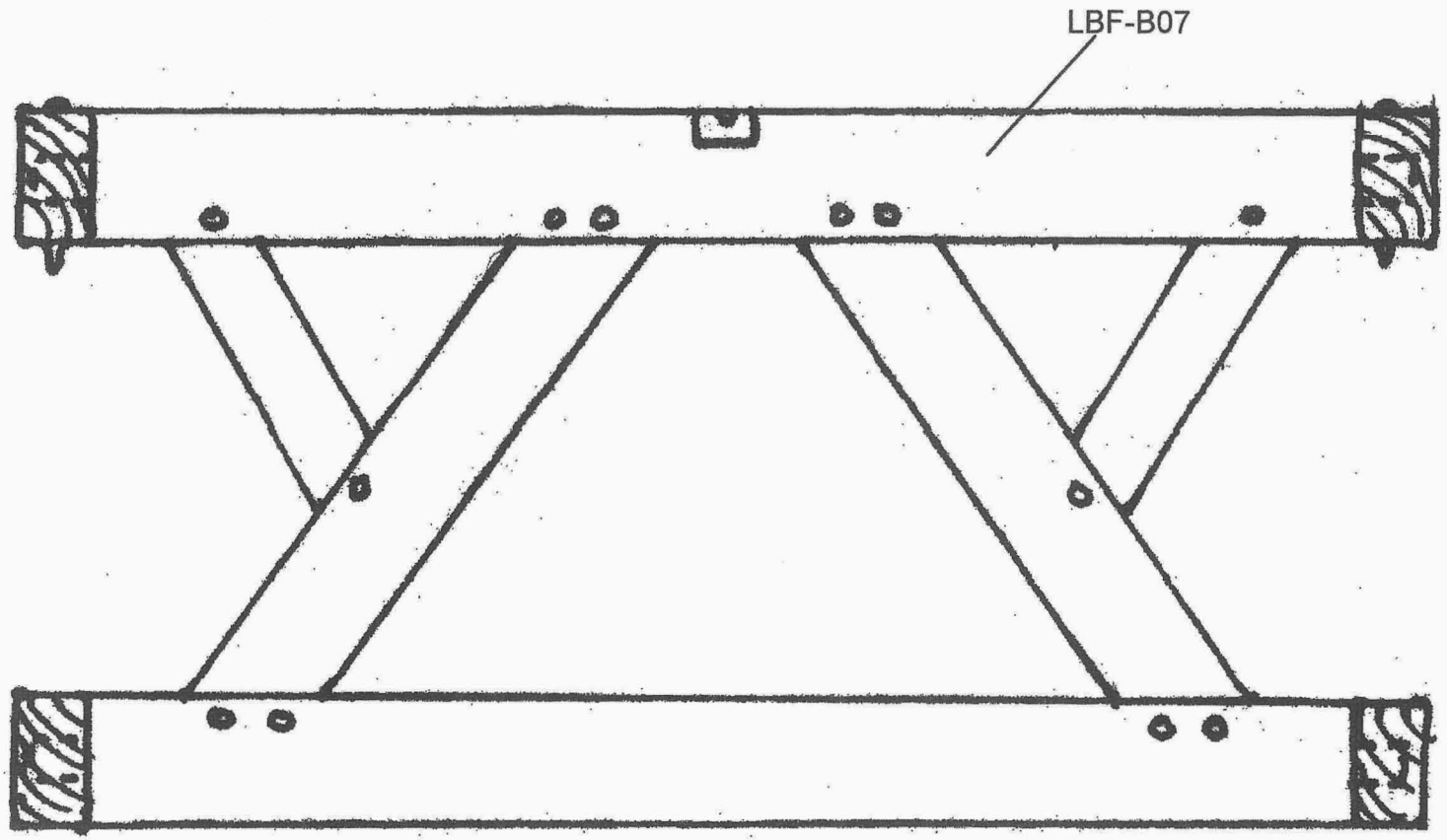


Figure 47: Bar diagram of samples in site sequences LBFBSQ01 and LBFBSQ02

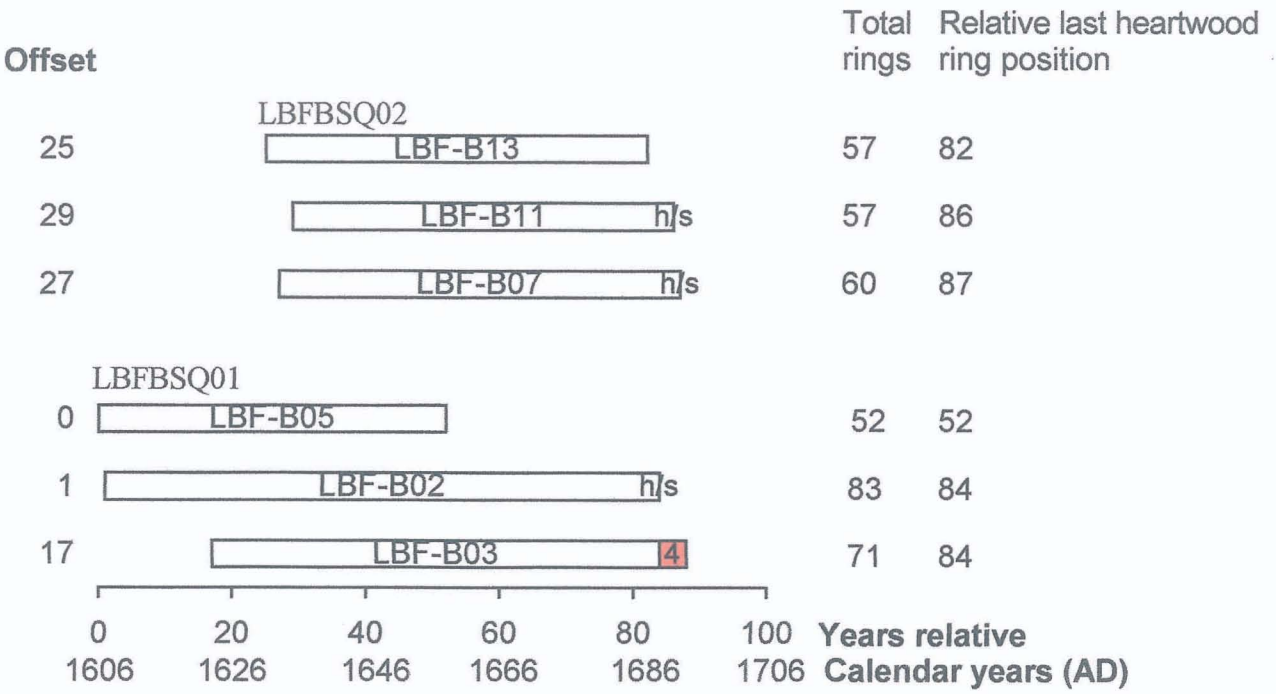
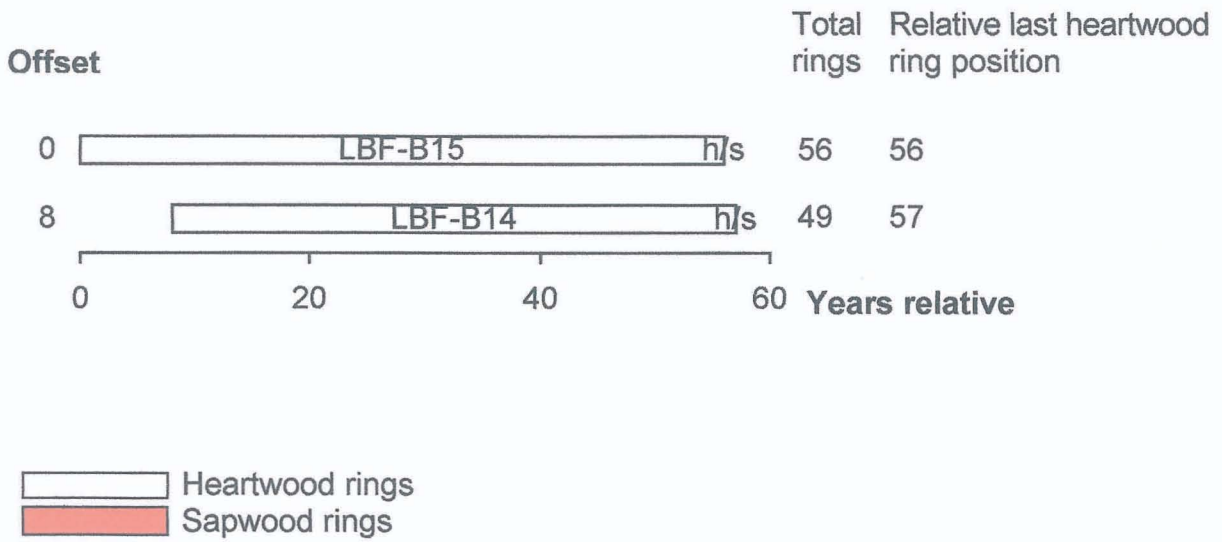


Figure 48: Bar diagram of samples in undated site sequence LBFBSQ03



h/s = heartwood/sapwood ring

4.3
Church of the Holy Trinity, Norton-juxta-Twycross (LBF-C)
(SK 322 071; Figs 49-59)

Description
This bellframe has four trusses and is for three bells. It is of hybrid construction, the two outer trusses are Pickford type 6.B, and the inner ones Pickford type 6.A (Figs 50-7). These are referred to here (east to west) as A, B, C, and D. The bottom sills are arched.

It is likely the frame was constructed at the same time as the two heaviest bells were originally cast, in the mid-seventeenth century.

Sampling, Analysis, and Results
Fifteen core samples were taken from the frame heads, braces, one sill and one post of this bellframe (Table 7; Figs 52-7). Analysis of all samples resulted in 14 of them forming two groups. Firstly, six samples matched and site sequence LBFCSQ01, of 110 rings, was constructed containing these samples at the relevant offsets (Fig 58). Secondly, eight samples matched and site sequence LBFCSQ02, of 134 rings, was constructed containing these samples at the relevant offsets (Fig 59). Attempts to date these site sequences by comparing them against the reference chronologies were unsuccessful.

Attempts to date the remaining, ungrouped sample, LBF-C08, also proved unsuccessful.

Discussion
The inability to successfully date any of the timbers of this bellframe is most likely due to the fact that the majority of the samples display the regular occurrence of narrow bands of growth rings. In fact only two of the samples do not have these narrow rings (LBF-C08 and LBF-C10). Those samples in site sequence LBFCSQ01 exhibit four separate growth retardation events, whereas those in site sequence LBFCSQ02 show only two of these events. It is likely to be these events that have effectively stopped the timbers dating, as the groups are both responding to local environmental effects, rather than the general climatic effects that we need for dating purposes. This is most likely to be some type of woodland management, such as pollarding or shredding.

The samples form two distinct groups with no crossmatching between the two. This might suggest two clear sources of timber were utilised or that each group represents a separate phase of construction. As the buildings survey identified the bellframe as being of one build with no obvious signs of reuse/insertion of timbers being noted it would appear more likely to be the former of these two explanations.

Dating of this bellframe must remain on stylistic grounds only, to the mid-seventeenth century.

Table 7: Details of tree-ring samples from timbers of the bellframe of the Church of the Holy Trinity, Orton Lane, Norton-juxta-Twycross, Leicestershire

Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Last heartwood ring date (AD)	Last measured ring date (AD)
LBF-C01	Frame head, truss A-A	118	09	----	----	----
LBF-C02	Frame head, truss B-B	114	09	----	----	----
LBF-C03	North brace, truss B-B	78	06	----	----	----
LBF-C04	Frame head, truss D-D	102	02	----	----	----
LBF-C05	Frame head, north end frame (E-E)	103	h/s	----	----	----
LBF-C06	Frame head, truss C-C	130	10	----	----	----
LBF-C07	South post, truss D-D	97	h/s	----	----	----
LBF-C08	Sill, truss C-C	67	16	----	----	----
LBF-C09	Frame head, south end frame (F-F)	83	h/s	----	----	----
LBF-C10	South brace, truss B-B	66	07	----	----	----
LBF-C11	South brace, truss C-C	80	--	----	----	----
LBF-C12	North brace, truss D-D	108	h/s	----	----	----
LBF-C13	South brace, truss D-D	90	h/s	----	----	----
LBF-C14	South post, truss A-A	66	--	----	----	----
LBF-C15	South brace, truss A-A	106	05	----	----	----

*h/s = the heartwood/sapwood boundary is the last ring on the sample

Figure 49: Church of the Holy Trinity, Norton-Juxta-Twycross (Dr C J Brooke)

Figure 50: Church of the Holy Trinity, Norton-Juxta-Twycross, general view of the bellframe, showing bells 3 (top) and 2 (foreground) with truss B-B in between (Dr C J Brooke)

Figure 51: Norton-juxta-Twycross Church, bellframe; plan (George Dawson)

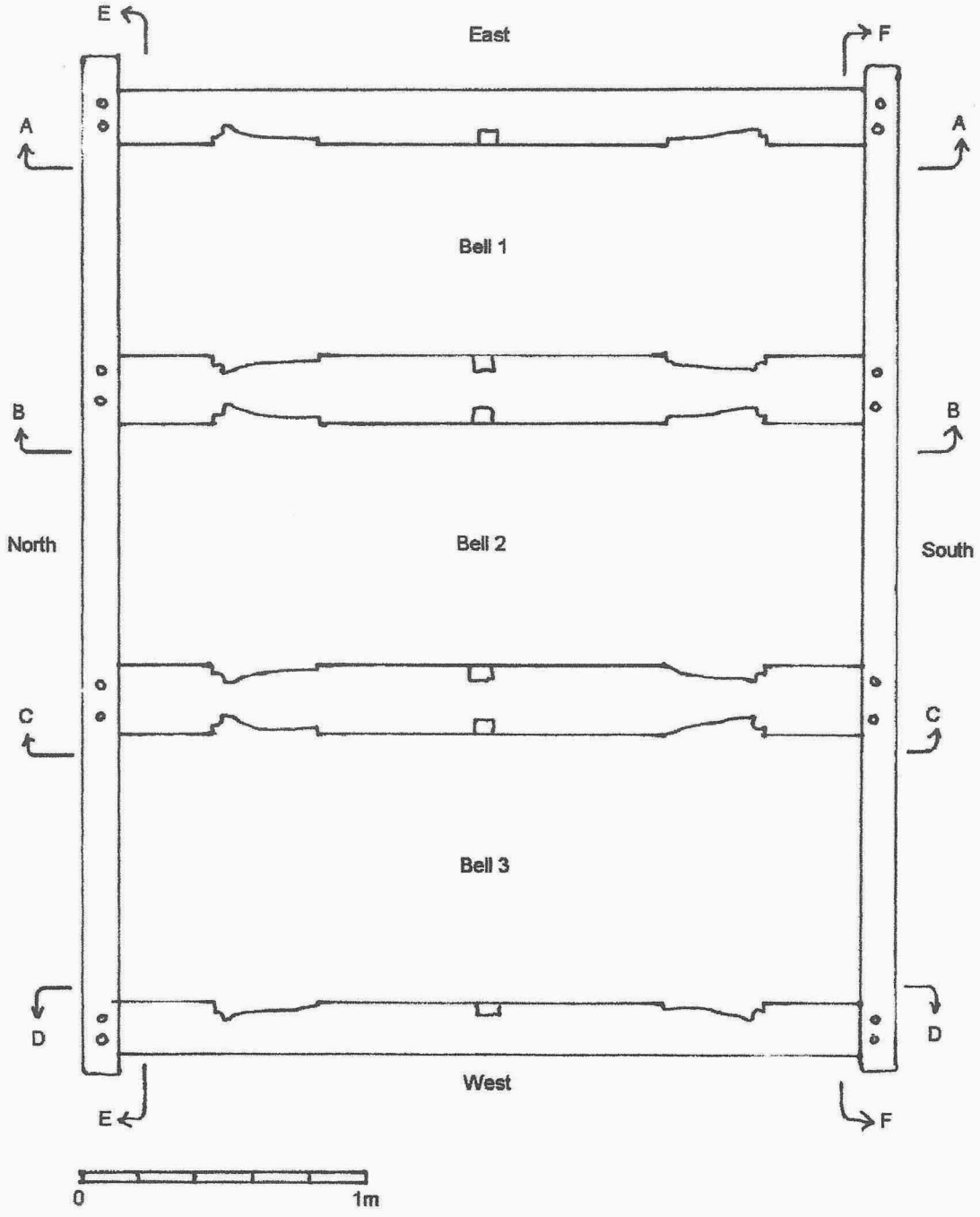


Figure 52: Norton-juxta-Twycross Church, bellf-frame; truss A-A, showing the location of samples LBF-C01, LBF-C14, and LBF-C15 (George Dawson)

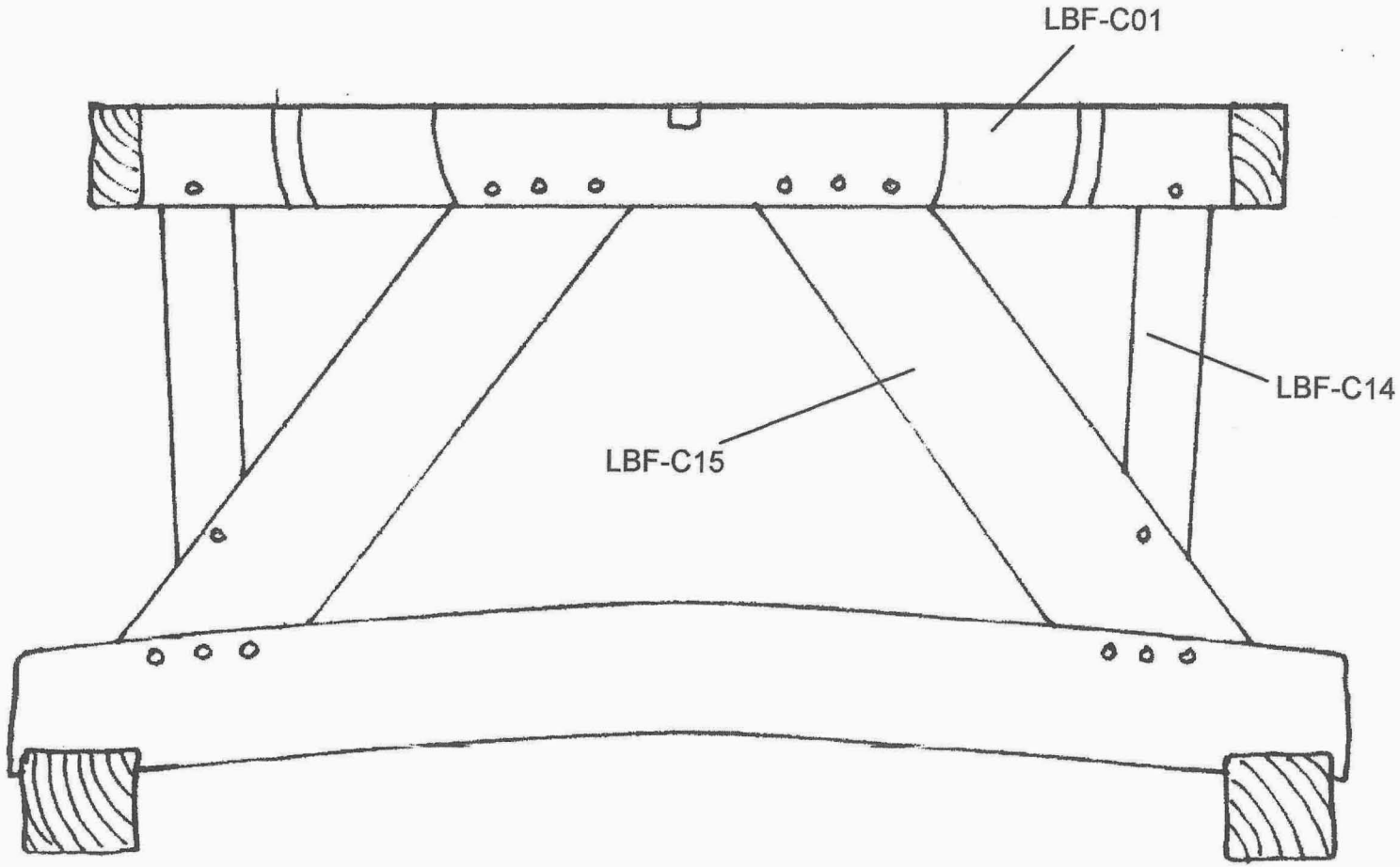


Figure 53: Norton-juxta-Twycross Church, bellframe; truss B-B, showing the location of samples LBF-C03, and LBF-C10 (George Dawson)

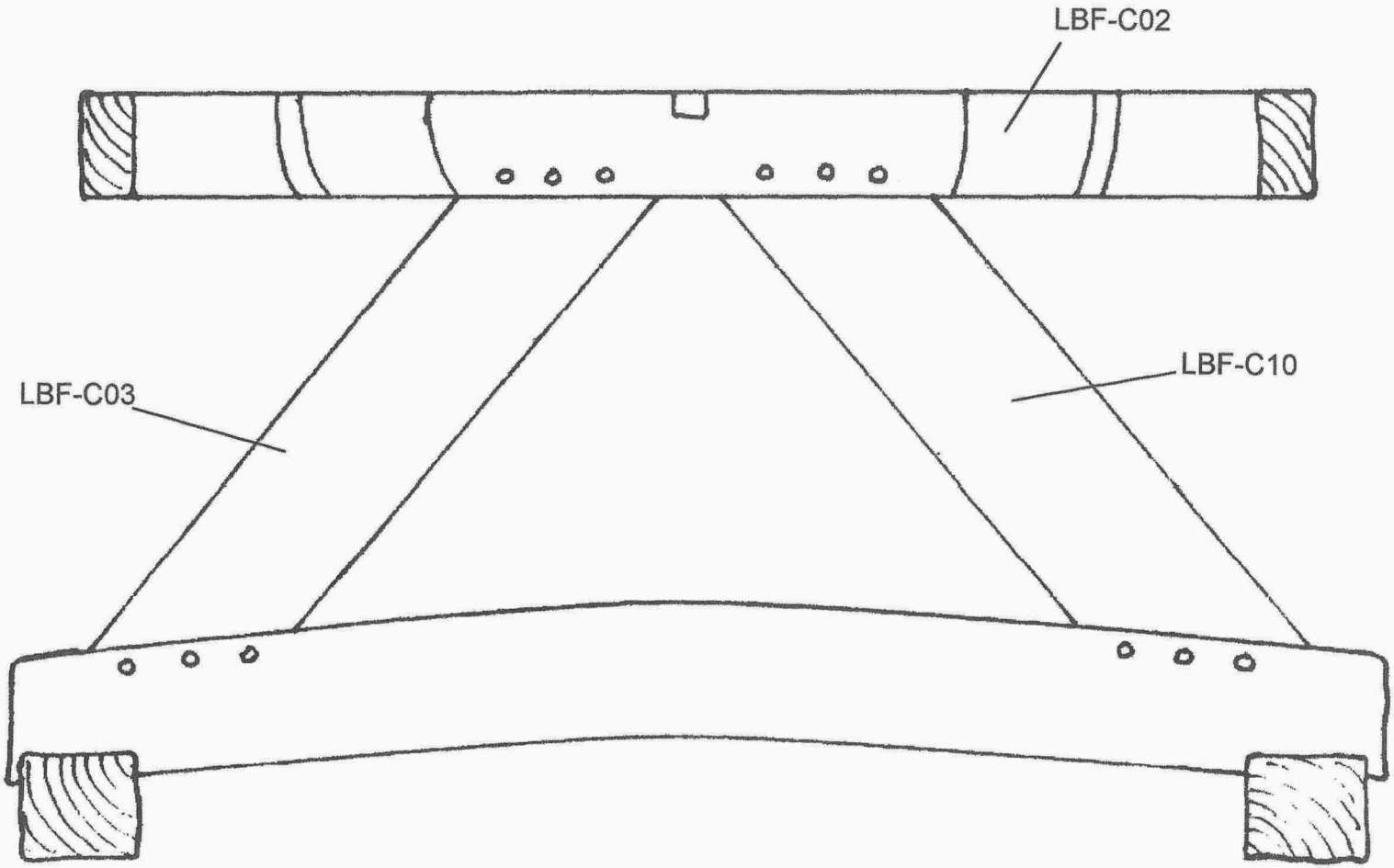


Figure 54: Norton-juxta-Twycross Church, bellframe; truss C-C, showing the location of samples LBF-C06, LBF-C08, and LBF-C11 (George Dawson)

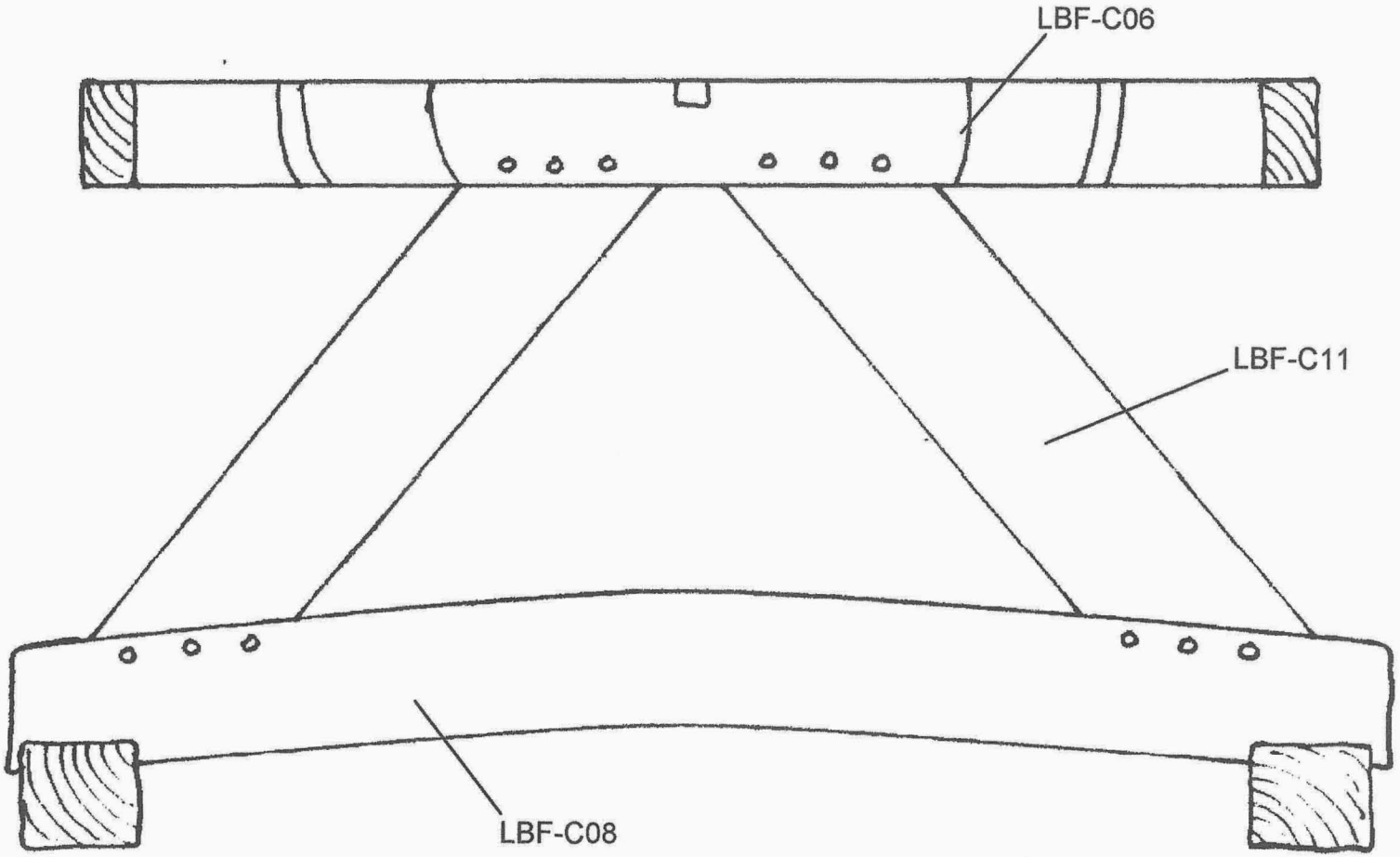


Figure 55: Norton-juxta-Twycross Church, bellframe; truss D-D, showing the location of samples LBF-C04, LBF-C07, LBF-C12, and LBF-C13 (George Dawson)

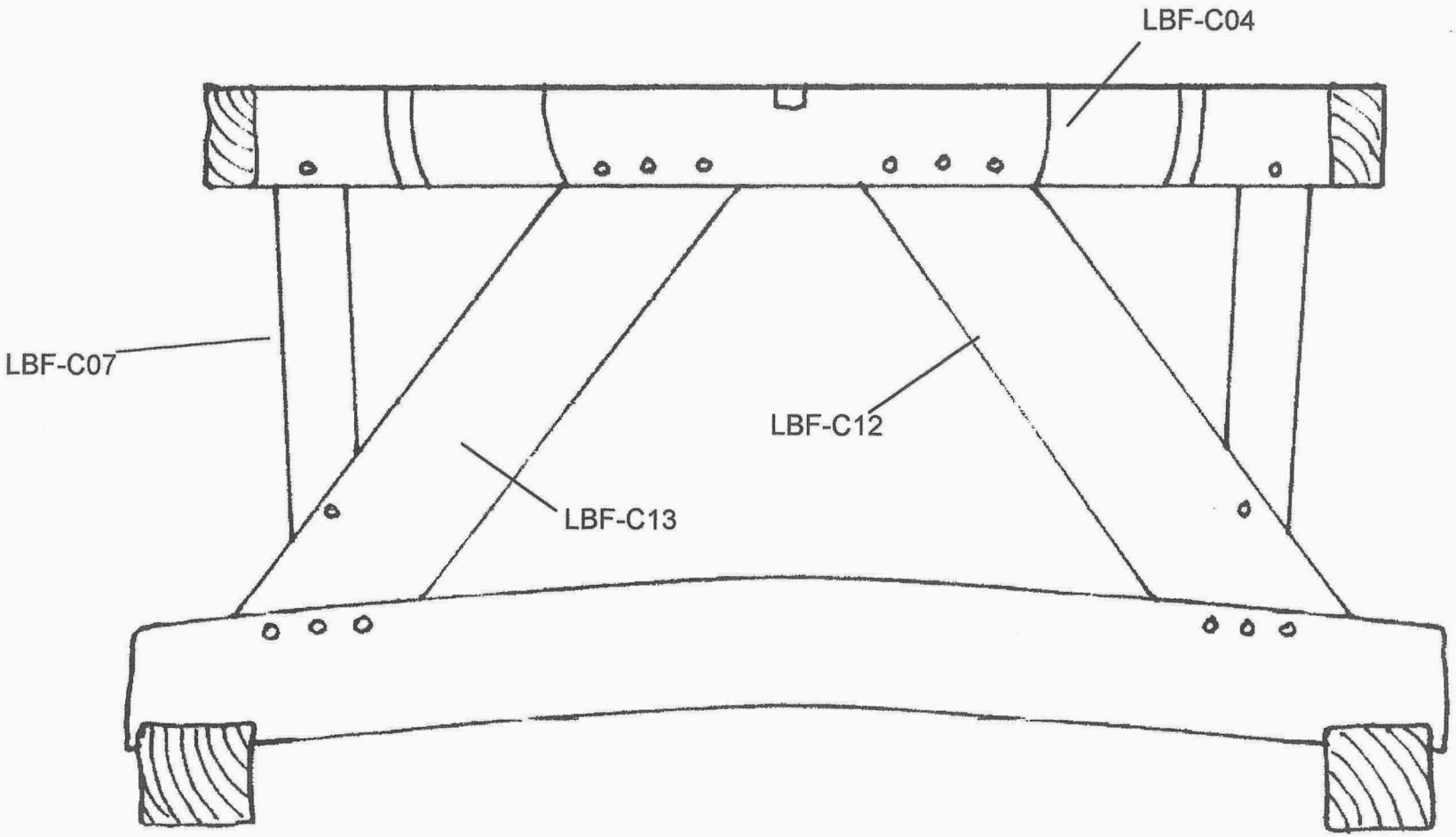


Figure 56: Norton-juxta-Twycross Church, bellframe; north end frame (E-E), showing the location of sample LBF-C05 (George Dawson)

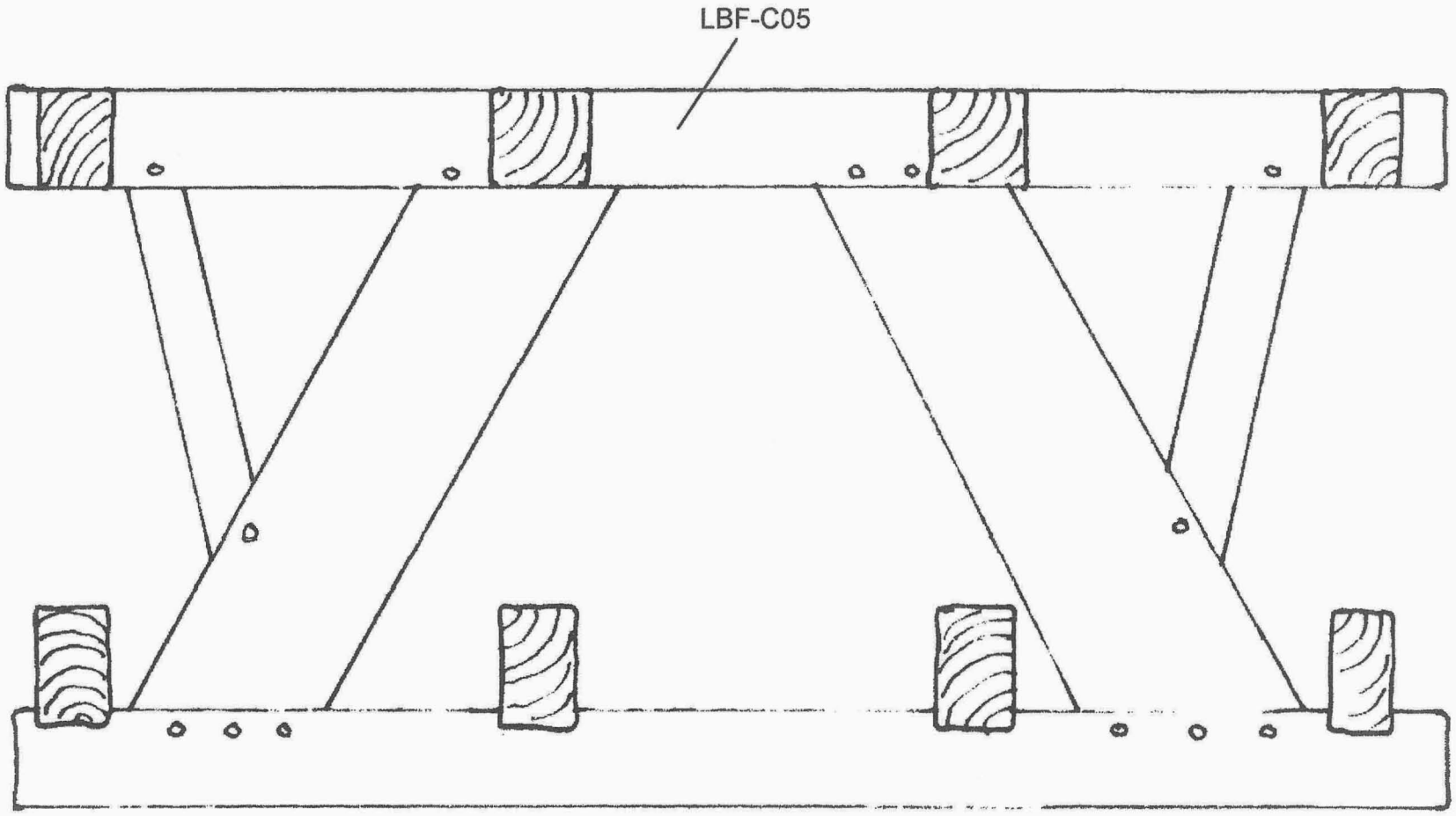


Figure 57: Norton-juxta-Twycross Church, bellframe; south end frame (F-F), showing the location of sample LBF-C09 (George Dawson)

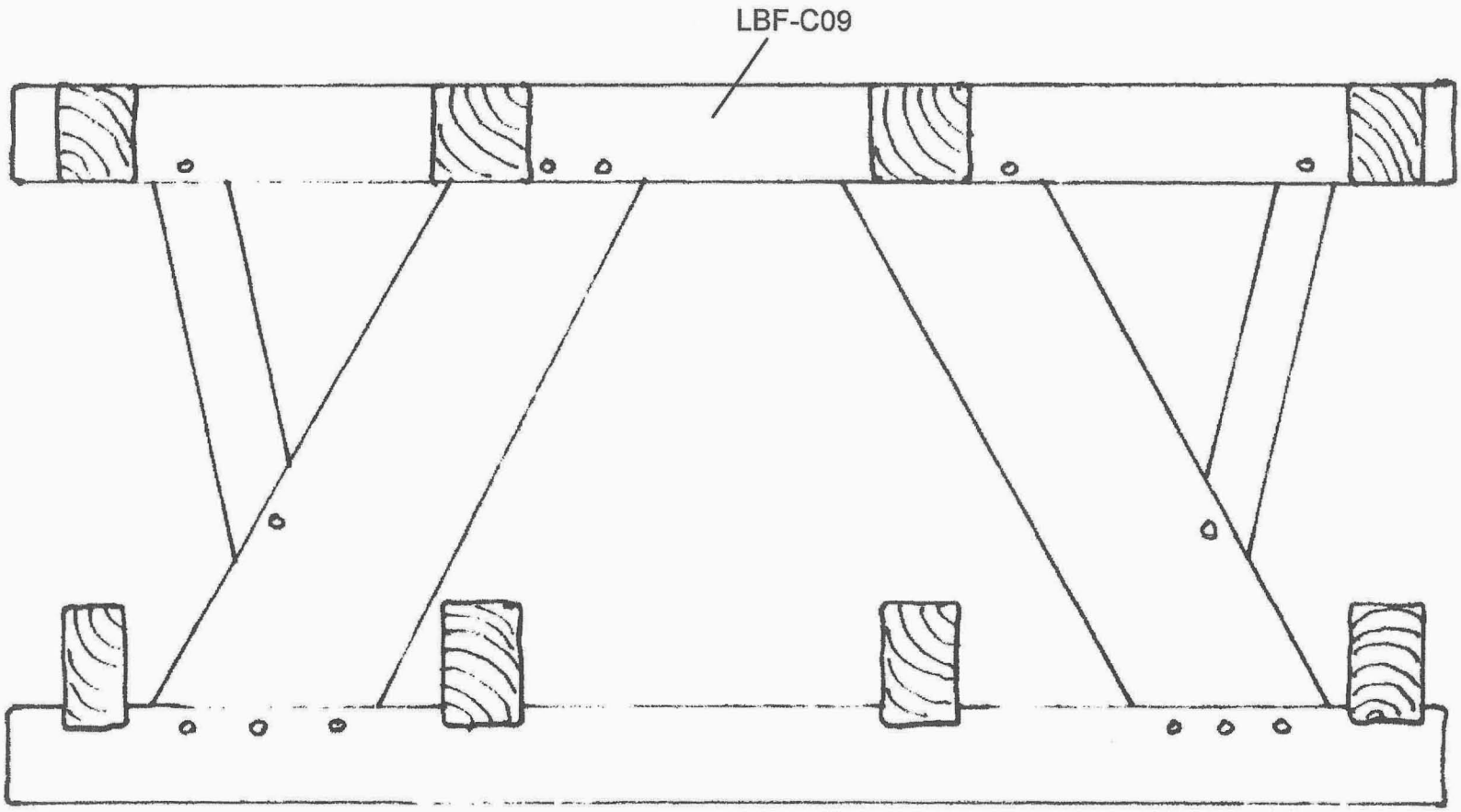
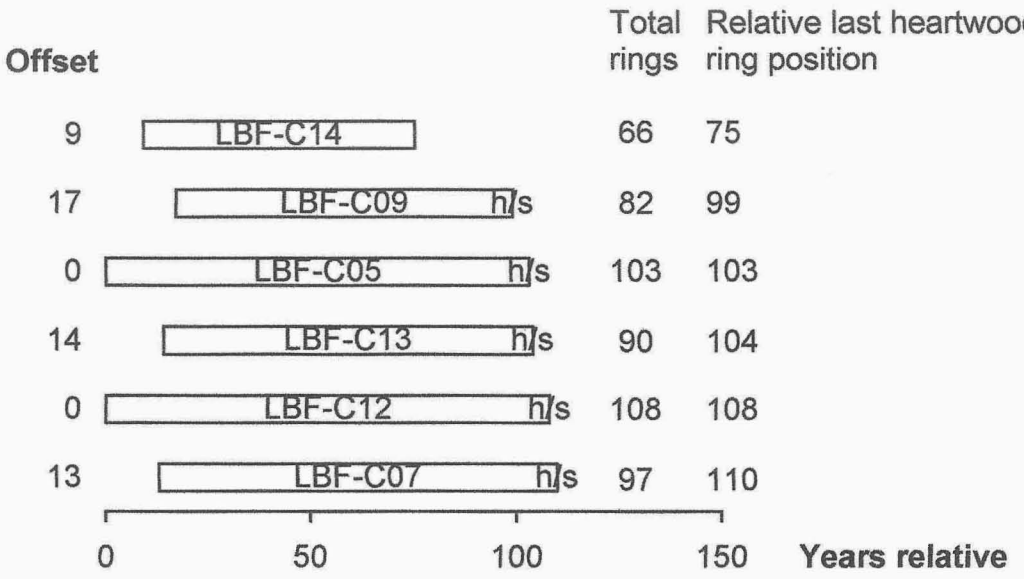


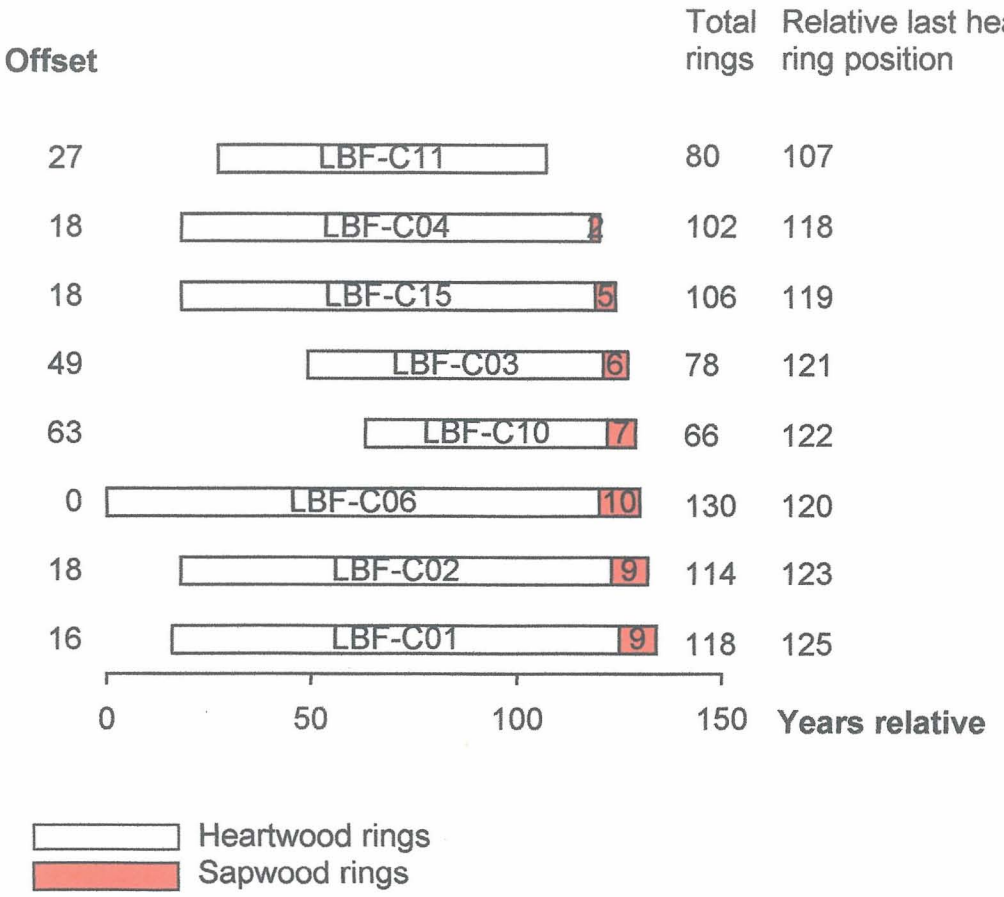
Figure 58: Bar diagram of samples in undated site sequence LBFCSQ01



Heartwood rings

h/s = the heartwood/sapwood boundary ring is the last measured ring on the sample

Figure 59: Bar diagram of samples in undated site sequence LBFCSQ02



4.4
Church of All Saints, Knipton (LBF-D)
(SK 825 311; Figs 61-7)

Description
This oak bellframe, for three bells, is one of the most interesting in Leicestershire. It is of short-headed queen-post type (ie double king posts), Pickford type 3.G, similar to bellframes at Lambley and Bramcote old church, Nottinghamshire. It has curved sills and braces. All four trusses are similar in design and here have been called (from east to west) B, A, C, and D.

All the truss short heads have been replaced in the nineteenth or twentieth century. They are not pegged to the king posts or braces but are held by nailed straps, which have a top-threaded section and a nut. There are transoms on both sides of the trusses. These are modern replacements, probably dating from the same time as the heads. The original transoms were broad and flat. They lay in slots cut where necessary into the faces of the curved braces.

Stylistically the frame dates from the fifteenth century.

Sampling, Analysis, and Results
Sixteen core samples were taken from posts, braces, and sills of all trusses. One sample (Table 8; LBF-D08) had too few rings for secure dating and so was not analysed. Analysis of the remaining 15 samples resulted in ten samples grouping at a least value of t=4.5. Site sequence LBFDSQ01, of 141 rings, was constructed containing these samples at the offsets shown in the bar diagram (Fig 67). This site sequence was found to span the period AD 1348-1488. The evidence for this dating is given by the t-values in Table 9.

Attempts were then made to date the remaining samples by individually comparing them against the reference chronologies. This resulted in sample LBF-D12 being dated to a first-ring date of AD 1413 and a last-ring date of AD 1490. The evidence for this dating is given by the t-values in Table 10.

Interpretation
Analysis of samples from the timbers of this bellframe has resulted in the production of one dated site sequence and one individually dated sample.

Site sequence LBFDSQ01 spans the period AD 1348-1488, and contains ten samples, nine of which have the heartwood/sapwood boundary ring. The average of this is AD 1467, allowing the calculation of an estimated felling date for the timbers represented to within the range AD 1489-1502 (taking account of sample LBF-D04 having a last measured ring date of AD 1488). The tenth sample, LBF-D10, does not have the heartwood/sapwood boundary ring and so an estimated felling date cannot be calculated for the timber represented, except to say that with a last measured ring date of AD 1458 this would be AD 1474 at the earliest, not inconsistent with a contemporary felling.

Sample LBF-D12 dated individually to the period AD 1413-90 was taken from a timber with complete sapwood; however, 2mm worth of sapwood rings was lost

during the sampling process. This would suggest that only one or two rings have been lost, giving a felling date of AD 1491/2 for the timber represented.

Discussion

Tree-ring analysis has resulted in the successful dating of 11 timbers of the bellframe. It is now known that one timber used in the construction of this structure was felled in AD 1491/2 with a further nine (and probably ten) being felled within the period AD 1489-1502, consistent with a felling of AD 1491/2. Thus it is likely that this bellframe is constructed from timbers of a single felling in AD 1491/2.

Table 8: Details of tree-ring samples from timbers of the bellframe of the Church of All Saints, Church Hill, Knipton, Leicestershire

Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Last heartwood ring date (AD)	Last measured ring date (AD)
LBF-D01	North post, truss D-D	55	03	----	----	----
LBF-D02	North brace, truss D-D	59	h/s	1404	1462	1462
LBF-D03	Sill, truss D-D	71	h/s	----	----	----
LBF-D04	South brace, truss C-C	83	17	1406	1482	1488
LBF-D05	Sill, truss C-C	63	--	----	----	----
LBF-D06	South post, truss C-C	118	09	1357	1465	1474
LBF-D07	North post, truss C-C	97	01	1372	1467	1468
LBF-D08	South post, truss D-D	NM	--	----	----	----
LBF-D09	North brace, truss C-C	84	h/s	1388	1471	1471
LBF-D10	North brace, truss A-A	81	--	1378	----	1458
LBF-D11	South post, truss A-A	93	14	1388	1466	1480
LBF-D12	Sill, truss A-A	77	15c(+1 or 2 lost)	1413	1475	1490
LBF-D13	North post, truss A-A	123	09	1348	1461	1470
LBF-D14	North post, truss B-B	48	h/s	----	----	----
LBF-D15	South brace, truss B-B	77	h/s	1392	1468	1468
LBF-D16	North brace, truss B-B	84	h/s	1386	1469	1469

*NM = not measured
h/s = the heartwood/sapwood boundary is the last ring on the sample
c = complete sapwood on timber, estimated number of rings lost in sampling in brackets

Table 9: Results of the cross-matching of site sequence LBFDSQ01 and relevant reference chronologies when the first-ring date is AD 1348 and the last-ring date is AD 1488

Reference chronology	*t*-value	Span of chronology	Reference
East Midlands	6.7	AD 882-1981	Laxton and Litton 1988
London	5.9	AD 413-1728	Tyers 1999 unpubl
Hagworthingham Church, Lincs	7.0	AD 1336-1533	Laxton and Litton 1988
Gainsborough Hall, Lincs	5.9	AD 1356-1462	Laxton and Litton 1988
Sinai Park Staffs	5.8	AD 1227-1750	Tyers 1997
Old Manor House (the hall), Mapledurham	4.9	AD 1278-1438	Haddon-Reece *et al* 1985
The Old Post Office, Normanton-on-Soar, Notts	4.8	AD 1344-1440	Laxton and Litton 1988

Table 10: Results of the cross-matching of sample LBF-D12 and relevant reference chronologies when the first-ring date is AD 1413 and the last-ring date is AD 1490

Reference chronology	*t*-value	Span of chronology	Reference
Bishop's House, Sheffield	5.1	AD 1359-1591	Morgan 1977
East Midlands	4.6	AD 882-1981	Laxton and Litton 1988
Whites Farm (wing range), South Leverton, Notts	5.6	AD 1399-1506	Howard *et al* 1994b
Ordsall Hall, Taylorson Street, Salford, Cheshire	5.5	AD 1385-1512	Howard *et al* 1994b
Sinai Park, Staffs	5.4	AD 1227-1750	Tyers 1997
Hardwick Old Hall, Derbys	5.2	AD 1375-1590	Howard *et al* 2002a
Combermere Abbey, Cheshire	4.9	AD 1363-1564	Howard *et al* 2003a

Figure 60: Church of All Saints, Knipton (Dr C J Brooke)

Figure 61: Church of All Saints, Knipton, general view of the bellframe showing bell 2 (left) and bell 3 (right), and with truss A-A between them (Dr C J Brooke)

Figure 62: Church of All Saints, bellframe; plan (George Dawson)

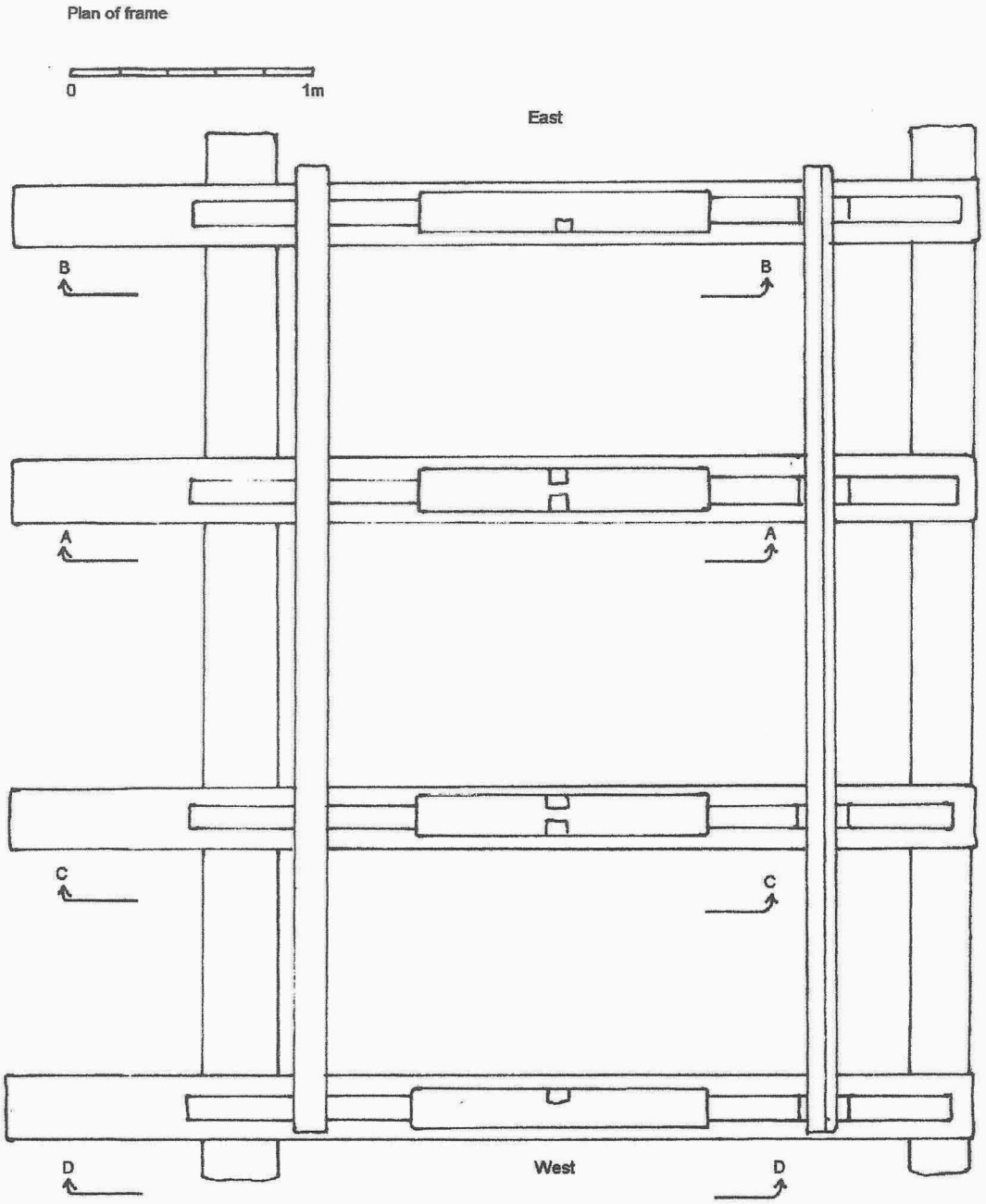


Figure 63: Church of All Saints, Knipton, bellframe: section A-A, showing the location of samples LBF-D10-D13 (George Dawson)

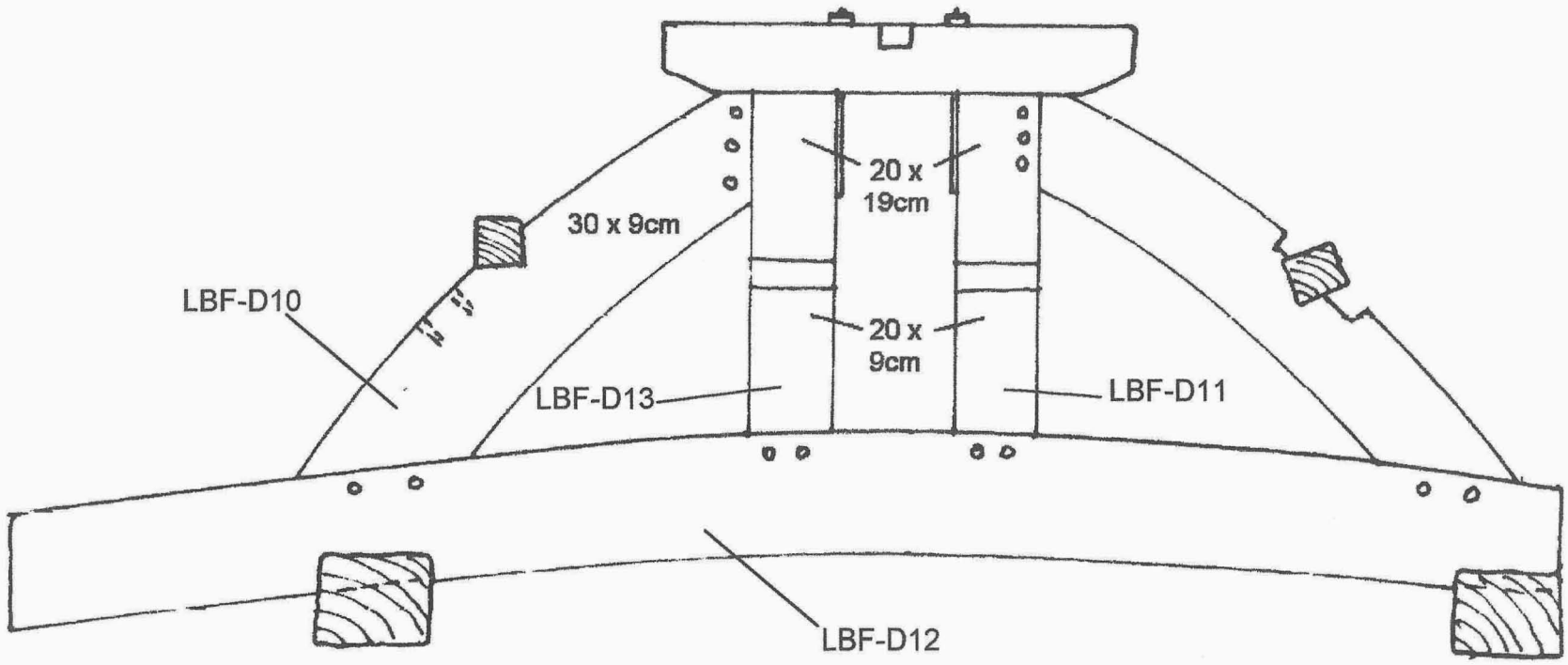


Figure 64: Church of All Saints, Knipton, bellframe: section B-B, showing the location of samples LBF-D14-D16 (George Dawson)

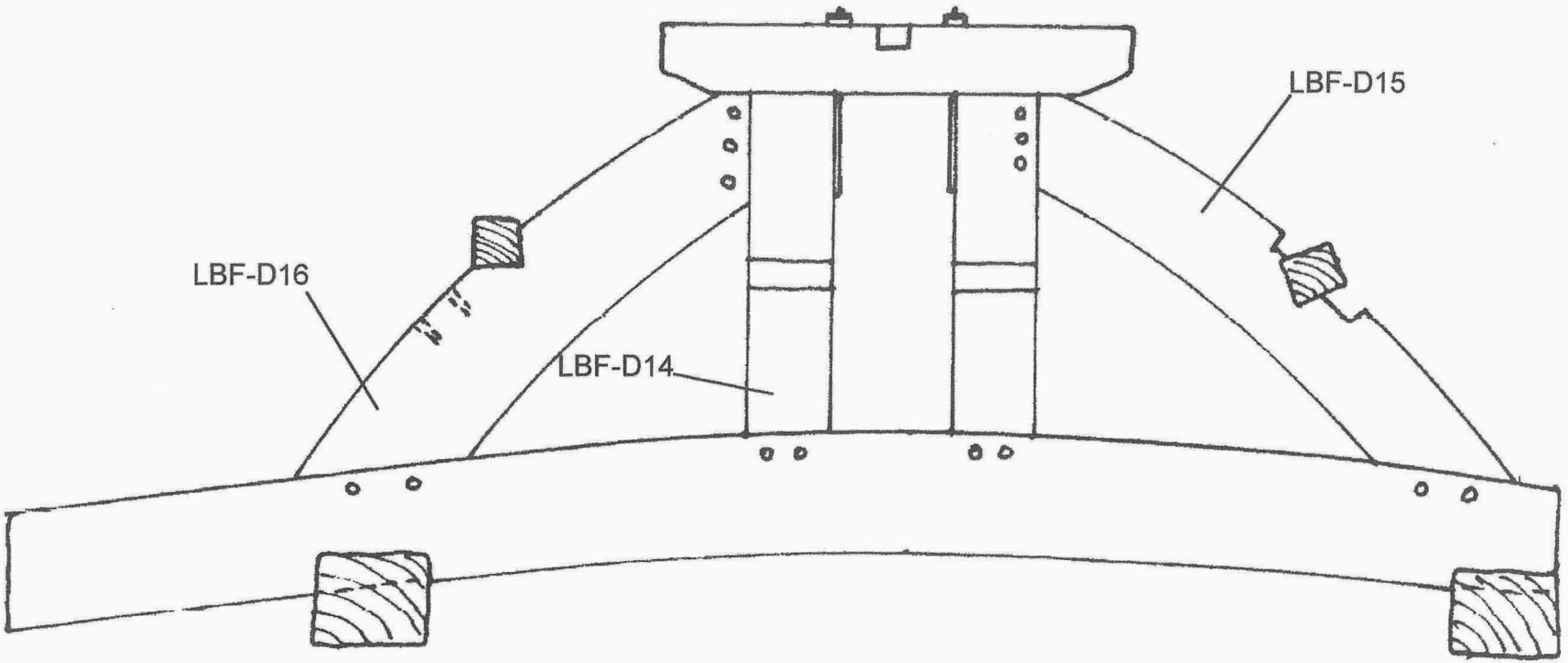


Figure 65: Church of All Saints, Knipton, bellframe: west end frame (C-C), showing the location of samples LBF-D04-D08, and LBF-D09 (George Dawson)

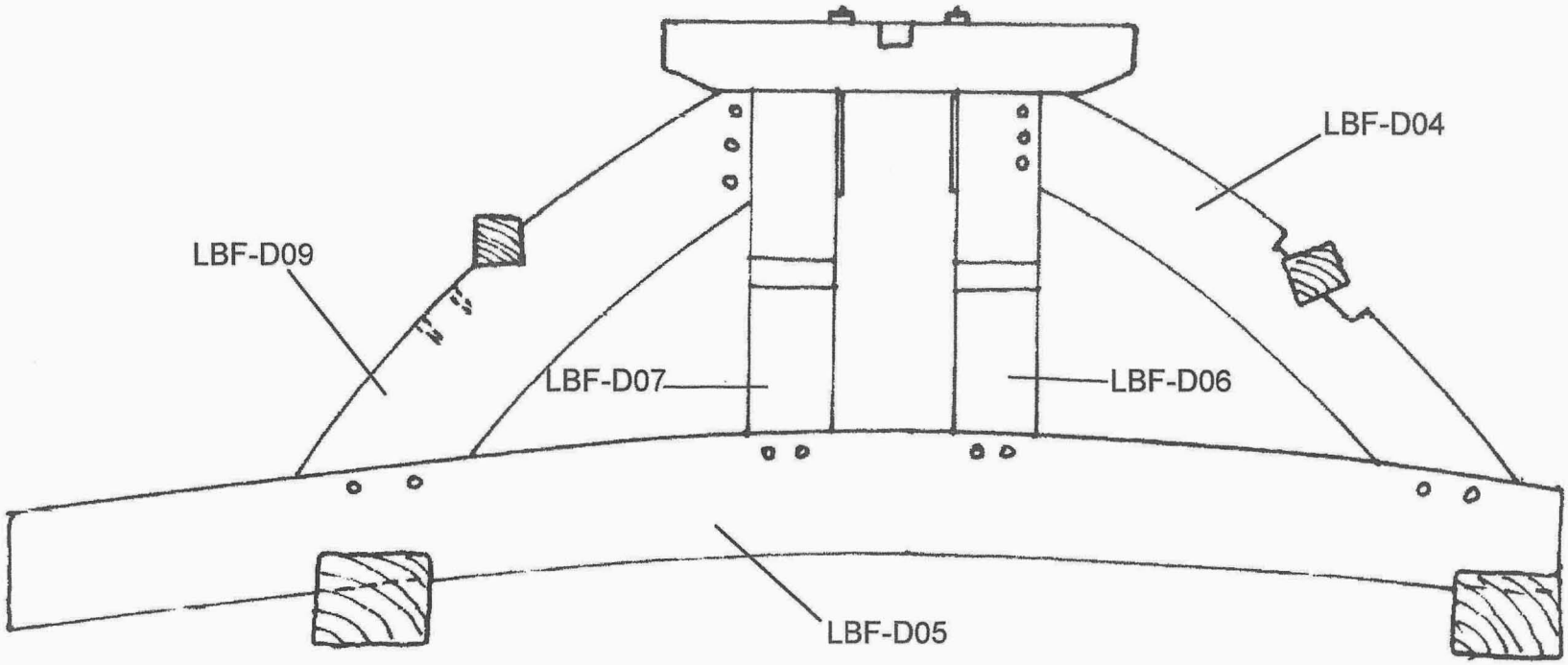


Figure 66: Church of All Saints, Knipton, bellframe: east end frame (D-D), showing the location of samples LBF-D01-D03, and LBF-D08 (George Dawson)

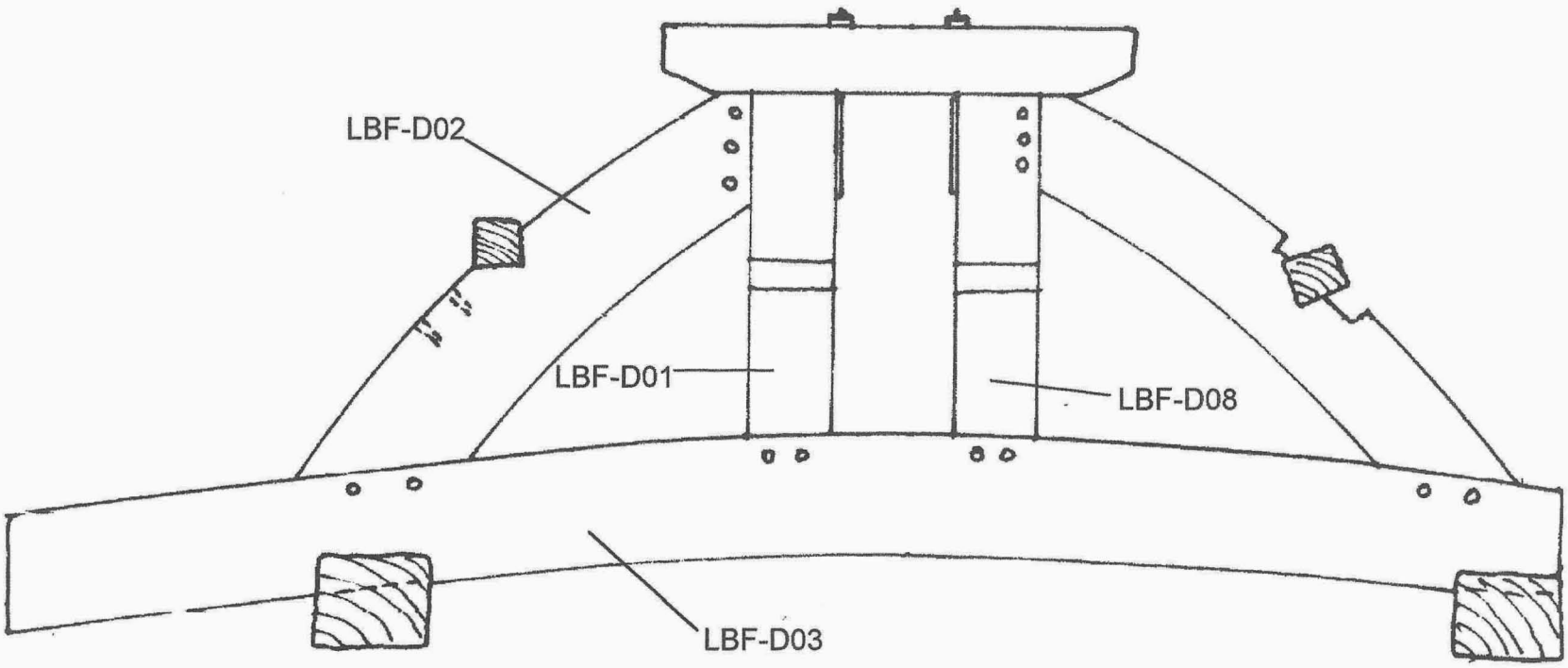
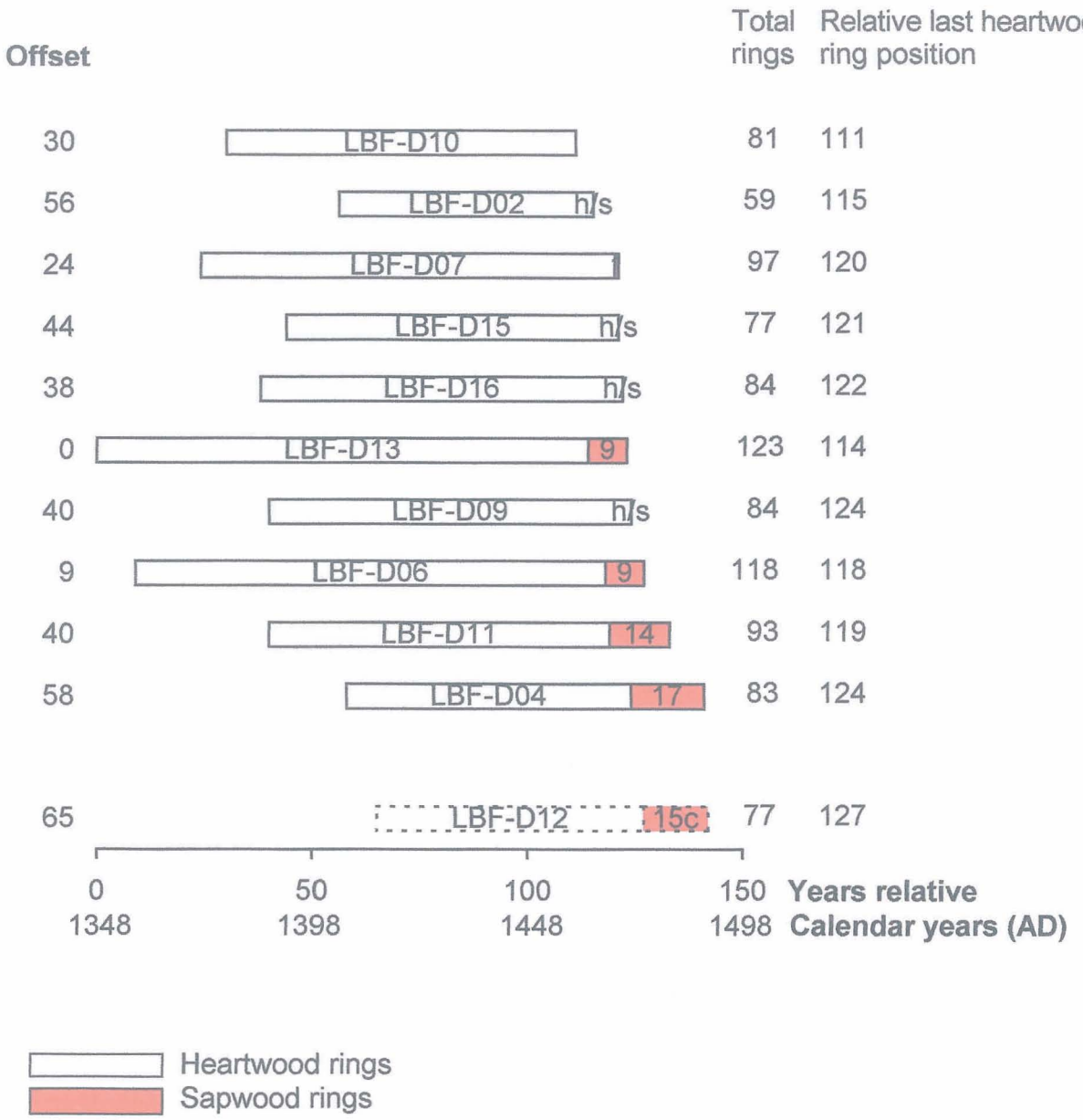


Figure 67: Bar diagram of samples in site sequence LBFDSQ01 and showing their relative position against sample LBF-D12 (dashed lines)



h/s = heartwood/sapwood ring
c = complete sapwood on timber, all or part lost in sampling

4.5
Church of St John the Baptist, Muston (LBF-E)
(SK 829 379; Figs 68-82)

The western tower and spire of this church contains a ring of four bells and a small service bell. It has two almost identical frames, each for two bells, one above the other, both of jack-braced construction, Pickford type 6.B. Each frame is of three trusses marked from north to south (upper) G, F, H and (lower) B, A, C.

In the lower frame the sills sit on the end gate sills (Pickford variant A.1 position 1, A2 method 7). These end gate sills sit on four beams which run east-west. These in turn are supported by two substantial base beams which run north-south and enter those walls adjacent to the east and west walls. In the top frame the bottom end frame sills enter the tower walls directly. This upper frame has no floor underneath it.

These frames may date from the early seventeenth century (two of the bells are dated 1601 & 1605), probably the AD 1630s. Carved into the stonework above the bottom door of the spiral staircase is the date 1633. The service bell sits in a small late nineteenth-century frame sitting in one of the spire window lights above the other frames.

Sampling, Analysis, and Results
Although believed to be contemporary it was thought appropriate to treat these two frames as separate phases. Twenty-four core samples were taken from frame heads, sills, braces, and jack braces, samples LBF-E01-12 from the upper frame, and LBF-E13-24 from the lower frame (Table 11; Figs 72-81). At a least value of t=4.5 all 24 samples grouped and site sequence LBFESQ01, of 175 rings, was constructed containing these samples at the offsets shown in the bar diagram (Fig 82). This site sequence was successfully matched against the relevant reference chronologies for oak at a first-ring date of AD 1437 and a last-ring date of AD 1611. The evidence for this dating is given by the t-values in Table 12.

Interpretation
Analysis of samples from the timbers of this bellframe has resulted in the production of one dated site sequence, containing all 24 samples.

Site sequence LBFESQ01, of 175 rings, was dated to the period AD 1437-1611. Two of the samples, LBF-E07 and LBF-E11 have complete sapwood and a last-ring date of AD 1611, the felling date of the two timbers represented. Sixteen other samples in this site sequence have the heartwood/sapwood boundary ring, the average of which is AD 1591. Allowing for samples LBF-E18 and LBF-E19 having the last ring date of AD 1607, it is possible to calculate an estimated felling date for the timbers represented to within the range AD 1608-26, consistent with a AD 1611 felling. The remaining six samples in this site sequence do not have the heartwood/sapwood boundary ring, but with last measured ring dates ranging from AD 1560 (LBF-E20) to AD

1583 (LBF-E08) it is possible that these could all also have been felled at the same time as the others.

Discussion

Tree-ring analysis has resulted in the successful dating of 24 timbers of the bellframe. It is now known that two timbers used in the construction of this structure were felled in AD 1611, with at least a further 16 also being quite likely to have been felled at this time. Both of the samples with complete sapwood are from the upper bell frame but the felling date range as discussed above and the high degree of matching between the samples from both frames points towards these being contemporary, as thought following structural analysis.

Table 11: Details of tree-ring samples from timbers of the bellframe of the Church of St John the Baptist, Main Street/Church Lane, Muston, Leicestershire

Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Last heartwood ring date (AD)	Last measured ring date (AD)
Upper frame						
LBF-E01	Sill, frame G-G	73	h/s	1524	1596	1596
LBF-E02	East brace, frame G-G	60	--	1521	----	1580
LBF-E03	Sill, east end frame (K-K)	120	--	1456	----	1575
LBF-E04	Sill, frame H-H	82	h/s	1504	1585	1585
LBF-E05	East brace, frame H-H	49	21c	1556	1584	1605
LBF-E06	Sill, west end frame (J-J)	79	h/s	1510	1588	1588
LBF-E07	Sill, frame F-F	89	21C	1523	1590	1611
LBF-E08	Frame head, frame F-F	96	--	1488	----	1583
LBF-E09	Frame head, frame G-G	69	h/s	1523	1591	1591
LBF-E10	Frame head, east end frame (K-K)	139	--	1437	----	1575
LBF-E11	North jack brace, west end frame (J-J)	111	36C	1501	1575	1611
LBF-E12	Frame head, frame H-H	54	h/s	1537	1590	1590
Lower frame						
LBF-E13	East brace, frame A-A	89	h/s	1504	1592	1592
LBF-E14	East brace, frame B-B	125	--	1447	----	1571
LBF-E15	East jack brace, frame B-B	88	08	1515	1594	1602
LBF-E16	Frame head, east end frame (E-E)	54	h/s	1530	1583	1583
LBF-E17	East jack brace, frame A-A	71	02	1531	1599	1601
LBF-E18	West jack brace, frame A-A	93	09	1515	1598	1607
LBF-E19	West brace, frame A-A	58	12	1550	1595	1607
LBF-E20	West brace, frame B-B	57	--	1504	----	1560
LBF-E21	Frame head, west end frame (D-D)	81	h/s	1507	1587	1587
LBF-E22	East brace, frame C-C	69	h/s	1522	1590	1590

LBF-E23	Frame head, frame C-C	96	h/s	1500	1595	1595
LBF-E24	South jack brace, west end frame (D-D)	64	h/s	1527	1590	1590

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

Table 12: Results of the cross-matching of site sequence LBFESQ01 and relevant reference chronologies when the first-ring date is AD 1437 and the last-ring date is AD 1611

Reference chronology	*t*-value	Span of chronology	Reference
East Midlands	9.2	AD 882-1981	Laxton and Litton 1988
England	9.1	AD 404-1981	Baillie and Pilcher 1982 unpubl
Western England and Wales	7.6	AD 1341-1636	Siebenlist-Kerner 1978
Stoneleigh Abbey (house), Warwicks	8.7	AD 1398-1658	Howard and Litton 2003 unpubl
Tusmore Granary, Tusmore Park, Bicester, Oxon	7.9	AD 1359-1545	Howard *et al* 1992
Colston Bassett Church (bell frame), Notts	7.6	AD 1465-1609	Howard *et al* 1995
Gotham Manor, Gotham, Notts	7.2	AD 1391-1590	Howard *et al* 1991

Figure 68: Church of St John the Baptist, Muston (Dr C J Brooke)

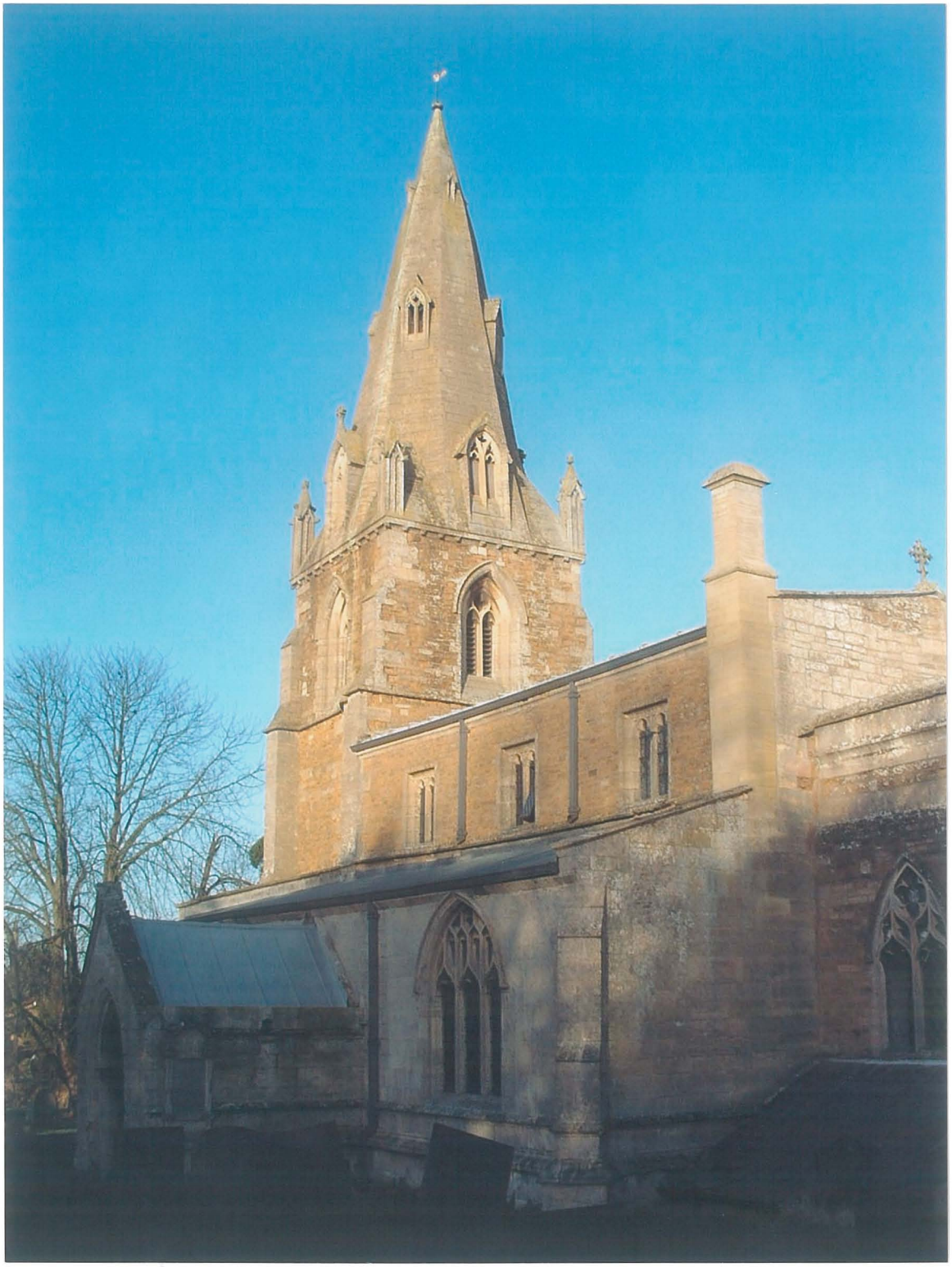


Figure 69: Church of St John the Baptist, Muston, upper frame with wheel of bell 1 to the left (Dr C J Brooke)

Figure 70: St John the Baptist Church, Muston, Lower bellframe; plan (George Dawson)

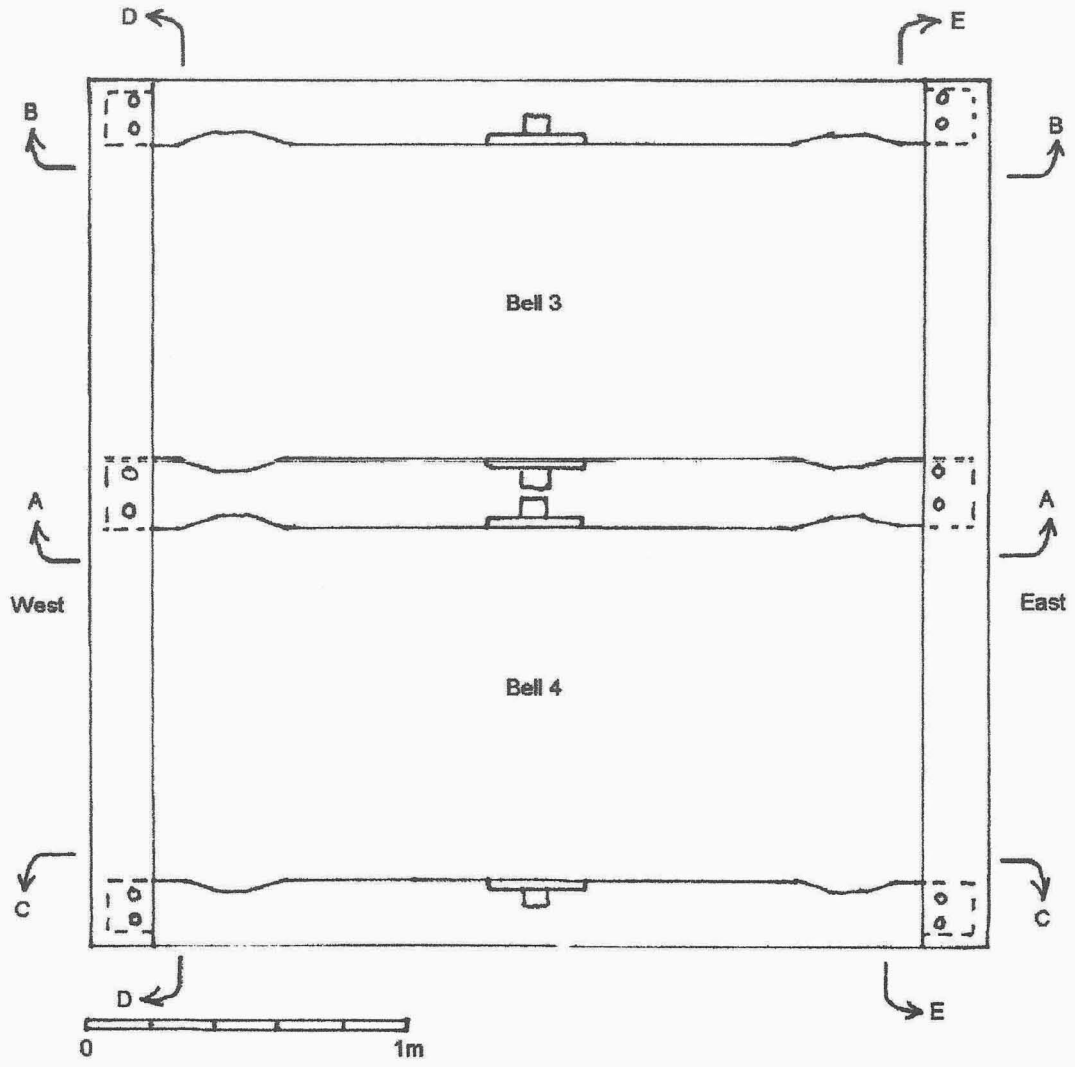


Figure 71: St John the Baptist Church, Muston, Upper bellframe; plan (George Dawson)

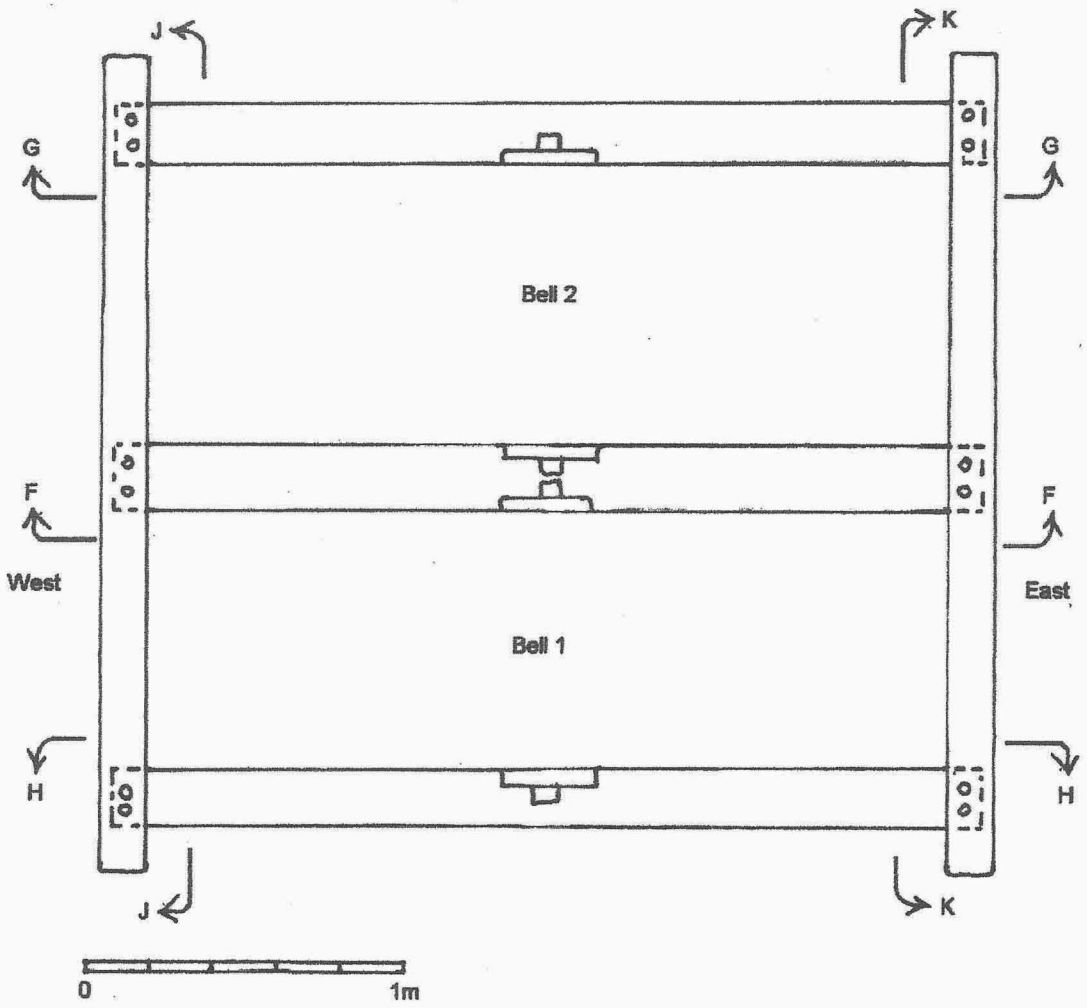


Figure 72: St John the Baptist Church, Muston, bellframe; truss A-A, showing the location of samples LBF-E13, and LBF-E17-19 (George Dawson)

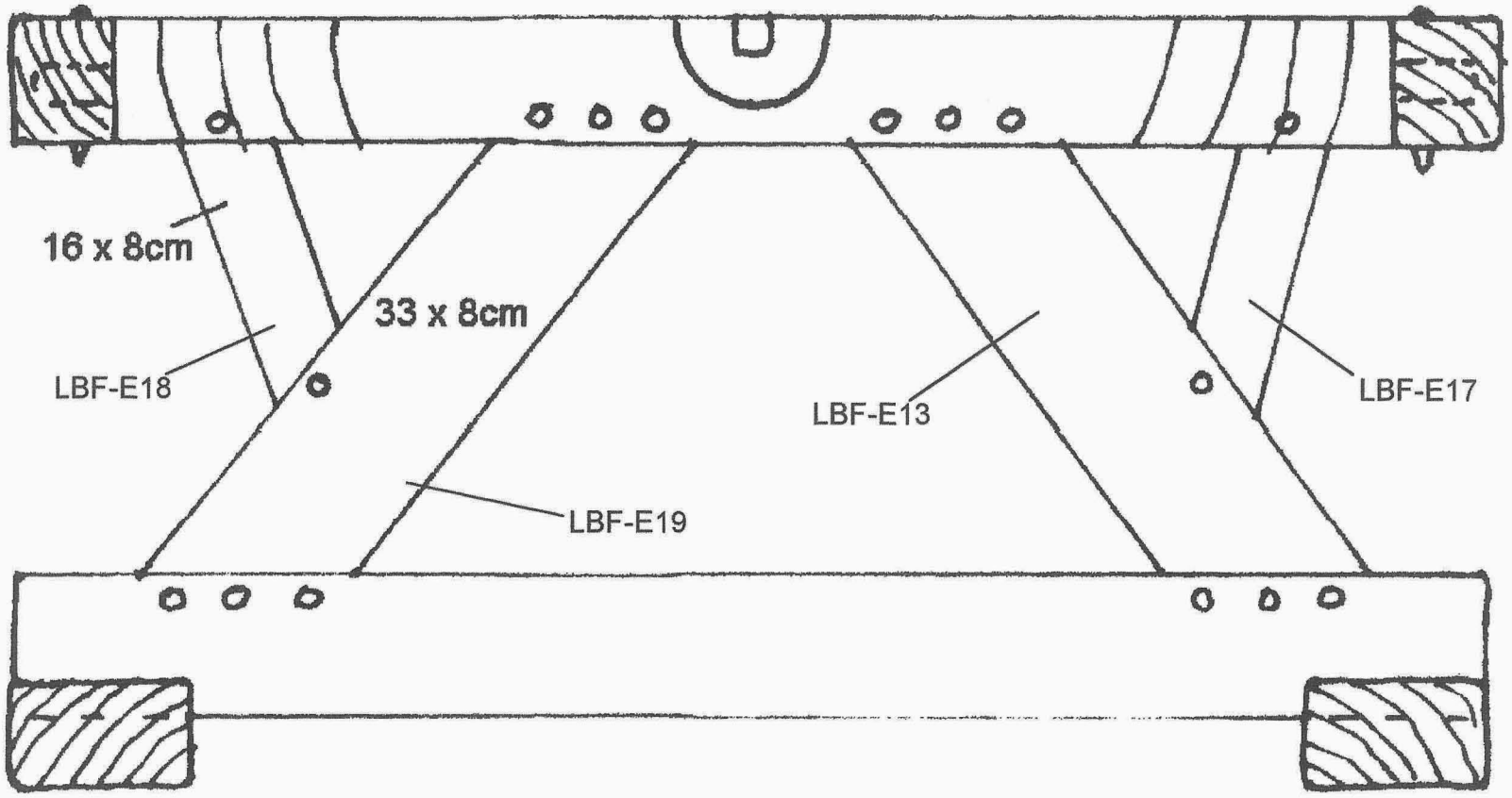


Figure 73: St John the Baptist Church, Muston, bellframe; truss B-B, showing the location of samples LBF-E14-15, and LBF-E20 (George Dawson)

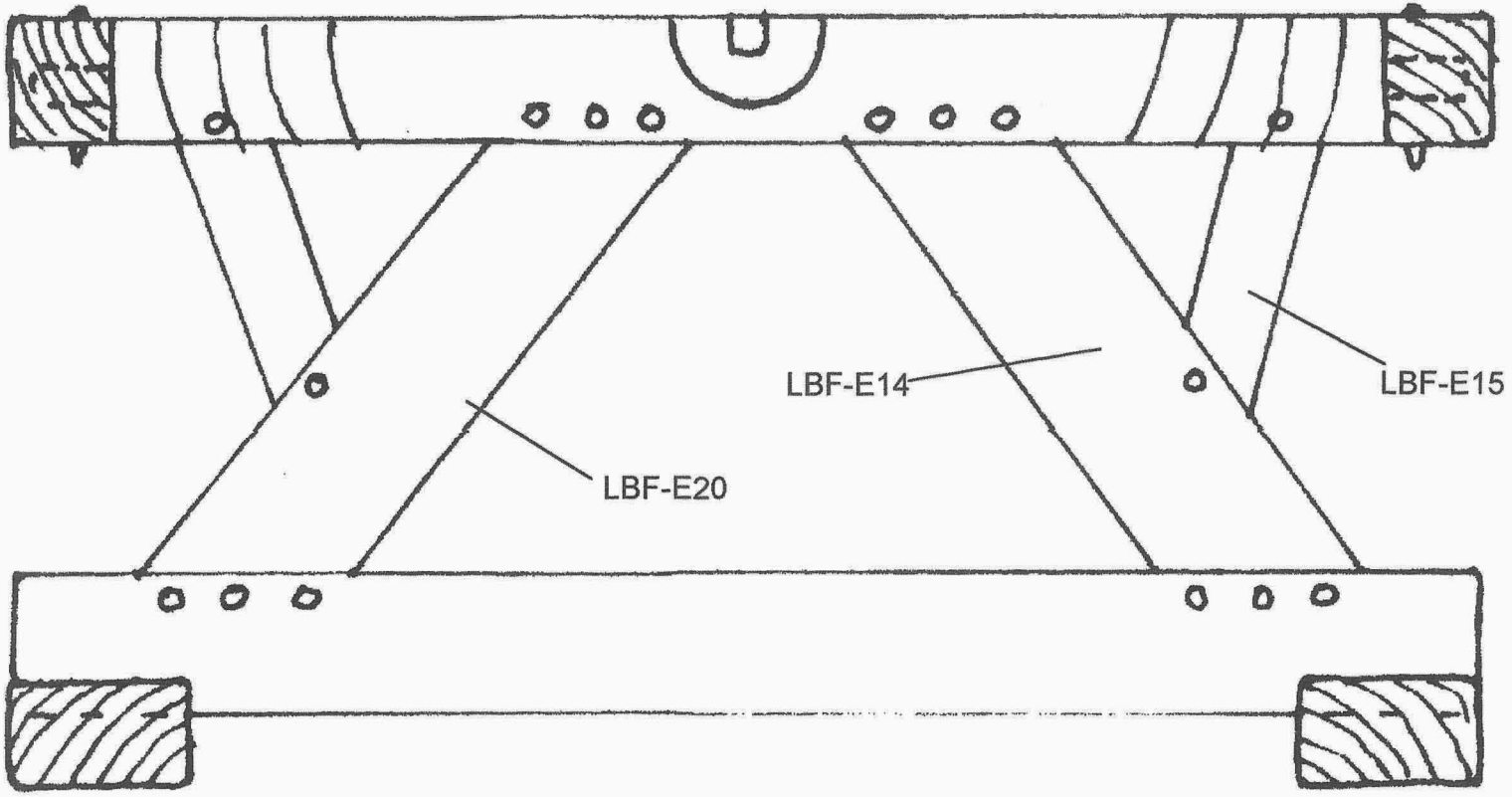


Figure 74: St John the Baptist Church, Muston, bellframe; truss C-C, showing the location of samples LBF-E22 and LBF-E23 (George Dawson)

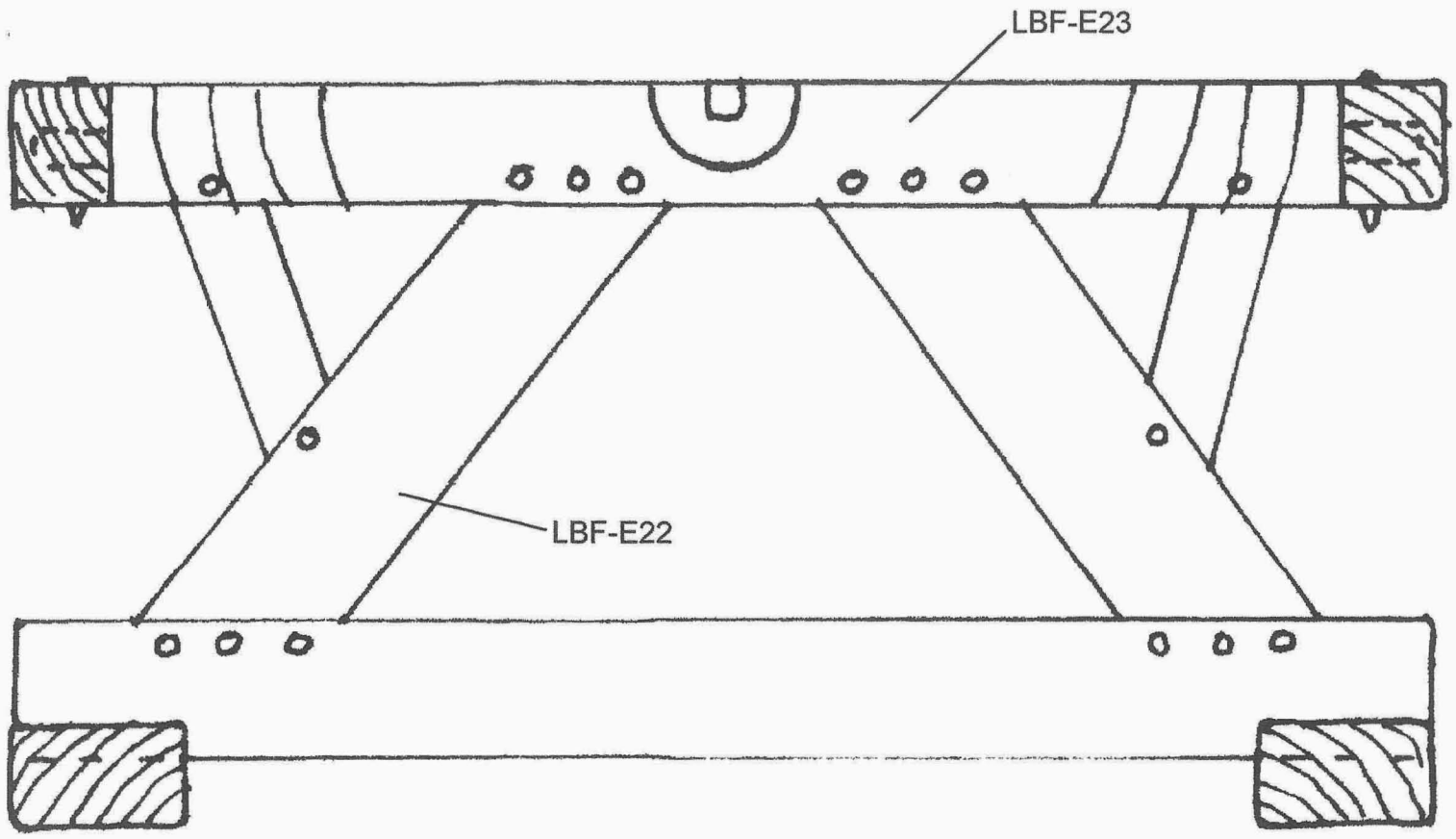


Figure 75: St John the Baptist Church, Muston, bellframe; west end frame (D-D), showing the location of samples LBF-E21 and LBF-E24 (George Dawson)

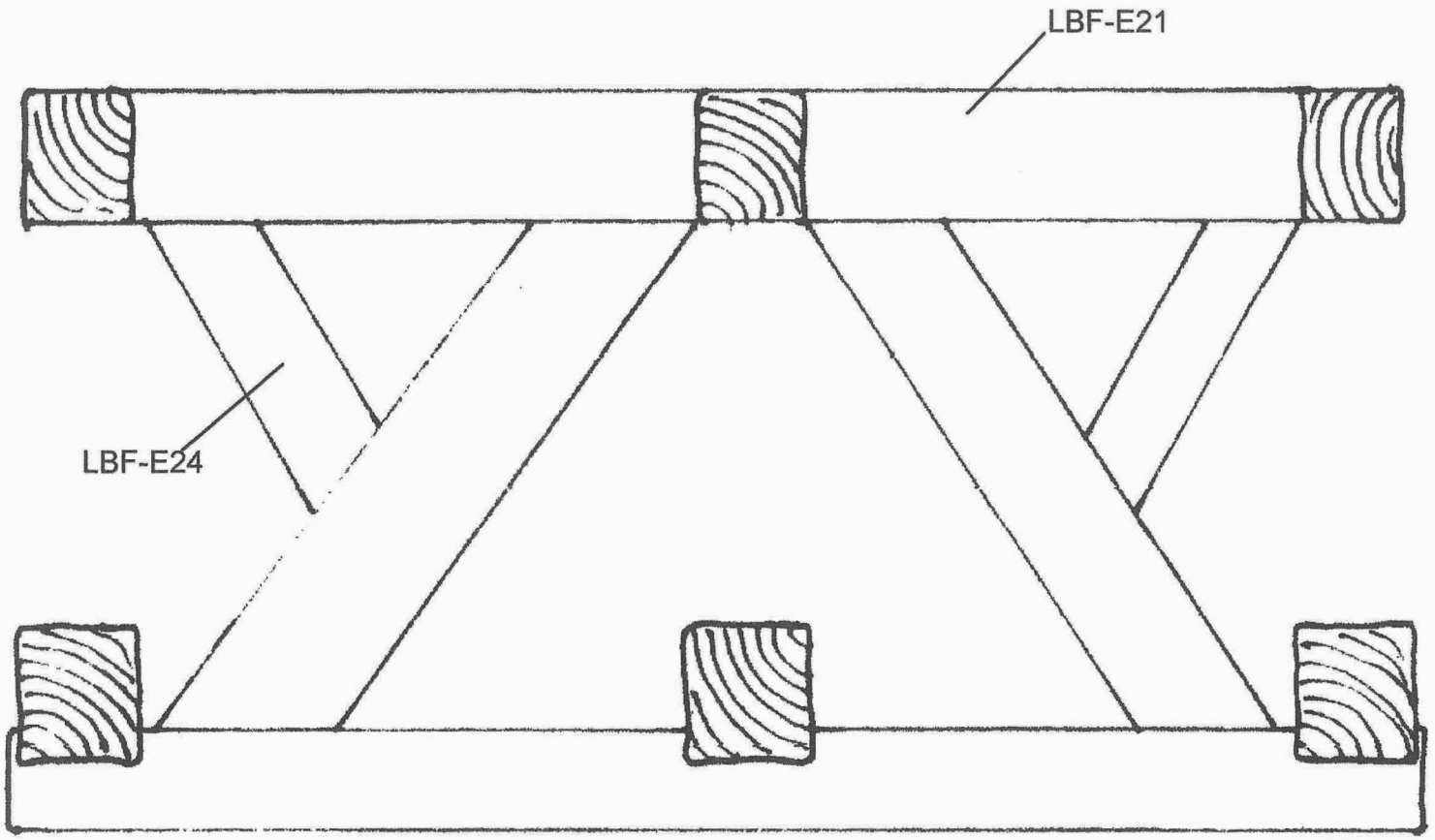


Figure 76: St John the Baptist Church, Muston, bellframe; east end frame (E-E), showing the location of sample LBF-E16 (George Dawson)

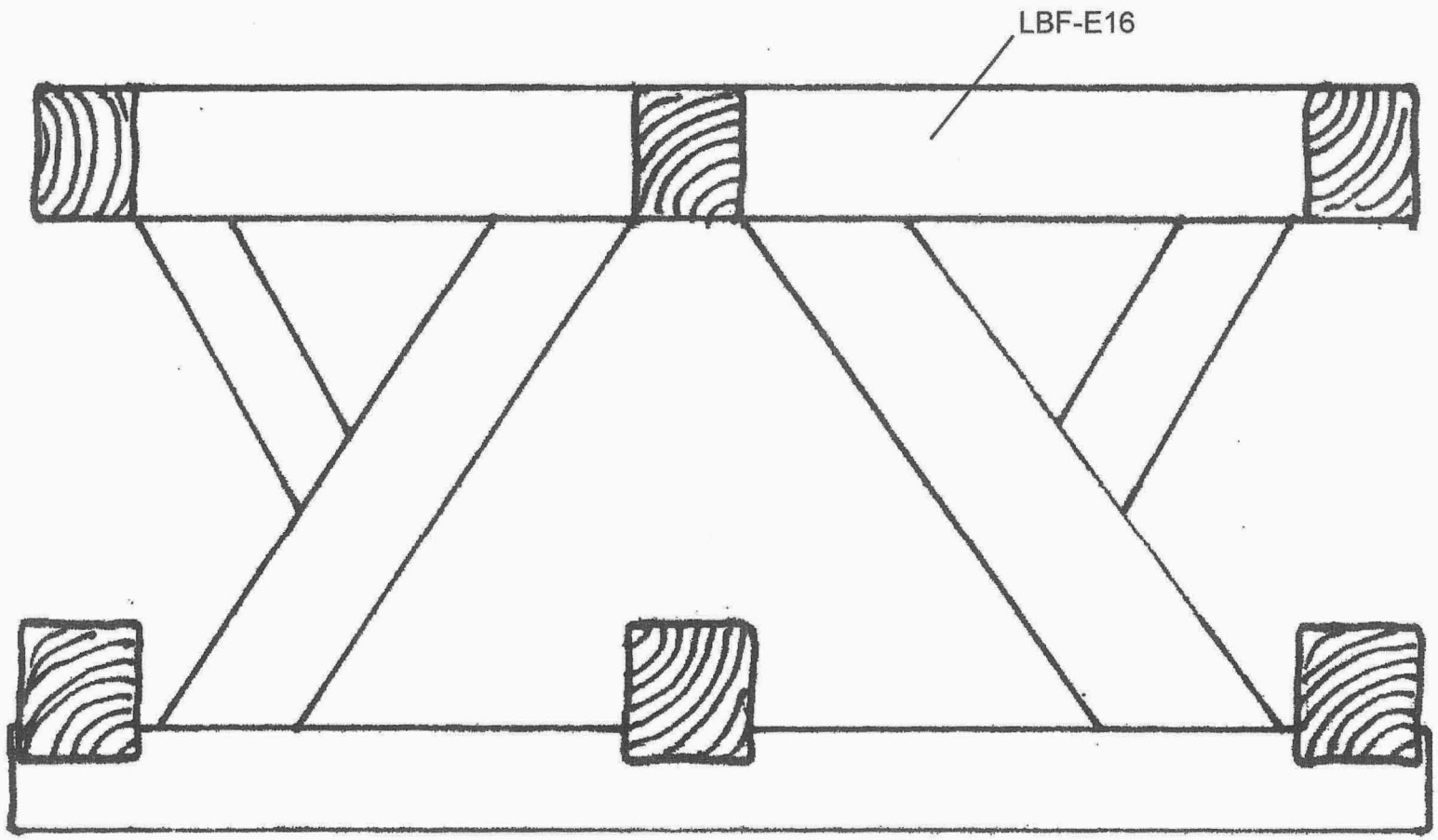


Figure 77: St John the Baptist Church, Muston, bellframe; truss F-F, showing the location of samples LBF-E07 and LBF-E08 (George Dawson)

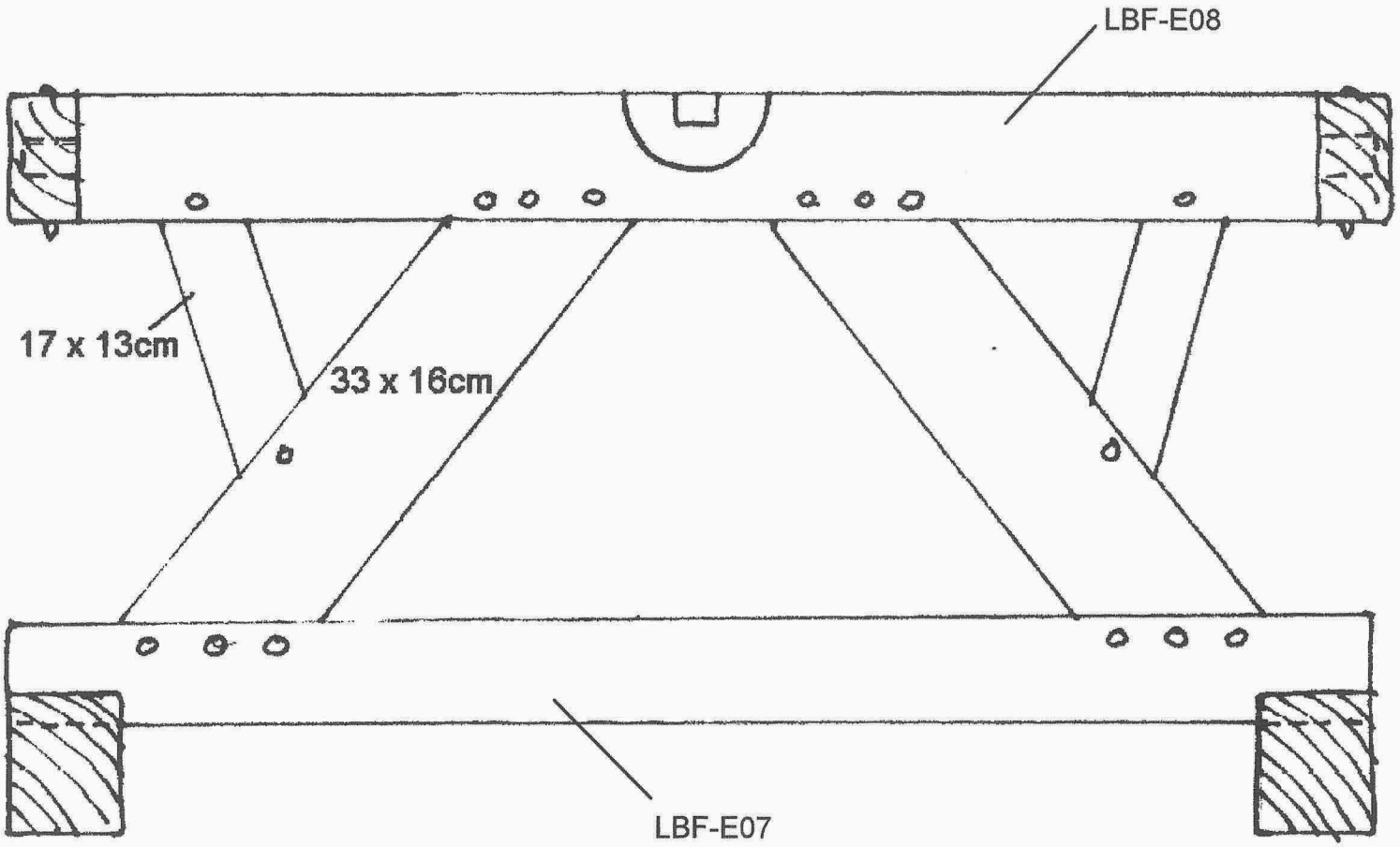


Figure 78: St John the Baptist Church, Muston, bellframe; truss G-G, showing the location of samples LBF-E01-02, and LBF-E09 (George Dawson)

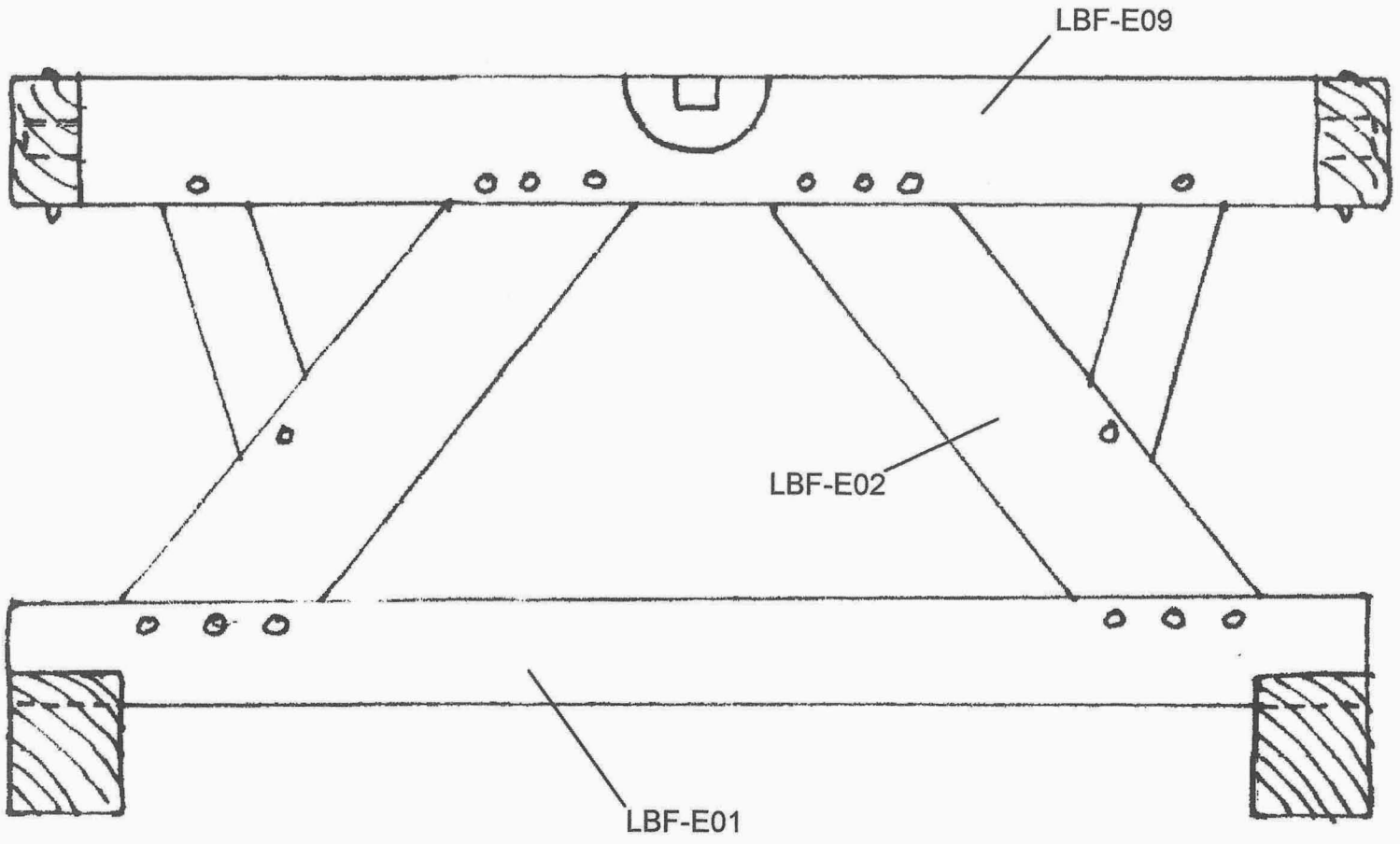


Figure 79: St John the Baptist Church, Muston, bellframe; truss H-H, showing the location of samples LBF-E04-05, and LBF-E12 (George Dawson)

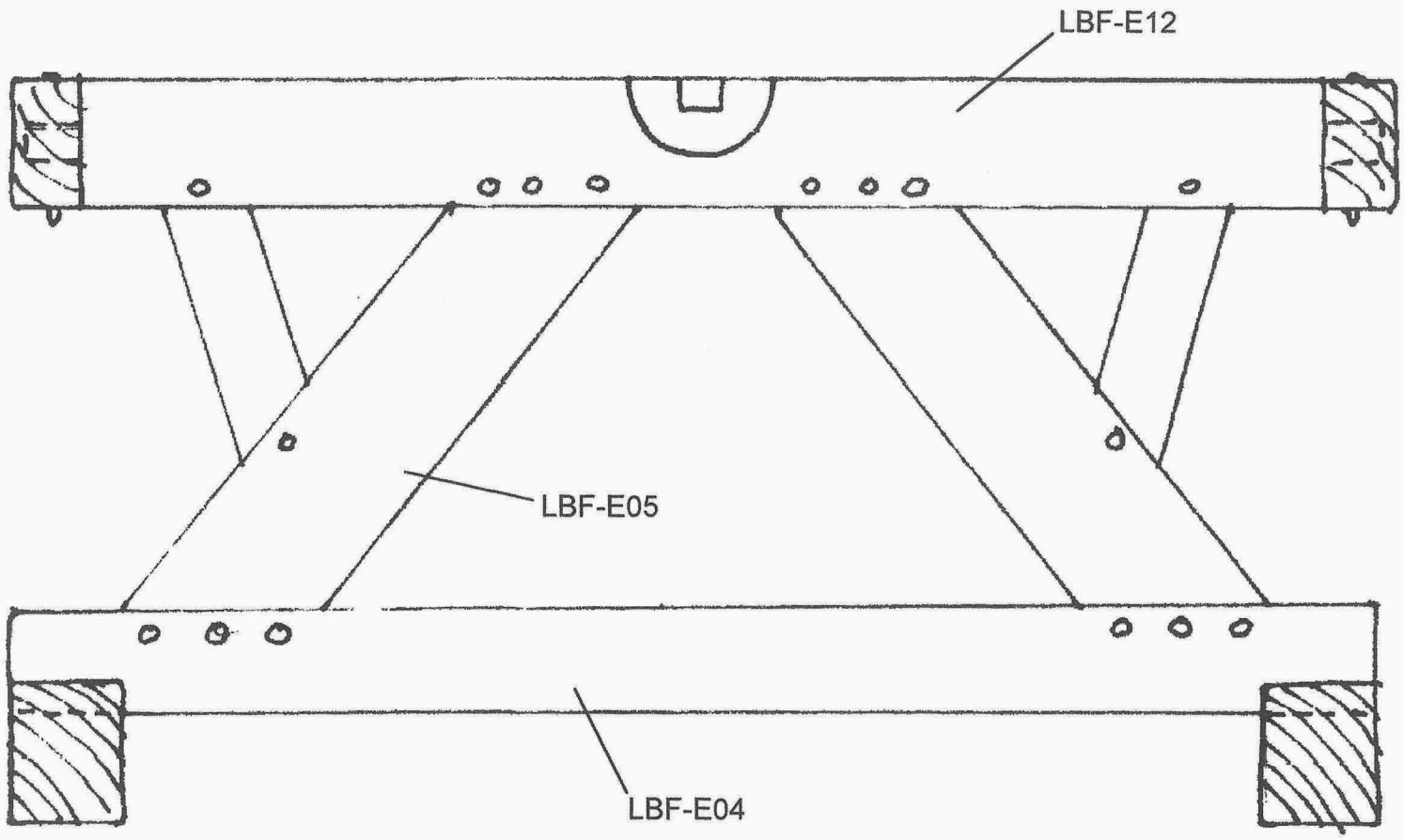


Figure 80: St John the Baptist Church, Muston, bellframe; west end frame (J-J), showing the location of samples LBF-E06 and LBF-E11 (George Dawson)

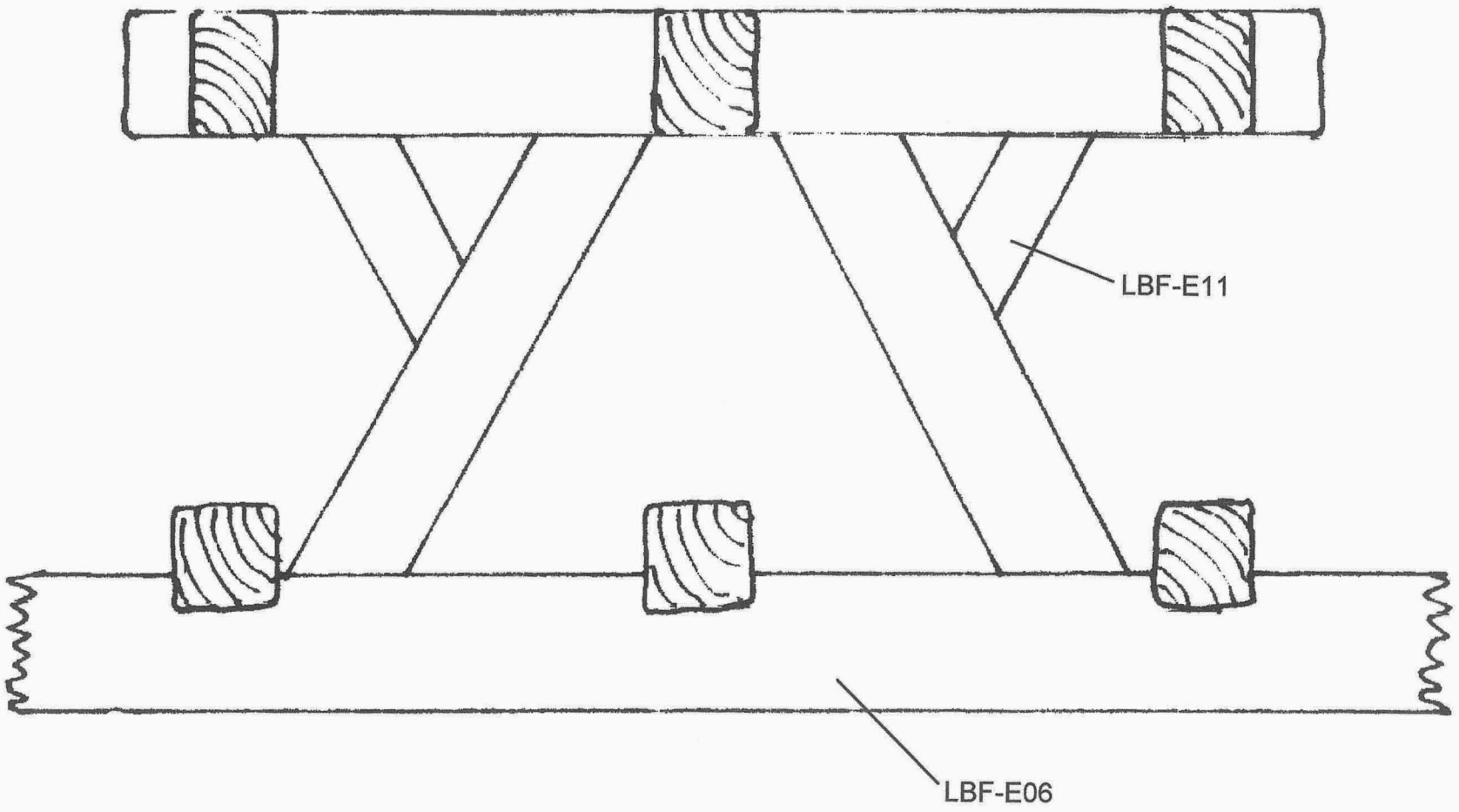
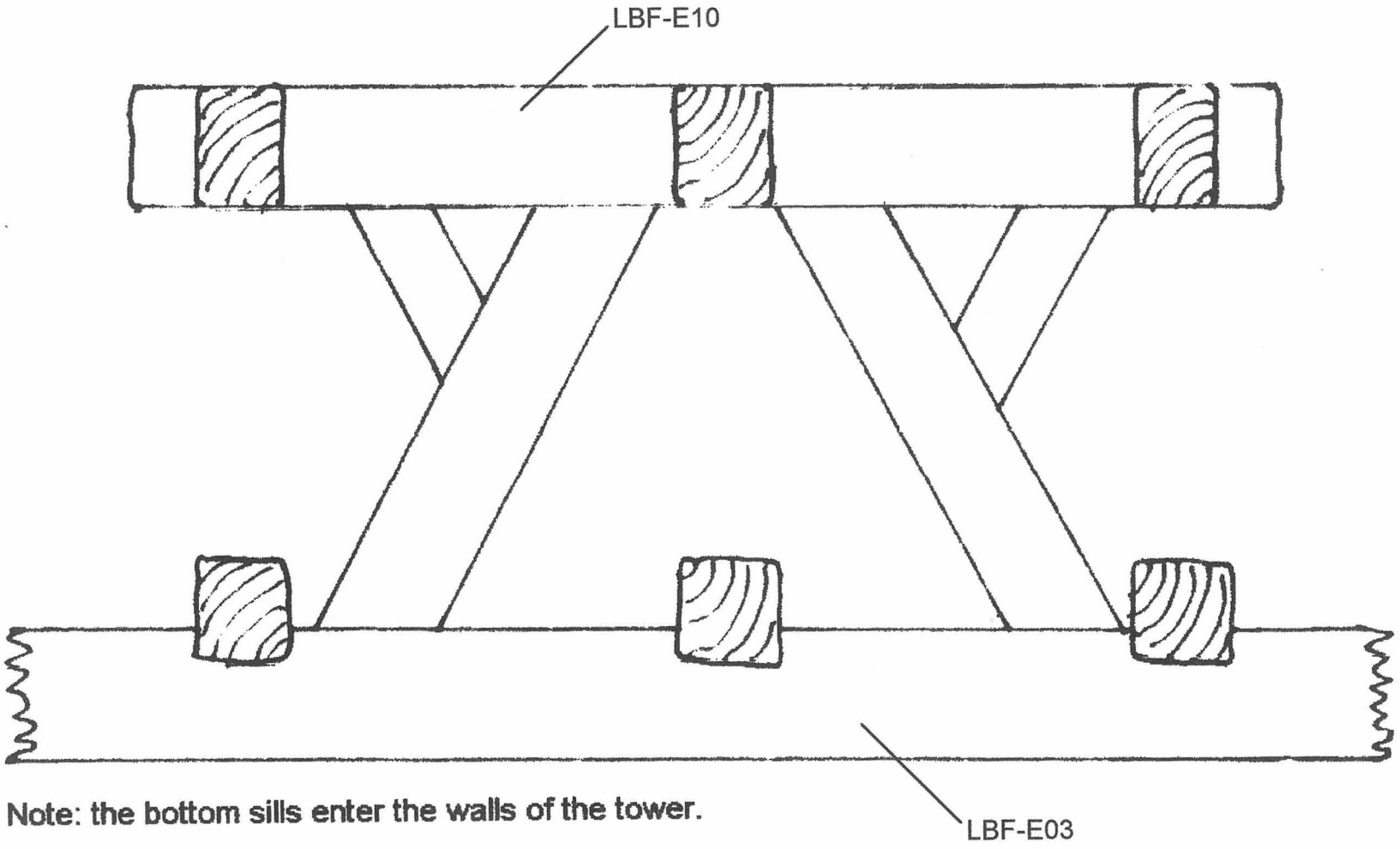
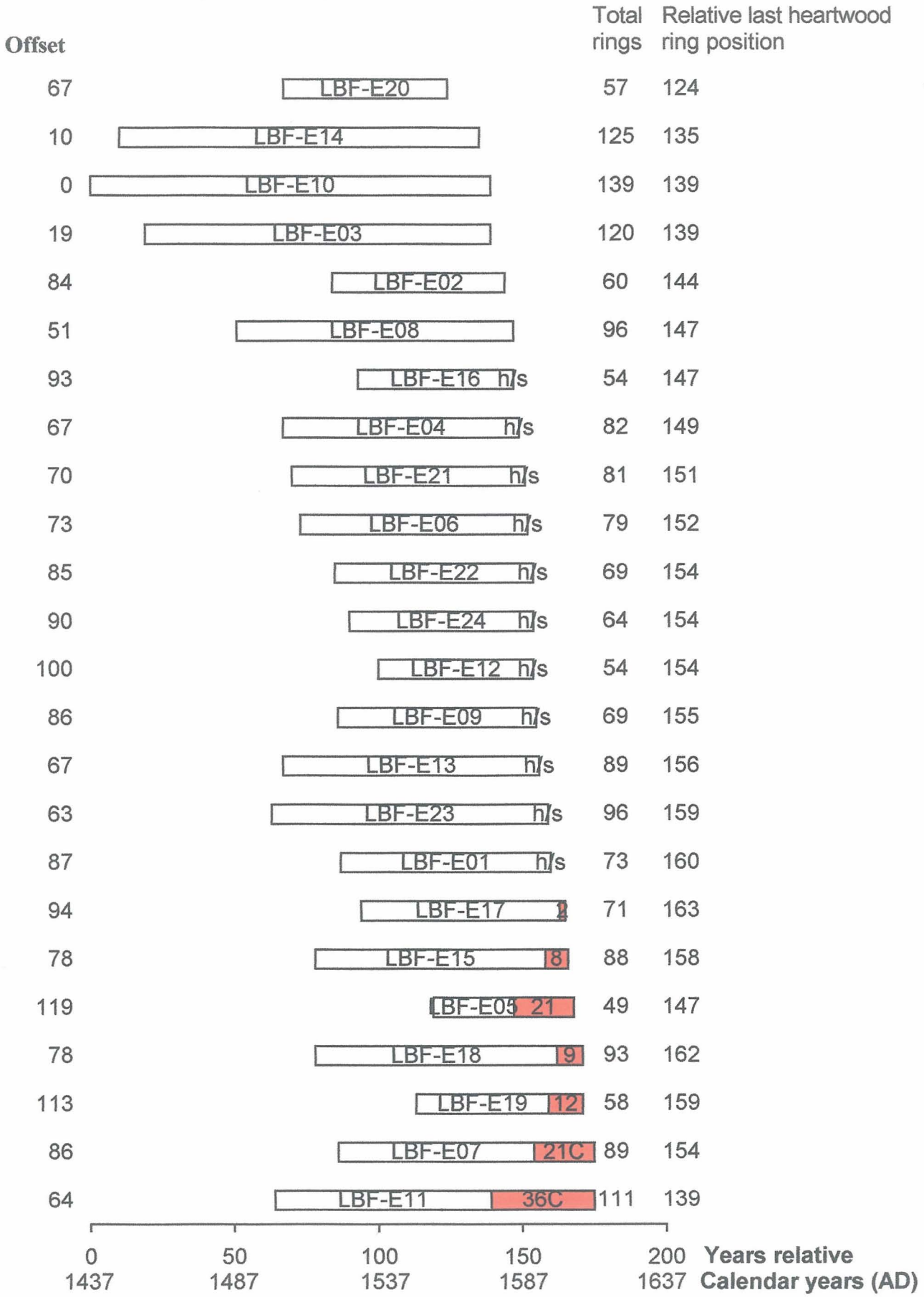


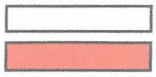
Figure 81: St John the Baptist Church, Muston, bellframe; east end frame (K-K), showing the location of samples LBF-E03 and LBF-E10 (George Dawson)



Note: the bottom sills enter the walls of the tower.

Figure 82: Bar diagram of samples in site sequence LBFESQ01





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

4.6
Church of St Nicholas, Bringhurst (LBF-F)
(SP 841 922; Figs 83-92)

Description
The pegged oak bellframe sits diagonally in the tower (Fig 83), with the two substantial sills of the end-gates acting as the main beams of the frame. In design this bellframe is a jack-braced frame (Pickford type 6.B). Each of the four trusses is attached to the end frames with lapped dovetail joints at the sills, and mortises and tenons at the frame heads. All trusses are similar in design and the frame was of one build. These have been marked (north to south) B, A, C, and D.

Sometime in the nineteenth century the frame was strengthened by the addition of extra timbers on the outsides of the sills of the outside braces and end frames. Steeply angled braces were then added up to the frame heads in an attempt to stiffen the frame. These timbers are not shown on the drawing of the frame.

Stylistically the frame is similar to a number of other frames in the area, and dates from the early-seventeenth century.

Sampling, Analysis, and Results
Fifteen core samples were taken from the frame heads, sills, and braces of this bellframe (Table 13; Figs 85-90). Analysis of these samples resulted in 14 samples forming three groups at a least value of t=4.5. Firstly, eight samples grouped and site sequence LBFFSQ01, of 186 rings, was constructed (Fig 91). This site sequence was successfully matched against the reference chronologies at a first-ring date of AD 1502 and a last-ring date of AD 1687. The evidence for this dating is given by the t-values in Table 14.

Secondly, four samples matched and site sequence LBFFSQ02, of 63 rings, was constructed (Fig 91). This site sequence was successfully matched against the relevant reference chronologies for oak to spanning the period AD 1619-81. The evidence for this dating is given by the t-values in Table 15.

Finally, two samples grouped and site sequence LBFFSQ03, of 77 rings was constructed (Fig 92). Unfortunately, this site sequence could not be matched against the reference chronologies and these samples are undated.

The remaining sample, LBF-F04, was then individually compared against the reference chronologies where it was found to span the period AD 1646-92. The evidence for this date is given by the t-values in Table 16.

Interpretation
Analysis of samples from the timbers of this bellframe has resulted in the production of two dated site sequences and one individually dated sample.

Site sequence LBFFSQ01, of 186 rings, contains eight samples, and was found to span the period AD 1502-1687. Site sequence LBFFSQ02, of 63

rings, and containing four samples was dated to the period AD 1619-1681. Lastly, sample LBF-F04 was dated individually to the period AD 1646-92. Eight of these dated samples have the heartwood/sapwood boundary ring which can be used to calculate an estimated felling date range for the timbers represented. As can be seen in Figure 91 these are broadly contemporary suggesting they were felled at the same time. The average heartwood/sapwood boundary ring for these eight samples is AD 1676, which gives an estimated felling date range for the eight timbers represented, allowing for sample LBF-F04 having a last measured ring date of AD 1692 without complete sapwood, to within the range AD 1693-1711.

The other five samples in site sequence LBFFSQ01 do not have the heartwood/sapwood boundary ring and so estimated felling dates cannot be calculated for them. However, with last measured ring dates ranging from AD 1606 (LBF-F15) to AD 1658 (LBF-F09) all of these could potentially have been a contemporaneous felling. However, equally they could represent a number of separate fellings.

Discussion

Tree-ring analysis has resulted in the successful dating of 13 of the timbers of this bellframe. It is now thought quite likely that at least seven of these timbers represent a single felling in AD 1693-1711. Whether a second felling is represented within this bellframe is unknown with estimated felling dates for the rest of the dated timbers not having been calculated. However, given the high degree of matching between these five samples and the other three in the site sequence it is more likely that they were also felled between AD 1693-1711.

Prior to tree-ring analysis being undertaken this bellframe had been dated on stylistic grounds to the early seventeenth century. It is now known to have been constructed from timbers felled in the very late seventeenth/early eighteenth century.

This difference in dating the frame confirms the thought of many bellframe researchers, such as Pickford, Dalton, and Dawson (pers comm), that the building style of a frame could be used for a considerable period.

Table 13: Details of tree-ring samples from timbers of the bellframe of the Church of St Nicholas, Bringhurst, Leicestershire

Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Last heartwood ring date (AD)	Last measured ring date (AD)
LBF-F01	Frame head, north end frame F-F	74	h/s	----	----	----
LBF-F02	Frame head, south end frame E-E	74	h/s	----	----	----
LBF-F03	Sill, north end frame F-F	59	03	1619	1674	1677
LBF-F04	North brace, frame B-B	47	15	1646	1677	1692
LBF-F05	Frame head, frame D-D	51	--	1502	----	1552
LBF-F06	Sill, frame D-D	129	h/s	1544	1672	1672
LBF-F07	North brace, frame C-C	59	h/s	1623	1681	1681
LBF-F08	Sill, frame C-C	119	--	1508	----	1626
LBF-F09	East brace, north end frame F-F	122	--	1537	----	1658
LBF-F10	Frame head, frame A-A	76	h/s	1589	1664	1664
LBF-F11	Sill, frame A-A	153	09	1535	1678	1687
LBF-F12	South brace, frame C-C	60	h/s	1620	1679	1679
LBF-F13	Sill, frame B-B	117	--	1516	----	1632
LBF-F14	South brace, frame A-A	57	01	1625	1680	1681
LBF-F15	Frame head, frame B-B	87	--	1520	----	1606

*h/s = the heartwood/sapwood boundary is the last ring on the sample

Table 14: Results of the cross-matching of site sequence LBFFSQ01 and relevant reference chronologies when the first-ring date is AD 1502 and the last-ring date is AD 1687

Reference chronology	*t*-value	Span of chronology	Reference
East Midlands	10.3	AD 882-1981	Laxton and Litton 1988
England	9.6	AD 404-1981	Baillie and Piclher 1982 unpubl
Western England and Wales	8.8	AD 1341-1636	Siebenlist-Kerner 1978
Astley Castle, Warwickshire, Warwicks	9.9	AD 1495-1627	Howard *et al* 1997b
De Greys Mausoleum, Flitton, Beds	9.0	AD 1510-1711	Arnold *et al* 2003b
Bolsover Castle (riding house), Derbys	8.1	AD 1494-1744	Arnold *et al* forthcoming

Table 15: Results of the cross-matching of site sequence LBFFSQ02 and relevant reference chronologies when the first-ring date is AD 1619 and the last-ring date is AD 1681

Reference chronology	*t*-value	Span of chronology	Reference
East Midlands	6.6	AD 882-1981	Laxton and Litton 1988
The Guide House, Arnold, Notts	6.1	AD 1596-1692	Laxton and Litton 1988
The Wheatsheaf, Cropwell Bishop, Notts	5.5	AD 1604-1703	Howard *et al* 1995d unpubl
South Luffenham Hall, South Luffenham	6.1	AD 1594-1709	Arnold *et al* 2002 unpubl
Bretby Hall, Derbys	5.4	AD 1494-1718	Howard *et al* 1999
Blidworth Church, Notts	4.9	AD 1621-1714	Laxton and Litton 1988
Bolsover (little castle), Derbys	4.8	AD 1532-1749	Arnold *et al* 2003c

Table 16: Results of the cross-matching of sample LBF-F04 and relevant reference chronologies when the first-ring date is AD 1646 and the last-ring date is AD 1692

Reference chronology	*t*-value	Span of chronology	Reference
East Midlands	5.5	AD 882-1981	Laxton and Litton 1988
Wheelwright's Shop, Chatham Docks	7.7	AD 1615-1780	Bridge 1998
South Luffenham Hall, South Luffenham	6.3	AD 1594-1709	Arnold *et al* 2002 unpubl
Blidworth Church, Notts	6.0	AD 1625-1717	Laxton and Litton 1988
Bretby Hall, Derbys	5.9	AD 1494-1718	Howard *et al* 1999
Bolsover Castle (riding house), Derbys	5.9	AD 1494-1744	Arnold *et al* forthcoming
Old Barn, Stratford on Avon, Warwicks	5.7	AD 1592-1735	Howard *et al* 1996a

Figure 83: Church of St Nicholas, Bringhurst, Plan of bellframe within tower (George Dawson)

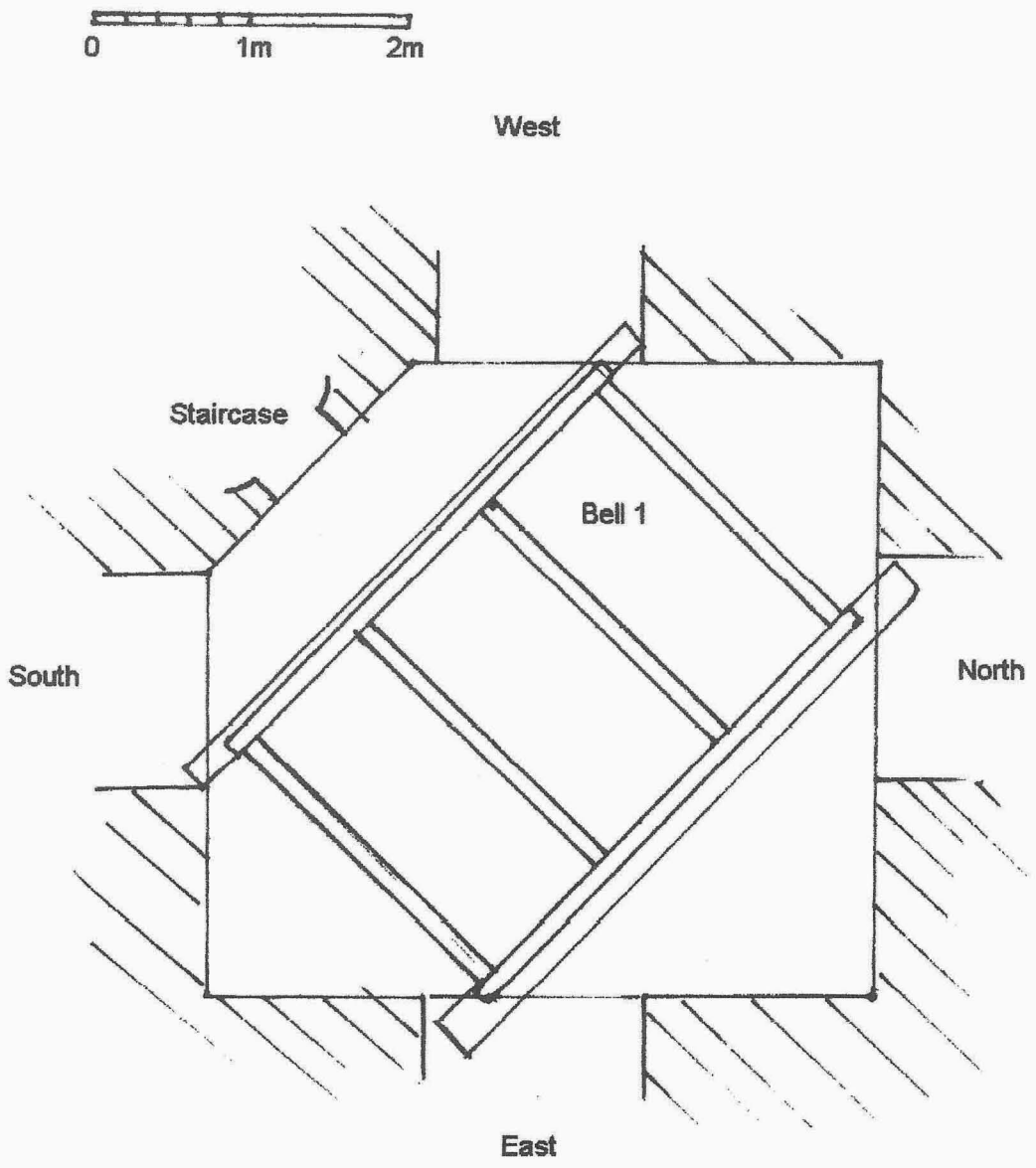


Figure 84: Church of St Nicholas, Bringhurst; plan (George Dawson)

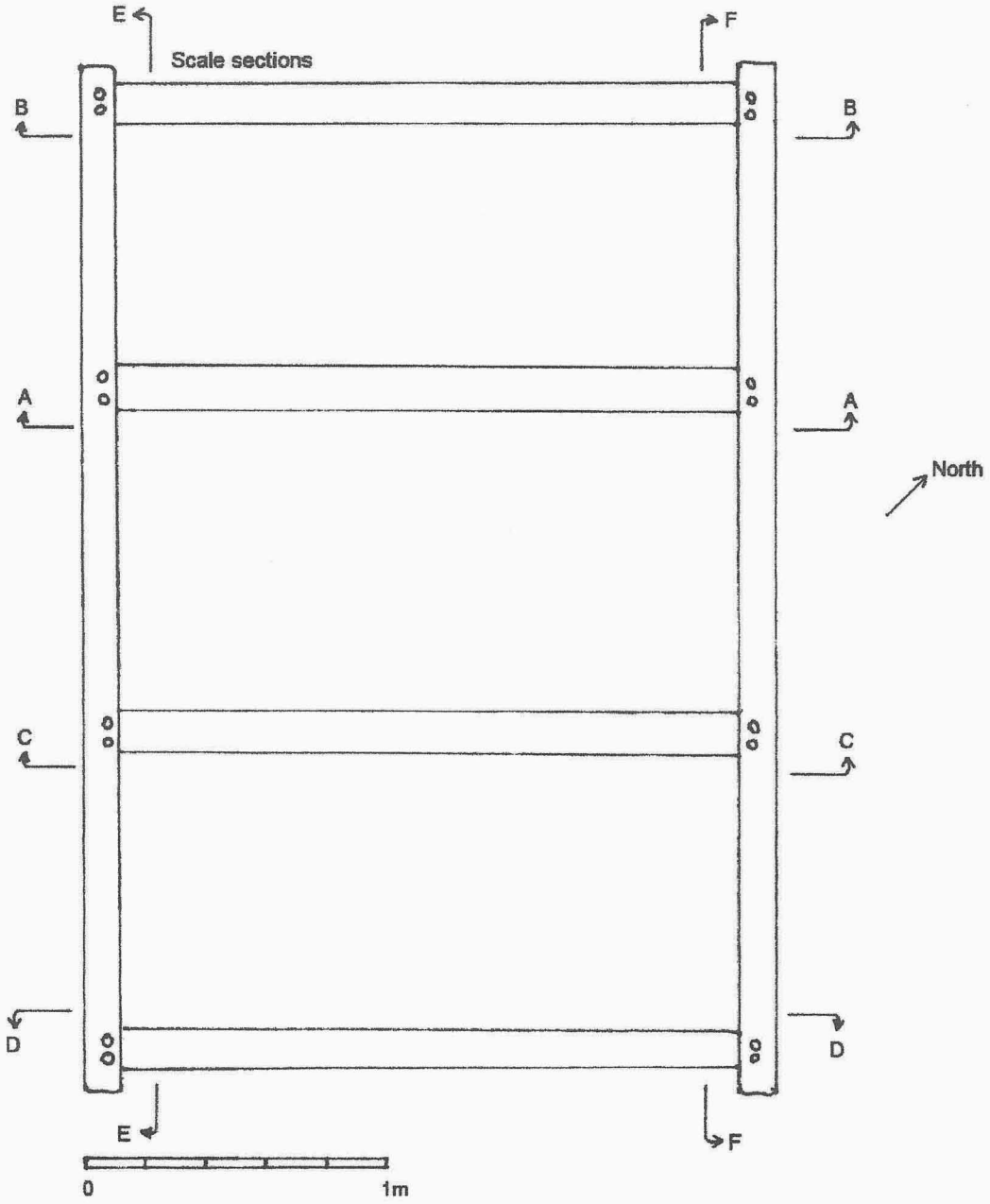


Figure 85: Church of St Nicholas, Bringhurst, bellframe; truss A-A, showing the location of samples LBF-F10-11, and LBF-F14 (George Dawson)

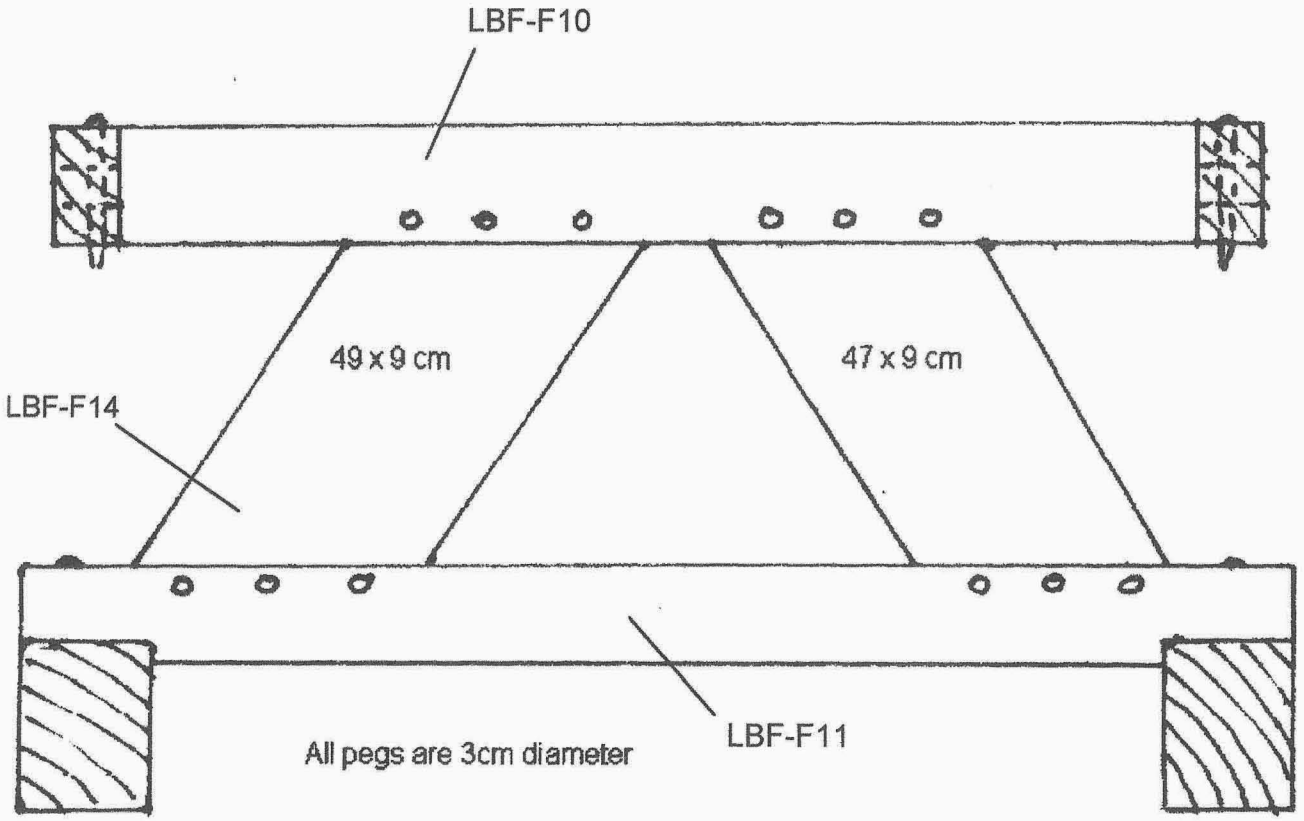


Figure 86: Church of St Nicholas, Bringhurst, bellframe; truss B-B, showing the location of samples LBF-F04, LBF-F13, and LBF-F15 (George Dawson)

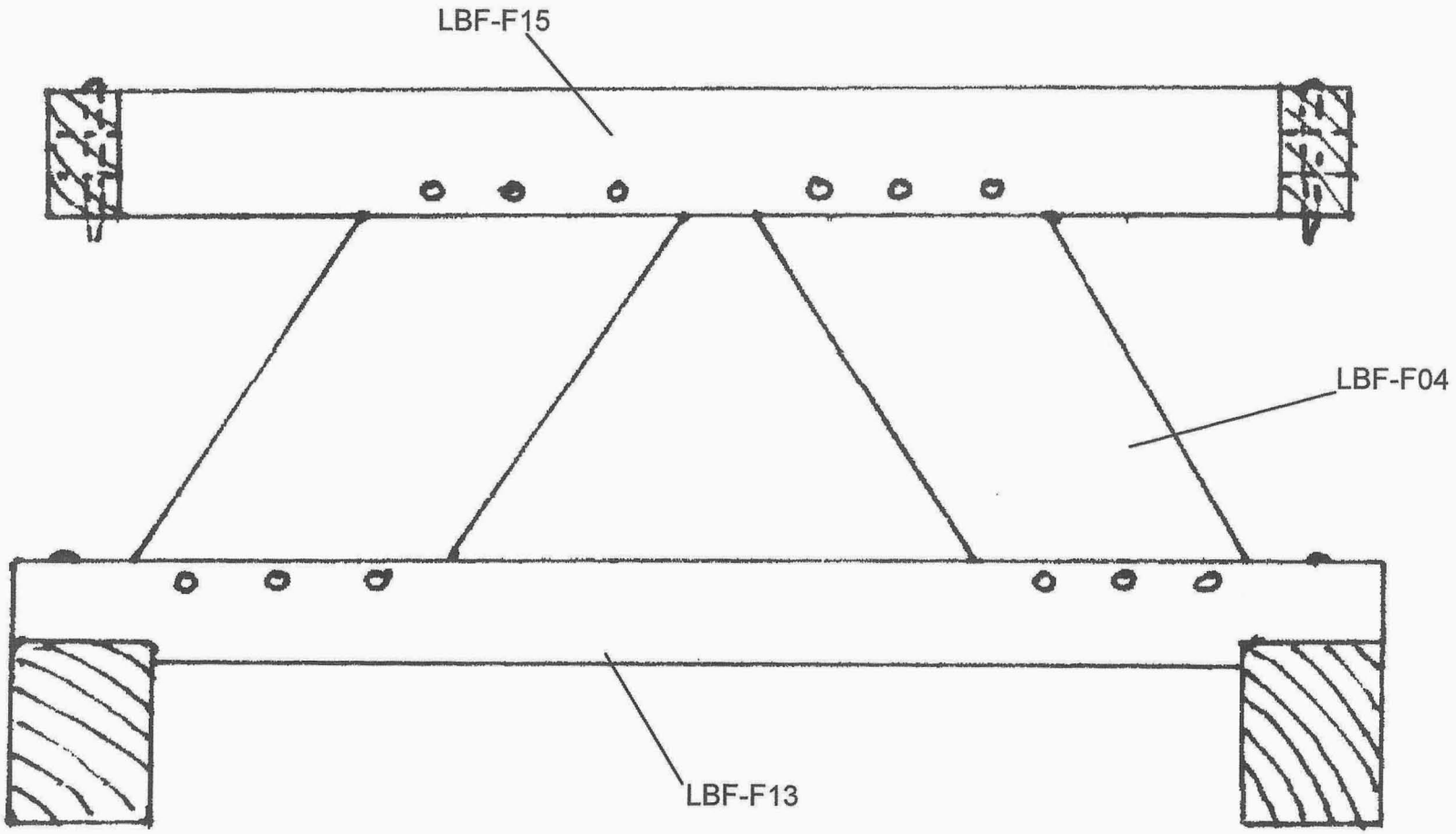


Figure 87: Church of St Nicholas, Bringhurst, bellframe; truss C-C, showing the location of samples LBF-F07-08, and LBF-F12 (George Dawson)

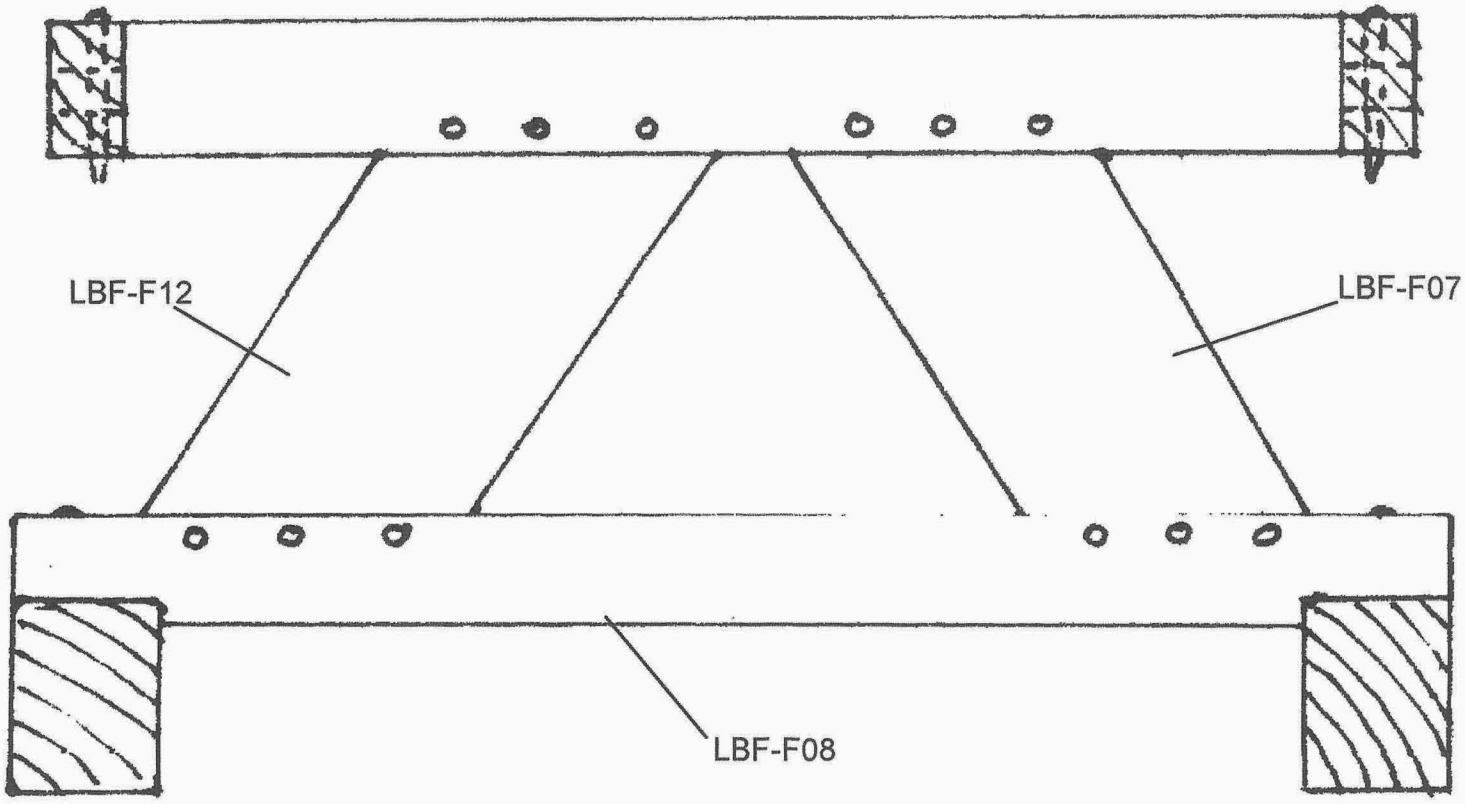


Figure 88: Church of St Nicholas, Bringhurst, bellframe; truss D-D, showing the location of samples LBF-F05 and LBF-F06 (George Dawson)

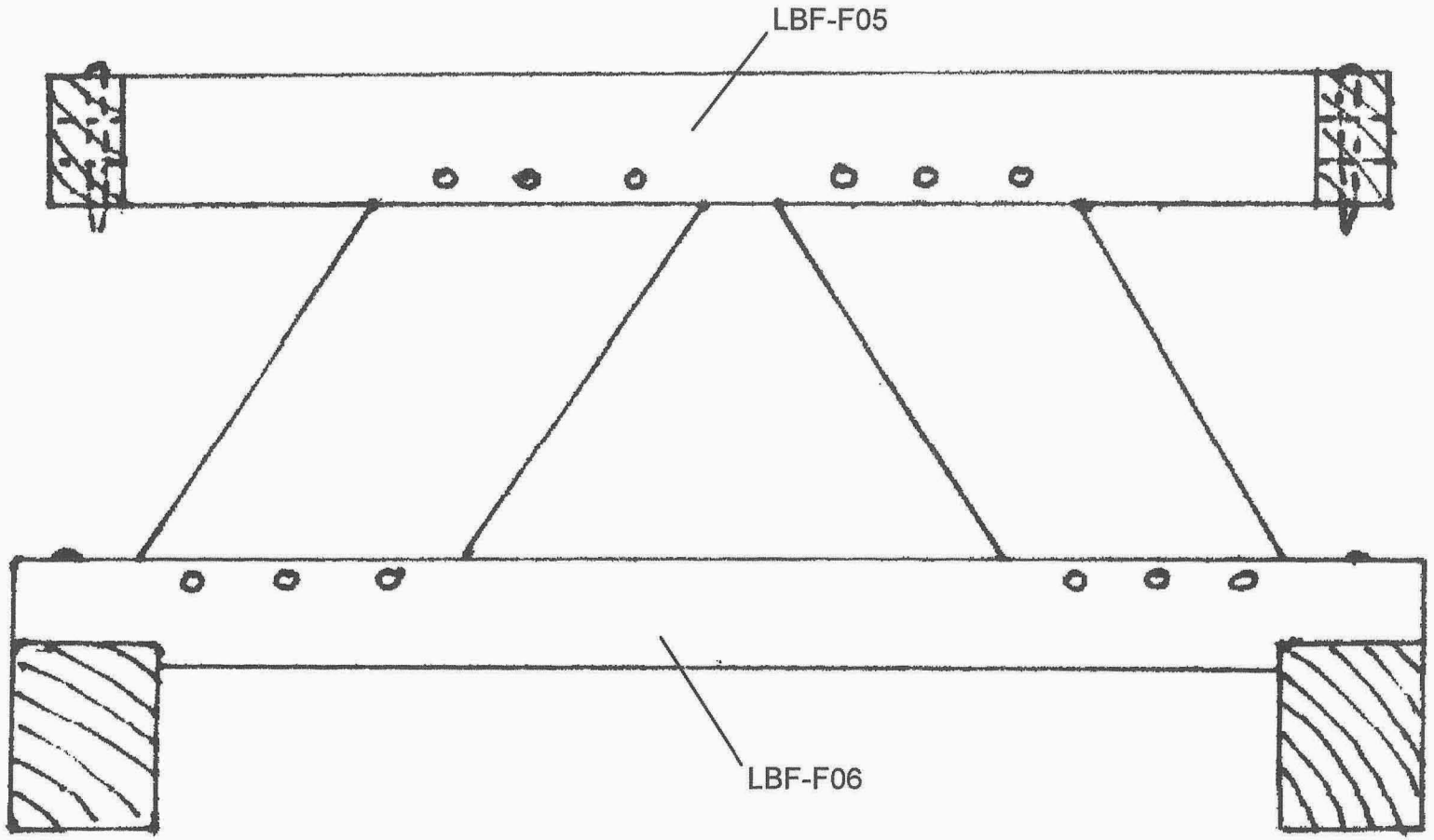


Figure 89: Church of St Nicholas, Bringhurst, bellframe; south end frame (E-E), showing the location of sample LBF-F02 (George Dawson)

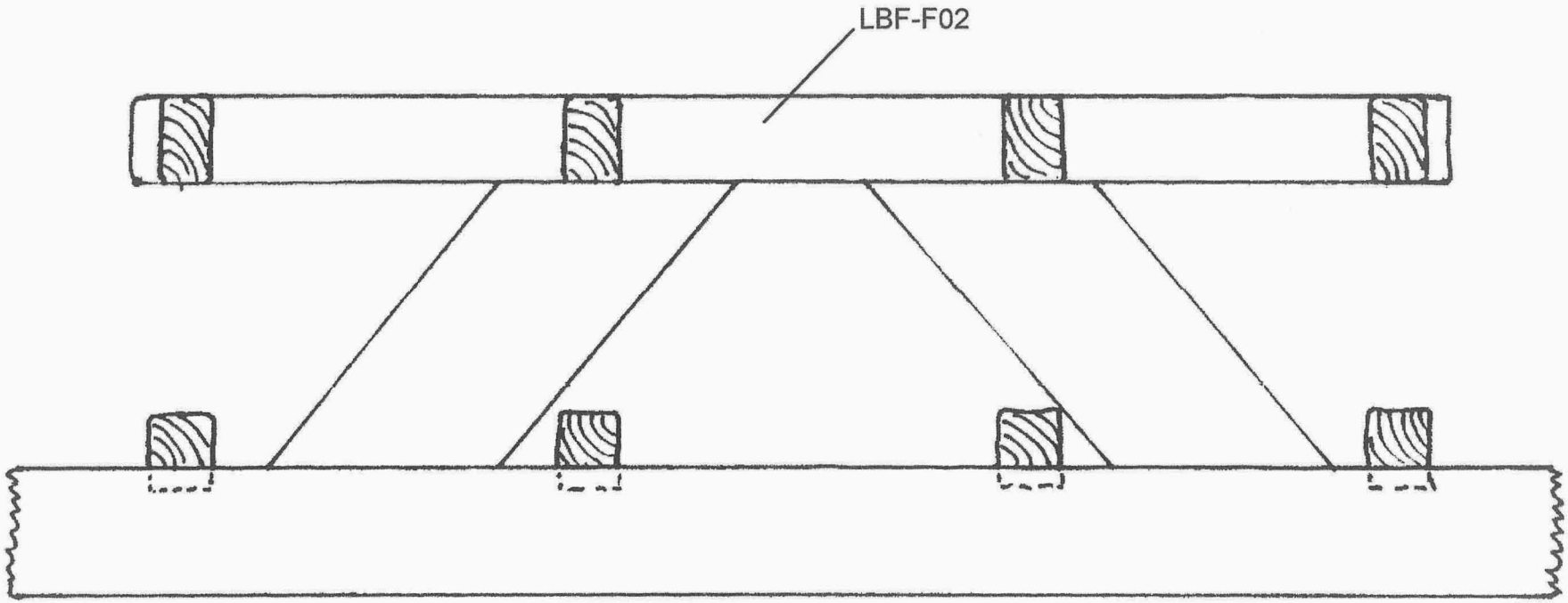


Figure 90: Church of St Nicholas, Bringhurst, bellframe; north end frame (F-F), showing the location of samples LBF-F01, LBF-F03, and LBF-F09 (George Dawson)

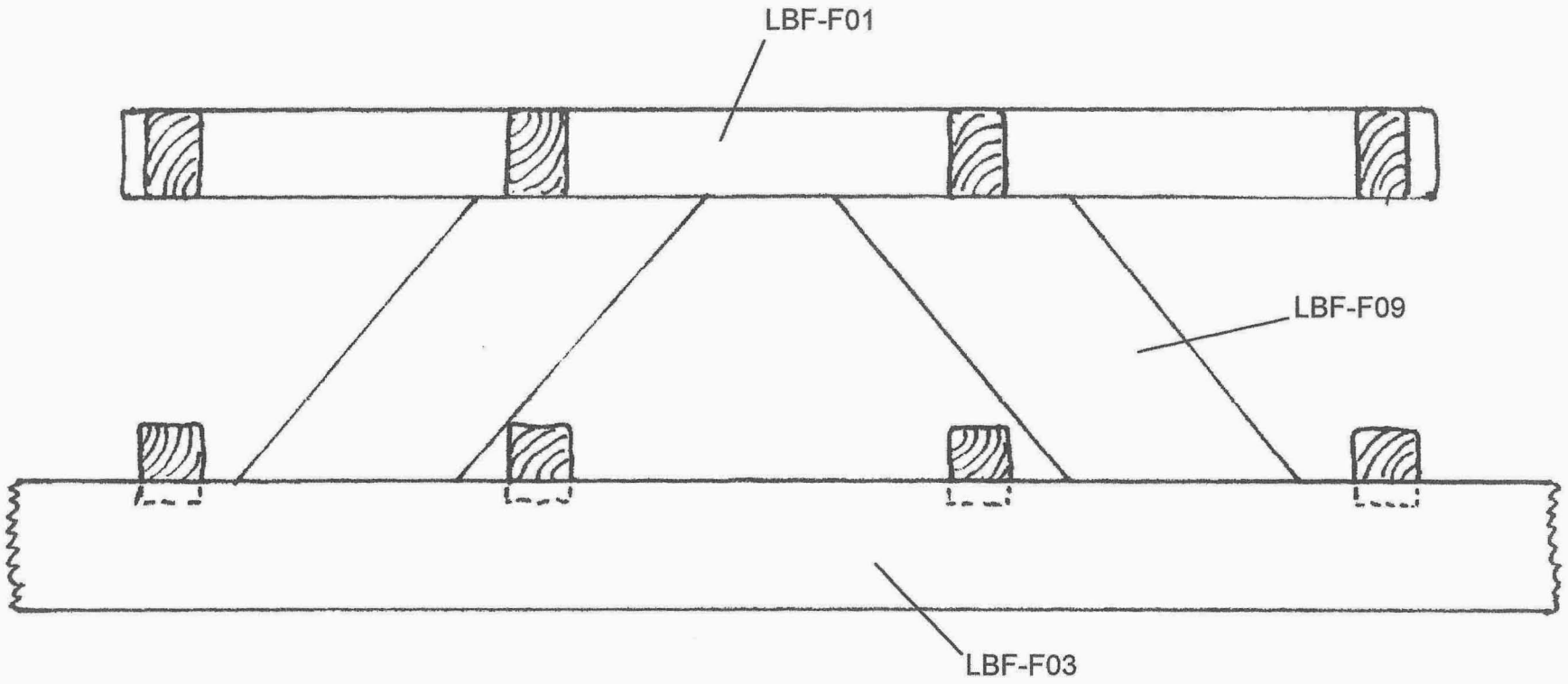
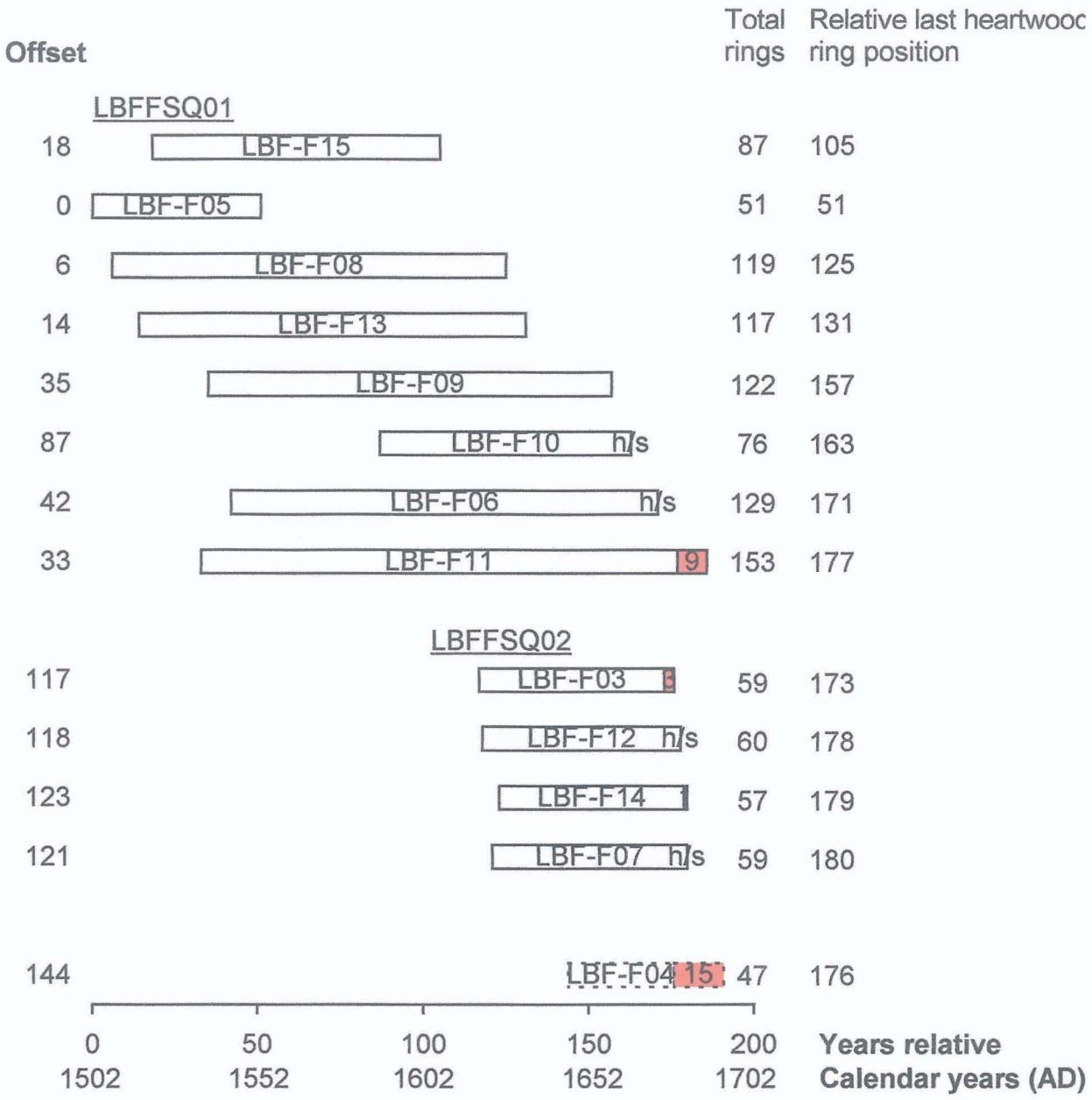
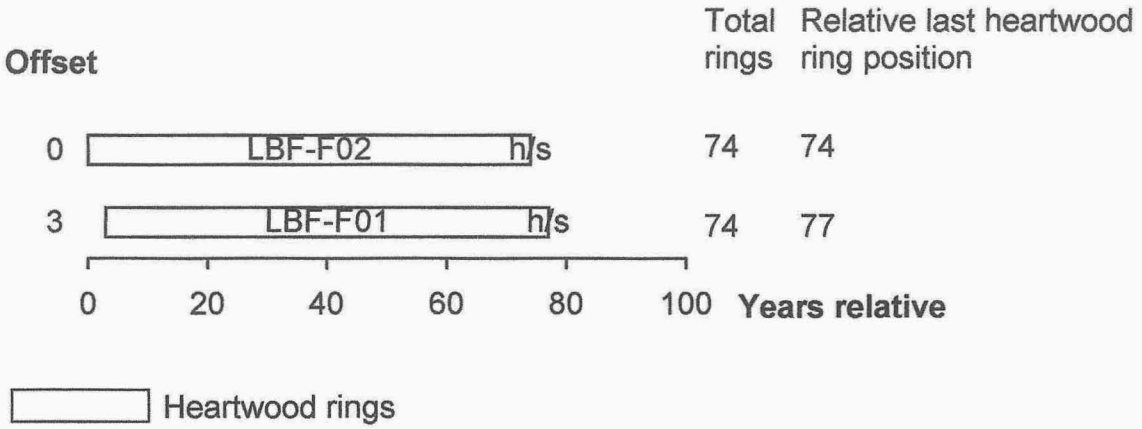


Figure 91: Bar diagram of samples in site sequences LBFFSQ01 and LBFFSQ02, and sample LBF-F04 (dashed)



h/s = heartwood/sapwood ring is the last measured ring

Figure 92: Bar diagram of samples in undated site sequences LBFFSQ03



h/s = the heartwood/sapwood ring is the last measured ring

4.7
Church of St John the Baptist, Grimston (LBF-G)
(SK 685 219; Figs 93-101)

This bellframe is of jack-braced design (Pickford type 6.B; Figs 93-9) and fills the tower at louvre level. All four trusses except truss B-B are similar in design and the frame was originally of one build. The southern truss B-B has had the braces and jack-braces removed and replaced with simple braces at a later date, probably as the result of decay of the original timbers. Trusses have been marked from north to south, D, C, A, and B.

Stylistically the frame probably dates from the AD 1630s.

Sampling, Analysis, and Results
Fourteen core samples were taken from the timbers of the bellframe, including some from truss B-B thought to be later. Two further samples were taken from timbers imbedded in the walls of the tower (Table 17; Figs 94-9). At this point three of the bellframe samples were deemed unsuitable for measurement. Sample LBF-G04 was too distorted to measure and samples LBF-G02 and LBF-G13 had too few rings to make successful dating a possibility. Analysis was carried out on the remaining 13 samples. At a least value of t=4.5 five samples grouped and site sequence LBFGSQ01, of 113 rings, was constructed containing these samples at the offsets shown in the bar diagram (Fig 100). This site sequence was successfully matched against the relevant reference chronologies for oak at a first-ring date of AD 1511 and a last-ring date of AD 1623. The evidence for this dating is given by the t-values in Table 18.

Four further samples grouped and site sequence LBFGSQ02 of 81 rings, was constructed containing these samples at the offsets shown in the bar diagram (Fig 100). This site sequence was again compared against the reference chronologies matching at a first-ring date of AD 1674 and a last-ring date of AD 1754. The evidence for this dating is given by the t-values in Table 19.

Finally, two samples grouped and site sequence LBFGSQ03, of 120 rings, was constructed containing these samples at the offsets shown in the bar diagram (Fig 101). Attempts to match this site sequence against the reference chronologies were unsuccessful and these samples are undated.

Interpretation
Analysis of samples from the timbers of this bellframe has resulted in the production of two dated site sequence.

Site sequence LBFGSQ01, of 113 rings, was dated to the period AD 1511-1623. Three of these samples have the heartwood/sapwood boundary ring, the average of which is AD 1613. This allows an estimated felling date to be calculated for the three timbers represented to AD 1628-48. The other two samples do not have the heartwood/sapwood boundary ring and so an estimated felling date cannot be calculated except to say that as they both have the last measured ring date of AD 1582 this is estimated to be, at the

earliest, AD 1598, a date that makes a contemporary felling with the other two samples possible. Two of the samples in this site sequence are from the wall timbers whereas the other three are all frame heads, LBF-G09 from the east end frame, LBF-G01 from the west end frame, and LBF-G08 from the top cill of truss 3.

Site sequence LBFGSQ02, of 81 rings, was dated to the period AD 1674-1754. All four samples this site sequence contains have the heartwood/sapwood boundary ring, the average of which is AD 1744. This allows an estimated felling date to be calculated for the four timbers represented to AD 1759-79. Three of these samples are from timbers of truss B-B, which as noted in the description, is known to have had the braces and jack braces replaced. From the dating of the sill and frame head, it now appears that the whole truss was replaced at the same time. Additionally, the frame head of truss D-D also dates to this time.

Discussion

Tree-ring analysis has resulted in the successful dating of seven timbers of the bellframe and two wall timbers. One of the wall timbers (LBF-G15) was felled in AD 1628-48 with it possible that the second wall timber (LBF-G16) was also felled at this time. Two frames heads, one from truss 3 and one from the west end frame also date to AD 1628-48 with a third timber also possibly felled at this time.

From a study of the bellframe George Dawson had identified that the braces and jack braces of truss B-B had been removed and replaced at some time. One of these braces, as well as the sill and frame head of this truss has now been dated to AD 1759-79. Additionally, the frame head of truss D-D has also been dated to this period.

This bellframe had been dated on stylistic grounds to the AD 1630s, with later replacement timbers in one truss. This has now been supported and strengthened by the tree-ring dating results.

A number of problems were encountered during the tree-ring analysis at Grimston Church. A high degree of core breakage occurred during sampling causing difficulty in the actual sampling process but also when it came to measurement of the samples. Another complication of measurement was the presence in a number of the samples of several bands of very tight growth rings.

Table 17: Details of tree-ring samples from timbers of the bellframe of the Church of St John the Baptist, Main Street, Grimston, Leicestershire

Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Last heartwood ring date (AD)	Last measured ring date (AD)
LBF-G01	Frame head, west end frame (F-F)	83	07	1541	1616	1623
LBF-G02	North jack brace, west end frame (F-F)	NM	--	----	----	----
LBF-G03	North brace, west end frame (F-F)	169	--	----	----	----
LBF-G04	East strut, truss B-B	NM	--	----	----	----
LBF-G05	Frame head, truss B-B	76	04	1674	1745	1749
LBF-G06	Frame head, truss C-C	80	h/s	----	----	----
LBF-G07	East jack brace, truss C-C	120	h/s	----	----	----
LBF-G08	Frame head, truss A-A	107	h/s	1512	1618	1618
LBF-G09	Frame head, east end frame (E-E)	72	--	1511	----	1582
LBF-G10	Frame head, truss D-D	68	h/s	1675	1742	1742
LBF-G11	Sill, truss B-B	60	h/s	1682	1741	1741
LBF-G12	West brace, truss A-A	56	h/s	----	----	----
LBF-G13	West brace, truss C-C	NM	--	----	----	----
LBF-G14	West brace, truss B-B	54	08	1701	1746	1754
LBF-G15	South wall timber, east-side	69	12	1551	1607	1619
LBF-G16	South wall timber, west-side	46	--	1537	----	1582

*h/s = the heartwood/sapwood boundary is the last ring on the sample

Table 18: Results of the cross-matching of site sequence LBFGSQ01 and relevant reference chronologies when the first-ring date is AD 1511 and the last-ring date is AD 1624

Reference chronology	*t*-value	Span of chronology	Reference
Southern England and Wales	5.3	AD 1386-1585	Fletcher 1980
England	4.7	AD 404-1981	Baillie and Pilcher 1982 unpubl
Hardwick Hall (west lodge stairs), Derbys	6.1	AD 1397-1625	Howard *et al* 2002b
Frith Hall Farm, Brampton, Derbys	5.5	AD 1480-1602	Howard *et al* 1993
Raynor House, Rocher Lane, Bradfield, Derbys	5.3	AD 1433-1593	Howard *et al* 1994b
Cartledge Hall (hall), Holmesfield, Derbys	5.2	AD 1459-1581	Howard *et al* 1993
Gate House, Hodsock Priory, Hodsock, Notts	5.2	AD 1397-1567	Howard et al 1995

Table 19: Results of the cross-matching of site sequence LBFGSQ02 and relevant reference chronologies when the first-ring date is AD 1674 and the last-ring date is AD 1754

Reference chronology	*t*-value	Span of chronology	Reference
East Midlands	5.5	AD 882-1981	Laxton and Litton 1988
London England	5.2	AD 413-1728	Tyers 1999 unpubl
Catholme, Staffs	6.5	AD 1649-1750	Howard *et al* 1992b unpubl
Wheelwright's Shop, Chatham, Kent	6.1	AD 1615-1780	Bridge 1998
Old Barn, Stratford on Avon, Warwicks	6.0	AD 1591-1735	Howard *et al* 1996b
Bolsover (Little Castle), Derbys	5.8	AD 1532-1749	Arnold *et al* 2003c
Bolsover Castle (Riding House), Derbys	5.7	AD 1494-1744	Arnold *et al* forthcoming

Figure 93: St John the Baptist Church, Grimston, bellframe; plan (George Dawson)

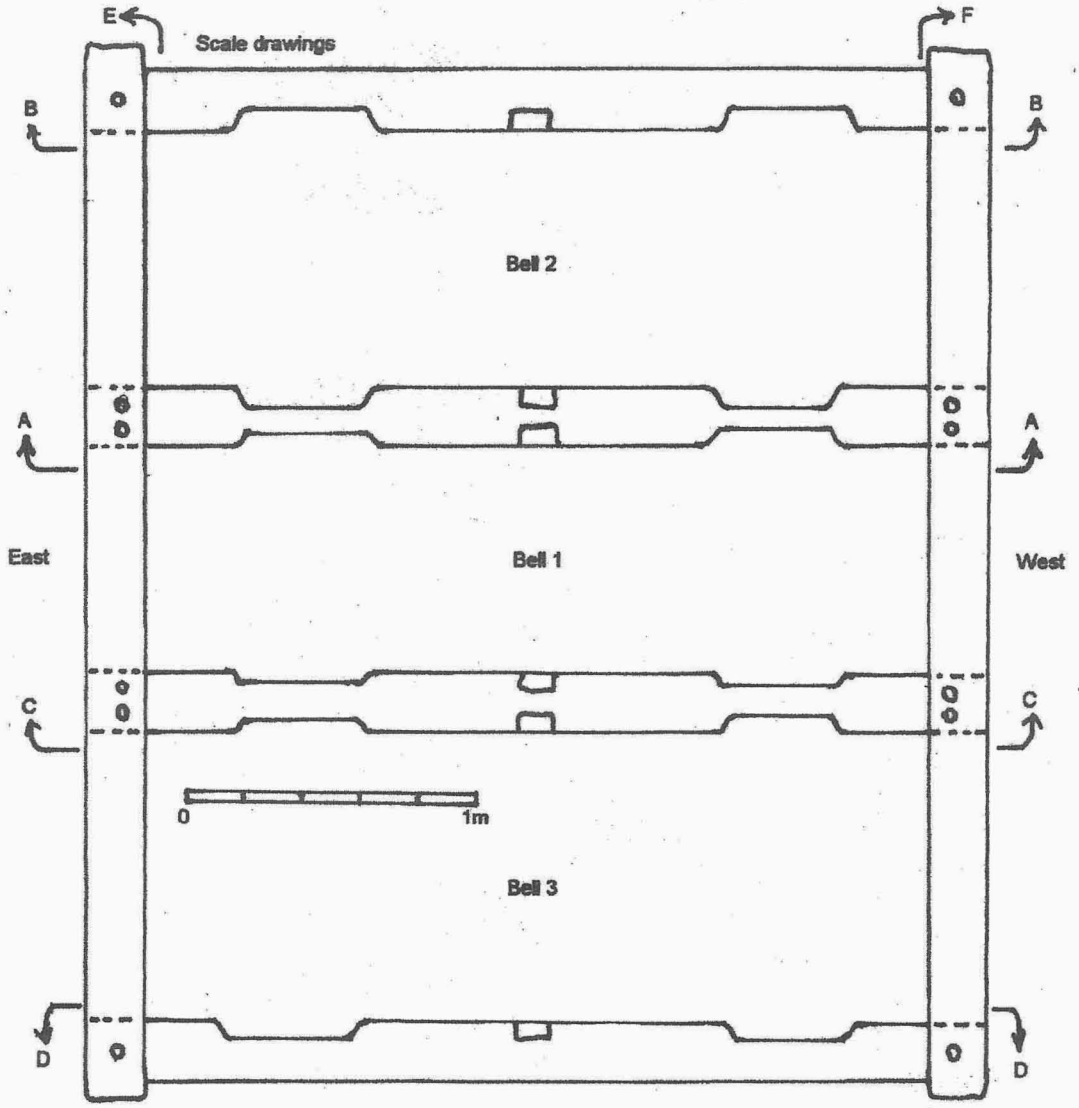


Figure 94: St John the Baptist Church, Grimston, bellframe; truss AA, showing the location of samples LBF-G08 and LBF-G12 (George Dawson)

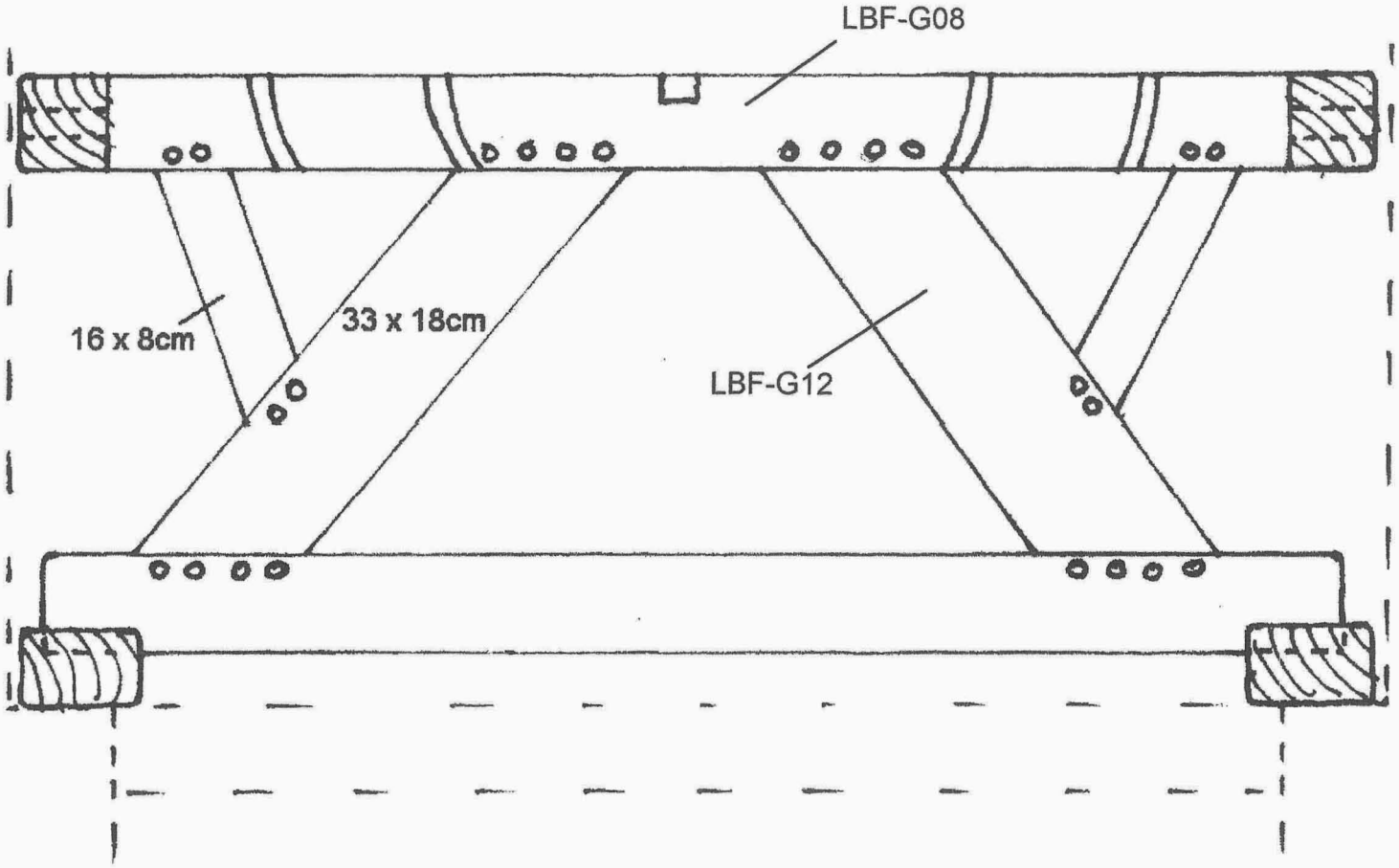


Figure 95: St John the Baptist Church, Grimston, bellframe; truss B-B, showing the location of samples LBF-G04-05, LBF-G11, and LBF-G14 (George Dawson)

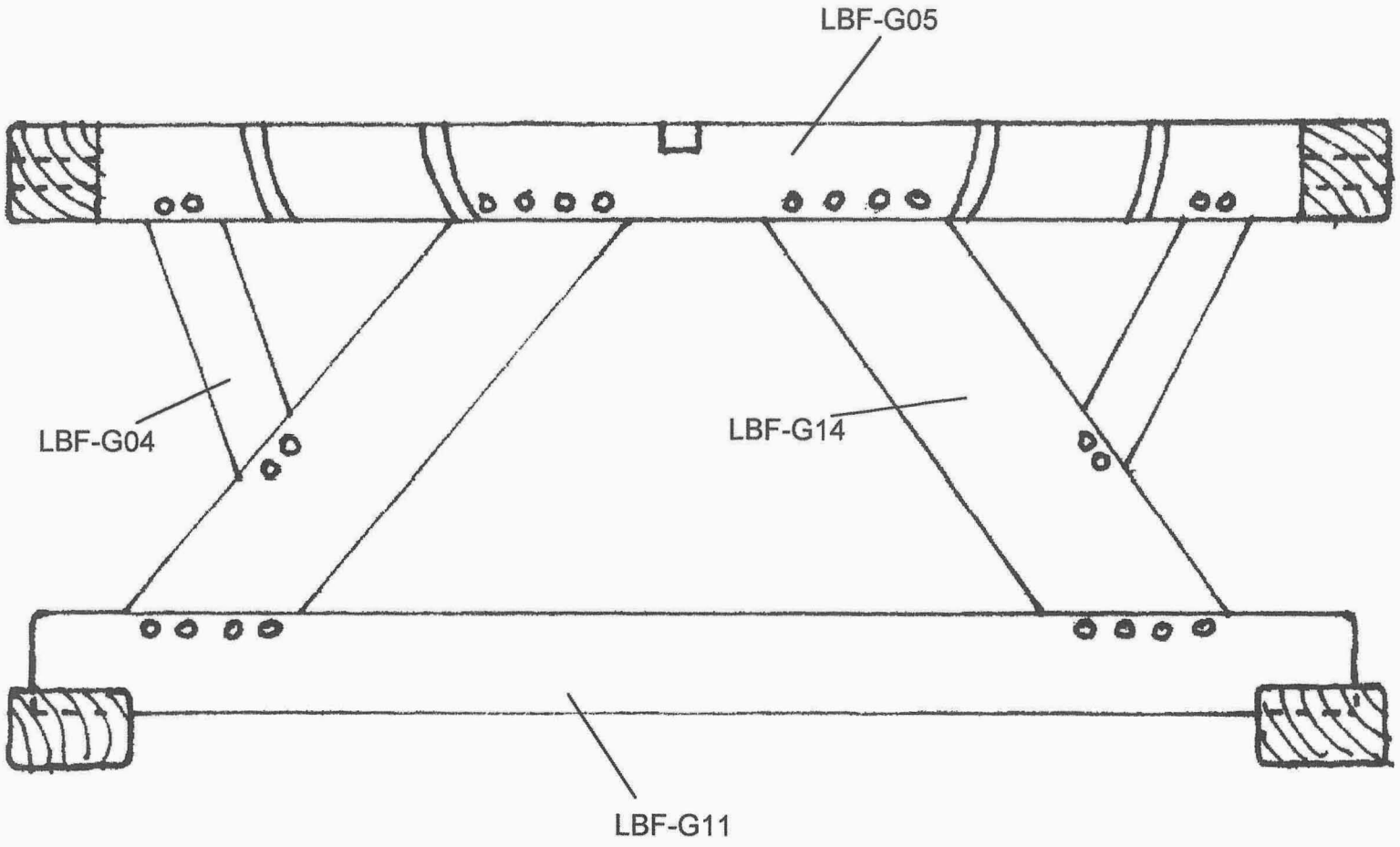


Figure 96: St John the Baptist Church, Grimston, bellframe; truss C-C, showing the location of samples LBF-G06, LBF-G07, and LBF-G13 (George Dawson)

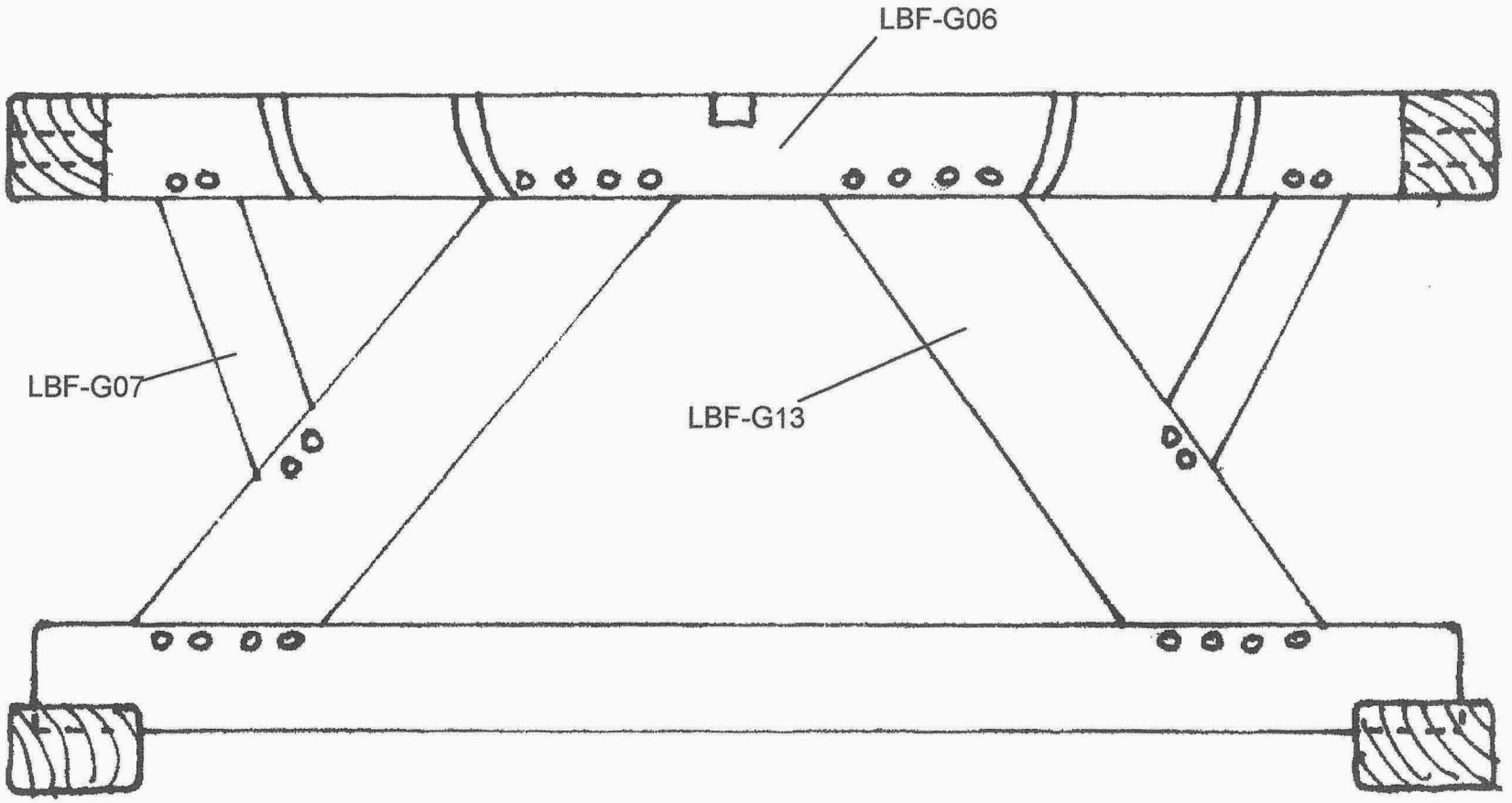


Figure 97: St John the Baptist Church, Grimston, bellframe; truss D-D, showing the location of sample LBF-G10 (George Dawson)

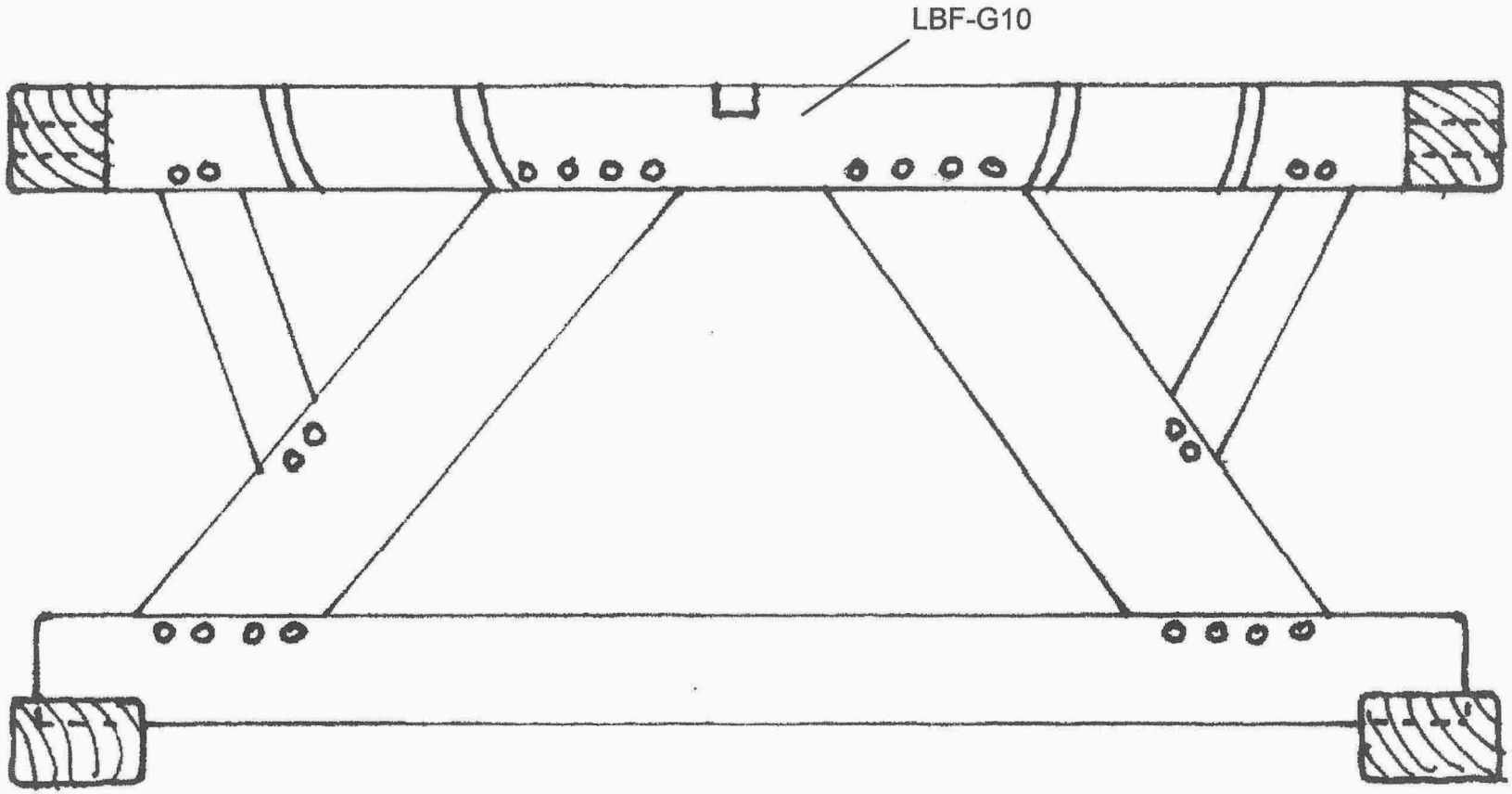


Figure 98: St John the Baptist Church, Grimston, bellframe; east end frame (E-E), showing the location of sample LBF-G09 (George Dawson)

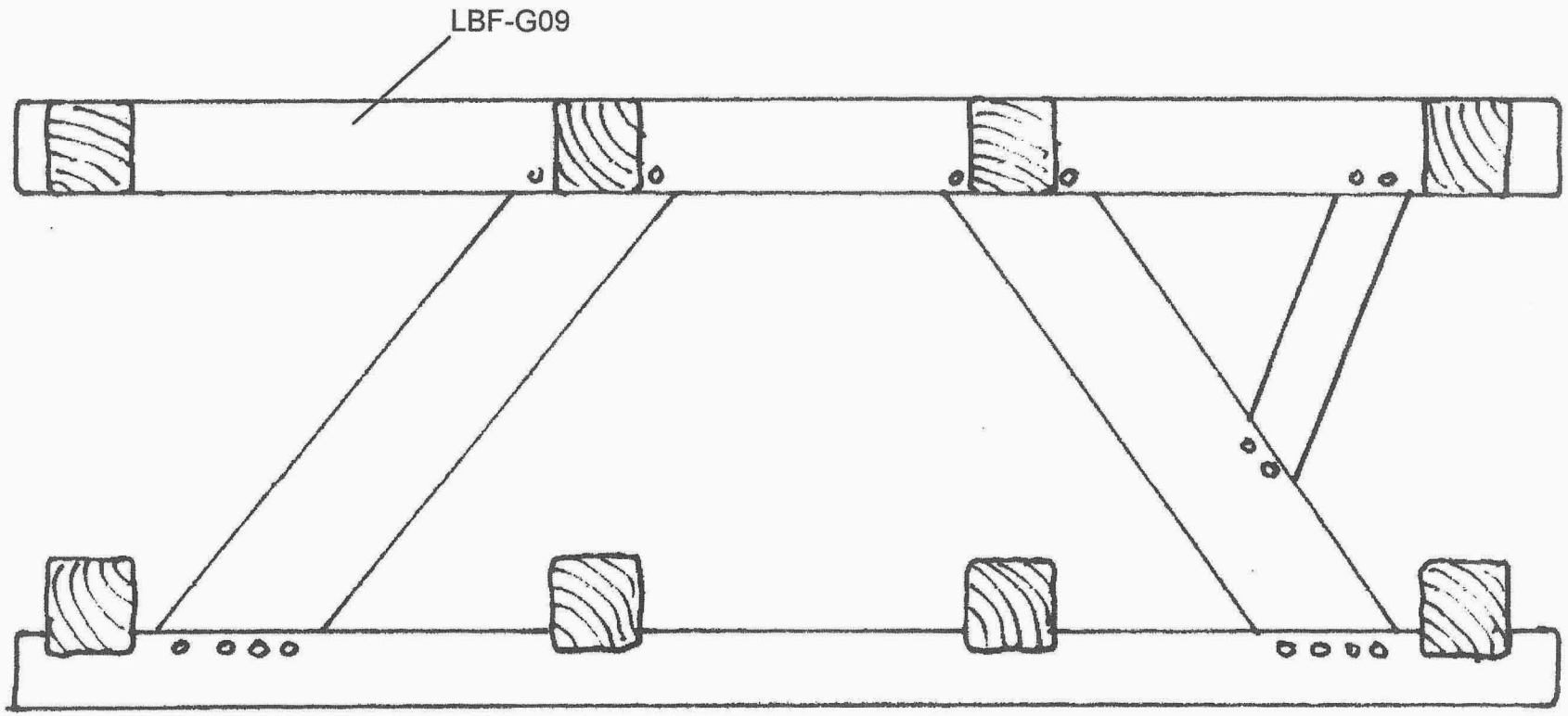


Figure 99: St John the Baptist Church, Grimston, bellframe; west end frame (F-F), showing the location of samples LBF-G01-03 (George Dawson)

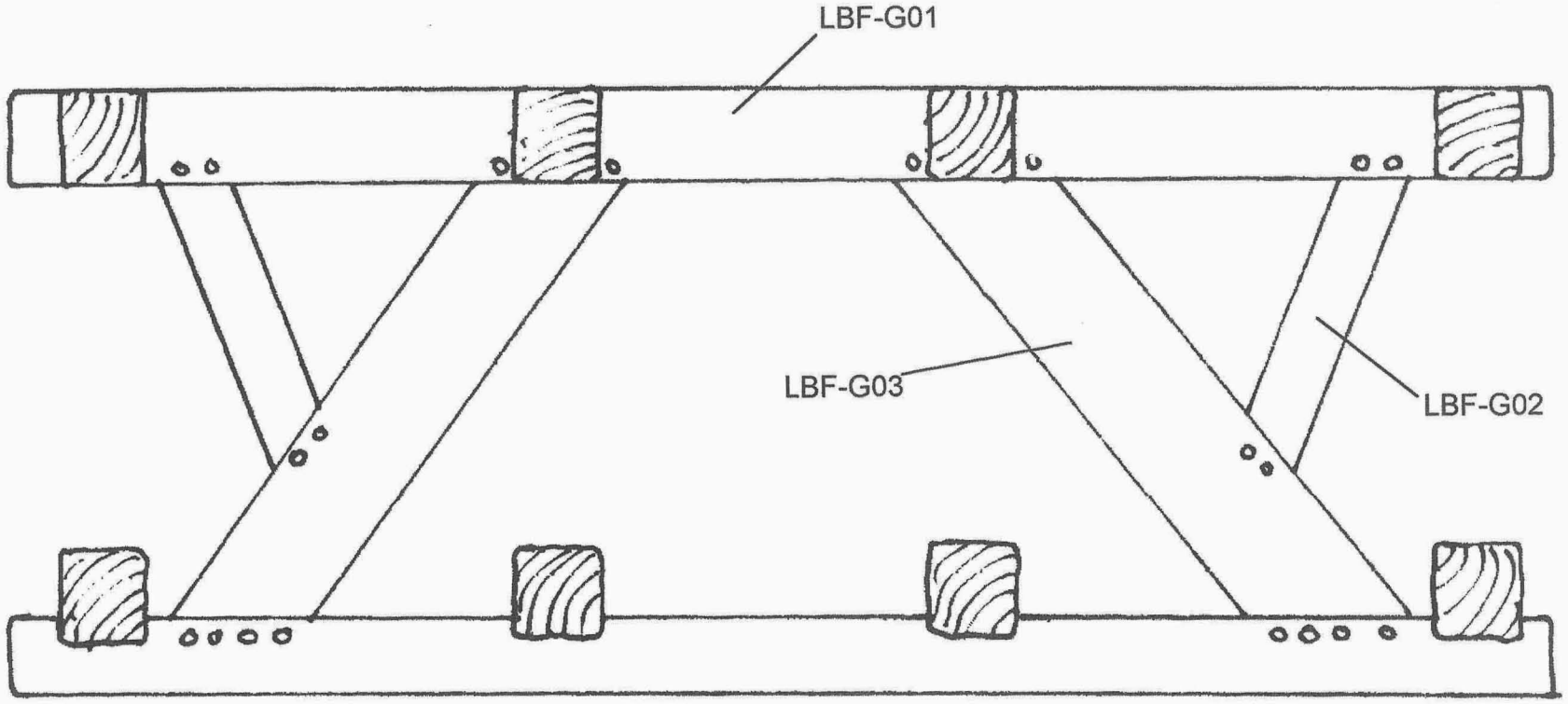
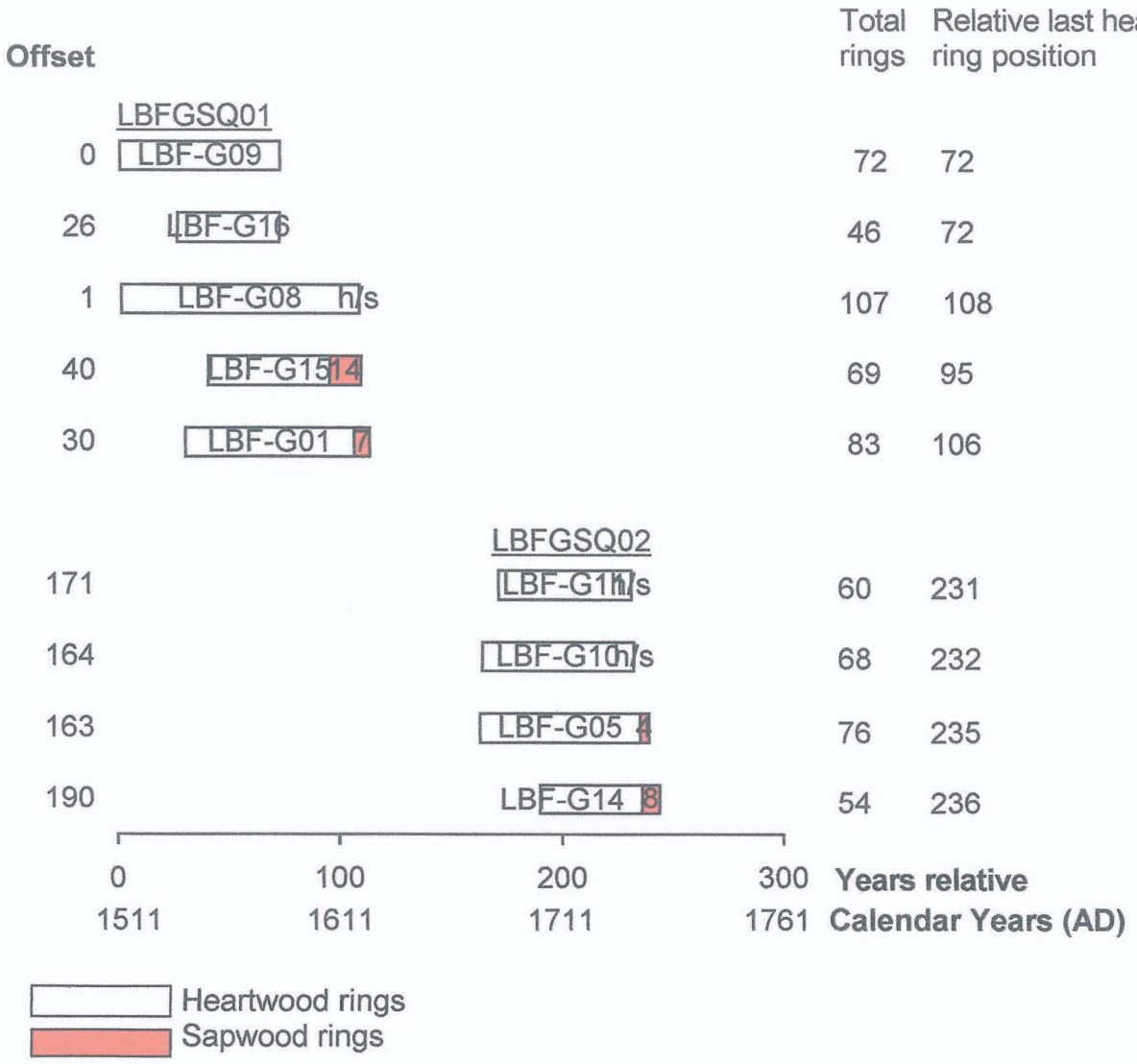
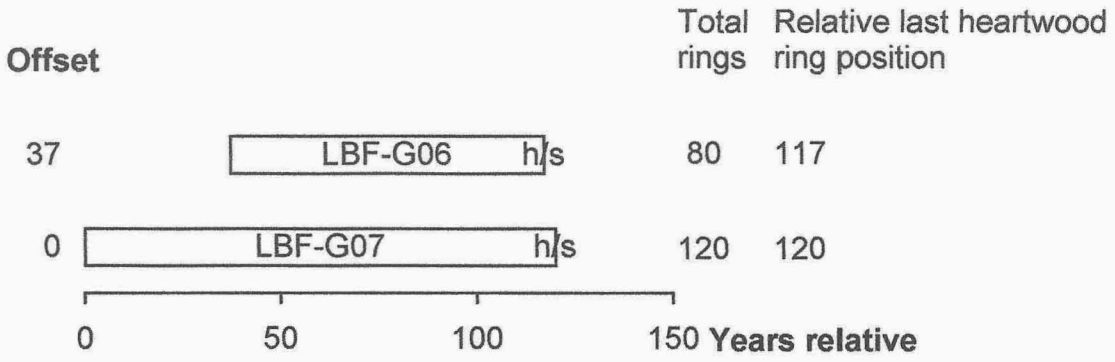


Figure 100: Bar diagram of samples in site sequences LBFGSQ01 and LBFGSQ02



h/s = heartwood/sapwood ring

Figure 101: Bar diagram of undated site sequence LBFGSQ03



Heartwood rings

h/s = heartwood/sapwood ring

4. 8
Church of St John the Baptist, Knossington (LBF-H)
(SK 810 101; Figs 102-5)

Description
The simple pegged oak frame at Knossington is for one bell, Pickford type 6.A. It has two trusses only (marked from east to west, B and A) and has extra lower jack braces. The frame sits directly on the belfry floor. The sanctus bell is hung between the frame and a post against the wall in the north-east corner of the tower.

The frame was thought likely to predate the bell, dating possibly from the seventeenth century.

Sampling, Analysis, and Results
Ten core samples were taken from frame heads, sills, braces, and a post (Table 20; Figs 102-4). At this point three samples were found to have too few rings for secure dating and so were rejected prior to measurement. The remaining seven samples were analysed. At a least value of t=4.5 six samples grouped and site sequence LBFHSQ01, of 60 rings, was constructed containing these samples at the offsets shown in the bar diagram (Fig 105). This site sequence was successfully matched against the relevant reference chronologies for oak at a first-ring date of AD 1662 and a last-ring date of AD 1721. The evidence for this dating is given by the t-values in Table 21.

Attempts to date the final sample, LBF-H04, by individually comparing it against the reference chronologies were unsuccessful and this sample remains undated.

Interpretation
Analysis of samples from the timbers of this bellframe has resulted in the production of one dated site sequence.

Site sequence LBFHSQ01, of 60 rings, was dated to the period AD 1662-1721. All six samples have the heartwood/sapwood boundary ring. The average of this is AD 1717, which allows an estimated felling date to be calculated for the six timbers represented to AD 1732-52.

Discussion
Tree-ring analysis has resulted in the successful dating of six timbers of the bellframe. It is now known that it is constructed from six timbers felled in AD 1732-52. Although the frame had been dated to the seventeenth century, another suggestion had been that it dated from the recasting of the bell, AD 1731. This latter hypothesis is now supported by the dendrochronological dating of the timbers.

The one measured sample that could not be dated, LBF-H04, came from a beam described as a sill but which actually did not reach from one truss to the other.

Table 20: Details of tree-ring samples from timbers of the bellframe of the Church of St John the Baptist, Main Street, Cold Overton, Knossington, Leicestershire

Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Last heartwood ring date (AD)	Last measured ring date (AD)
LBF-H01	Frame head, truss B-B	58	06	1664	1715	1721
LBF-H02	Frame head, truss A-A	46	h/s	1672	1717	1717
LBF-H03	Post (west side of small bellframe)	NM	--	----	----	----
LBF-H04	Sill, north end	45	h/s	----	----	----
LBF-H05	Frame head, truss B-A	NM	--	----	----	----
LBF-H06	North brace, truss A-A	NM	--	----	----	----
LBF-H07	North brace, truss B-B	49	h/s	1671	1719	1719
LBF-H08	Sill, truss B-B	45	01	1674	1717	1718
LBF-H09	Sill, truss A-A	54	h/s	1662	1715	1715
LBF-H10	South brace, truss A-A	57	h/s	1663	1719	1719

*NM = not measured
h/s = the heartwood/sapwood boundary is the last ring on the sample

Table 21: Results of the cross-matching of site sequence LBFHSQ01 and relevant reference chronologies when the first-ring date is AD 1662 and the last-ring date is AD 1721

Reference chronology	*t*-value	Span of chronology	Reference
East Midlands	5.6	AD 882-1981	Laxton and Litton 1988
Main Street, Cosby, Leics	6.5	AD 1642-1734	Alcock *et al* 1991
Catholme, Staffs	6.2	AD 1649-1750	Howard *et al* 1992b unpubl
Trenthams Barn, Purley-on-Thames, Berks	5.6	AD 1640-1731	Howard *et al* 1996b
Worcester Cathedral, Nave roof (inserted timber), Worcs	4.9	AD 1597-1730	Howard *et al* 1995
Ely Cathedral, Cambs	4.8	AD 1592-1736	Esling *et al* 1991 unpubl
Claydon House, Bucks	4.7	AD 1613-1756	Tyers 1995b

Figure 102: Church of St John the Baptist, Knossington, bellfframe; plan, showing the location of sample LBF-H03 (George Dawson)

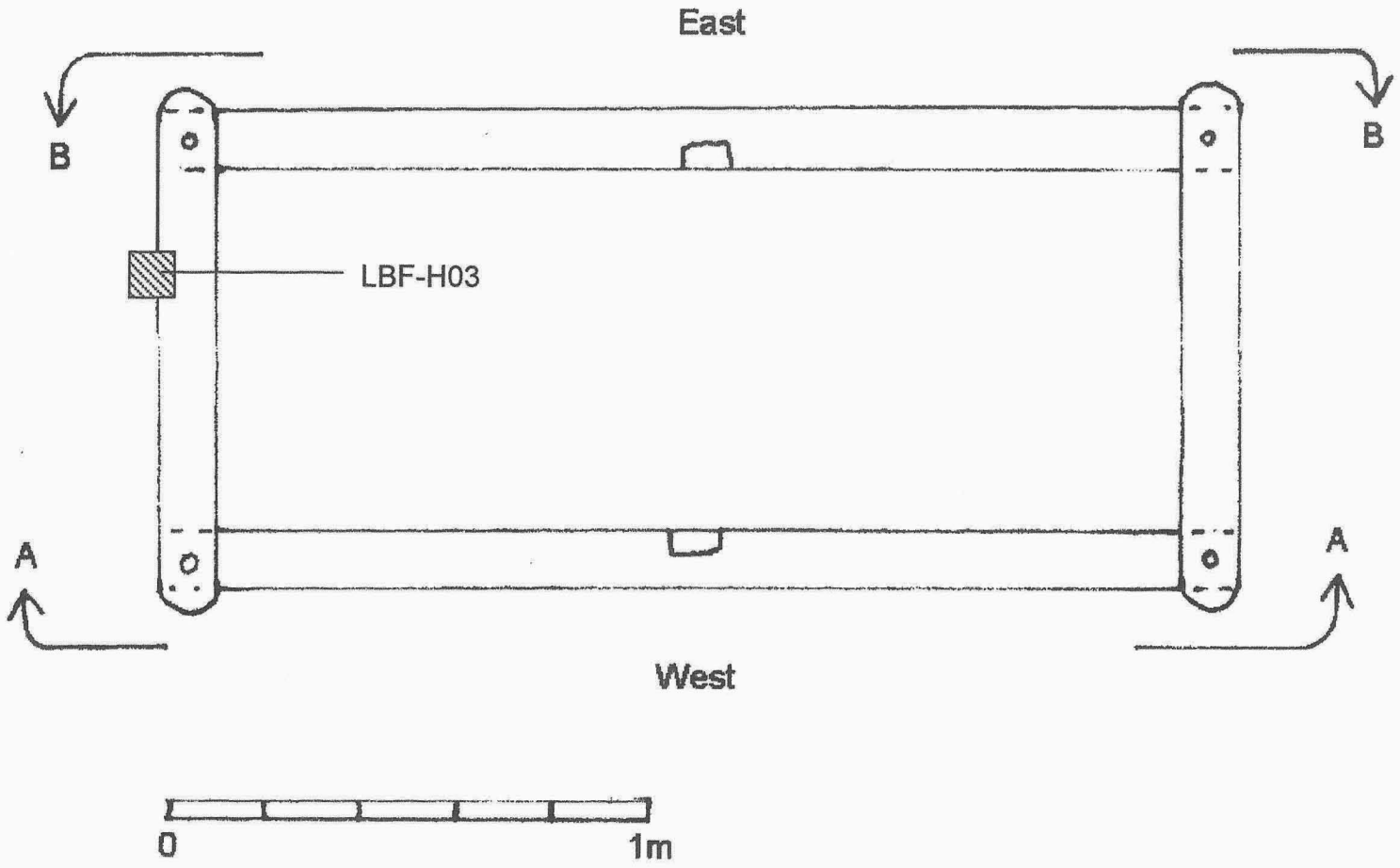


Figure 103: Church of St John the Baptist, Knossington, bellframe; truss A-A, showing the location of samples LBF-H02, LBF-H04-06, and LBF-H09-10 (George Dawson)

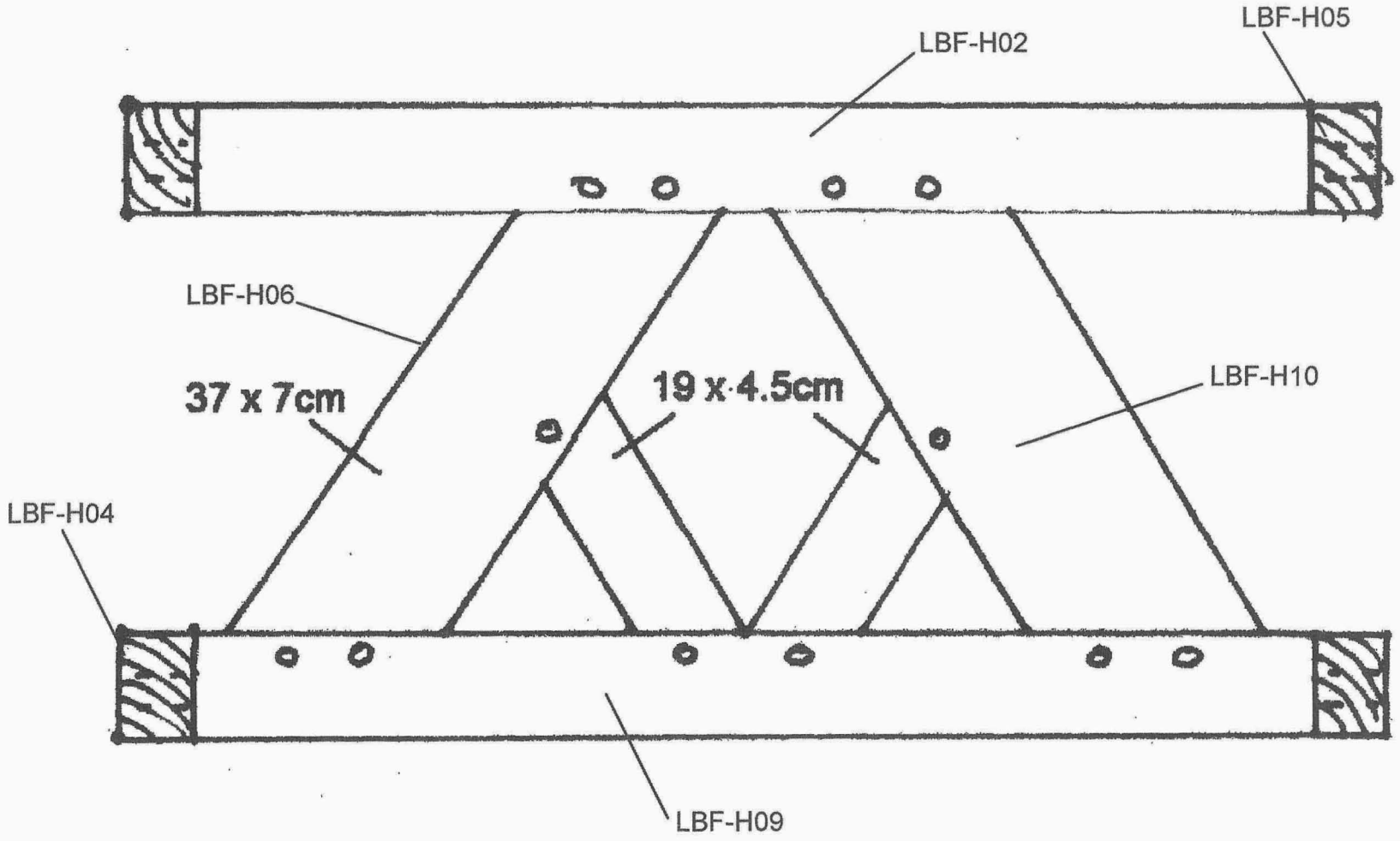


Figure 104: Church of St John the Baptist, Knossington, bellframe; truss B-B, showing the location of samples LBF-H01, LBF-A07, and LBF-H08 (George Dawson)

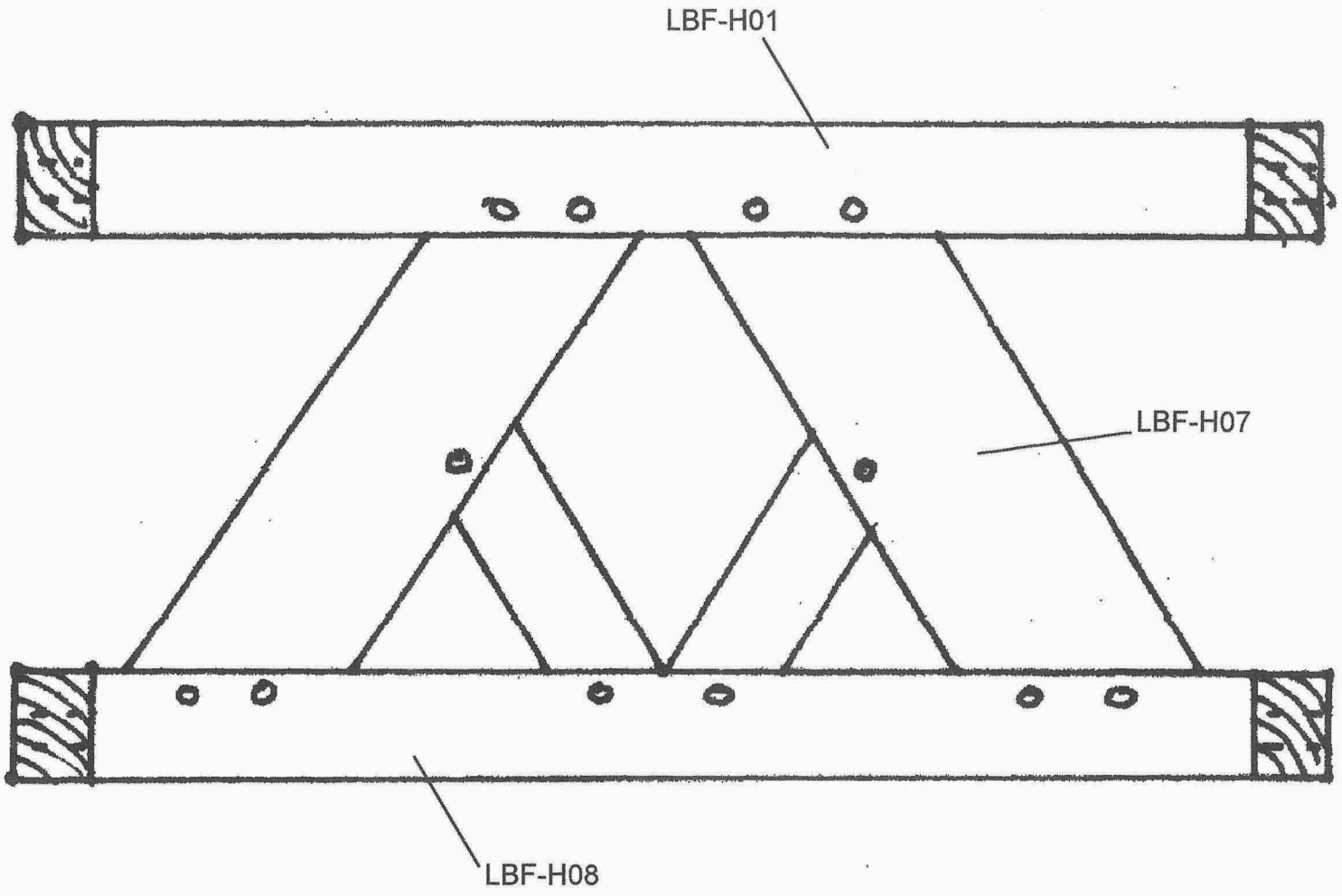
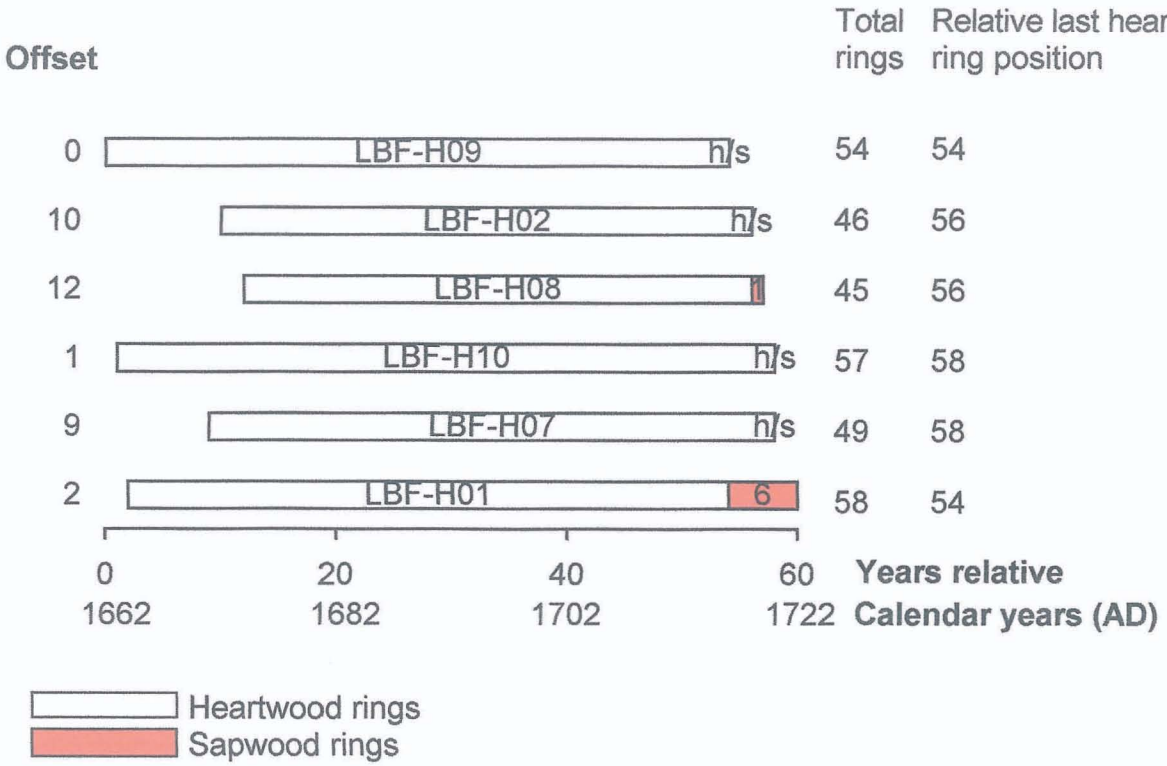


Figure 105: Bar diagram of samples in site sequence LBFHSQ01



h/s = heartwood/sapwood ring

4.9
Church of St John the Evangelist, Shenton (LBF-I)
(SK 387 003; Figs 107-16)

Description
The oak bellframe at this church is for three bells and is of jack-braced design, Pickford type 6.B. Unlike the usual three parallel pit form, this frame has two parallel pits and a transverse pit across the end (Fig 108; Pickford frame configuration 3.3). Within the timbers of the frame are four curved braces that clearly come from an earlier medieval frame (these have been marked on the frame drawings; Figs 111 and 112). Although being of similar dimensions to the other braces contained within this frame these four are distinguished by the fact that they are the only curved beams, and also have empty mortises, an indication of their reuse.

The bellframe is of an earlier date than the tower and has been rebuilt in its current location.

Sampling, Analysis, and Results
Twelve core samples were taken from various beams, including the four braces identified as reused (Table 22; Figs 109-14). Three samples had too few rings for secure dating and were rejected prior to measurement. Analysis of the remaining nine samples resulted in seven samples forming two groups. Firstly, five samples grouped and site sequence LBFISQ01, of 70 rings, was constructed (Fig 115). This site sequence was matched against the relevant reference chronologies to the period AD 1402-71. The evidence for this dating is given by the *t*-values in Table 23.

Two samples matched and site sequence LBFISQ02 of 53 rings was constructed containing these samples (Fig 116). Attempts to date this site sequence by cross-matching it against the reference chronologies were unsuccessful and these samples remain undated.

Attempts to date the remaining two samples individually were unsuccessful.

Interpretation
Analysis of samples from the timbers of this bellframe has resulted in the production of dated site sequence, LBFISQ01, which spans the period AD 1402-71. All samples have the heartwood/sapwood boundary ring, the average of which is AD 1466 allowing an estimated felling date range to be calculated for the five timbers represented to AD 1481-1501.

Discussion
Prior to tree-ring analysis it had been thought that the bellframe dated to the seventeenth century but contained four reused braces.

Unfortunately, only five of the timbers of the presumed original structure have been dated. These dated samples are taken from three braces and two frame heads. Rather than being seventeenth century these are now known to have been felled in AD 1481-1501. Therefore, if the stylistic date is to be believed it

must be said that when constructed more reused timber was utilised than just the four curved braces previously identified, but that these other beams had had all signs of reuse removed. Obviously, in the light of these results a reassessment of the history of this frame is necessary.

The second undated site sequence, contains two samples, one of which (LBF-I04), is from one of the presumed reused braces, whereas the other one (LBF-I08) is a strut not thought to be reused. Although undated the heartwood/sapwood boundary ring of these two samples are consistent with the two timbers represented being felled at the same time.

Table 22: Details of tree-ring samples from timbers of the bellframe of the Church of St John the Evangelist, Church Lane, Shenton, Leicestershire

Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Last heartwood ring date (AD)	Last measured ring date (AD)
LBF-I01	South brace, truss C-C	NM	--	----	----	----
LBF-I02	West brace, truss D-D	NM	--	----	----	----
LBF-I03	North brace, truss C-C	66	h/s	----	----	----
LBF-I04	East brace, truss D-D	52	h/s	----	----	----
LBF-I05	Frame head, truss A-A	52	04	----	----	----
LBF-I06	West brace, truss A-A	NM	--	----	----	----
LBF-I07	North brace, truss E-E	52	h/s	1420	1471	1471
LBF-I08	East strut, truss A-A	53	h/s	----	----	----
LBF-I09	Frame head, truss C-C	61	h/s	1402	1462	1462
LBF-I10	Frame head, truss B-B	52	h/s	1409	1460	1460
LBF-I11	East brace, truss A-A	58	h/s	1414	1471	1471
LBF-I12	South brace, truss F-F	66	h/s	1402	1467	1467

*NM = not measured
h/s = the heartwood/sapwood boundary is the last ring on the sample

Table 23: Results of the cross-matching of site sequence LBFISQ01 and relevant reference chronologies when the first-ring date is AD 1402 and the last-ring date is AD 1471

Reference chronology	*t*-value	Span of chronology	Reference
East Midlands	4.9	AD 882-1981	Laxton and Litton 1988
England	4.7	AD 404-1981	Baillie and Pilcher 1982 unpubl
Western England and Wales	4.2	AD 1341-1636	Siebenlist-Kerner 1978
Church Cottage, Main Street, Cadeby, Leics	6.6	AD 1362-1472	Alcock *et al* 1991
Manor Farm, Upper Midhope, Bradfield, S Yorks	5.5	AD 1380-1550	Howard *et al* 1996c
Ordsall Hall, Taylorson Street, Salford, Cheshire	5.1	AD 1385-1512	Howard *et al* 1994b
Nether Levens Hall, Kendal, Cumbria	5.0	AD 1395-1541	Howard *et al* 1991

Figure 106: Church of St John the Evangelist, Shenton (Dr C J Brooke)

Figure 107: Church of St John the Evangelist, Shenton, general view of the frame from above, bell 3 is in the background (Dr C J Brooke)

Figure 108: Church of St John the Evangelist, Shenton, bellframe; plan (George Dawson)

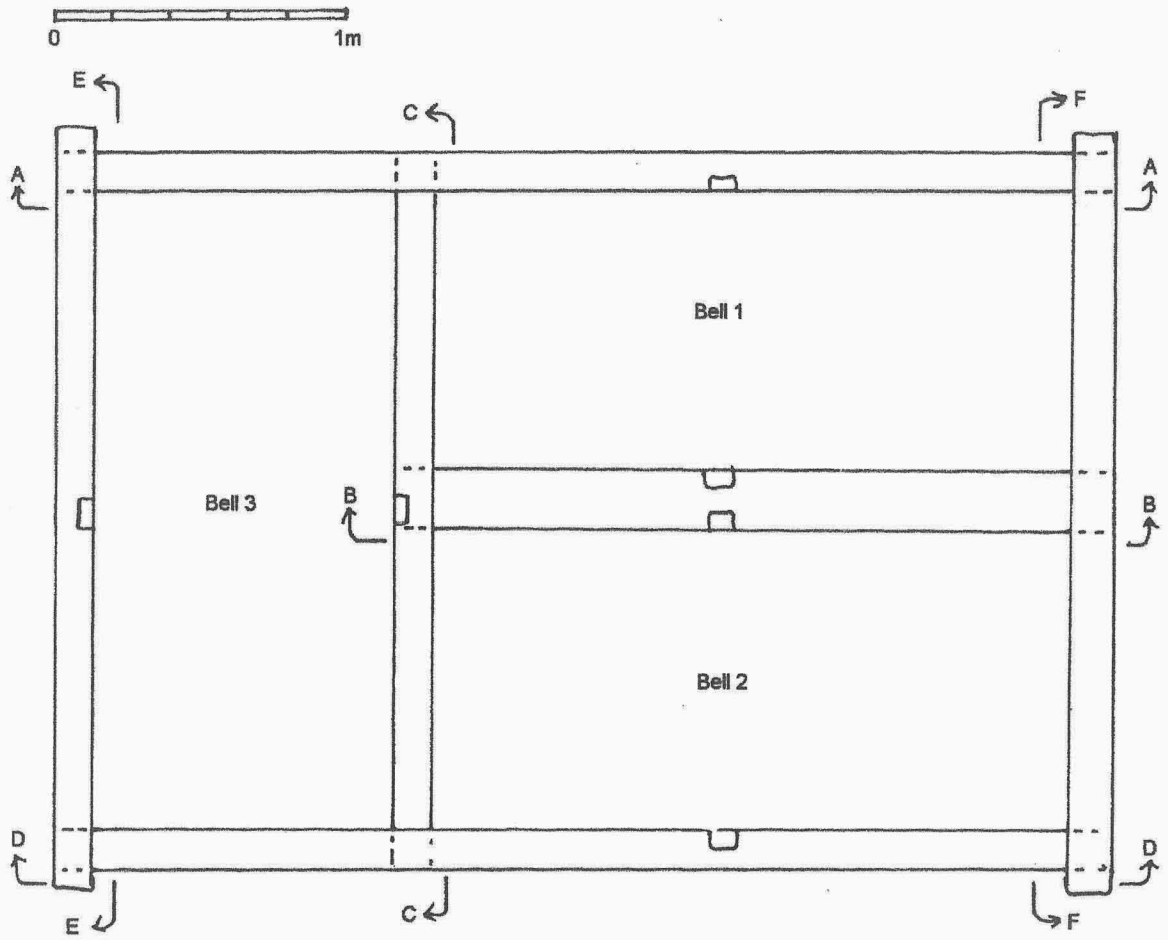


Figure 109: Church of St John the Evangelist, Shenton, bellframe; truss A-A, showing the location of samples LBF-I05-06, LBF-I08, and LBF-I11 (George Dawson)

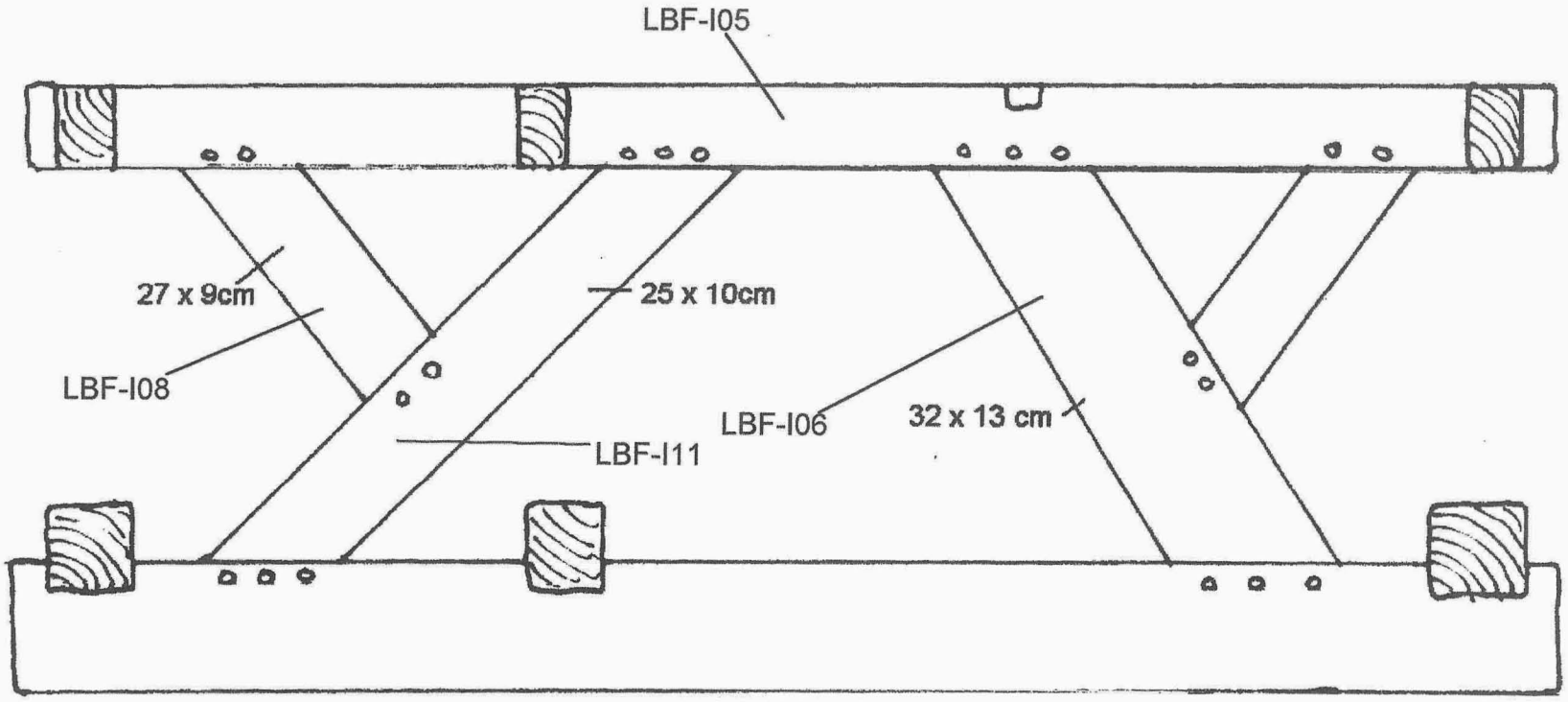


Figure 110: Church of St John the Evangelist, Shenton, truss B-B, showing the location of sample LBF-I10 (George Dawson)

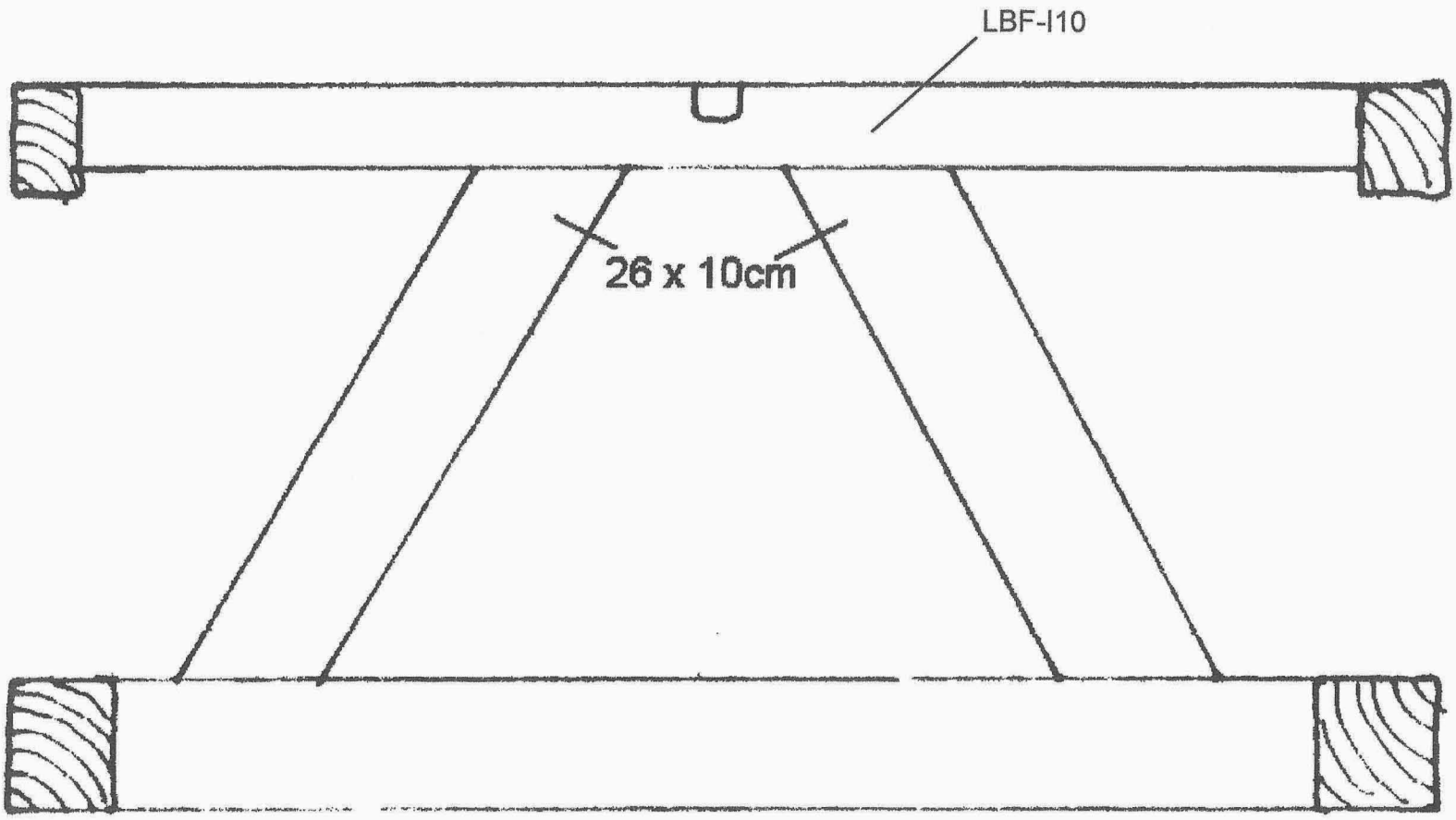


Figure 111: Church of St John the Evangelist, Shenton, truss C-C, showing the location of samples LBF-I01, LBF-I03, and LBF-I09 (George Dawson)

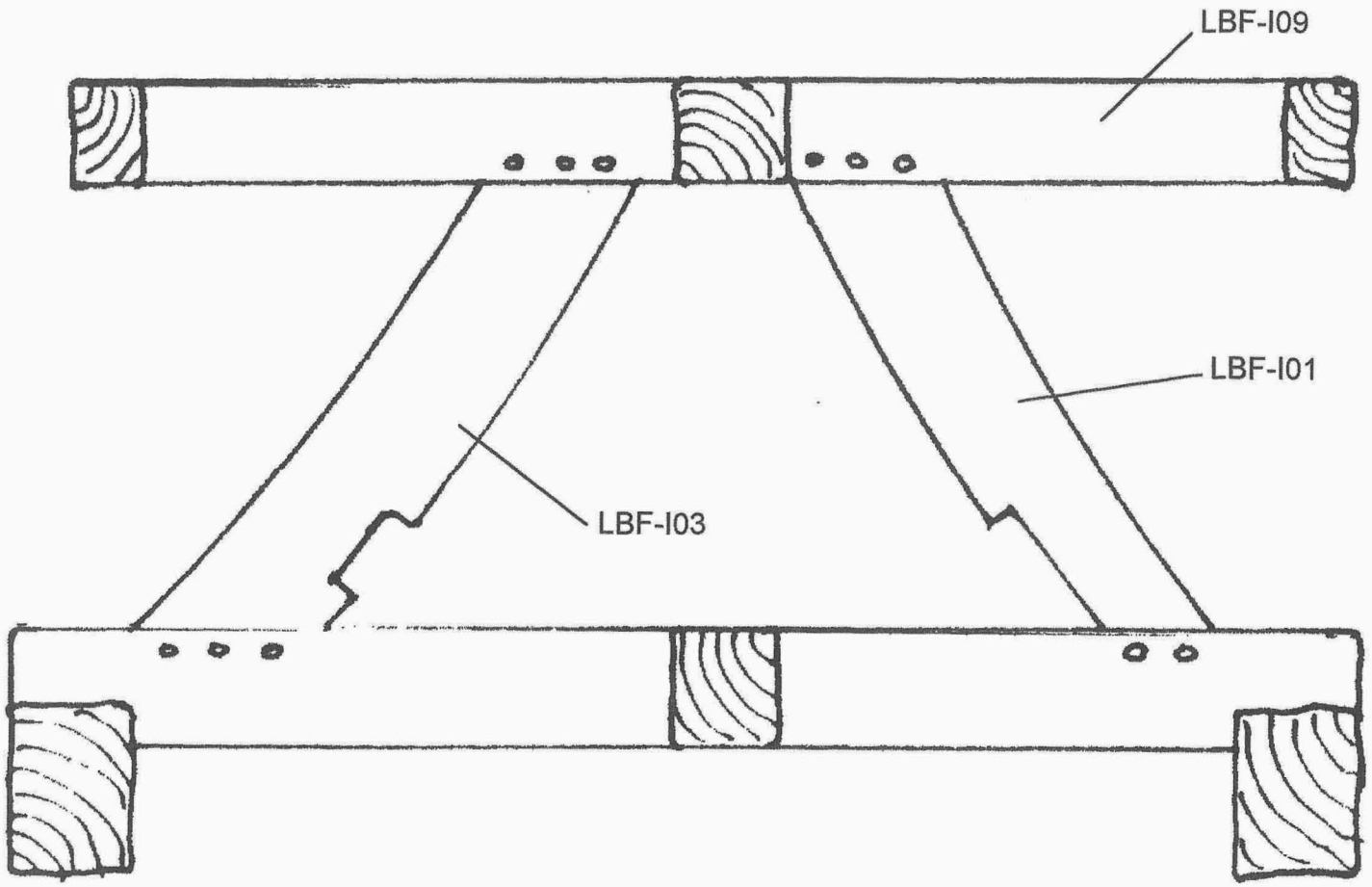


Figure 112: Church of St John the Evangelist, Shenton, bellfframe; truss D-D, showing the location of samples LBF-I02 and LBF-I04 (George Dawson)

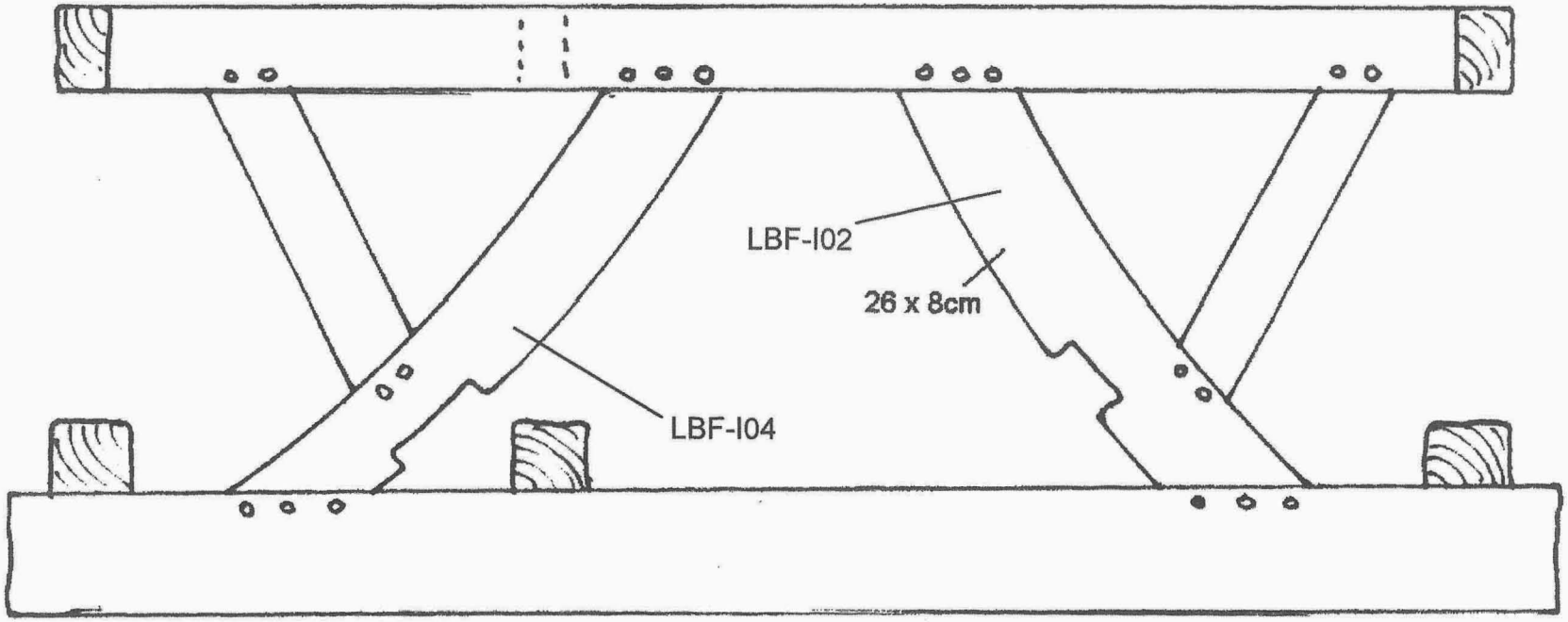


Figure 113: Church of St John the Evangelist, Shenton, bellframe; end frame (E-E), showing the location of sample LBF-I07 (George Dawson)

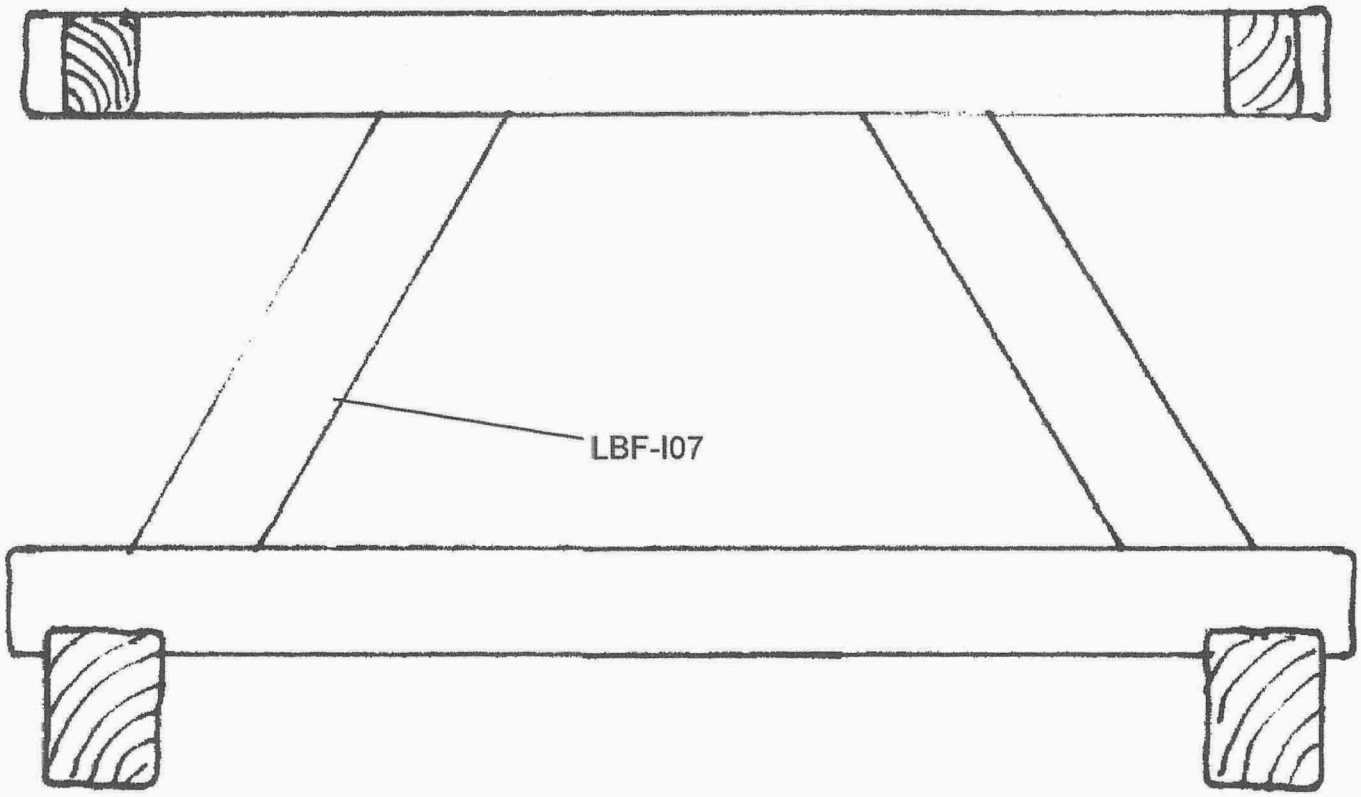


Figure 114: Church of St John the Evangelist, Shenton, bellframe; end frame (F-F), showing the location of sample LBF-I12 (George Dawson)

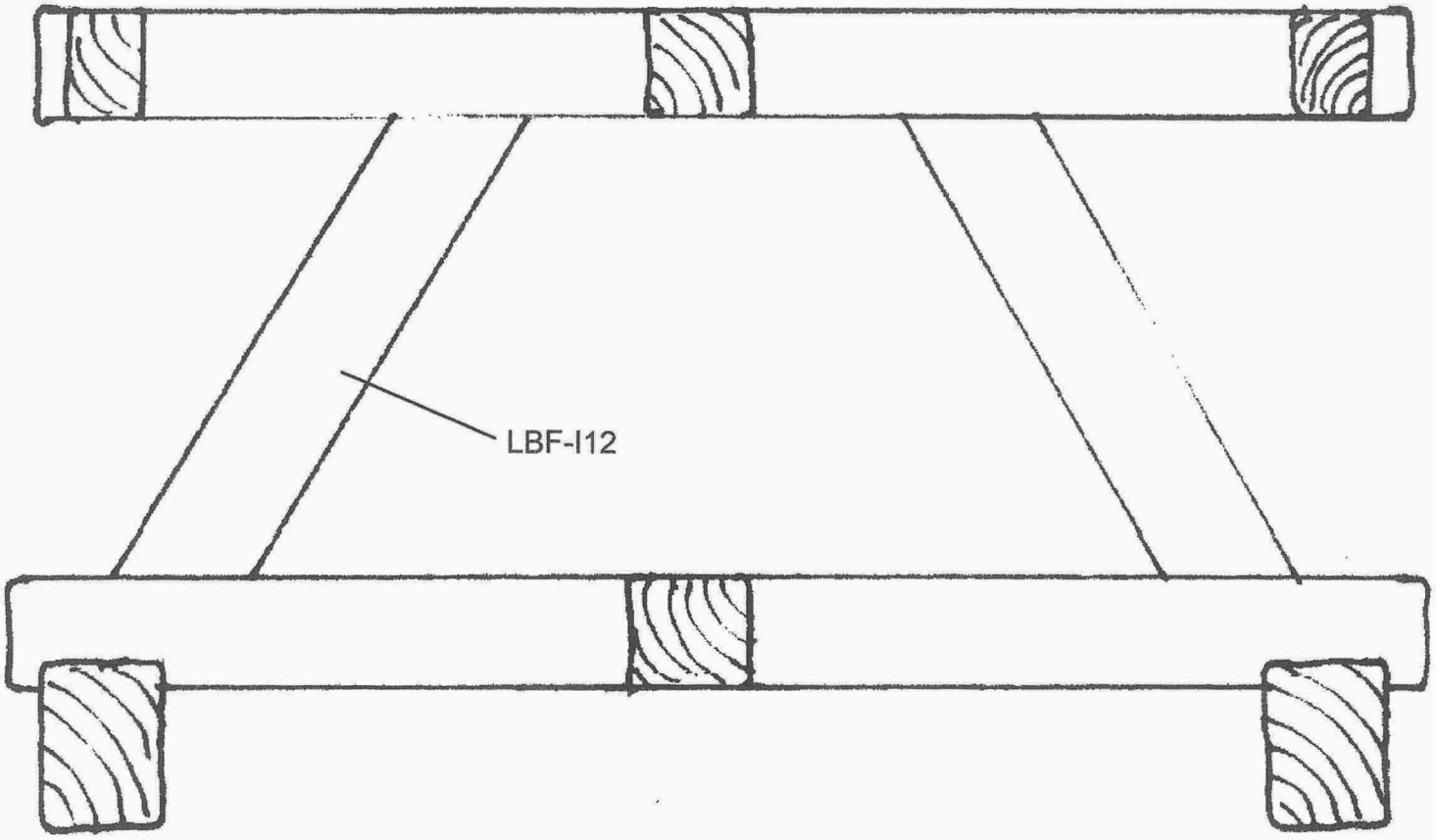
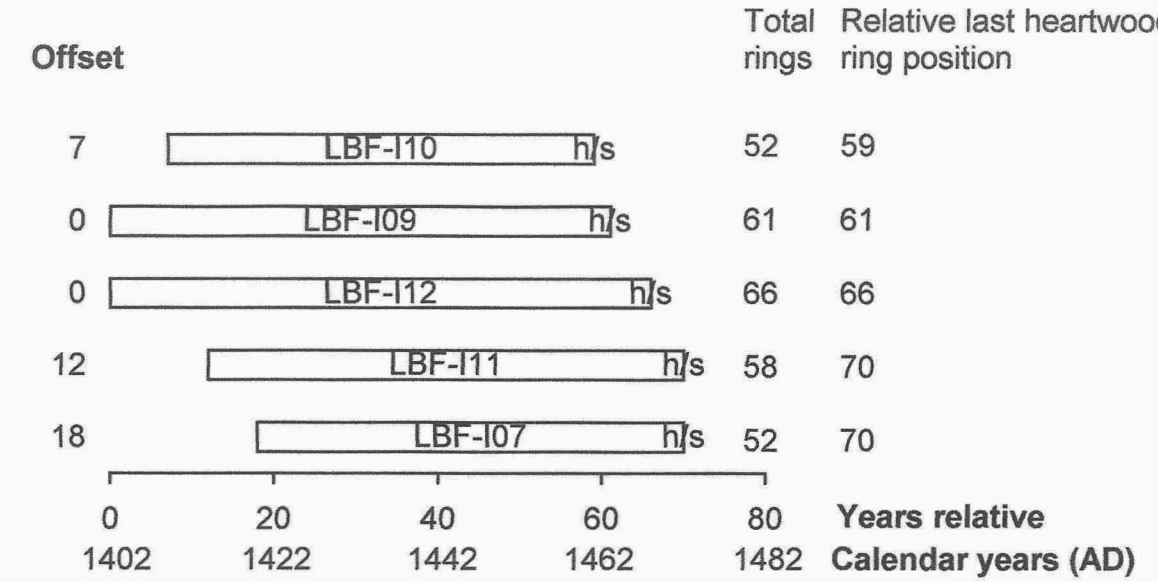


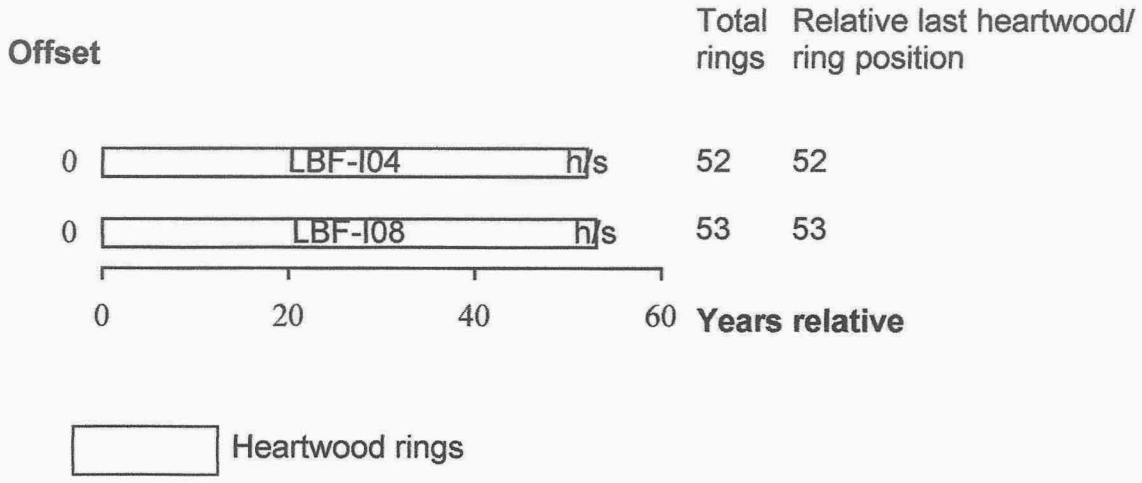
Figure 115: Bar diagram of samples in site sequence LBFISQ01



Heartwood rings

h/s = the heartwood/sapwood boundary is the last measured

Figure 116: Bar diagram of samples in undated site sequence LBFISQ02



h/s = the heartwood/sapwood ring is the last measured ring

4.10
Church of St Peter, Gaulby (LBF-J)
(SK 695 010; Figs 117-26)

The oak bellframe at Gaulby is for six bells and is of mixed design, Pickford types 6.A and 6B. There are four parallel pits and two transverse pits, one on either side of the ends of the parallel pits. However, the frame is constructed so that the two central parallel pits and the two transverse pits are constructed between the two main trusses of the frame, and then the two outer parallel pits are added on to the outside of the frame asymmetrically.

Overall it is a fine piece of work, all of one build, which just fits into the tower. It is certain that the frame was erected when the bells were installed and so the installation is an excellent example of eighteenth-century work.

Sampling, Analysis, and Results
Ten core samples were taken from the frame heads, sills, and a brace (Table 24; Figs 118-26). Only one of the samples taken had enough rings to make measurement worthwhile. This sample was matched against the reference chronologies where it was found to span the period AD 1623-1686. The evidence for this dating is given by the *t*-values in Table 25.

Interpretation
Sample LBF-J01 was found to span the period AD 1623-86. This sample does not have the heartwood/sapwood boundary ring and so an estimated felling date cannot be calculated for it, except to say that this would be AD 1702 at the earliest.

Discussion
This bellframe has been dated stylistically to the mid-eighteenth century and is thought to be contemporary with the bells that hang within it, which date to AD 1741. Unfortunately, tree-ring analysis has not proved very successful at this site, with the dating of only one of the timbers. Obviously, little can be deduced from one dated timber. However, the felling date of after AD 1701 does not contradict the stylistic dating.

Table 24: Details of tree-ring samples from timbers of the bellframe of the Church of St Peter, Gaulby, Leicestershire

Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Last heartwood ring date (AD)	Last measured ring date (AD)
LBF-J01	Frame head, truss J-J	64	h/s	1623	1686	1686
LBF-J02	Frame head, truss D-D	NM	--	----	----	----
LBF-J03	Frame head, truss A-B	NM	--	----	----	----
LBF-J04	Frame head, truss D-E	NM	--	----	----	----
LBF-J05	Frame head, truss A-A	NM	--	----	----	----
LBF-J06	Frame head, truss C-C	NM	--	----	----	----
LBF-J07	North-east brace, truss A-A	NM	--	----	----	----
LBF-J08	Sill, truss C-C	NM	--	----	----	----
LBF-J09	Sill, truss G-G	NM	--	----	----	----
LBF-J10	Frame head, truss B-B	NM	--	----	----	----

*NM = not measured
h/s = the heartwood/sapwood boundary ring is the last measured ring on the sample

Table 25: Results of the cross-matching of sample LBF-J01 and relevant reference chronologies when the first-ring date is AD 1623 and the last-ring date is AD 1686

Reference chronology	*t*-value	Span of chronology	Reference
East Midlands	4.9	AD 882-1981	Laxton and Litton 1988
Ely Cathedral, Cambs	6.6	AD 1592-1736	Esling *et al* 1991 unpubl
Southwell Minster (aisle roof), Notts	5.3	AD 1573-1716	Howard *et al* 1996b
Blidworth Church, Blidworth, Notts	5.1	AD 1621-1713	Laxton and Litton 1988
South Luffenham Hall	4.9	AD 1594-1709	Arnold *et al* 2002 unpubl
De Grey Mausoleum, Flitton, Beds	4.6	AD 1510-1711	Arnold *et al* 2003b
Old Barn, Stratford on Avon, Warwicks	4.6	AD 1591-1735	Howard *et al* 1996b

Figure 117: Church of St Peter, Gaulby, bellframe; Plan at frame head level (George Dawson)

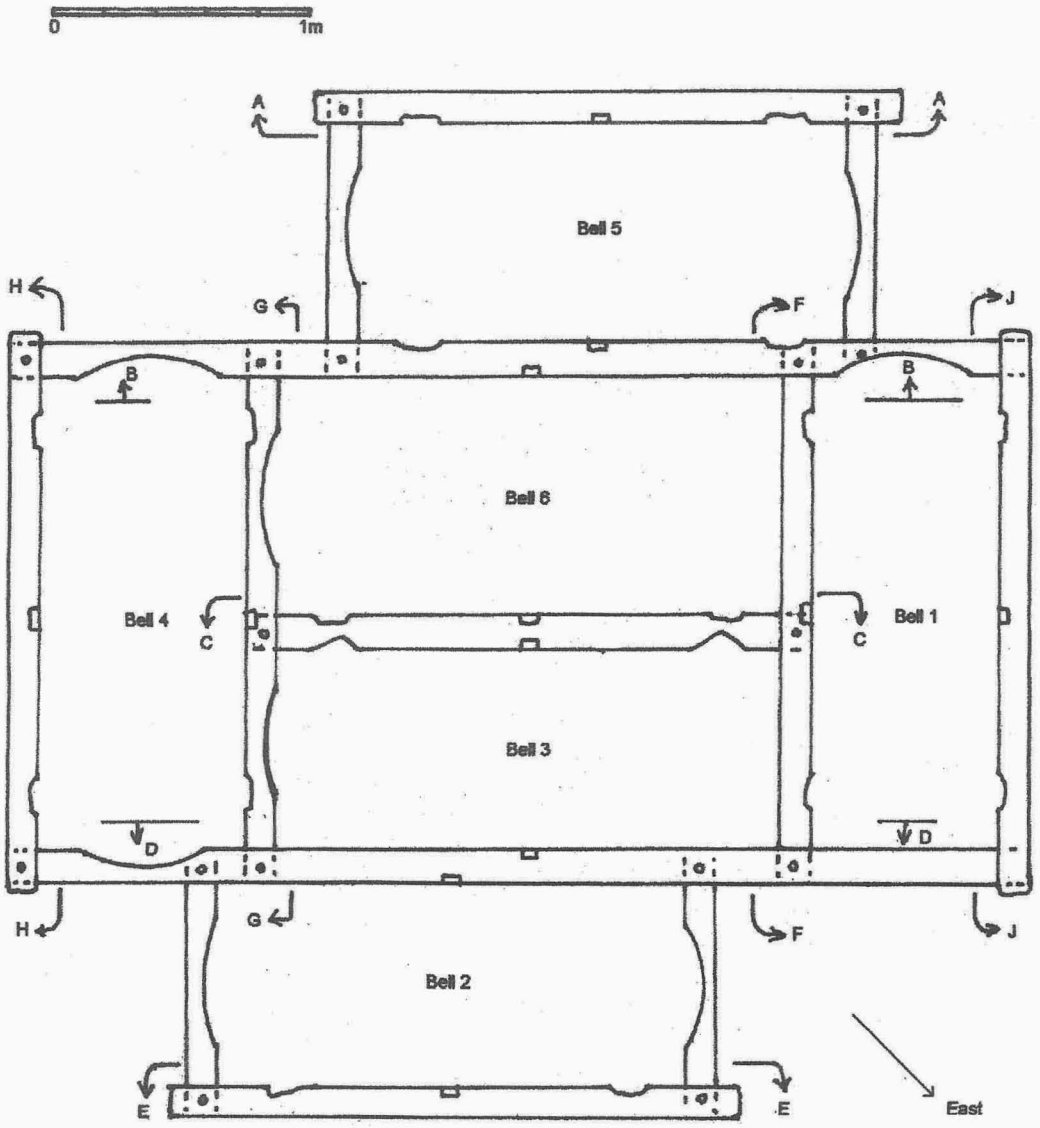


Figure 118: Church of St Peter, Gaulby, bellframe; truss A-A, showing the location of samples LBF-J03, LBF-J05, and LBF-J07 (George Dawson)

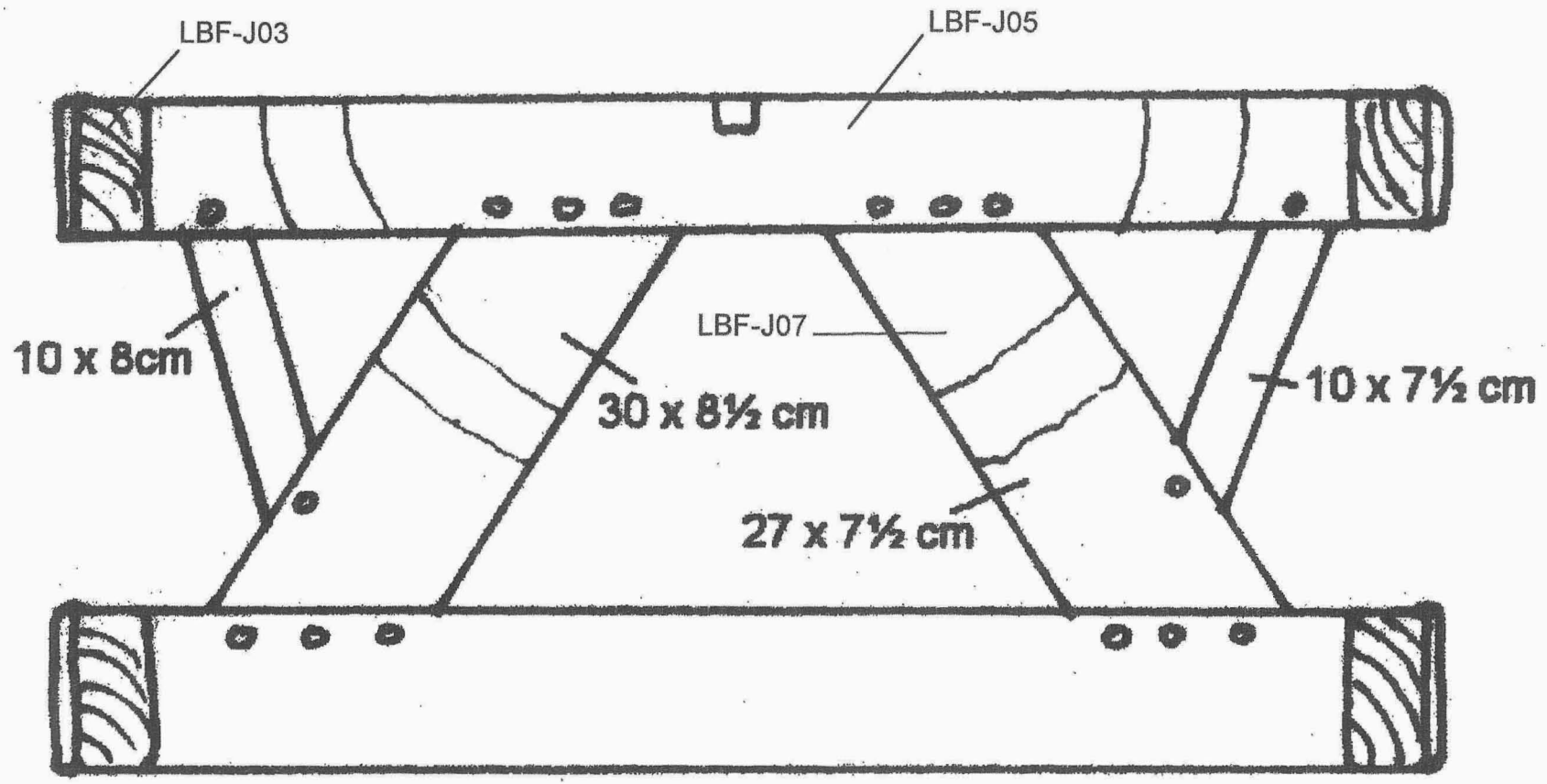


Figure 119: Church of St Peter, Gaulby, bellframe; truss B-B, showing the location of sample LBF-J10 (George Dawson)

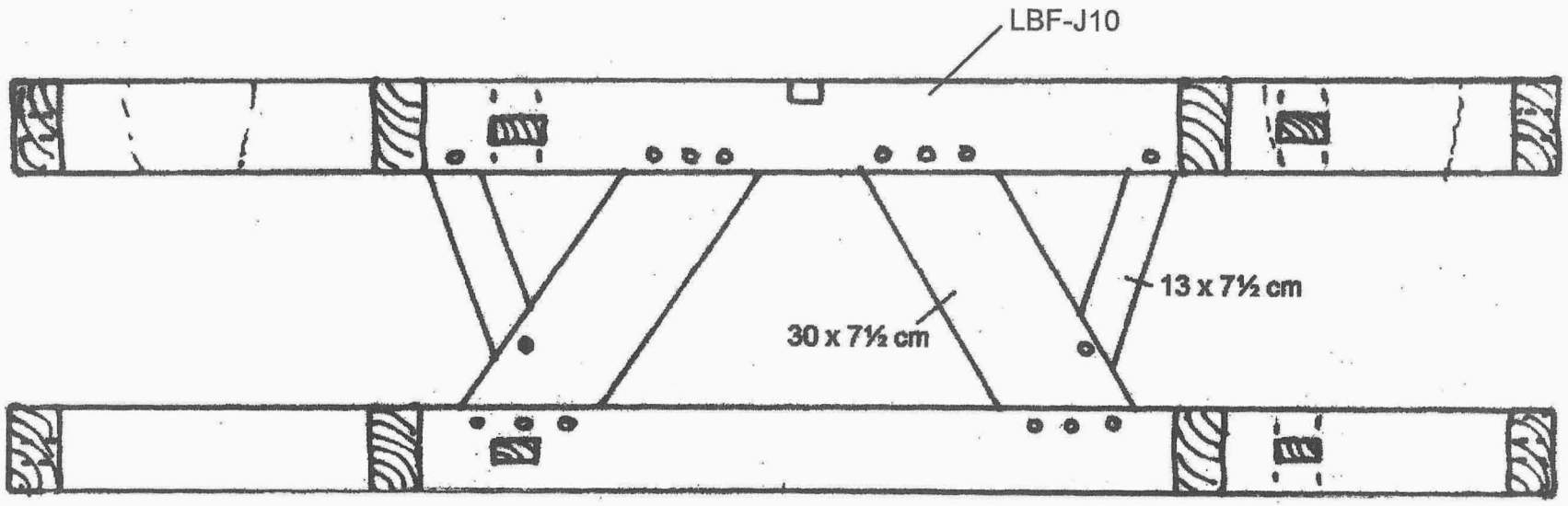


Figure 120: Church of St Peter, Gaulby, bellframe; truss C-C, showing the location of samples LBF-J06 and LBF-J08 (George Dawson)

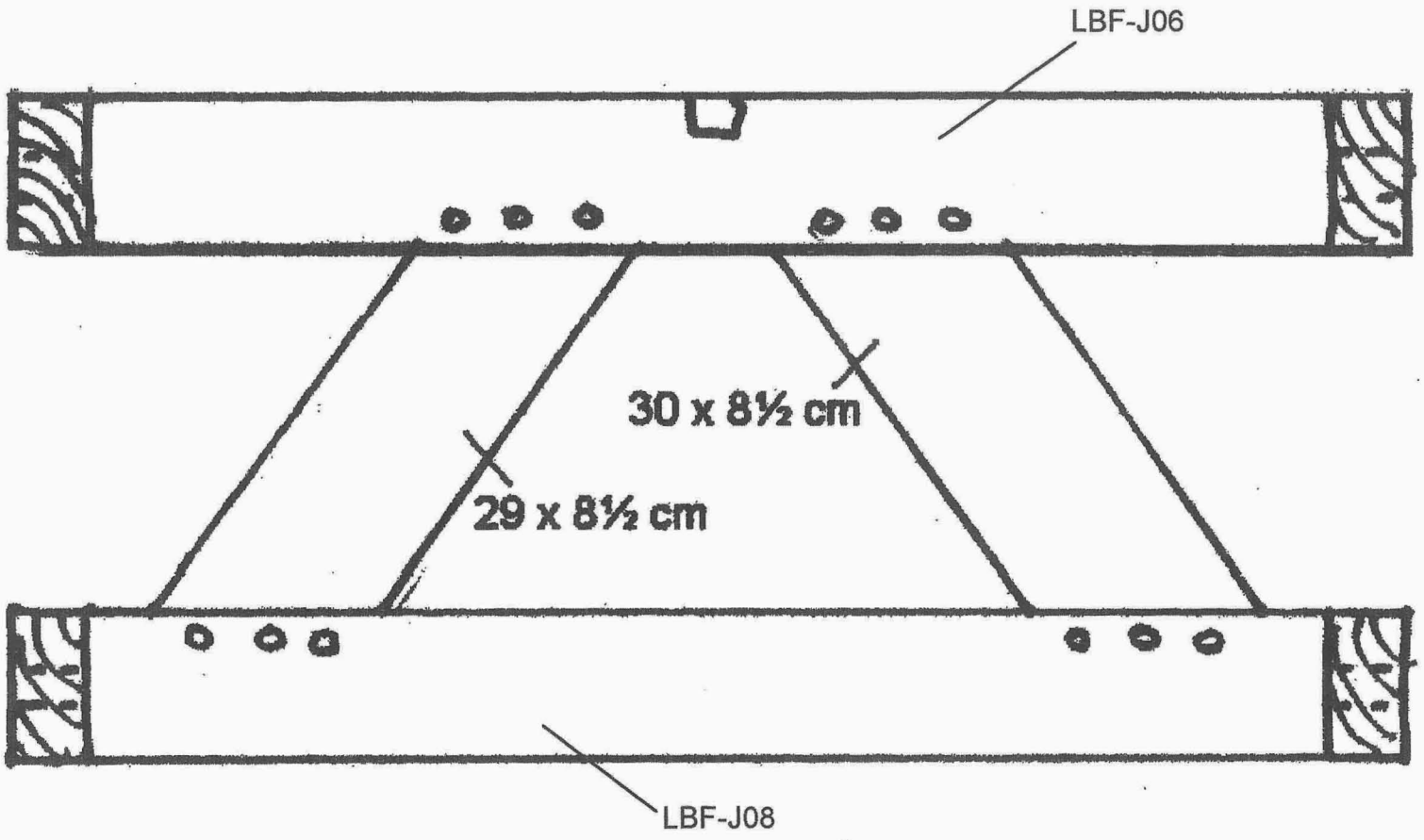


Figure 121: Church of St Peter, Gaulby, bellframe; truss D-D, showing the location of sample LBF-J02 (George Dawson)

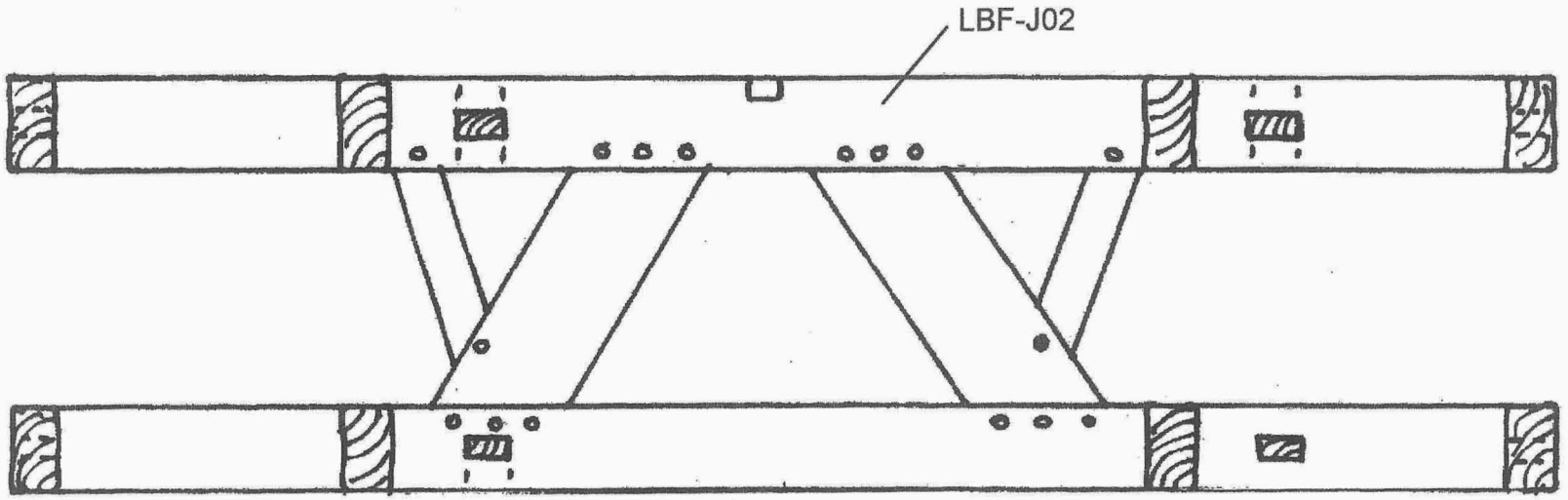


Figure 122: Church of St Peter, Gaulby, bellframe; truss E-E, showing the location of sample LBF-J04 (George Dawson)

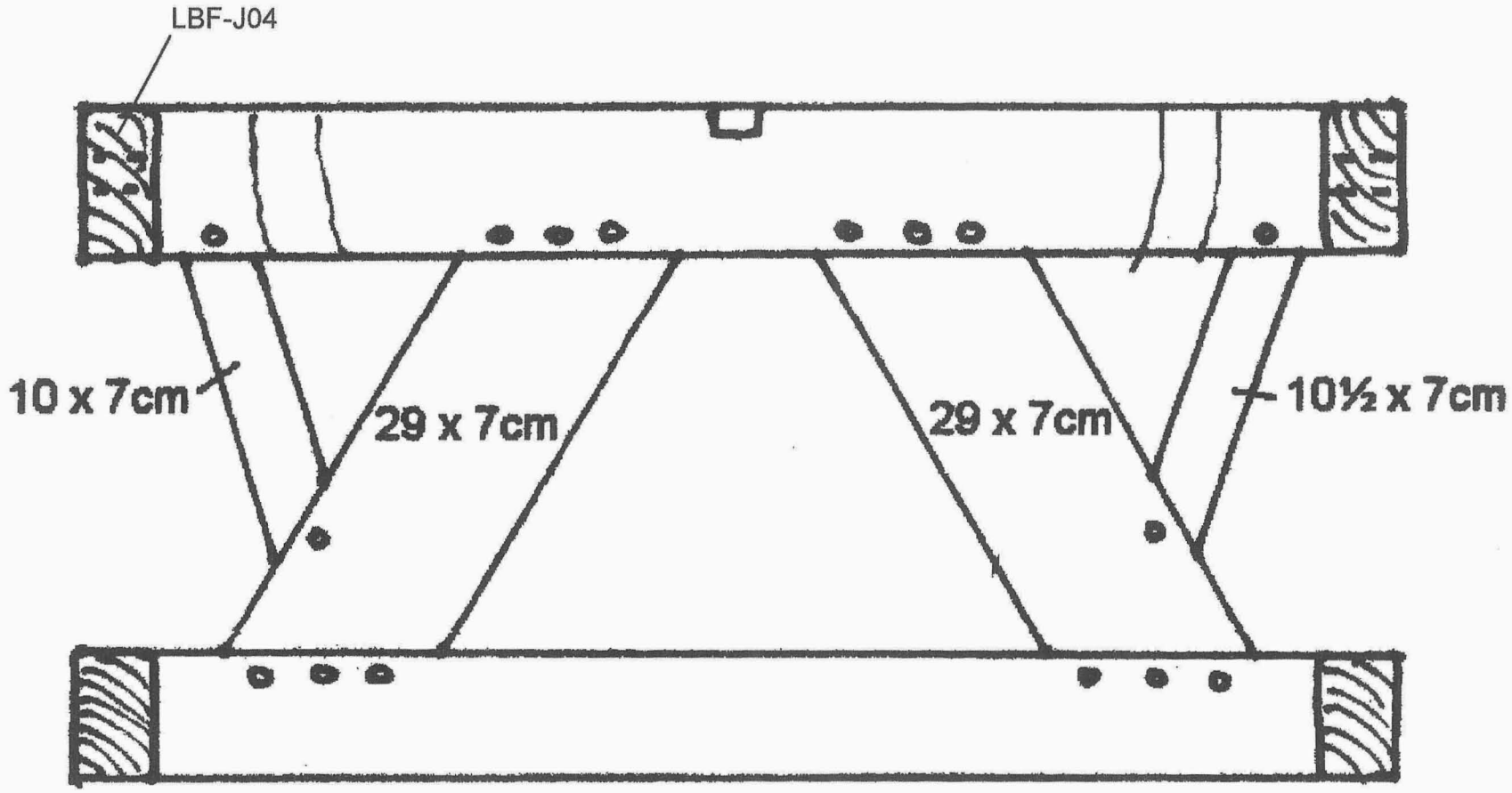


Figure 123: Church of St Peter, Gaulby, bellframe; truss F-F (George Dawson)

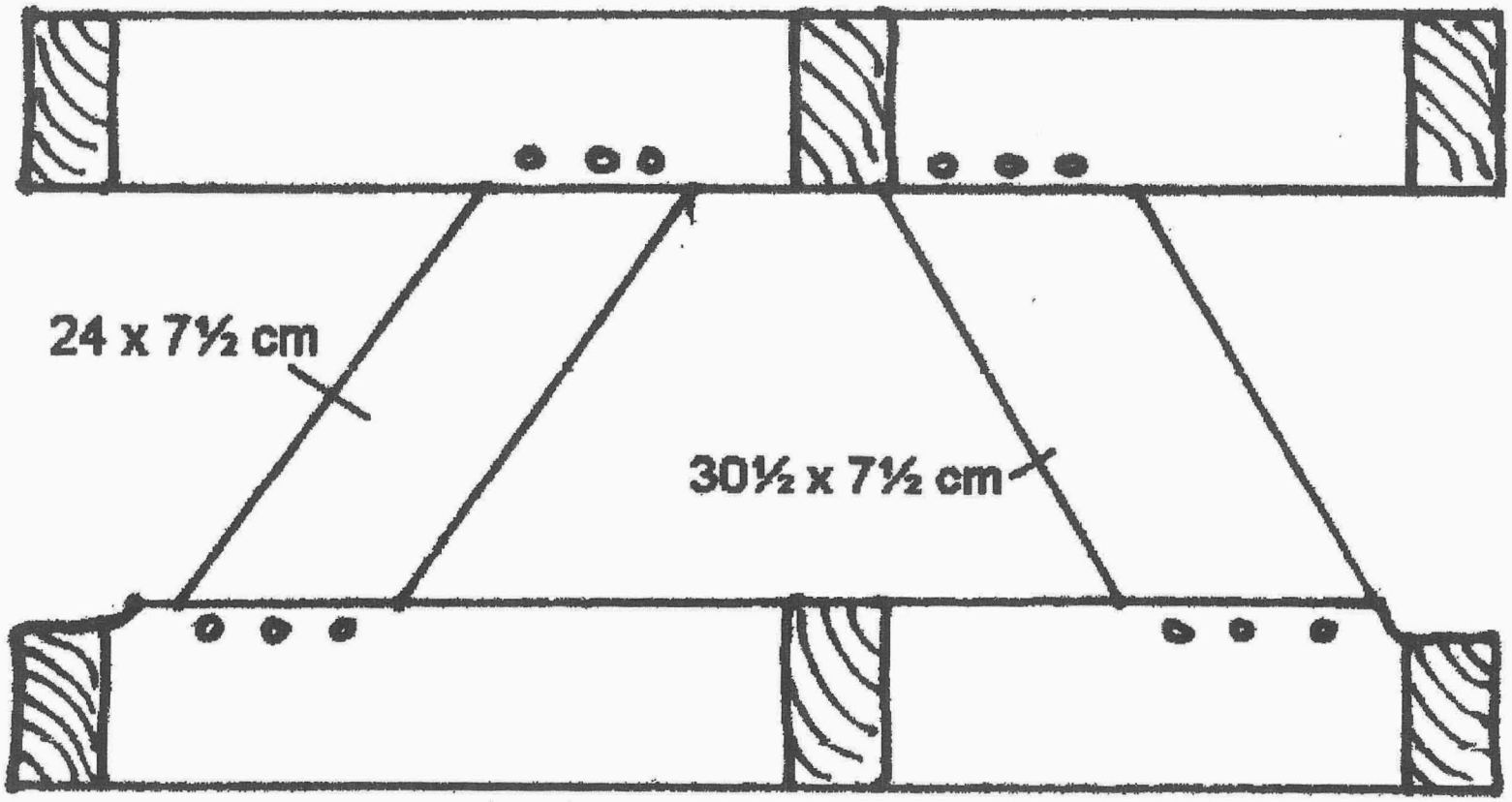


Figure 124: Church of St Peter, Gaulby, bellframe; truss G-G, showing the location of sample LBF-J09 (George Dawson)

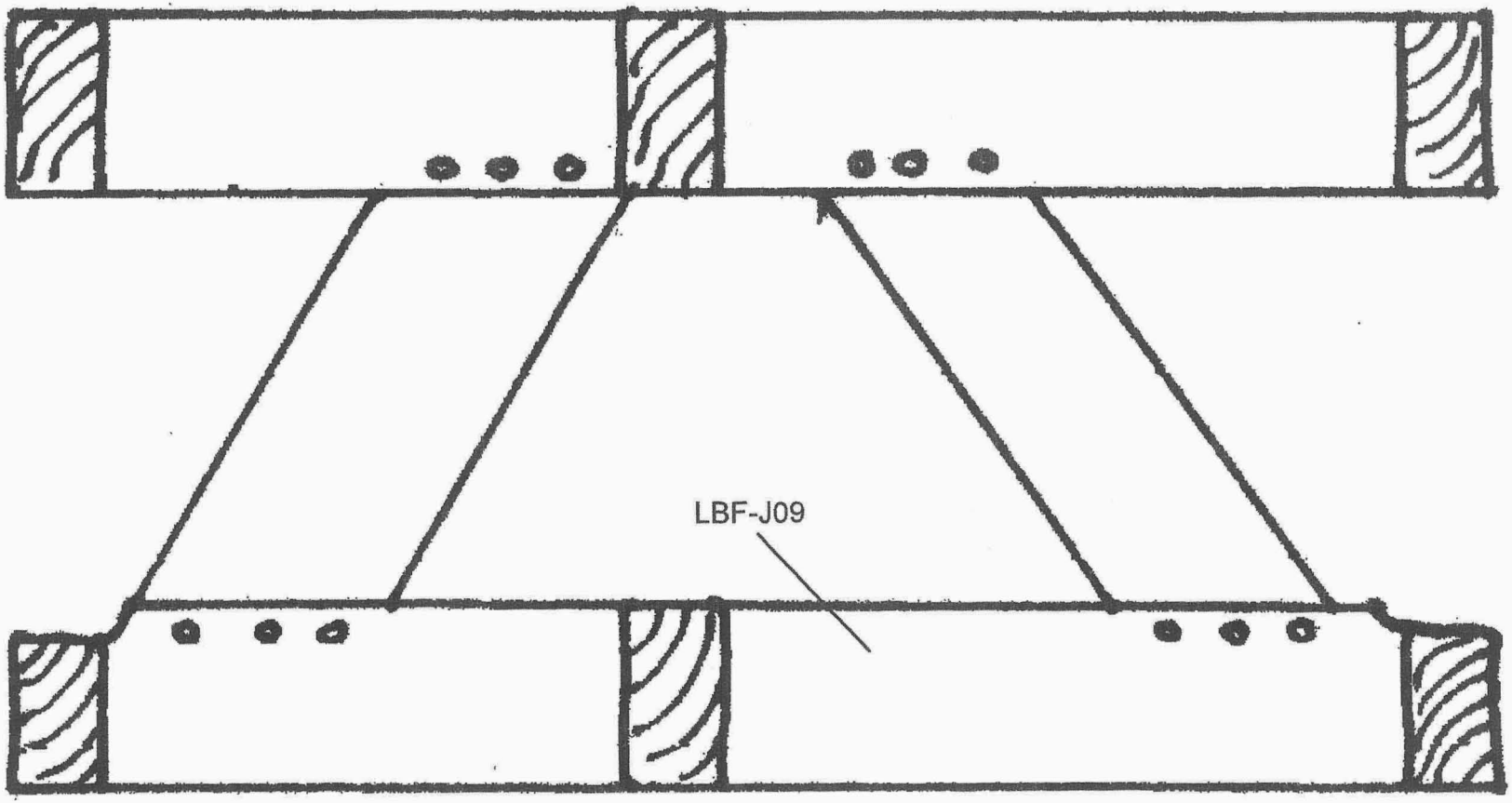


Figure 125: Church of St Peter, Gaulby, bellframe; truss H-H (George Dawson)

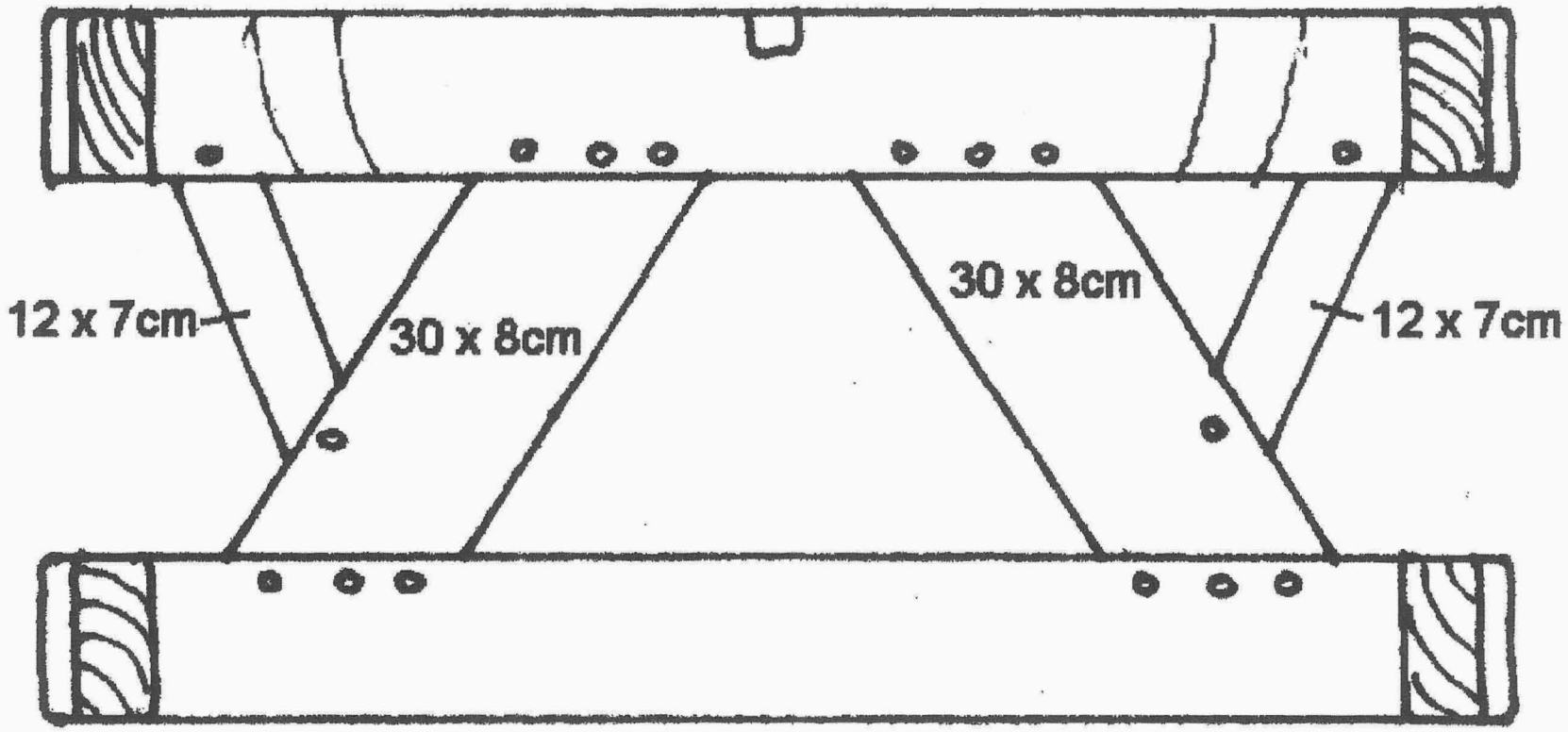
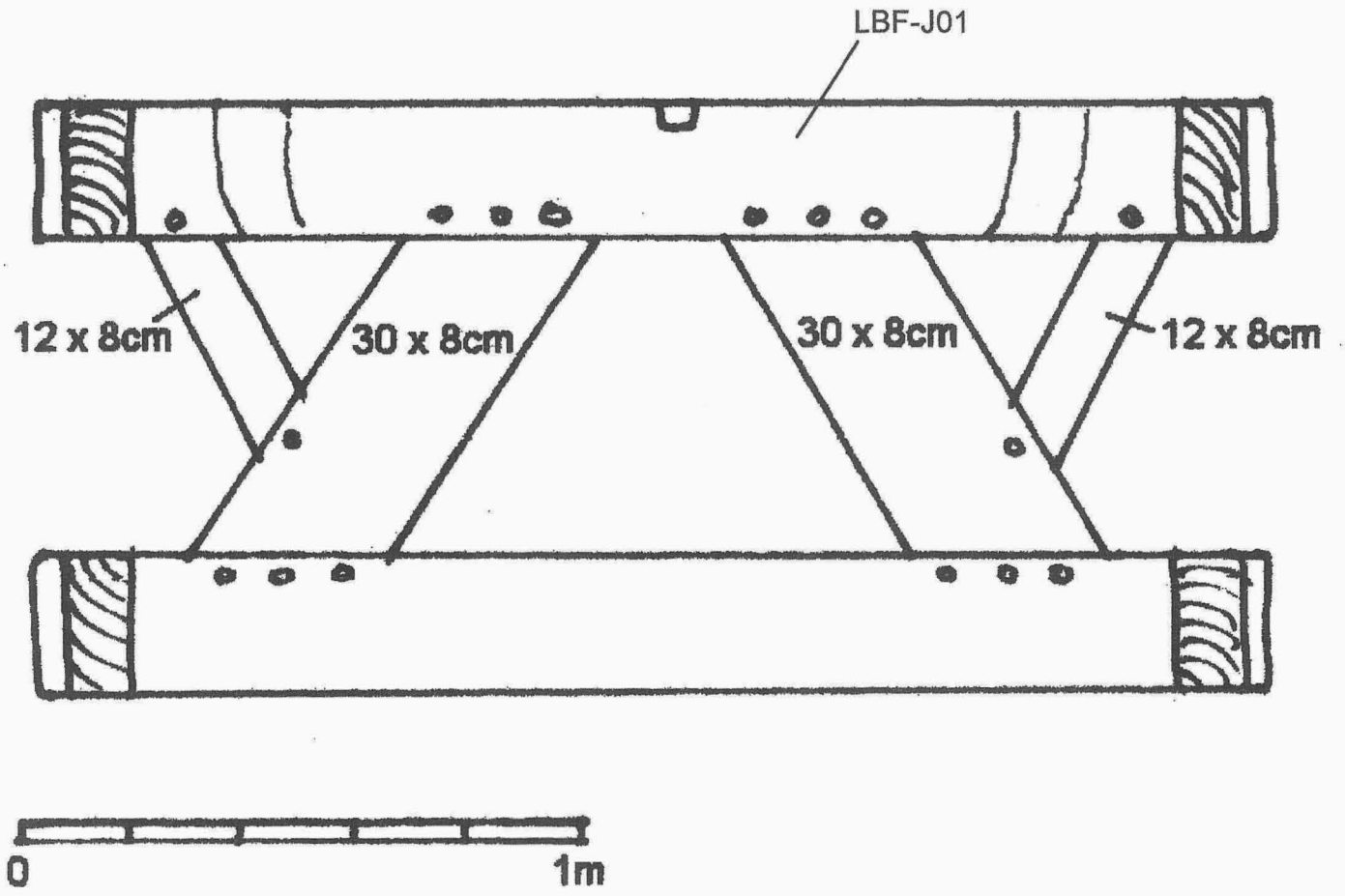


Figure 126: Church of St Peter, Gaulby, bellframe; truss J-J, showing the location of sample LBF-J01 (George Dawson)



4.11
Church of St Peter, Ashby Parva (LBF-K)
(SP 525 887; Figs 127-136)

Description
The pegged oak bellframe for three bells at Ashby Parva fills the tower at the bellframe stage. It is a simple jack-braced frame (Pickford type 6.A), all built at the same time, and is typical of a series of frames in the south of Leicestershire. It is slightly unusual in that the sills of the trusses are mortised into the sills of the end frames. These end frame sills sit on a small tower offset. It has four trusses, D, C, A, and B (north to south).

Stylistically the frame dates from the AD 1630s.

Sampling, Analysis, and Results
Sixteen core samples were taken from a variety of beams (Table 26; Figs 130-5). At this point four samples were found to have too few rings for secure dating and so were rejected prior to measurement. The remaining 12 samples were analysed. At a least value of t=4.5 nine samples had formed into three groups.

Firstly, two samples matched and site sequence LBFKSQ01, of 54 rings, was constructed containing these samples at the offsets shown in the bar diagram (Fig 136). This site sequence was successfully matched against the relevant reference chronologies for oak at a first-ring date of AD 1572 and a last-ring date of AD 1625. The evidence for this dating is given by the t-values in Table 27.

Secondly, four samples grouped and site sequence LBFKSQ02, of 82 rings, was constructed containing these samples at the offsets shown in the bar diagram (Fig 136). This site sequence was successfully matched against the relevant reference chronologies for oak at a first-ring date of AD 1549 and a last-ring date of AD 1630. The evidence for this dating is given by the t-values in Table 28.

Finally, three samples matched and site sequence LBFKSQ03, of 89 rings, was constructed containing these samples at the offsets shown in the bar diagram (Fig 136). This site sequence was then matched against the reference chronologies to spanning the period AD 1542-1630, with the evidence for this dating given by the t-values in Table 29.

Attempts to date the remaining samples by individually comparing them against the reference material resulted in sample LBF-K06 matching at a first-ring date of AD 1585 and a last-ring date of AD 1632. The result of this dating is given by the t-values in Table 30.

Interpretation
Analysis of samples from the timbers of this bellframe has resulted in the production of three dated site sequences and one individually dated sample.

Site sequence LBFKSQ01, of 54 rings, was dated to the period AD 1572-1625. Both of the samples contained within this site sequence have the heartwood/sapwood boundary ring. The average of this is AD 1623, allowing an estimated felling date to be calculated for the two timbers represented to within the range AD 1638-58.

Site sequence LBFKSQ02, of 82 rings, contains four samples and spans the period AD 1549-1630. All four samples have the heartwood/sapwood boundary ring. The average of these is AD 1617, allowing an estimated felling date to be calculated for the four timbers represented to AD 1632-52.

The third site sequence, LBFKSQ03, of 89 rings, contains three samples and spans the period AD 1542-1630. Two of the samples have the heartwood/sapwood boundary ring. The average of these is AD 1623, allowing an estimated felling date to be calculated for the two timbers represented to within the range AD 1638-58.

Sample LBF-K06 was dated individually to the period AD 1585-1632. With a heartwood/sapwood boundary ring date of AD 1619, this sample has an estimated felling date within the range AD 1634-54.

The felling date ranges as outlined above are very similar and suggestive of all ten samples having a contemporary felling. Therefore, the average heartwood/sapwood boundary date (for the nine samples which have this ring) is calculated, to AD 1620, allowing an estimated felling date to be calculated for the nine timbers represented to within the range AD 1635-55. The tenth dated sample, LBF-K14, does not have the heartwood/sapwood boundary ring and so an estimated felling date cannot be calculated for it, except to say that with a last measured ring date of AD 1609, this would be estimated to be AD 1625 at the earliest, a date which does not rule out a felling with the other samples.

Discussion

Tree-ring analysis has resulted in the successful dating of ten timbers of the bellframe. It is now known that it contains nine (and possibly ten) timbers felled in AD 1635-55. This bellframe had been dated on stylistic grounds to the AD 1630s, a date now supported by the dendrochronological evidence.

Table 26: Details of tree-ring samples from timbers of the bellframe of the Church of St Peter, Main Street, Ashby Parva, Leicestershire

Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Last heartwood ring date (AD)	Last measured ring date (AD)
LBF-K01	Frame head, truss F-F	74	h/s	1549	1622	1622
LBF-K02	West jack brace, truss A-A	47	18c(+*c*3NM)	----	----	----
LBF-K03	Frame head, truss C-C	65	02c(+*c*8NM)	1560	1622	1624
LBF-K04	West jack brace, truss D-D	68	14	1563	1616	1630
LBF-K05	Sill, truss F-F	62	h/s	1554	1615	1615
LBF-K06	East brace, truss D-D	48	13	1585	1619	1632
LBF-K07	East jack brace, truss D-D	NM	--	----	----	----
LBF-K08	East jack brace, truss C-C	NM	--	----	----	----
LBF-K09	Frame head, truss D-D	51	h/s	1575	1625	1625
LBF-K10	Frame head, truss E-E	61	h/s	1554	1614	1614
LBF-K11	Frame head, truss B-B	50	h/s	1572	1621	1621
LBF-K12	East brace, truss A-A	54	06	1577	1624	1630
LBF-K13	Sill, truss C-C	50	h/s	----	----	----
LBF-K14	East brace, truss C-C	68	--	1542	----	1609
LBF-K15	Sill, truss D-D	NM	--	----	----	----
LBF-K16	South brace, truss F-F	NM	--	----	----	----

*NM = not measured

h/s = the heartwood/sapwood boundary is the last measured ring

c(+*c*xNM) = complete sapwood on timber, all or part lost in sampling (estimated number of sapwood rings lost)

C = complete sapwood retained on sample, last measured ring is the felling date

Table 27: Results of the cross-matching of site sequence LBFKSQ01 and relevant reference chronologies when the first-ring date is AD 1572 and the last-ring date is AD 1625

Reference chronology	*t*-value	Span of chronology	Reference
Oak House (barn), Oak Hill, West Bromwich, West Midlands	5.8	AD 1562-1655	Howard *et al* 1991
Langford Manor, Langford, Notts	5.6	AD 1467-1632	Esling *et al* 1989
Cheddleton, South, Staffs	4.5	AD 1551-1682	Howard *et al* 1995c unpubl
Astley Castle, Warwicks	4.3	AD 1495-1627	Howard *et al* 1997b
Sherwood Trees, Notts	4.2	AD 1426-1981	Laxton and Litton 1988
Fair Flats Farm, Kirkedge Road, Bradfield, South Yorks	4.2	AD 1492-1633	Howard *et al* 1994a
15/19 Station Street, Mansfield Woodhouse, Notts	4.1	AD 1546-1660	Howard *et al* 1997c

Table 28: Results of the cross-matching of site sequence LBFKSQ02 and relevant reference chronologies when the first-ring date is AD 1549 and the last-ring date is AD 1630

Reference chronology	*t*-value	Span of chronology	Reference
Colston Bassett Church (bellframe), Notts	5.5	AD 1465-1609	Howard *et al* 1995
Astley Castle, Warwicks	5.4	AD 1495-1627	Howard *et al* 1997b
Ely Cathedral (Queens Hall), Cambs	5.3	AD 1466-1610	Esling *et al* 1992 unpubl
Alford Manor, Lincs	5.2	AD 1500-1611	Arnold *et al* 2003a
The Manor House, Donington-le-Heath, Leics	5.0	AD 1411-1618	Esling *et al* 1989
26 Westgate Street, Glos	4.8	AD 1399-1622	Howard *et al* 1998
Hardwick Hall (east lodge roof), Derbys	4.6	AD 1518-1609	Howard *et al* 2000

Table 29: Results of the cross-matching of site sequence LBFKSQ03 and relevant reference chronologies when the first-ring date is AD 1542 and the last-ring date is AD 1630

Reference chronology	*t*-value	Span of chronology	Reference
1 Soar Lane, Sutton Bonnington, Notts	5.8	AD 1552-1651	Howard *et al* 1993
The Standing at the Bucks Head, Debenham, Suffolk	5.0	AD 1561-1620	Arnold *et al* 2003d
Colston Bassett Church (bellframe), Notts	4.4	AD 1465-1609	Howard *et al* 1995
Guns Mills, Mitcheldean, Glos	4.4	AD 1438-1681	Arnold *et al* 2002b
Oak House (barn), Oak Hill, West Bromwich, West Midlands	4.3	AD 1562-1655	Howard *et al* 1991
Keyworth Barn, Notts	4.3	AD 1451-1628	Laxton and Litton 1988
Leicester Castle (great hall), Leics	4.2	AD 1567-1695	Laxton and Litton 1988

Table 30: Results of the cross-matching of sample LBF-K06 and relevant reference chronologies when the first-ring date is AD 1585 and the last-ring date is AD 1632

Reference chronology	*t*-value	Span of chronology	Reference
England	5.6	AD 404-1981	Baillie and Pilcher 1982 unpubl
East Midlands	4.7	AD 882-1981	Laxton and Litton 1988
Manor House, Dev Sq, Sutton-in-Ashfield, Notts	7.5	AD 1441-1656	Howard *et al* 1996a
Cheddleton Grange, Staffs	5.9	AD 1551-1682	Howard *et al* 1995c unpubl
Staircase Café, Stockport, Manchester	5.6	AD 1402-1604	Howard *et al* 2003b
Brewhouse Yard Museum, Notts	5.5	AD 1524-1688	Howard *et al* 1994b
Nun Appleton Hall, Tadcaster, Yorks	5.4	AD 1478-1657	Howard *et al* 1995b unpubl

Figure 127: Church of St Peter, Ashby Parva (Dr C J Brooke)

Figure 128: Church of St Peter, Ashby Parva, general view of the frame, truss A-A is visible between bells 1 and 2, with bell 1 being furthest from the camera (Dr C J Brooke)

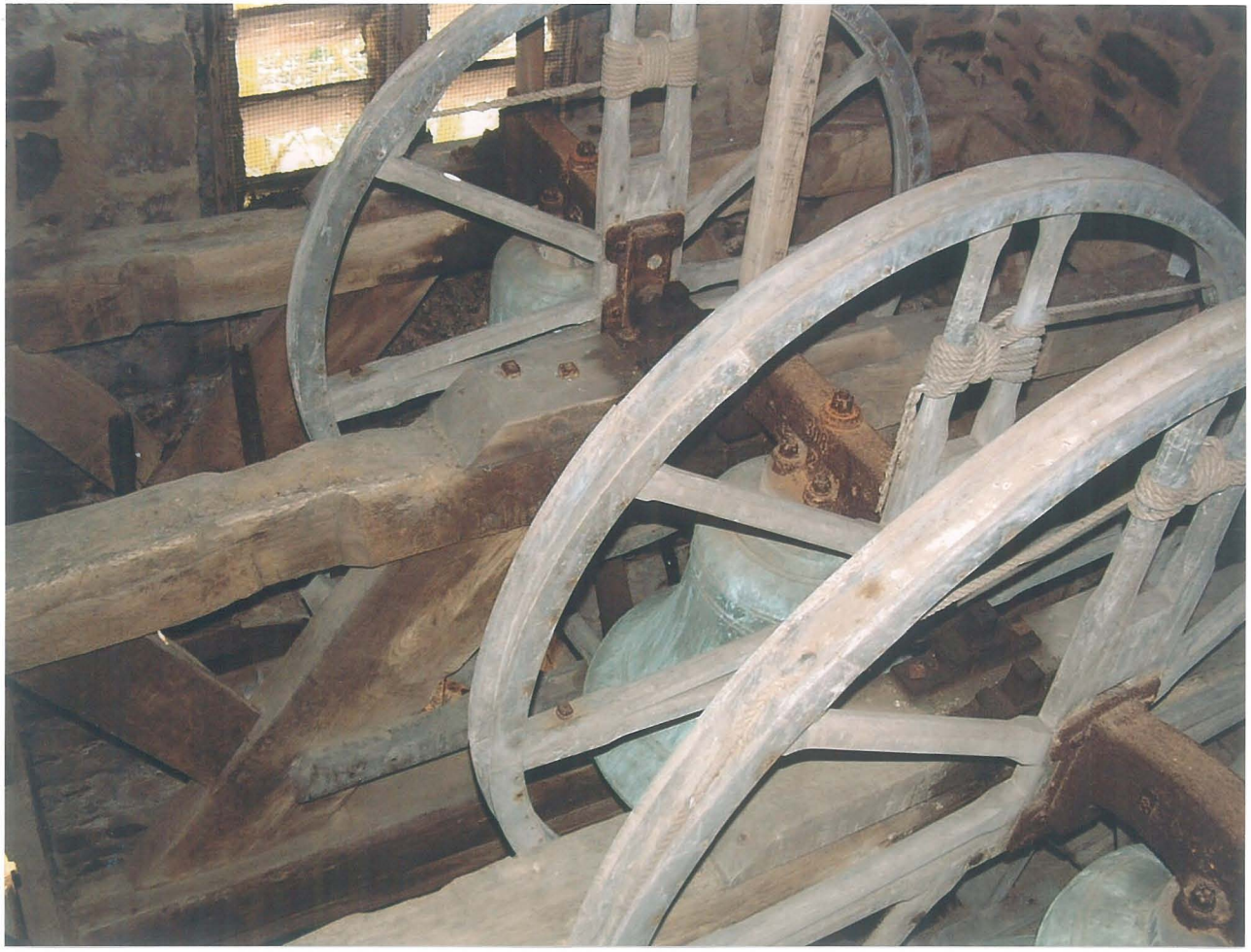


Figure 129: Church of St Peter, Ashby Parva, bellframe; plan (George Dawson)

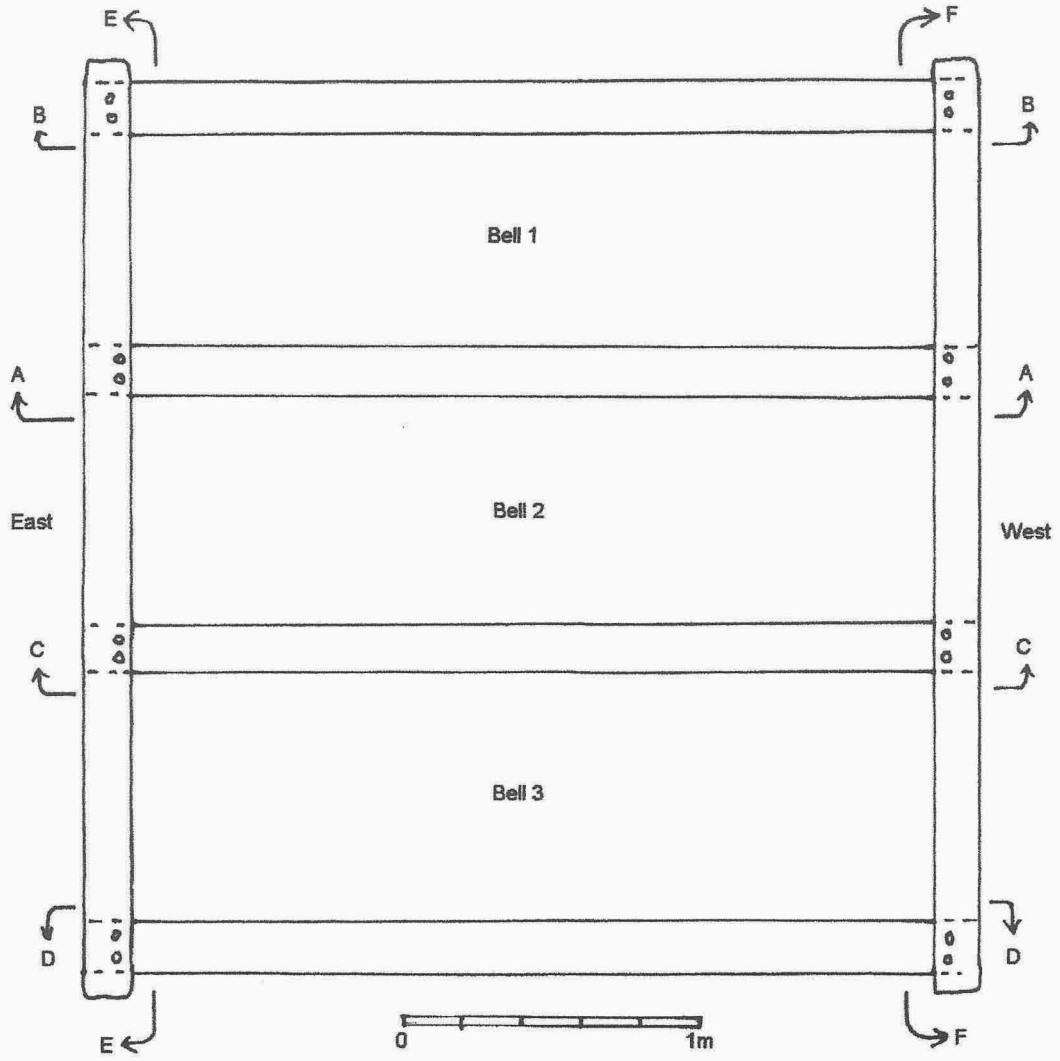


Figure 130: Church of St Peter, Ashby Parva, bellframe; truss A-A, showing the location of samples LBF-K02 and LBF-K12 (George Dawson)

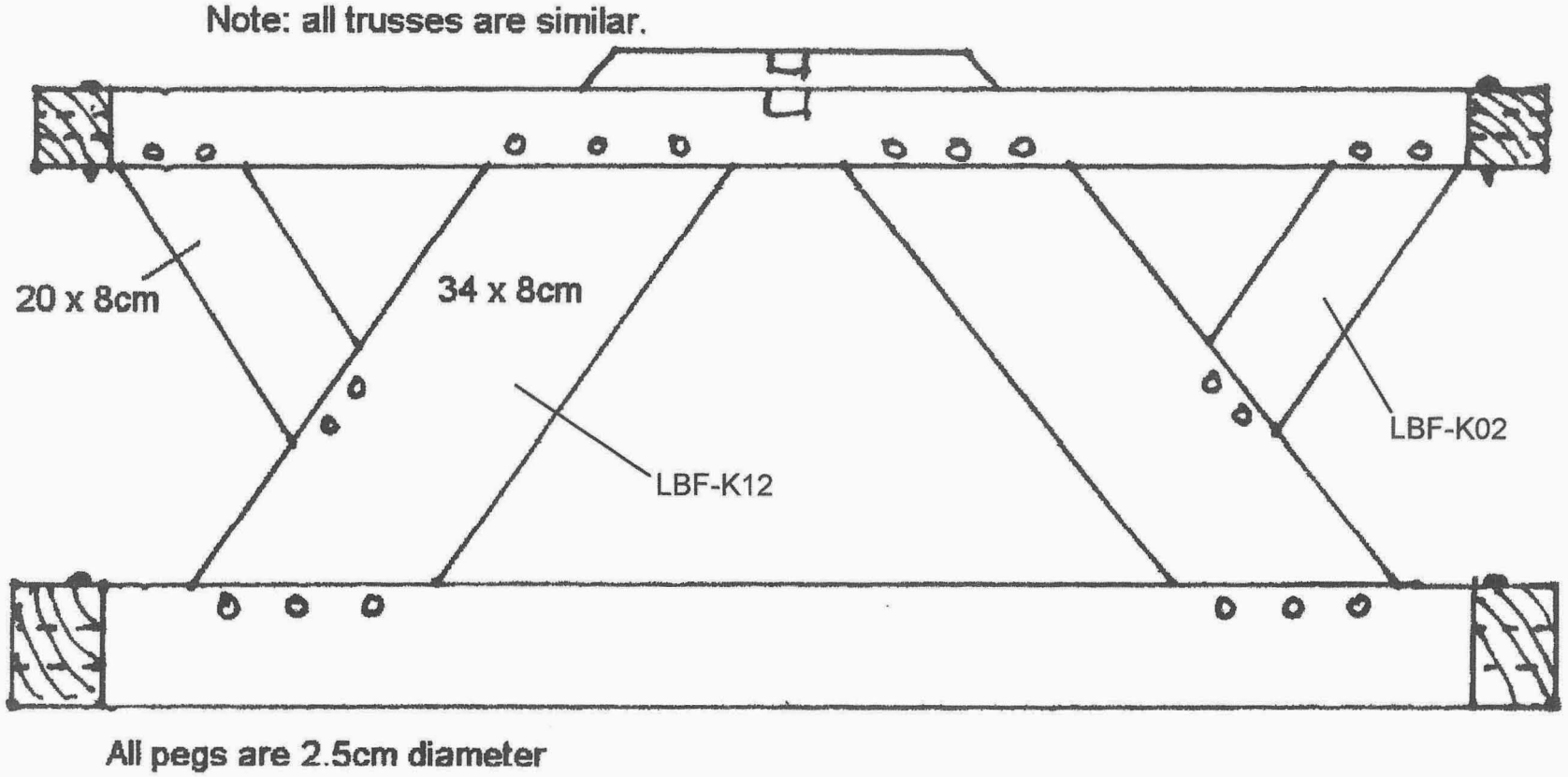


Figure 131: Church of St Peter, Ashby Parva, bellframe; truss B-B, showing the location of sample LBF-K11 (George Dawson)

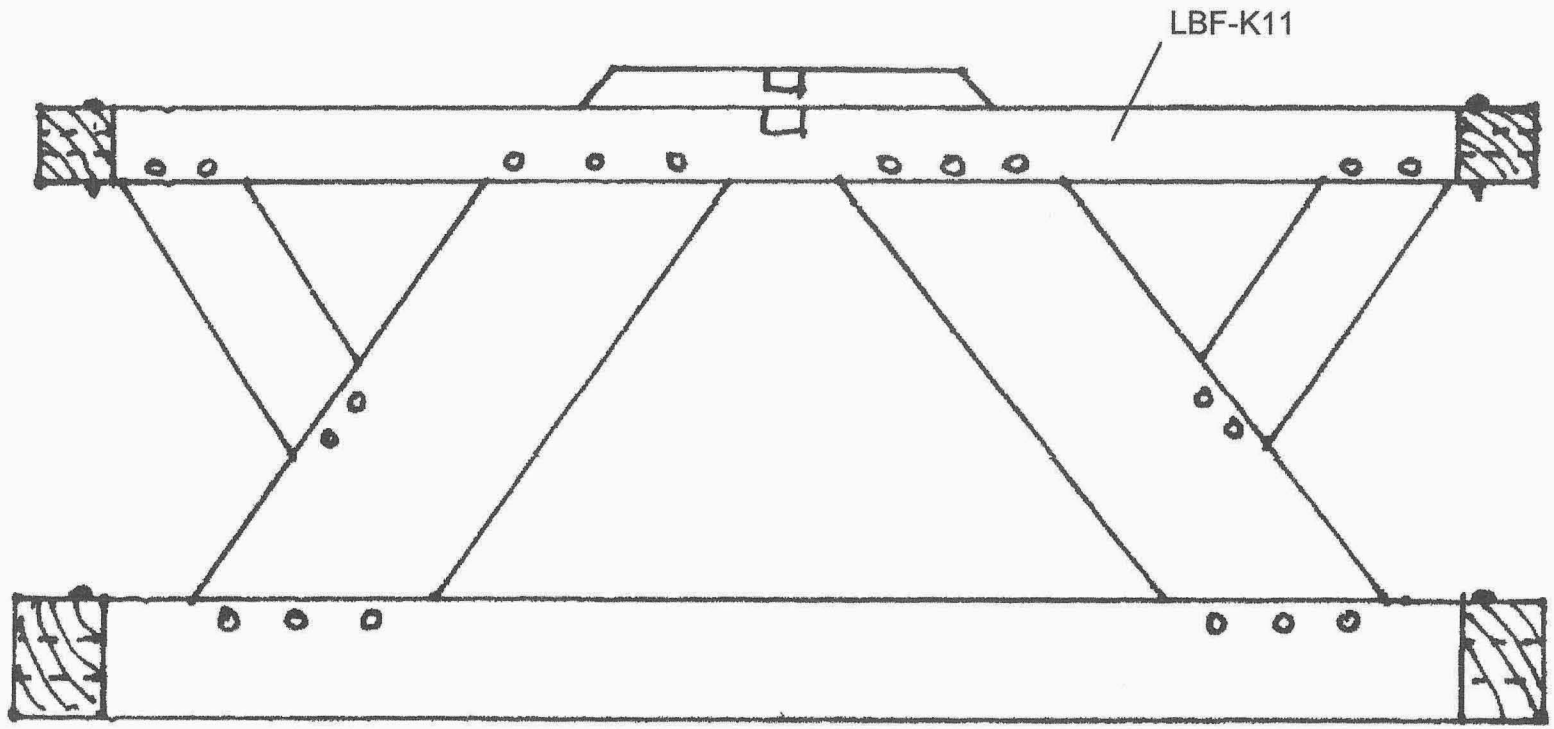


Figure 132: Church of St Peter, Ashby Parva, bellframe; truss C-C, showing the location of samples LBF-K03, LBF-K08, and LBF-K13-14 (George Dawson)

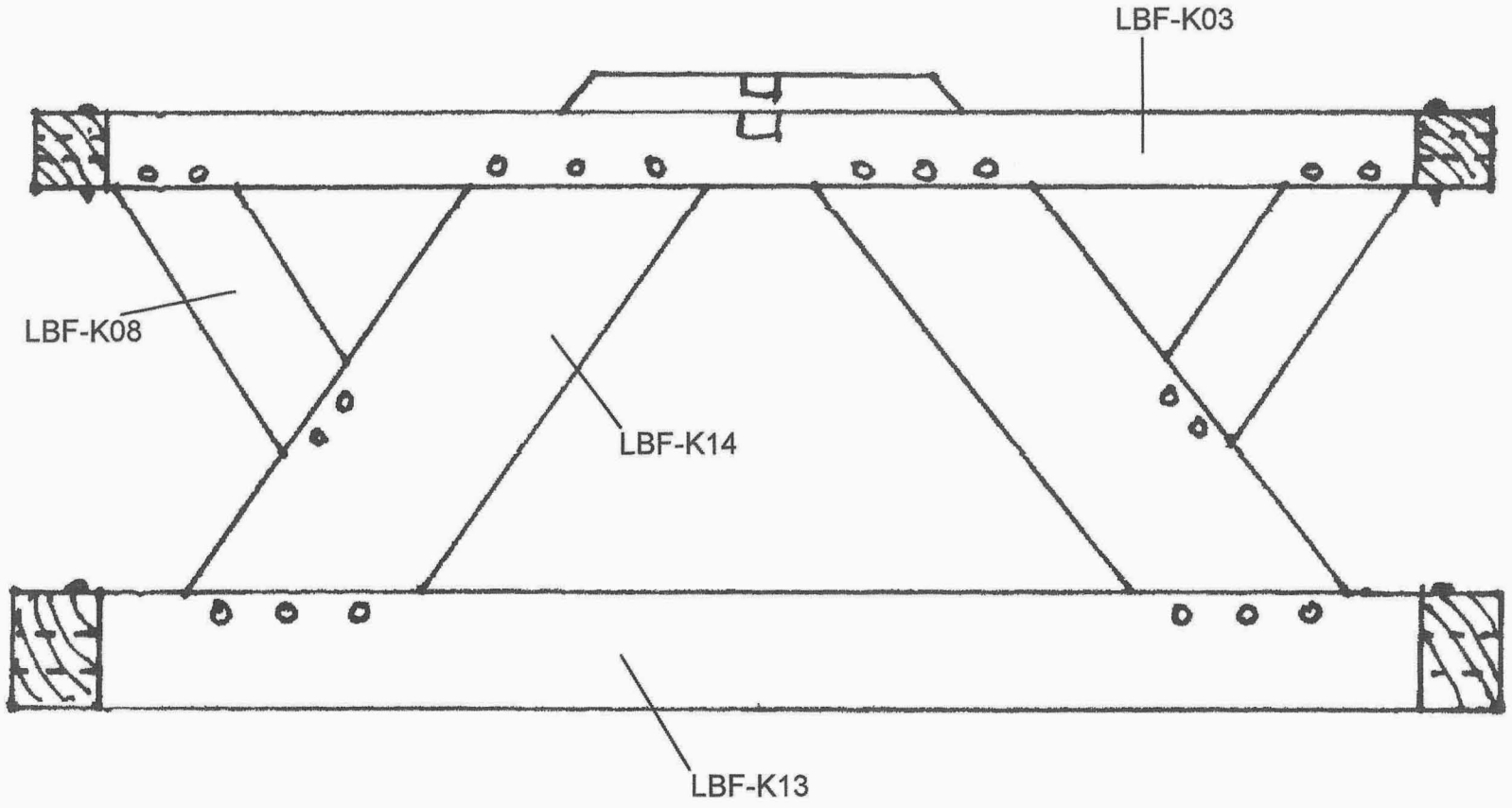


Figure 133: Church of St Peter, Ashby Parva, bellframe; truss D-D, showing the location of samples LBF-K04, LBF-K06-07, LBF-K09, and LBF-K15 (George Dawson)

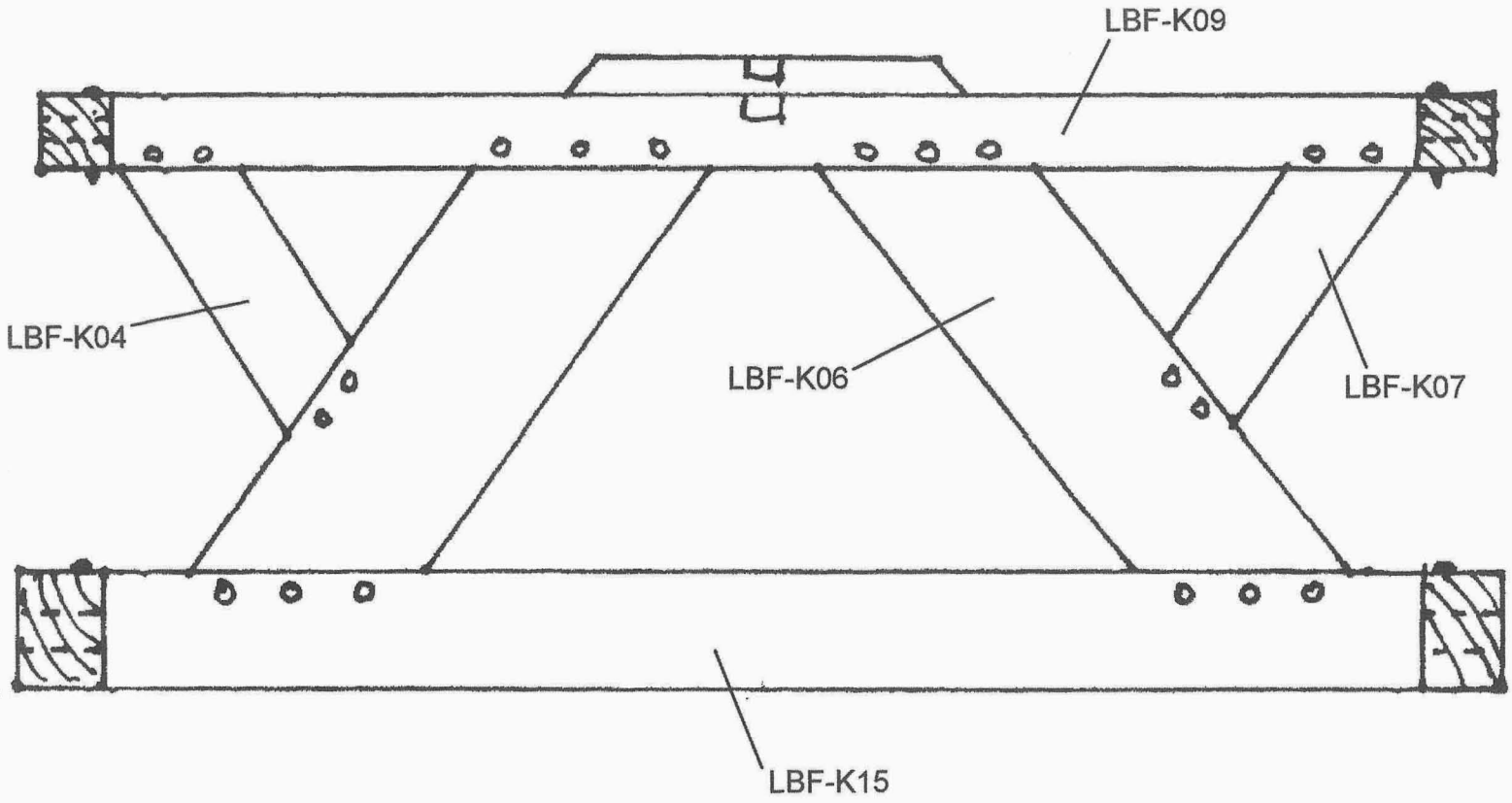


Figure 134: Church of St Peter, Ashby Parva, bellframe; east end frame (E-E), showing the location of sample LBF-K10 (George Dawson)

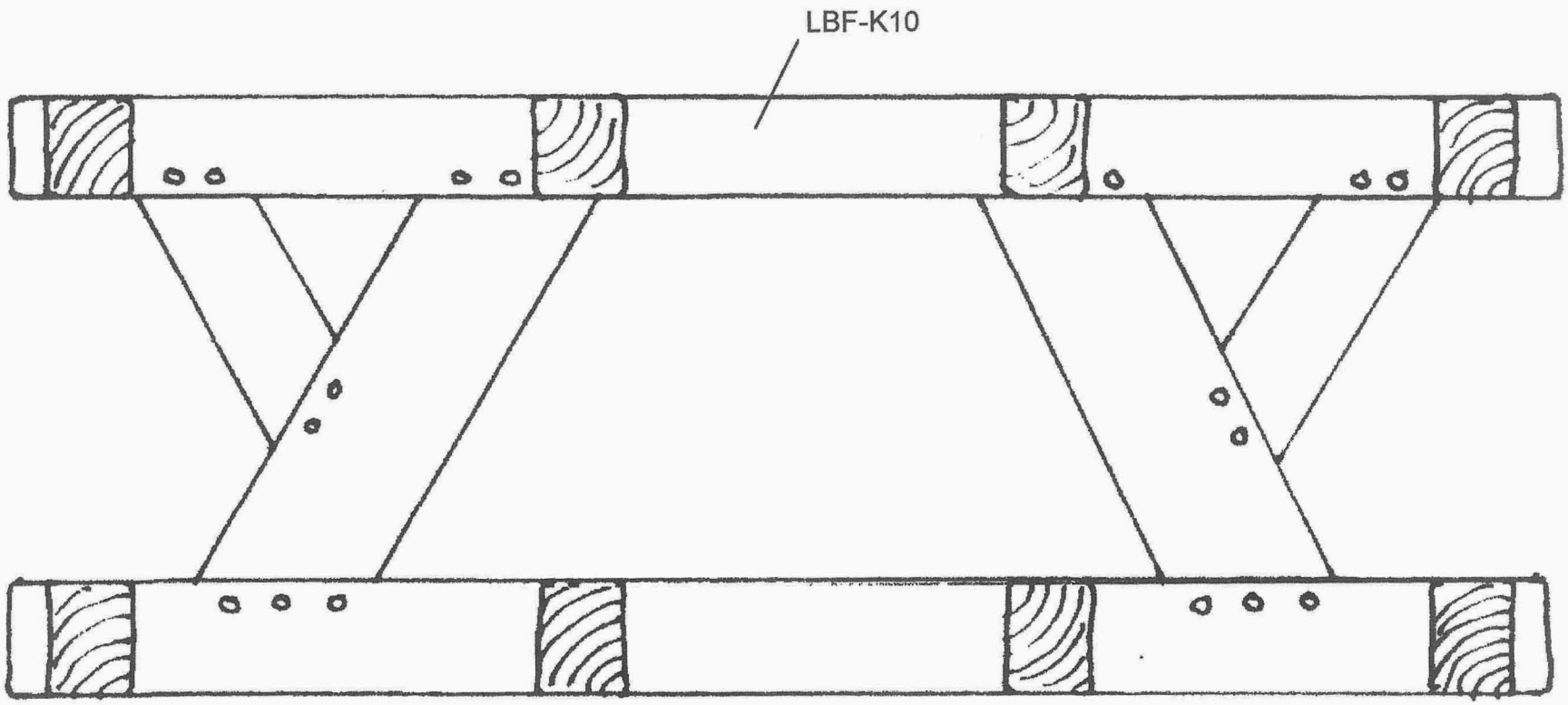


Figure 135: Church of St Peter, Ashby Parva, bellframe; west end frame (F-F), showing the location of samples LBF-K01, LBF-K05, and LBF-K16 (George Dawson)

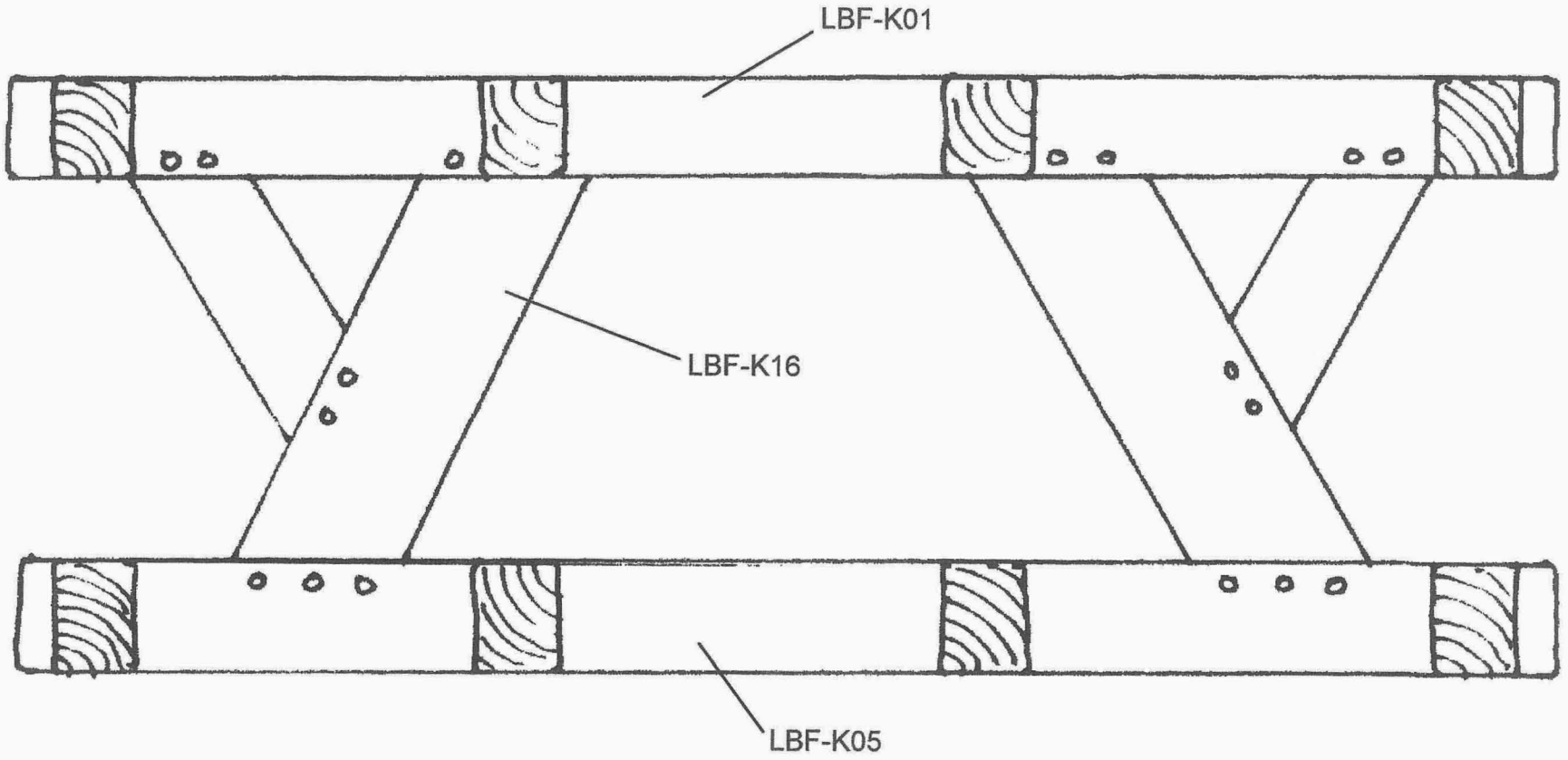
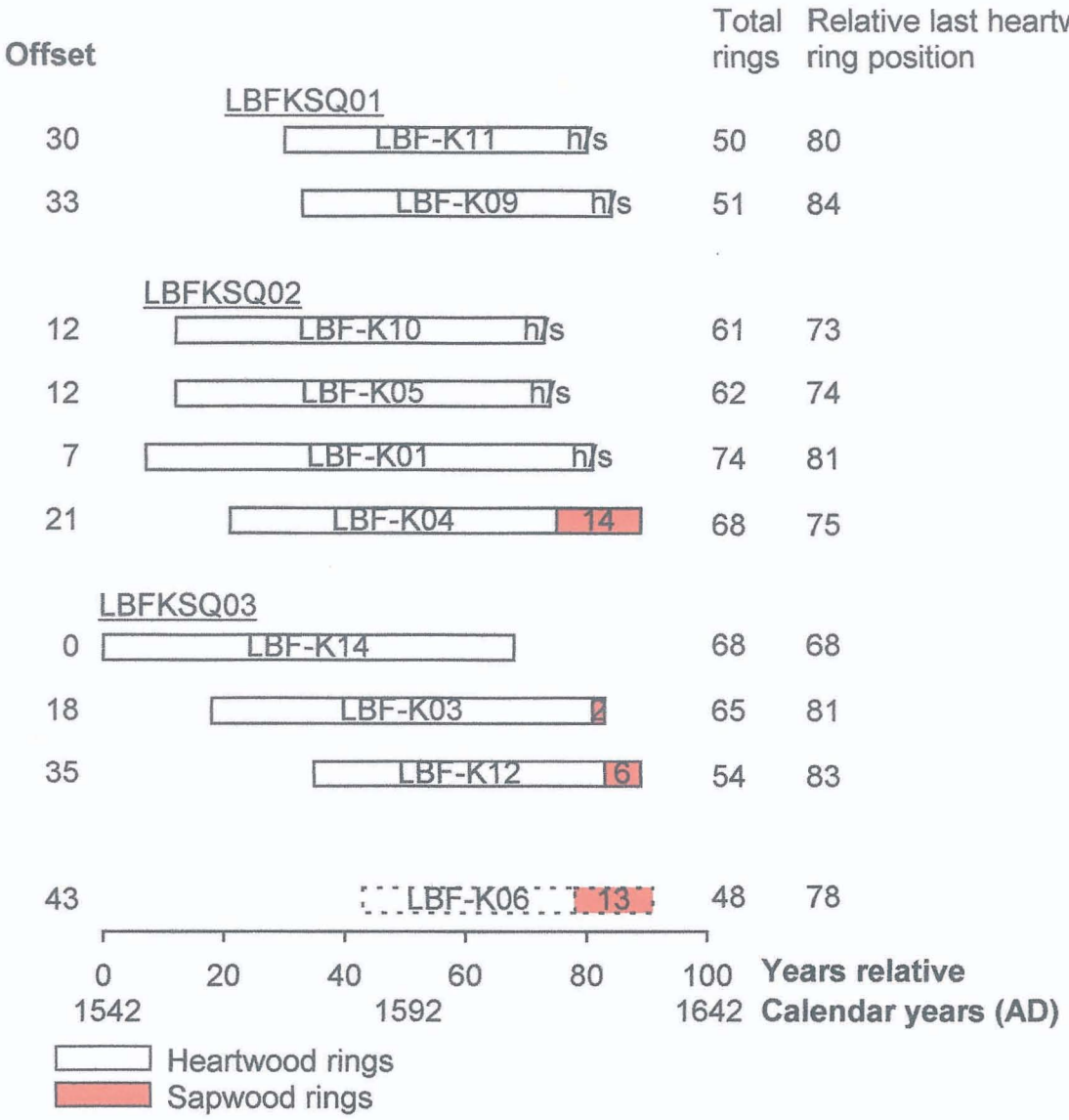


Figure 136: Bar diagram of samples is site sequences LBFKSQ01, LBFKSQ02, LBFKSQ03, and showing their relative positions against sample LBF-K06 (dashed line)



h/s = the heartwood/sapwood boundary ring is the last measured ring

4.12
Church of St Peter, Aston Flamville (LBF-L)
(SP 463 028; Figs 137-40

Description
It is somewhat of a misnomer to talk about the 'bellframe' at this church as, in contrast with the frames seen at the other churches investigated here, the bells at this church simply hang between two substantial reused oak beams. These beams sit on the bottom of the window openings. They are fluted on all faces and possibly represent a previous phase of the building, only having been used to support the bells from the nineteenth-century restoration.

Sampling, Analysis and Results
Two core samples were taken from the two reused beams (Table 31; Fig 139). The two samples were analysed and found to match each other. Site sequence LBFLSQ01, of 146 rings, was constructed containing these samples at the offsets shown in the bar diagram (Fig 140). This site sequence was successfully matched against the relevant reference chronologies for oak at a first-ring date of AD 1475 and a last-ring date of AD 1620. The evidence for this dating is given by the *t*-values in Table 32.

Interpretation
Site sequence LBFLSQ01, of 146 rings, was dated to the period AD 1475-1620. Neither of these samples have the heartwood/sapwood boundary ring which means that estimated felling dates cannot be calculated for them, except to say that with last measured ring dates of AD 1574 (LBF-L02) and AD 1620 (LBF-L01) these are estimated to be at the earliest AD 1590 and AD 1636 respectively.

Discussion
The two moulded beams from which the bells hang at this church are known to be reused but are thought to have been in their present position from the nineteenth century. It was hoped that tree-ring analysis would provide an absolute felling date for the beams. Unfortunately, due to the carved and slightly rotted surface of the timbers the important outer rings have been lost and this has not been possible. However, it is now known that one was felled after AD 1590 and the other some time after AD 1636. Additionally, although it is not possible to be absolutely certain of their contemporary felling, given they match each other very well, and the similar characteristics they display it is likely that they were both felled some time after AD 1636.

Table 31: Details of tree-ring samples from timbers of the bellframe of the Church of St Peter, Lynchgate Lane, Aston Flamville, Leicestershire

Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Last heartwood ring date (AD)	Last measured ring date (AD)
LBF-L01	West beam	100	--	1521	----	1620
LBF-L02	East beam	100	--	1475	-----	1574

Table 32: Results of the cross-matching of site sequence LBFLSQ01 and relevant reference chronologies when the first-ring date is AD 1475 and the last-ring date is AD 1620

Reference chronology	*t*-value	Span of chronology	Reference
East Midlands	7.2	AD 882-1981	Laxton and Litton 1988
London England	7.0	AD 413-1728	Tyers 1999 unpubl
Alford Manor, Lincs	7.4	AD 1500-1611	Arnold *et al* 2003a
Keyworth Barn, Notts	7.2	AD 1451-1628	Laxton and Litton 1988
Sinai Park, Staffs	7.2	AD 1227-1750	Tyers 1997
26 Westgate Street, Glos	7.1	AD 1399-1622	Howard *et al* 1998
Stoneleigh Abbey (house),	7.1	AD 1398-1658	Howard *et al* 2003 unpubl

Figure 138: Church of St Peter, Aston Flamville, general view of bellframe beams with bell 1 to the left and bell 2 to the right (Dr C J Brooke)

Figure 137: Church of St Peter, Aston Flamville (Dr C J Brooke)

Figure 139: Church of St Peter, Aston Flamville, sketch plan (not to scale) of tower in which bells are hung, showing the location of samples LBF-L01 and LBF-L02

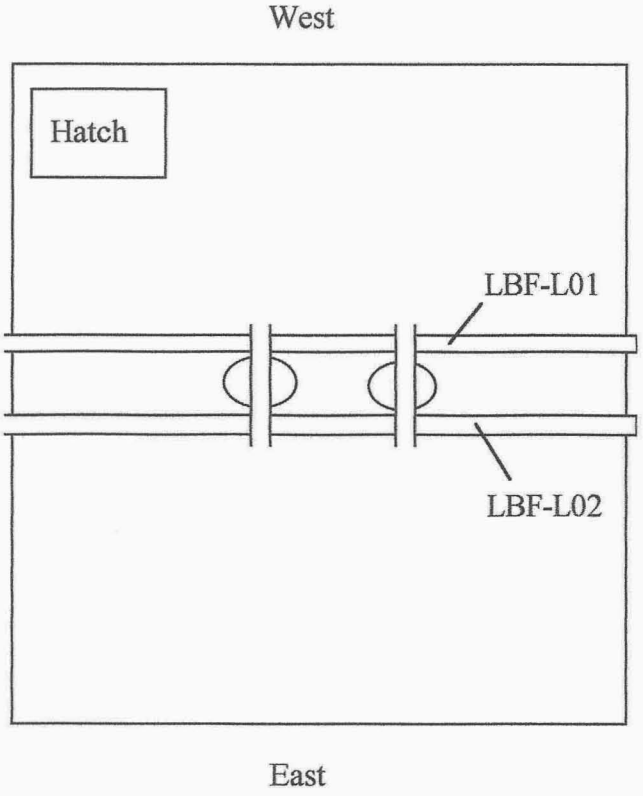
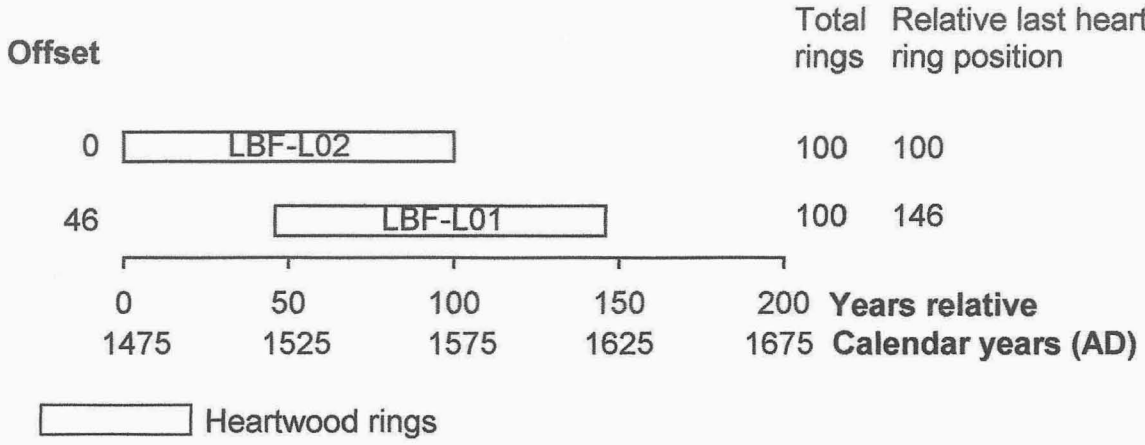


Figure 140: Bar diagram of samples in site sequence LBFLSQ01



5. Discussion

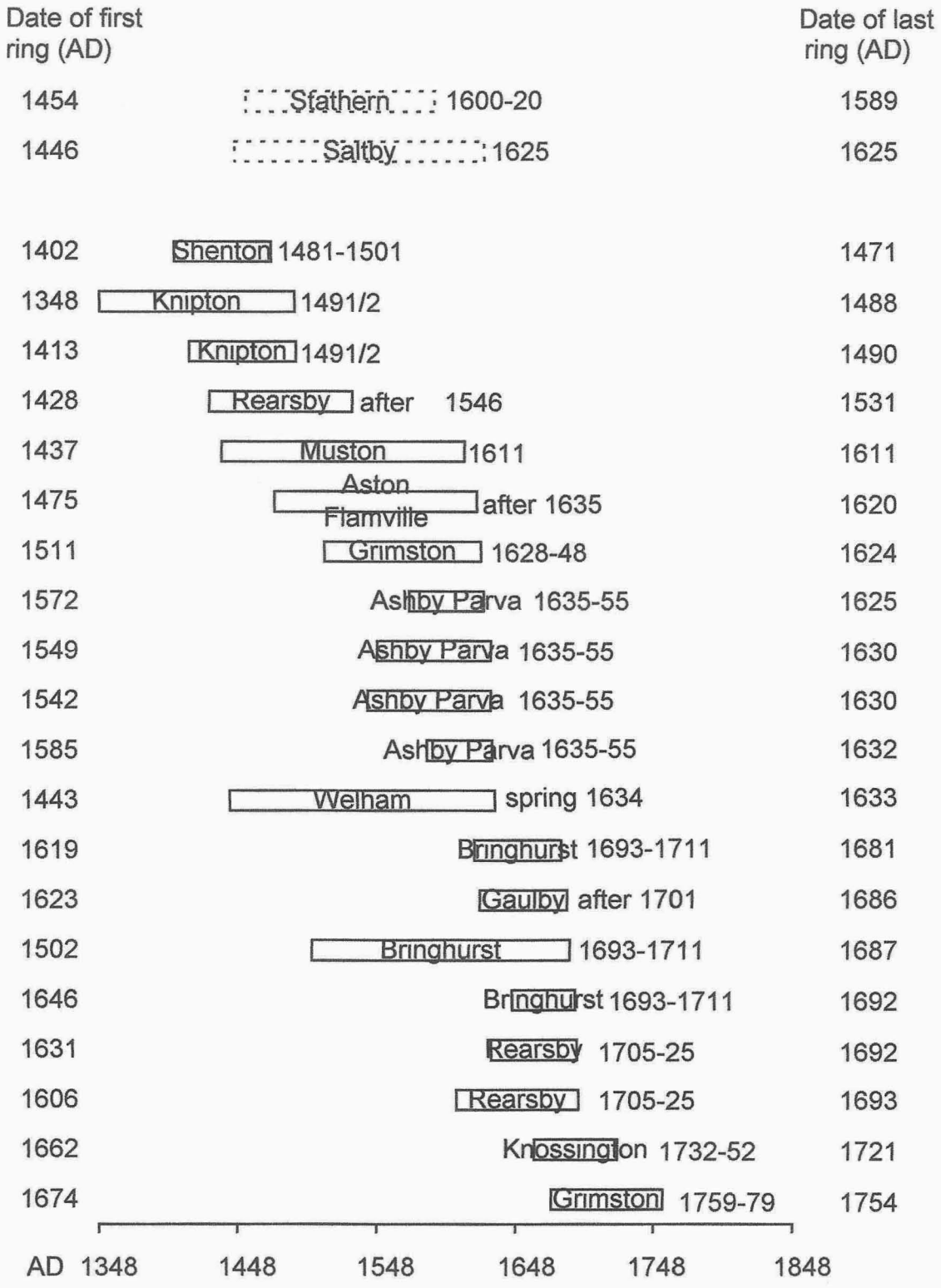
This project resulted in timbers from 12 bellframes being sampled, with 11 of these producing dated timbers (Fig 141). The earliest bellframe identified was that at Knipton Church, a bellframe of queen-post type, constructed from timber felled in AD 1491/2. However, these are not the earliest timbers dated during this project. The bellframe at Shenton Church, stylistically placed in the seventeenth century, contains five timbers with a felling date range of AD 1481-1501, but this date is not thought to relate to its construction. Instead, although no obvious signs of reuse were noted on them, it is now believed that these timbers had a previous use before incorporation in the structure.

Dates gained from timbers of the double bellframe at Muston Church have shown that both frames are constructed from timbers felled in AD 1611. Also dated to the first half of the seventeenth century is the bellframe at Welham Church, constructed from timbers felled in spring AD 1634. Slightly later is the bellframe at Ashby Parva, its timbers dated to AD 1635-55. Grimston Church bellframe contains timbers felled in AD 1628-48, with construction thought to follow soon after. However, tree-ring dating has shown that the timbers of one of this bellframe's trusses were replaced in the second half of the eighteenth century, with these timbers dating to a felling of AD 1759-79.

Containing timbers felled in AD 1693-1711, the bellframe at Bringhurst Church dates to the very end of the seventeenth century/beginning of the eighteenth century. Also dated to the beginning of the eighteenth century (AD 1705-25) is the bellframe at Rearsby Church. Knossington Church bellframe is constructed from timbers dating to AD 1732-52.

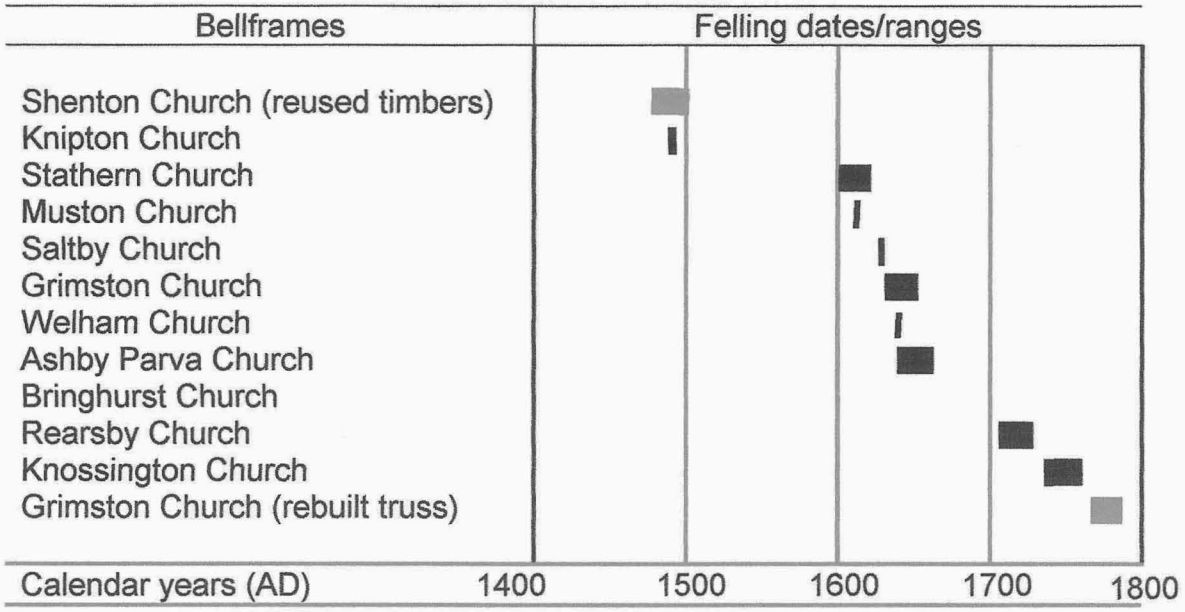
The bells at Aston Flamville are supported on two reused moulded beams thought to have been in their present position since the nineteenth century. Although successfully dated neither of these samples had the heartwood/sapwood boundary ring, therefore, it is only possible to calculate earliest possible dates for them, AD 1590 and AD 1636. Only one of the timbers from Gaulby church could be successfully dated. Again without the heartwood/sapwood boundary ring this is only known as having been felled in AD 1702 at the earliest, and the bells dating from AD 1741. With a stylistic date of mid-eighteenth century the tree-ring date does not contradict this but the date of only one timber cannot be used to date the structure. Unfortunately, none of the timbers from the Norton-juxta-Twycross bellframe could be dated so this must remain dated on stylistic grounds only to the mid-seventeenth century.

Figure 141: Bar diagram of all dated site sequences from Leicestershire bellframes (including Stathern and Saltby, dashed)



From the above it can be seen that we have identified 10 construction dates/phases. If we add to this the dates gained from Saltby Church and Stathern, this rises to 12. This is illustrated in the Figure below (Fig 142).

Figure 142: Chart demonstrating the spread of dated bellframes in Leicestershire



Black = primary construction; light grey = reused/replacement timbers

The earliest timbers are from the second half of the fifteenth century and relate to one primary construction (Knipton) and a group of reused timbers (Shenton). No bellframes have been identified from the sixteenth century. The first half of the seventeenth century sees the greatest concentration of bellframes, six out of the 12 dated phases belong to this period. With no timbers dating to the second half of the seventeenth century (with the possible exception of Bringhurst which has a felling date range encompassing the very end of this period), the next and final cluster is that of the first half of the eighteenth century, where we find three primary constructions and the rebuilt truss at Grimston Church.

The peak of activity seen in the first half of the seventeenth century may in part be due to the adoption of 'full circle ringing' of bells in the early AD 1600s. This type of bell ringing required a more robust frame than previously, possibly resulting in the replacement at this time of a number of earlier bellframes. This may also go some way to explaining the apparent gap in the sixteenth century, with many of these frames being removed as no longer suitable. This is in addition to the fact that many bellframes may have been reaching the end of their natural life at this time. This is not to say that Leicestershire does not have any surviving bellframes from this period, only that none were identified by this project. The gap in the second half of the seventeenth century may be due to the settling down of bellframe construction after the introduction of

'change ringing' but also it has to be said that the original list of 18 bellframes was slightly biased to examples from the early AD 1600s. Additionally, two of the bellframes on the list, not sampled, Stonesby and Shackerstone, are thought to date to this later seventeenth century period.

Previously bellframes have been dated using a well-defined typology or by association with dated bells, etc. With the tree-ring results we now have a series of independent dates with which to compare those gained by other means (Table 33).

Table 33: Comparison of stylistic and tree-ring dates

Bellframe	Stylistic date	Tree-ring date (AD)
Welham	Early 17th	spring 1634
Rearsby	Early-mid 18th	1705-25
Norton-juxta-Twycross	mid-17th	--
Knipton	15th	1491/2
Muston	Early 17th	1611
Bringhurst	Early 17th	1693-1711
Grimston	1630s	1628-48 – original timbers 1759-79 – replacement timbers
Knossington	17th	1732-52
Shenton	17th	1481-1501 (reused?)
Gaulby	18th	After 1701
Ashby Parva	1630s	1635-55
Aston Flamville	--	After 1589 and 1635

It can be seen that in the majority of cases the tree-ring dating has supported that given on the basis of type. However, this project has identified two examples where a successful bellframe type has continued for longer than previously believed, a consideration in the future when using the conventional typology. Bringhurst church bellframe had been dated stylistically to the early seventeenth century but was actually found to be built from timbers felled about 100 years later (AD 1693-1711). Similarly with Knossington church, its seventeenth-century date will now have to be reassessed as it is constructed from timbers felled in the eighteenth century (AD 1732-52).

As seen above the stylistic dating of bellframes is in the main very successful, although of course tree-ring dating can be absolute and give much greater precision. The tree-ring results can also be used to support/dispute some established developmental ideas and in such way be a very useful tool in refining these. The upper and lower frames of the bellframe at Muston Church had been identified as being contemporary and dating to the early seventeenth century. This has now been confirmed by the tree-ring dating, with both frames constructed from timbers felled in AD 1611.

Where dendrochronology has proved especially helpful is in those cases, which are a bit more complex. The bellframe at Grimston had been dated to the AD 1630s with the braces and jack braces of one truss replaced at some

later stage. The original structure is now known to have been built from timbers felled in AD 1628-48, with probably an entire truss and at least one other frame head being replaced with timber felled in AD 1759-79. What traditional structural analysis had suggested has been confirmed and further elaborated upon by the tree-ring analysis.

Amongst the timbers of the bellframe at Shenton Church are four obviously reused curved braces, which had clearly come from an earlier frame. Although none of these reused braces could be dated, five other timbers were found to be late-fifteenth century (AD 1481-1501 in date). Prior to tree-ring analysis these timbers were thought to be original to the structure, which had been stylistically placed in the seventeenth century. If this stylistic dating is to stand it must be said that more reused timber than the four braces already identified was used in its construction. These results have identified timbers of a much greater age than previously thought. With the removal of all signs of reuse from these timbers, this important aspect of the bellframe's history had been missed by the more traditional means of study. This case also highlights the possibility that other bellframes containing important medieval timbers might not be recognised without tree-ring analysis.

The results gained by Tyers (1996) during his investigations in Essex suggested construction was generally using fast grown young trees with only a limited number of trees used in each bellframe. The analysis undertaken in Leicestershire has shown the timbers used here to be far more diverse in character. Timbers from Norton-juxta-Twycross (discussed further below) show periods of very slow growth and the use of some trees that would have been nearing 150 years old at felling. In contrast at Gaulby and Knossington bellframes the timber has a more fast-grown character and the trees in general appear to have been much younger at felling. At Muston and Bringhurst a mixture of slow and fast-grown, immature and mature trees have been utilised.

Not only does there appear to be variations in timber type but also in the sources exploited for the timber, both between bellframes of a similar date in the same locality but also within individual bellframes (Table 34). Although analysis of the trees used in the construction of the bellframes at Welham and Muston suggests the exploitation of a single source, at others, such as Bringhurst, Rearsby, and Ashby Parva, several sources of timber appear to have been exploited for the same construction phase. For example, at Bringhurst, the two dated sequences and one sample only match each other at low values ranging from t=1.2 to 2.3.

This use of different sources and the incorporation of reused timber suggest some of these churches did not have substantial woodlands to exploit. In fact Leicestershire is today one of the least wooded parts of England, a situation thought to have existed for many centuries. The Domesday Book (1086) mentions the poorly wooded nature of Leicestershire describing it as having an uneven distribution of woodland with some large areas apparently having no wooded areas at all. By the sixteenth century it is thought that the south and east Leicestershire had little woodland left with the west and north being much more wooded. This appears to be supported to some degree by the dendrochronology,

with those bellframes located in the far north of the county (Muston and Knipton) utilising older trees from one main source, whereas the further south (Ashby Parva) and south-east bellframes (Bringhurst) all apparently used timber from a number of sources.

Although this project has proved very successful, some problems were encountered during it. In two cases, Grimston and Norton-Juxta-Twycross, the ring width pattern of the samples showed recurring bands of tight growth rings, suggestive of disrupted growth of the trees concerned. This was especially notable at Norton-Juxta-Twycross making measurement very difficult and interfering so much with the growth pattern that the samples are undated. These two churches are in very different parts of Leicestershire with Grimston Church being in the north-east and Norton-Juxta-Twycross the south-west. However, the stylistic date for this latter bellframe, *c* AD 1640, is very similar to the AD 1628-48 tree-ring date for the Grimston bellframe and may reflect the use of similar woodland management at this time. In Leicestershire the two types of tree management carried out were 'coppicing with standards' and 'pollarding', with the latter being most commonly associated with oaks in this county. In the years immediately after coppicing it would not be unusual to expect slow growth whilst the tree recovered.

Table 34: Offset table showing at what a value each bellframe site sequence matches the other; offset above diagonal, *t*-value below (good matches in bold)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Shenton (LBFISQ01)	1	***	-54	*	*	*	*	*	*	*	*	*	*	*	*	*
Knipton (LBFDSQ01)	2	1.8	***	89	*	*	*	*	*	*	*	*	*	*	*	*
Muston (LBFESQ01)	3	*	0.9	***	38	74	*	105	112	6	*	65	*	*	*	*
Aston Flamville (LBFLSQ01)	4	*	*	**5.6**	***	36	*	67	74	-32	*	27	*	*	*	*
Grimston (LBFGSQ01)	5	*	*	2.8	3.6	***	61	31	38	-68	*	-9	*	*	*	*
Ashby Parva (LBFKSQ01)	6	*	*	*	*	1.8	***	-30	-23	-129	*	-70	*	*	*	*
Ashby Parva (LBFKSQ03)	7	*	*	2.7	3.2	3.4	2.6	***	7	-99	*	-40	*	*	*	*
Ashby Parva (LBFKSQ02)	8	*	*	4.3	**6.6**	2.3	2.8	2.5	***	-106	*	-47	*	*	*	*
Welham (LBFASQ01)	9	*	*	**5.3**	**7.8**	**5.1**	**4.7**	3.0	3.2	***	*	59	*	*	*	*
Bringhurst (LBFFSQ02)	10	*	*	*	*	*	*	*	*	*	***	-118	11	-14	*	*
Bringhurst (LBFFSQ01)	11	*	*	**7.7**	**5.6**	3.6	1.4	2.0	3.8	**7.7**	2.3	***	129	104	*	*
Rearsby (LBFBSQ02)	12	*	*	*	*	*	*	*	*	*	2.1	2.5	***	-25	*	*
Rearsby (LBFBSQ01)	13	*	*	*	*	*	*	*	*	*	2.0	4.1	2.2	***	*	*
Knossington (LBFHSQ01)	14	*	*	*	*	*	*	*	*	*	*	*	*	*	***	
Grimston (LBFGSQ02)	15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	***

6. Conclusion

With the completion of this project, over 250 years of bellframe construction has been investigated, from the fifteenth century to the eighteenth century. The earliest bellframe dated is that at Knipton, which is now known to have been built from timbers felled in AD 1491/2. The bellframe at Shenton also contains timbers dating to the late fifteenth or very beginning of the sixteenth century although this is not thought to have been their original location. With no further sixteenth century timbers dated, the majority of the bellframes investigated date from the first half of the seventeenth century, with the last group dating to the first half of the eighteenth century. The latest bellframe is that at Knossington Church which is constructed from timbers felled in AD 1732-52.

The tree-ring results have been shown to largely concur with the dates assigned to these bellframes on the basis of type, on documentary evidence or by association with their bells. However, dendrochronology has been able to date some of these much more precisely, and in two cases identified the continuation of a successful bellframe type for longer than previously realised. Dendrochronology, therefore, has a vital part in the continuing enhancement of developmental ideas, in the argument as to whether frame styles were continually changing and evolving or successful designs were used for considerable periods of time. It can be used to support and, therefore, strengthen established theories, or question accepted premises. Within this project we have seen how dendrochronology has 'found' medieval timbers that could not have been identified through other means, with the historic nature of these beams perhaps being underestimated without this work.

The timber used in these structures has been shown to be of diverse character, in both growth rate and age at felling, with various sources being exploited both within individual bellframes and between bellframes of a similar period and locality. It is suggested that this may be to do with woodland cover which varied greatly between different parts of the county with possibly those churches in the south and east having the most problems with supply.

With these dates we have the beginnings of an independent chronological framework for the development of bellframes without recourse to the traditional means of typology or documentary evidence. The results from this project and from others undertaken around the country, along with more detailed stylistic and documentary research has started to produce a greater understanding of these important structures. In this endeavour, the value of dendrochronological research cannot be underestimated, providing crucial information as it does about the very fabric of these bellframes. In understanding the significance of these timbers informed decisions can be made regarding appropriate repair and maintenance strategies, and about how best to preserve them and direct funds to those areas of most importance.

This project has shown the importance of detailed assessment being undertaken prior to sampling. This allowed the Laboratory to make informed decisions as to the most suitable bellframes to sample. As a result only one bellframe, that from the church at Gaulby, gave disappointing results. Also very helpful during this

project was that drawings of the bellframes were to hand prior to sampling. In addition to the bellframe at Shackerstone Church, a number of other bellframes have been identified and already recorded which would might be suitable for tree-ring dating in the future. These include the bellframe at Loddington Church, a smaller version of that seen at Bringhurst which has now been tree-ring dated to about one hundred years later than previously thought, thereby supporting the theory that bellframe types may have been used for longer than formerly believed. An interesting example at Rotherby almost certainly predates AD 1600 and that at Swinford is of the same south Leicestershire group as Ashby Parva, Twycross, and Welham but of four bells. At Plungar church the bells are known to date to AD 1745 but the frame appears to date from much earlier, possible *c* AD 1600. Additionally, it would be very useful to further investigate some of the later seventeenth-century bellframes.

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9. Data of measured samples – measurements in 0.01mm units

Church of St Andrew, Welham

LBF-A01A 130
200 212 232 176 178 153 98 122 185 138 144 176 106 108 115 110 93 136 80 78
136 83 66 74 67 77 53 67 39 58 64 65 69 68 56 60 54 51 54 38
82 72 132 169 154 122 103 104 158 199 172 129 209 199 180 218 252 233 209 215
243 261 151 125 148 144 199 141 150 162 186 162 211 220 215 174 207 119 83 85
211 173 189 122 162 118 125 107 131 147 128 135 125 95 92 98 72 97 129 102
111 178 144 107 137 175 193 212 180 130 143 110 116 128 147 143 151 140 114 139
155 119 169 152 156 128 101 132 176 198
LBF-A01B 130
208 213 230 173 180 153 108 120 180 132 148 162 115 105 100 119 98 132 70 99
113 104 68 64 67 70 59 63 45 51 61 72 69 63 63 67 42 58 44 55
94 56 128 188 136 126 72 132 173 210 167 130 213 218 179 222 251 230 199 228
254 256 149 126 137 157 195 135 153 158 192 176 218 235 215 181 182 134 83 95
200 169 196 126 156 123 121 102 139 153 119 142 119 94 93 102 71 100 123 98
121 178 136 112 135 174 189 227 179 131 153 98 111 135 142 140 156 137 110 145
155 112 168 153 148 132 95 134 176 218
LBF-A02A 63
166 167 135 186 204 169 273 286 264 278 376 147 93 141 234 226 294 236 257 213
191 149 146 169 148 199 157 83 84 99 89 92 170 168 147 245 161 97 159 136
178 278 235 247 269 141 110 136 239 264 278 171 203 275 238 157 200 294 354 228
119 194 303
LBF-A02B 63
158 162 154 175 208 173 257 294 267 278 368 139 105 139 245 228 308 235 261 213
192 149 148 186 145 190 162 86 88 90 90 89 183 176 132 260 156 107 144 158
190 278 237 252 283 140 127 152 226 254 287 173 207 282 252 146 207 296 345 207
122 224 289
LBF-A03A 68
122 85 156 145 141 101 123 135 144 194 161 191 111 244 235 82 121 231 180 173
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94 137 211 170 208 140 100 98 108 97 110 134 149 132 126 85 81 108 115 129
137 167 161 159 170 165 187 237
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106 96 149 135 166 100 140 149 126 189 168 195 115 257 225 104 117 239 167 198
174 188 173 190 151 176 213 191 134 114 69 58 55 80 121 127 122 137 192 97
100 141 223 181 214 139 95 104 100 101 111 130 153 173 118 95 83 112 110 125
145 172 150 170 170 179 169 300
LBF-A04A 101
91 73 84 89 81 71 60 78 82 98 95 63 82 95 92 110 117 149 174 171
148 132 210 145 118 135 235 381 388 358 266 294 184 78 111 135 64 85 38 59
59 89 104 101 130 112 121 111 77 102 160 114 144 145 170 149 114 113 117 146
122 104 80 72 81 96 77 84 86 121 150 192 158 133 174 157 180 173 173 142
172 113 138 124 198 172 144 123 110 129 108 90 104 170 213 144 134 149 97 124
179

LBF-A04B 101
93 76 78 85 83 79 52 75 90 96 97 68 78 93 87 121 108 157 172 157
154 140 208 143 118 136 247 374 381 361 263 296 183 78 111 135 68 79 37 60
62 89 103 101 130 109 125 115 71 104 153 122 145 152 156 148 113 111 116 146
113 108 82 82 70 87 77 84 102 119 151 191 152 139 165 158 177 181 175 139
175 118 127 128 202 178 146 123 112 121 114 98 107 165 238 131 143 142 74 137
164
LBF-A05A 170
148 107 111 152 54 49 95 106 126 89 135 153 123 95 103 114 116 112 89 99
94 78 59 96 74 103 102 71 91 76 110 124 108 68 78 100 87 70 60 66
78 65 81 44 63 92 82 103 82 86 90 90 120 77 58 58 39 64 91 59
110 100 109 106 114 137 107 119 132 113 179 206 213 192 202 169 179 160 80 154
138 57 84 94 156 120 102 95 136 135 93 136 107 71 70 112 102 114 130 148
126 123 113 117 120 100 117 89 66 44 44 48 79 107 120 142 176 118 128 141
155 179 203 152 149 147 120 127 183 188 170 182 136 109 116 137 111 149 161 181
168 162 208 177 189 198 150 174 134 113 129 125 140 171 192 170 201 190 177 162
136 119 131 171 193 210 124 102 186 163
LBF-A05B 170
118 90 121 152 52 54 99 101 129 82 141 154 142 99 102 107 120 104 96 93
92 90 61 101 67 96 103 76 94 85 103 119 108 69 77 104 83 70 61 69
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89 103 111 101 122 142 106 118 132 116 185 202 211 188 202 174 175 167 80 150
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LBF-A07B 178
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LBF-A14B 92
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LBF-B13B 57
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Church of the Holy Trinity, Norton-juxta-Twycross

LBF-C01A 118
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LBF-C08A 67
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LBF-D01A 55
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LBF-E01A 73
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LBF-E10A 139
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LBF-F01A 74
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LBF-F06A 129
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LBF-F09B 122
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LBF-F13B 117
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LBF-G01A 83
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LBF-G07A 120
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LBF-G11A 60
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LBF-H01A 58
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LBF-H04A 45
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LBF-H10A 57
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LBF-I03A 64
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Church of St Peter, Gaulby

LBF-J01A 64
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LBF-K01A 74
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106 73 95 74 106 86 118 127 91 110 103 131 143 106 131 108 165 182 189 133
138 150 207 207 224 219 234 144 142 126 91 101 166 159 150 163 117 142 147 165
200 257 131 133 149 214 185 178 145 151 93 85 151 137 209 160 174 173 195 148
177 159 282 400 302 262 235 197
LBF-K05A 62
175 262 181 111 91 128 172 162 199 156 233 173 224 234 266 313 343 374 333 295
333 479 413 355 300 387 436 378 280 289 316 338 292 286 281 267 155 134 127 113
163 184 145 181 173 119 120 112 128 200 197 145 131 184 163 185 247 227 190 197
156 227
LBF-K05B 62
200 263 199 110 87 127 160 164 205 161 231 182 212 187 263 305 376 391 337 305
353 485 427 368 300 389 436 379 279 288 329 342 306 279 286 288 144 139 134 119
155 215 117 184 178 121 119 121 128 203 197 119 139 180 165 202 247 208 186 197
172 180

LBF-K06A 48
460 378 352 319 350 294 284 349 466 383 426 300 243 303 381 330 340 299 350 365
279 280 327 299 254 240 230 260 274 249 294 237 254 283 271 319 340 478 416 368
279 279 396 401 547 349 254 331
LBF-K06B 48
428 322 321 328 370 320 333 365 433 395 428 318 228 305 394 339 341 293 349 367
275 272 331 294 259 244 229 257 279 251 312 222 256 286 288 316 351 408 464 369
266 277 386 390 572 329 255 363
LBF-K09A 51
311 284 380 266 409 502 329 309 321 405 353 436 397 427 384 291 322 370 425 409
366 292 286 347 321 318 315 288 273 248 263 318 405 352 426 349 258 265 270 241
306 216 186 243 211 236 194 243 249 254 169
LBF-K09B 51
289 274 392 268 408 501 328 299 321 406 363 420 378 429 375 304 319 372 428 406
365 301 282 352 347 310 314 297 289 259 256 335 393 351 424 347 267 273 258 252
308 219 187 247 218 242 204 226 244 241 167
LBF-K10A 61
278 395 253 174 186 213 295 317 320 211 216 156 163 152 158 197 271 246 182 159
175 191 191 169 219 310 302 229 209 191 292 254 287 237 217 213 134 132 119 99
104 152 144 136 161 135 122 137 120 179 201 121 152 158 154 202 207 141 173 111
146
LBF-K10B 61
277 390 232 176 190 216 311 320 317 211 223 160 157 158 154 213 255 246 176 173
173 195 198 159 217 297 322 215 211 186 294 252 292 229 225 200 136 131 122 104
101 138 157 124 150 140 129 128 120 182 214 107 158 157 159 211 204 152 154 128
114
LBF-K11A 50
250 331 356 434 441 505 452 433 510 344 329 312 387 329 346 409 244 230 158 171
170 222 221 286 171 192 262 225 183 212 164 209 224 191 218 202 198 222 193 170
219 194 203 262 175 103 174 207 241 193
LBF-K11B 50
240 313 348 429 450 452 423 388 485 339 318 308 386 324 349 415 254 267 176 191
192 248 239 279 161 194 238 220 167 177 145 232 220 188 206 200 196 226 200 177
215 198 204 270 162 112 179 220 225 256
LBF-K12A 54
462 466 583 601 345 353 448 556 450 324 378 292 429 251 372 382 406 427 243 180
181 128 112 166 217 213 225 212 133 160 184 159 274 299 290 238 190 94 140 136
181 145 217 212 150 147 192 145 118 101 145 176 252 267
LBF-K12B 54
446 469 560 585 341 366 466 543 470 293 386 324 452 231 372 344 398 426 229 189
175 123 112 163 231 206 228 225 151 136 190 159 266 306 302 238 188 120 119 142
159 150 220 227 156 145 207 138 121 115 133 179 271 257
LBF-K13A 50
360 313 435 377 443 313 343 458 454 375 365 485 510 477 493 436 485 428 357 434
519 462 502 494 435 449 512 466 476 561 477 544 401 456 469 457 371 468 437 345
403 316 476 354 319 373 492 588 433 380
LBF-K13B 49
375 424 374 454 317 338 450 459 391 364 483 542 481 499 426 490 404 379 429 521
446 492 518 456 441 509 460 488 550 440 549 402 457 475 471 402 467 443 349 403
323 470 360 327 375 481 589 433 366

LBF-K14A 68
122 189 155 180 228 216 244 209 221 208 180 247 203 197 215 223 262 503 438 473
352 321 382 326 214 238 251 364 445 464 431 324 261 372 319 389 350 465 561 357
331 448 395 257 214 296 179 243 164 204 209 218 266 170 149 135 138 144 152 187
177 277 292 162 241 242 211 217
LBF-K14B 68
202 244 139 169 224 189 241 205 238 215 180 232 204 183 223 216 270 497 444 479
343 329 388 320 219 231 259 375 457 473 425 322 282 358 317 395 348 464 568 348
338 446 373 268 190 306 180 251 151 197 206 203 259 175 163 133 148 135 152 182
179 285 304 170 265 248 209 206

LBF-L01A 100
130 176 203 198 227 252 294 248 197 129 246 222 182 181 188 211 194 193 160 155
135 77 130 147 171 126 125 148 158 151 153 173 172 135 127 137 92 145 189 193
171 158 133 141 116 94 88 110 128 125 139 107 116 106 139 144 119 105 121 165
102 97 118 72 107 133 132 117 152 107 128 125 130 132 171 155 133 146 107 118
146 111 177 137 86 85 159 147 168 160 162 164 125 133 170 94 163 110 128 138
LBF-L01B 100
138 181 204 195 233 276 298 254 186 140 247 219 182 178 181 216 177 198 149 151
130 75 108 156 163 133 120 139 155 147 149 184 164 140 131 122 95 159 178 192
171 145 134 130 132 86 92 102 122 138 143 116 96 90 132 136 130 98 116 148
105 107 110 75 104 132 130 116 156 92 130 124 117 148 157 155 132 134 113 118
127 110 184 138 91 94 157 145 164 163 149 166 121 151 165 88 158 121 148 143
LBF-L02A 100
172 144 82 81 87 131 148 118 114 100 138 75 92 83 91 145 47 69 57 80
94 198 185 139 122 128 93 120 95 132 103 108 71 91 146 141 144 225 191 144
160 196 194 204 184 81 93 100 106 120 76 84 118 130 126 70 152 131 124 95
164 169 210 212 165 191 192 95 155 183 175 137 104 155 212 138 169 158 130 127
153 86 78 74 94 154 128 183 122 196 160 85 56 113 125 166 148 114 148 140
LBF-L02B 100
160 136 80 88 87 143 138 101 111 89 131 68 89 72 95 131 66 57 63 73
104 190 204 134 124 143 119 76 97 125 102 103 75 99 132 157 118 206 195 152
153 206 190 163 191 83 81 102 111 107 79 78 123 142 116 74 158 128 112 112
165 169 202 219 162 189 189 90 147 180 174 119 112 158 203 139 172 134 115 142
161 93 68 62 106 150 132 176 124 197 164 83 59 90 132 165 145 109 108 105

10. Bell Information – George Dawson

Church of St Mary, Chadwell

The Bells

Treble. [X 41] IHC [stop] NAZARENVS [stop] REX [stop] IVDEORVM [stop]

2. [63] sce petri

Tenor. [63] ave maria

Badge numbers are taken from the Church Bells of Leicestershire (North 1876).

Physical data:

	Diameter(m)	Weight (Cwt.Qr.Lbs)
Treble.	0.725	*c* 4.5cwt
2.	0.780	*c* 5.5cwt
Tenor.	0.865	*c* 7.25cwt

The treble was cast by Johannes de Colsale, the location of whose foundry is not yet known, in the period AD 1409-21. The two tenors were cast by a member of the Seliok family of Nottingham in the period AD 1470-1530.

Church of St Denys, Goadby Marwood

The Bells

Treble THE CHVRCH^{S} PRAISE I SOVND ALLWAYS 1775 *THO^{S} HEDDERLY Founder*

2. GOD SAVE HIS CHVRCH [12] LEO DAVIS WARDEN [12] 1710 [12]

Tenor. [1] HIS NAZARENVS [12] REX IVDEORVM [12] FILI DEI [12] MISERERE MEI [12] 1625

Badge numbers are taken from the Church Bells of Leicestershire (North 1876).

Physical data:

	Diameter(m)	Weight (Cwt.Qr.Lbs)
Treble	0.680	*c* 4cwt
2.	0.690	*c* 4cwt
Tenor.	0.755	*c* 4.75cwt

The treble was cast by Thomas Hedderly I of Nottingham. The second is the work of William Noone, also of Nottingham. The tenor, which is cracked, was cast by Hugh Watts II of Leicester.

Church of St Peter, Stonesby

The Bells

Treble. [+ 72] OMNIA [ ] FIANT [ ] AD [ ] GLORIAM [ ] DEI [ ] 1626

2. [52]
[X] Sacra Trinitate Fiat Hec Campana Beata
[32]

Tenor. [Decoration]
THOMAS HEDDERLY FOUNDER NOTT^{M} 1761 IOHN SMITH CHURCH WARDEN :

Badge numbers are taken from the Church Bells of Leicestershire (North 1876). [ ] indicates a decoration which does not occur in that book.

Physical data:

	Diameter(m)	Weight (Cwt.Qr.Lbs)
Treble.	0.795	*c* 5cwt
2.	0.875	*c* 7cwt
Tenor.	0.965	*c* 9cwt

The treble bell was cast by Thomas Norris of Stamford, the second by George Lee, one of the foremen founders at the Nottingham bell foundry *c* 1590, and the tenor was cast by Thomas I Hedderly of Nottingham.

At some time in the early nineteenth century the bells were re-hung with new fittings. To accommodate the new bearings wooden inserts were added to the frame. There is also some extra timbers nailed to the end frames in an attempt to stiffen the frame. These are not shown on the drawings.

Chuch of St James, Twycross

The Bells

Treble. GOD [12] SAVE [12] HIS [12] CHVRCH I W I O WARDENS 1691

2. T MEARS OF LONDON FECIT RECAST 1814 WM CLARE

CHURCHWARDEN

Tenor. T MEARS OF LONDON RECAST 1814

Badge numbers are taken from the Church Bells of Leicestershire (North 1876).

Physical data:

	Diameter(m)	Weight (Cwt.Qr.Lbs)
Treble	0.685	*c* 3.75cwt
2.	0.755	*c* 4.75cwt
Tenor	0.855	*c* 6.25cwt

The treble bell was cast by William Noone of Nottingham. The two heavier bells were cast by Thomas Mears of the Whitechapel, London, bell foundry.

Church of St Peter, Shackerstone

The Bells

Treble. [1] IHS NAZARENVS [12] REX IVDEORVM [12] FILI DEI [12] MISERERE MEI [12] 1633

2. GOD [14] SAVE [14] HIS [14] CHVRCH [14] 1664 [14]

Tenor (i). [+] ALL GLORY BE TO GOD ON HIGH 1664 RECAST A : D 1868 [ ]
(ii). [+] JOHN TAYLOR & CO FOUNDERS LOUGHBOROUGH [ ]

Badge numbers are taken from the Church Bells of Leicestershire (North 1876). [+] & [ ] denotes badges not in that book.

Physical data:

	Diameter (m)	Weight (Cwt.Qr.Lbs)
Treble.	0.790	*c* 5.5cwt
2.	0.855	*c* 7cwt
Tenor.	0.915	9.2.11

The treble bell was cast by Hugh Watts II of Leicester, and the second and previous tenor bells were the work of George Oldfield I of Nottingham. The tenor was recast by Taylors of Loughborough.

Church of St Edith of Polesworth, Orton-on-the-Hill

The Bells

The bells which hung in the old frame are:

Treble. GAVDETE [12] IN DOMINO [12] ET EXVLTATE [12] IVSTI [12] 1701

2. MORABOR [12] IN DOMO DOMINI [12] IN LONGITVDINEM [12] DIERVM 1701 [12]

3 (now service bell). [+ 2] PRAYSE GOD 1595

Tenor (line 1). IESVS [12] NAZARENVS [12] REX IVDEORVM [12] FILI DEI [12] MISERERE MEI [12] I POYNTON T MORHALL
(Line 2). CHVRCH WARDEN 1701 [Decoration]

Badge numbers are taken from the Church Bells of Leicestershire (North 1876).

Physical data:

	Diameter (m)	Weight (Cwt.Qr.Lbs)
Treble.	0.725	4.2.14
2.	0.765	5.1.8
3.	0.840	6.1.15
Tenor.	0.935	8.2.0

Bells 1, 2 and 4 were cast by William Noone of Nottingham, and the old third bell by one of the Watts family of Leicester.

Church of St Andrew, Welham

The Bells

The two bells are:

Treble (i). [+ 72] MVLTI [67] VOCATI [67] PAVCI [67] ELECTI [67]GVLIELMVS [stop] HAVFORDE [stop] ARMIGER 1604

(ii). T [67] S [67] R [67] N

Tenor.
[52]
Celorum xte placeat tibi rex sonus iste
[32]
Waist: [75]

Badge numbers are taken from the Church Bells of Leicestershire (North 1876).

Physical data on the bells:

	Diameter(m)	Weight (Cwt.Qr.Lbs)	Note
Treble	0.76	5.1.9	C sharp
Tenor	0.87	7.0.11	A

The treble was cast by Tobie Norris I of Stamford, Lincolnshire and the tenor was cast in the late fifteenth/early sixteenth century by one of the Mellours family of Nottingham. From stylistic considerations, it was probably cast by Richard Mellours before his death in AD 1508. The notes of the bells are two whole tones apart, implying they are bells 1 and 3 of a ring of three. North, in his Church Bells of Leicestershire (*ibid*), reports that a third bell was cracked circa AD 1820 and improperly sold. So the scrapped bell must have been the second of three.

The bells were rehung by Taylors of Loughborough in AD 1999 when they provided all new fittings, canon retaining cast iron headstocks, ball bearings, etc, in the old frame.

Church of St Michael, Rearsby

The Bells

Treble. ABC DEF GH 1607

2. GOD [13] SAVE [13] HIS [13] CHVRCH [13] [10] 1652

Tenor. (i). Clemens Atque Pia Miseris Succurre Maria
(ii). [63]

Badge numbers are taken from the Church Bells of Leicestershire (North 1876).

Physical data:

	Diameter(m)	Weight (Cwt.Qr.Lbs)
Treble.	0.75	4.0.11
2.	0.80	5.0.3
Tenor.	0.91	7.3.11

The treble was cast by Hugh Watts I of Leicester, the second by George Oldfield I of Nottingham and the tenor by one of the Seliok family of Nottingham in the period AD 1470-1530. Stylistic considerations suggest this bell was cast by Richard Seliok II *c* AD 1530.

The bells were rehung with new fittings, cast iron headstocks, plain bearings, new wheels and pulleys, etc by Taylors of Loughborough in AD 1897.

Church of the Holy Trinity, Norton-juxta-Tycross

The Bells

Treble. [1] IHS NAZARENVS [9] REX IVDEORVM [9] FILI DEI [9] MISERERE MEI [9]1640 [9]

2. GOD [14] SAVE [14] THE [14] CHVRCH [14] 1663 [14]

Tenor. CHARLES & GEORGE MEARS LONDINI FECERUNT A.D. 1849

Badge numbers are taken from the Church Bells of Leicestershire (North 1876).

Physical data:

	Diameter (m)	Weight (Cwt.Qr.Lbs)
Treble	0.79	*c* 5cwt
2.	0.865	*c* 7cwt
Tenor.	0.94	8.1.1

The treble is a late bell by Hugh Watts II of Leicester. The second bell is the work of George Oldfield I of Nottingham and the tenor by Charles & George Mears of the Whitechapel bellfoundry, London. The bells are tuned as bells 1 to 3 of a ring of five.

Church of All Saints, Knipton

The Bells

Treble. IHESVS [35] BE [35] OVR [35][35][35] SPEDE [35] [52]
Waist: [H 37] [32] [D 38]

2(i). ROBERT IONES RECTOR [ ] RICHARD MARRIOTT CHURCHWARDEN ANNO DOM : 1731. T : EAYRE FECIT. [ ] [ ] [ ]
(ii). [Decoration] [ ] [Decoration] [ ] [Decoration]

Tenor. GOD SAVE HIS CHVRCH G WRIGHT RECTOR W HARVEY WARDEN 1717 [12]

Badge numbers are taken from the Church Bells of Leicestershire (North 1876). [ ] denotes a badge not in that book.

Physical data:

	Diameter (m)	Weight (Cwt.Qr.Lbs)
Treble.	0.795	5cwt
2.	0.855	6 1/2cwt
Tenor.	0.92	8cwt

The treble is the work of Henry Dand of Nottingham in the period AD 1550-80. The second is by Thomas Eayre of Kettering and the tenor is by William Noone of Nottingham.

Church of St John the Baptist, Muston

The Bells

Treble. IHS MARIA [badge 51 with OH]

2(i). [21] GOD SAVE THE CHURCH AND REALME AND SEND VS PEACE 1601
(ii). IN CHRIST AMEN [8]

3(i). [+ 24] [□ IHESVS [ ] [ ] [ ] BE [ ]OVRE [79] [ ] SPED [9] [70]
(ii). [ ]

Tenor (i). All men that heare my mournful sound repent before you lye in ground 1605
(ii). [8]

Service bell. Blank.

Badge numbers are taken from the Church Bells of Leicestershire (North 1876)
[ ] indicates badges not recorded in that book.

Physical data:

	Diameter (m)	Weight (Cwt.Qr.Lbs)
Treble.	0.825	*c* 6.5cwt
2.	0.825	*c* 6.5cwt
3.	0.945	*c* 9cwt
Tenor.	1.08	*c* 11.5cwt

The treble bell was cast by Henry Oldfield I of Nottingham in the period AD 1550-60, as was the third, but at a rather later date, *c* AD 1570-80. The second and tenor bells are the work of his son, Henry II, and both are dated.

Church of St Nicholas, Bringhurst

The Bells

Treble. No inscription.

Physical data:

	Diameter(m)	Weight (Cwt.Qr.Lbs)
Treble	0.46	0.3.5

The second-hand uninscribed bell was cast by an unknown nineteenth-century brass-founder. It was placed in the tower in the early AD 1980s after the then existing ring of three bells were removed and dispersed after concerns as to the safety of the frame.

Church of St John the Baptist, Grimston

The Bells

Treble (i). I WAS RECAST AGAIN TO SING. BY FRIENDS TO COUNTRY CHURCH & KING
(ii). THO^{S} HEDDERLY, FOUNDER, NOTTINGHAM, THO^{S} GLOVER : THO^{S} AUSTIN, C : W :
(iii). [12]

2. 1826 [Running border] ANTHONY HEMSLEY CHURCHWARDEN [Running border]

Tenor (shoulder). [Border]
(i). Hec Campana [12] Sacra Fiat [12] Trinitate Beata 1749 *THO^{S} HEDDERLY Founder*

Badge numbers are taken from the Church Bells of Leicestershire (North 1876).

Physical data:

	Diameter(m)	Weight (Cwt.Qr.Lbs)
Treble.	0.81	6.0.18
2.	0.90	*c* 7.5cwt
Tenor.	0.985	*c* 9.5cwt

The treble was cast in AD 1778/9 by Thomas Hedderly II, of Nottingham. The second bell was the work of Thomas Mears II of the Whitechapel, London foundry. The tenor was cast by Thomas Hedderly I of Nottingham.

Church of St John the Baptist, Knossington

The Bells

Treble. COME COME AND PRAY [ ] ALEX : HALLSAL RECTOR [ ] RICHARD MARTIN CHURCH WARDEN. 1731.

Sanctus. Blank.
Waist: KNOSTON ·· ·: 1735:

[ ] denotes a decoration not in Church Bells of Leicestershire (North 1876).

Physical data:

	Diameter (m)	Weight (Cwt.Qr.Lbs)
Treble.	0.79	*c* 4.5cwt
Sanctus	0.33	*c* 0.5cwt

Both bells are the work of Thomas Eayre, bell founder of Kettering.

Church of St John the Evangelist, Shenton

The Bells

Treble. [1] IHS NAZARENVS [9] REX : IVDEORVM [9] FILI DEI [9] MISERERE MEI [9] 1628 [9]

2. [+ 45] SCE : LEONARDE : ORA : PRO NOBIS

Tenor. THO^{S} HARDING [+] EDW^{D} ARNOLD FECIT 1788

Badge numbers are taken from the Church Bells of Leicestershire (North 1876). [+] represents a badge not in that book.

Physical data:

	Diameter (m)	Weight (Cwt.Qr.Lbs)
Treble.	0.72	4.1.10
2.	0.80	6.1.9
Tenor.	0.875	7.1.24

The treble was cast by Hugh Watts II of Leicester, the second bell was cast by Johannes de Stafford, a Leicester bellfounder in the late-fourteenth century and the tenor was cast by Edward Arnold, also of Leicester.

The bells were rehung 'dead' with chiming clappers by Taylors of Loughborough in AD 1975.

Church of St Peter, Gaulby

The Bells

Treble (i). [+] GLORIA DEO SOLI [ ] [ ] OMNIA FIANT AD GLORIAM DEI : ·· [ ] [+] [ ] ·· : ANNO DOMINI [+] 1741
(ii). Line of decoration.

2 (i). GRATA SIR ARGUTA RESONANS CAMPANULA VOCE : . . GLORIA DEO SOLI : T. EAYRE. 1741 :
(ii). Line of decoration.

3 (i). OMNIA FIANT AD GLORIAM DEI : ··· : GLORIA PATRI FILIO ET SPIRITUI SANCTO : 1741 :
(ii). Line of decoration.

4 (i). OMNIA FIANT AD GLORIAM DEI [ ] [ ] [ ]GLORIA PATRI FILIO ET SPIRITUI SANCTO : 1741 · T · E :
(ii). Line of decoration.

5 (i). OMNIA FIANT AD GLORIAM DEI : · [Crown] [Crown] · : GLORIA PATRI FILIO ET SPIRITUI SANCTO : 1741 · : ·
(ii). Line of decoration.

Tenor (i). OMNIA FIANT AD GLORIAM DEI : · [ ] [ ] [ ] · : GLORIA PATRI FILIO ET SPIRITUI SANCTO : 1741 : ·· [ ] T : · EAYRE KETT : · 1740 : · : · :
(ii). Line of decoration.

Badge numbers are taken from the Church Bells of Leicestershire (North 1876). [ ] represents a badge not illustrated in that book.

Physical data:

	Diameter (m)	Weight (Cwt.Qr.Lbs)
Treble.	0.735	6.0.4
2.	0.76	5.3.16
3.	0.81	6.2.22
4.	0.82	6.2.18
5.	0.89	7.2.18
Tenor.	0.965	9.0.6

All bells were cast by Thomas Eayre of Kettering at the order of Squire William Fortrey, a keen supporter of ringing in the eighteenth century.

The bells were rehung with all new fittings (cast iron headstocks, ball bearings and new wheels and pulleys etc), in the old frame in AD 1984 by Taylors of Loughborough. Sadly at that time the canons (the hanging loops on the top of the bells) were removed.

Church of St Peter, Ashby Parva

The Bells

Treble. [22] NEWCOMBE OF LEICESTER MADE MEE 1607 [13]

2. [+ 2] SERVE [4] THE [4] LORD 1591

Tenor. BE YT KNOWNE TO ALL THAT DOTH ME SEE THAT NEWCOMBE OF LEICESTER MADE MEE 1603 [13]

On the second bell the 5 and 9 are each reversed. Badge numbers are taken from the Church Bells of Leicestershire (North 1876).

Physical data:

	Diameter (m)	Weight (Cwt.Qr.Lbs)
Treble	0.68	3.0.22
2.	0.71	3.2.17
Tenor.	0.79	4.3.26

All three bells are by members of the Newcombe family of Leicester at different times.

In AD 1909 the bells were rehung in the old frame by Messrs Taylor, bellfounders of Loughborough with all new fittings, cast iron headstocks, plain bearings, new wheels and pulleys. At this time some strengthening work was undertaken in the form of a large timber plank on the south side of the treble pit to stabilise the lower ends of the braces as these had decayed where they enter the lower sill timbers. This has worked well and the frame does not move when the bells are rung. (These modifications are not shown on the drawings).

Church of St Peter, Aston Flamville

The Bells

Treble. [+ 2] PRAYSE THE LORD 1596

Tenor. Sca catherina ora pro nobis [5]

Badge numbers are taken from the Church Bells of Leicestershire (North 1876).

Physical data:

	Diameter (m)	Weight (Cwt.Qr.Lbs)
Treble.	0.735	*c* 4cwt
Tenor.	0.85	*c* 5.5cwt

The treble was cast by a member of the Newcombe family of Leicester in AD 1596. The tenor bell is unique. The founders mark [5] does not occur on any other bell. It shows a strong resemblance to mark [32], which was used by the Mellours family of Nottingham, and may be the mark of William Millers, a Leicester bellfounder who died in AD 1506. Some commentators have suggested that Millers was related to Mellours.

APPENDIX

Tree-Ring Dating

The Principles of Tree-Ring Dating

Tree-ring dating, or *dendrochronology* as it is known, is discussed in some detail in the Laboratory's Monograph, '*An East Midlands Master Tree-Ring Chronology and its uses for dating Vernacular Building*' (Laxton and Litton 1988) and, *Dendrochronology; Guidelines on Producing and Interpreting Dendrochronological Dates* (English Heritage 1988). Here we will give the bare outlines. Each year an oak tree grows an extra ring on the outside of its trunk and all its branches just inside its bark. The *width* of this annual ring depends largely on the weather during the growing season, about April to October, and possibly also on the weather during the previous year. Good growing seasons give rise to relatively wide rings, poor ones to very narrow rings and average ones to relatively average ring widths. Since the climate is so variable from year to year, almost random-like, the widths of these rings will also appear random-like in sequence, reflecting the seasons. This is illustrated in Figure 1 where, for example, the widest rings appear at irregular intervals. This is the key to dating by tree rings, or rather, by their widths. Records of the average ring widths for oaks, one for each year for the last 1000 years or more, are available for different areas. These are called master chronologies. Because of the random-like nature of these sequences of widths, there is usually only one position at which a sequence of ring widths from a sample of oak timber with at least 70 rings will match a master. This will date the timber and, in particular, the last ring.

If the bark is still on the sample, as in Figure 1, then the date of the last ring will be the date of felling of the oak from which it was cut. There is much evidence that in medieval times oaks cut down for building purposes were used almost immediately, usually within the year or so (Rackham 1976). Hence if bark is present on several main timbers in a building, none of which appear reused or are later insertions, and if they all have the same date for their last ring, then we can be quite confident that this is the date of construction or soon after. If there is no bark on the sample, then we have to make an estimate of the felling date; how this is done is explained below.

The Practice of Tree-Ring Dating at the University of Nottingham Tree-Ring dating Laboratory

1. ***Inspecting the Building and Sampling the Timbers.*** Together with a building historian the timbers in a building are inspected to try to ensure that those sampled are not reused or later insertions. Sampling is almost always done by coring into the timber, which has the great advantage that we can sample *in situ* timbers and those judged best to give the date of construction, or phase of construction if there is more than one in the building. The timbers to be sampled are also inspected to see how many rings they have. We normally look for timbers with at least 70 rings, and preferably more. With fewer rings than this, 50 for example, sequences of widths become difficult to match to a unique position within a master sequence of ring widths and so are difficult to date (Litton and Zainodin 1991). The cross-section of the rafter shown in Figure 2 has about 120 rings; about 20 of which are sapwood rings – the lighter rings on the outside. Similarly the core has just over 100 rings with a few sapwood rings.

   To ensure that we are getting the date of the building as a whole, or the whole of a phase of construction if there is more than one, about 8 to 10 samples per phase are usually taken. Sometimes we take many more, especially if the construction is complicated. One reason for taking so many samples is that, in general, some will fail to give a date. There may be many reasons why a particular sequence of ring widths from a sample of timber fails to give a date even though others from the same building do. For example, a particular tree may have grown in an odd ecological niche, so odd indeed that the widths of its rings were determined by factors other than the local climate! In such circumstances it will be impossible to date a timber from this tree using the master sequence whose widths, we can assume, were predominantly determined by the local climate at the time.

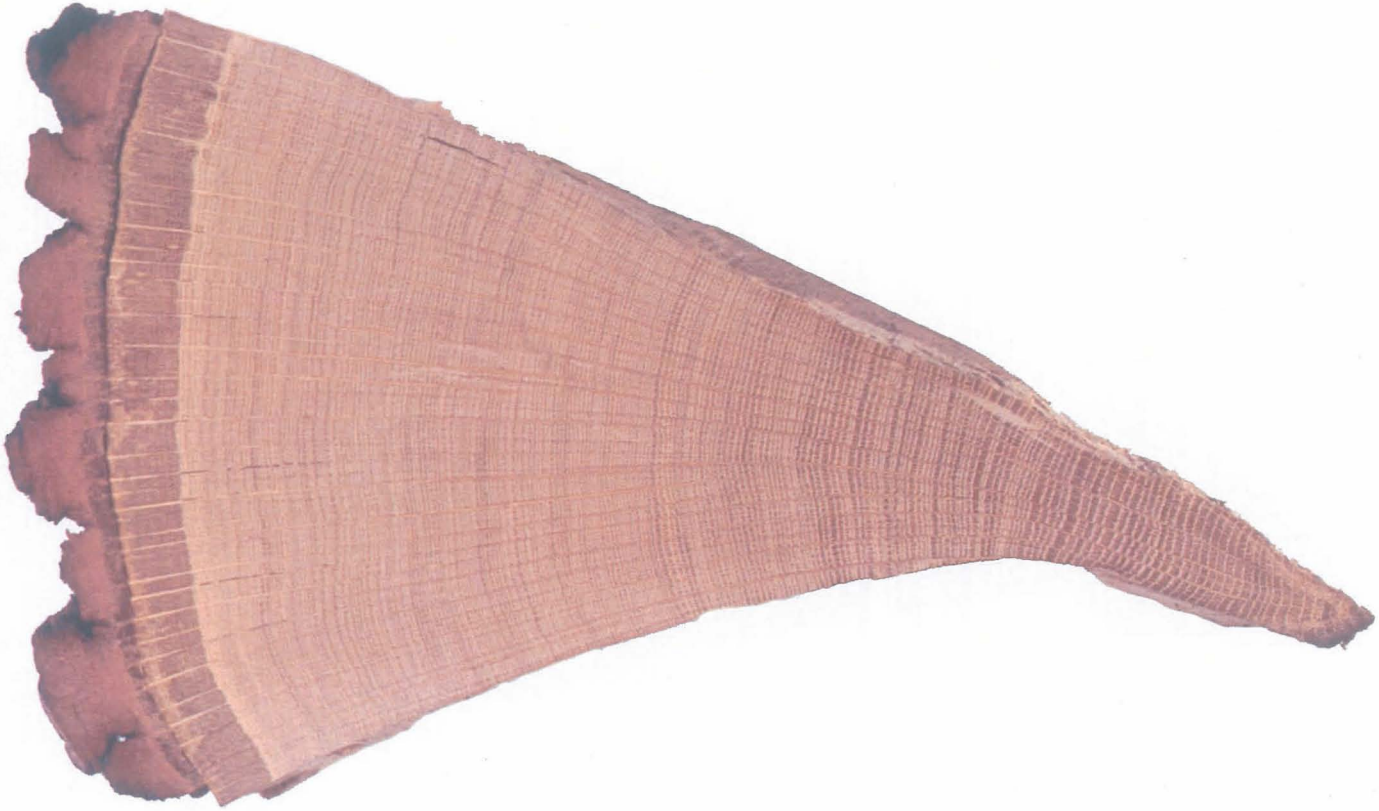


Fig 1. A wedge of oak from a tree felled in 1976. It shows the annual growth rings, one for each year from the innermost ring to the last ring on the outside just inside the bark. The year of each ring can determined by counting back from the outside ring, which grew in 1976.

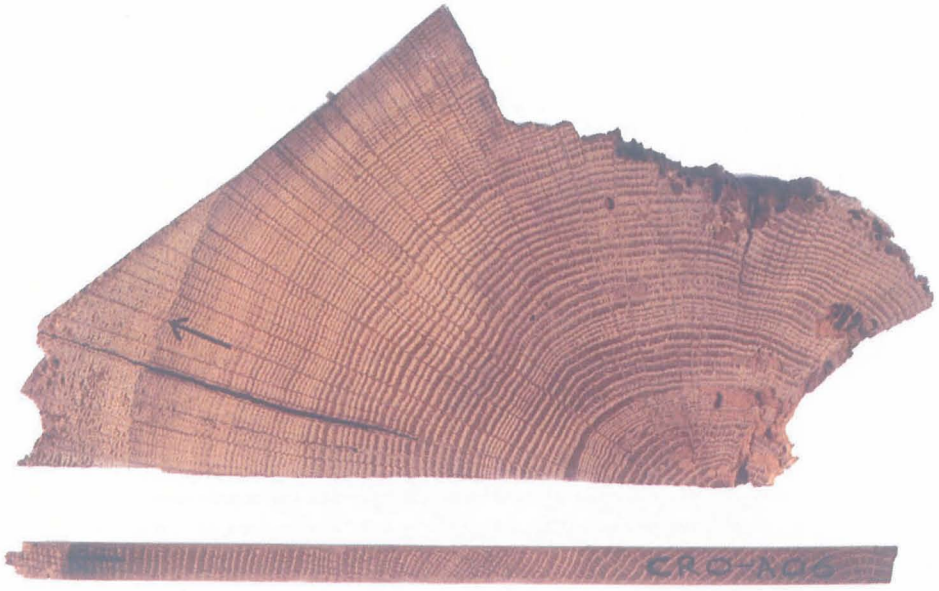


Fig 2. Cross-section of a rafter showing the presence of sapwood rings in the left hand corner, the arrow is pointing to the heartwood/sapwood boundary (H/S). Also a core with sapwood; again the arrow is pointing to the H/S. The core is about the size of a pencil.

Fig. 3 Measuring ring widths under a microscope. The microscope is fixed while the sample is on a moving platform. The total sequence of widths is measure twice to ensure that an error has not been made. This type of apparatus is needed to process a large number of samples on a regular basis.

Fig 4. Three cores from timbers in a building. They come from trees growing at the same time. Notice that, although the sequences of widths look similar, they are not identical. This is typical.

Sampling is done by coring into the timber with a hollow corer attached to an electric drill and usually from its outer rings inwards towards where the centre of the tree, the pith, is judged to be. An illustration of a core is shown in Figure 2; it is about 15cm long and 1cm diameter. Great care has to be taken to ensure that as few as possible of the outer rings are lost in coring. This can be difficult as these outer rings are often very soft (see below on sapwood). Each sample is given a code which identifies uniquely which timber it comes from, which building it is from and where the building is located. For example, CRO-A06 is the sixth core taken from the first building (A) sampled by the Laboratory in Cropwell Bishop. Where it came from in that building will be shown in the sampling records and drawings. No structural damage is done to any timbers by coring, nor does it weaken them.

During the initial inspection of the building and its timbers the dendrochronologist may come to the conclusion that, as far as can be judged, none of the timbers have sufficient rings in them for dating purposes and may advise against sampling to save further unwarranted expense.

All sampling by the Laboratory is undertaken according to current Health and Safety Standards. The Laboratory's dendrochronologists are insured.

2. ***Measuring Ring Widths***. Each core is sanded down with a belt sander using medium-grit paper and then finished by hand with flourgrade-grit paper. The rings are then clearly visible and differentiated from each other with a result very much like that shown in Figure 2. The core is then mounted on a movable table below a microscope and the ring-widths measured individually from the innermost ring to the outermost. The widths are automatically recorded in a computer file as they are measured (see Fig 3).

3. ***Cross-matching and Dating the Samples***. Because of the factors besides the local climate which may determine the annual widths of a tree's rings, no two sequences of ring widths from different oaks growing at the same time are exactly alike (Fig 4). Indeed, the sequences may not be exactly alike even when the trees are growing near to each other. Consequently, in the Laboratory we do not attempt to match two sequences of ring widths by eye, or graphically, or by any other subjective method. Instead, it is done objectively (ie statistically) on a computer by a process called cross-matching. The output from the computer tells us the extent of correlation between two sample sequences of widths or, if we are dating, between a sample sequence of widths and the master, at each relative position of one to the other (offsets). The extent of the correlation at an offset is determined by the *t-value* (defined in almost any introductory book on statistics). That offset with the maximum *t*-value among the *t*-values at all the offsets will be the best candidate for dating one sequence relative to the other. If one of these is a master chronology, then this will date the other. Experiments carried out in the past with sequences from oaks of known date suggest that a *t*-value of at least 4.5, and preferably at least 5.0, is usually adequate for the dating to be accepted with reasonable confidence (Laxton and Litton 1988; Laxton *et al* 1988; Howard *et al* 1984-1995).

This is illustrated in Fig 5 with timbers from one of the roofs of Lincoln Cathedral. Here four sequences of ring widths, LIN-C04, 05, 08, and 45, have been cross-matched with each other. The ring widths themselves have been omitted in the *bar-diagram*, as is usual, but the offsets at which they best cross-match each other are shown; eg the sequence of ring widths of C08 matches the sequence of ring widths of C45 best when it is at a position starting 20 rings after the first ring of C45, and similarly for the others. The actual *t*-values between the four at these offsets of best correlations are in the matrix. Thus at the offset of +20 rings, the *t*-value between C45 and C08 is 5.6 and is the maximum found between these two among all the positions of one sequence relative to the other.

It is standard practice in our Laboratory first to cross-match as many as possible of the ring-width sequences of the samples in a building and then to form an average from them. This average is called a *site sequence* of the building being dated and is illustrated in Fig 5. The fifth bar at the bottom is a site sequence for a roof at Lincoln Cathedral and is constructed from the matching sequences of the four timbers. The site sequence width for each year is the average of the widths in each of the sample sequences which has a width for that year. Thus in Fig 5 if the widths shown are 0.8mm for C45, 0.2mm for C08, 0.7mm for C05, and 0.3mm for C04, then the corresponding width of the site sequence is the average of these, 0.55mm. The actual sequence

of widths of this site sequence is stored on the computer. The reason for creating site sequences is that it is usually easier to date an average sequence of ring widths with a master sequence than it is to date the individual component sample sequences separately.

The straightforward method of cross-matching several sample sequences with each other one at a time is called the 'maximal *t*-value' method. The actual method of cross-matching a group of sequences of ring-widths used in the Laboratory involves grouping and averaging the ring-width sequences and is called the 'Litton-Zainodin Grouping Procedure'. It is a modification of the straight forward method and was successfully developed and tested in the Laboratory and has been published (Litton and Zainodin 1991; Laxton *et al* 1988).

4. ***Estimating the Felling Date.*** As mentioned above, if the bark is present on a sample, then the date of its last ring is the date of the felling of its tree. Actually it could be the year after if it had been felled in the first three months before any new growth had started, but this is not too important a consideration in most cases. The actual bark may not be present on a timber in a building, though the dendrochronologist who is sampling can often see from its surface that only the bark is missing. In these cases the date of the last ring is still the date of felling.

Quite often some, though not all, of the original outer rings are missing on a timber. The outer rings on an oak, called *sapwood* rings, are usually lighter than the inner rings, the *heartwood*, and so are relatively easy to identify. For example, sapwood can be seen in the corner of the rafter and at the outer end of the core in Figure 2, both indicated by arrows. More importantly for dendrochronology, the sapwood is relatively soft and so liable to insect attack and wear and tear. The builder, therefore, may remove some of the sapwood for precisely these reasons. Nevertheless, if at least some of the sapwood rings are left on a sample, we will know that not too many rings have been lost since felling so that the date of the last ring on the sample is only a few years before the date of the original last ring on the tree, and so to the date of felling.

Various estimates have been made and used for the average number of sapwood rings in mature oak trees (English Heritage 1998). A fairly conservative range is between 15 and 50 and that this holds for 95% of mature oaks. This means, of course, that in a small number of cases there could be fewer than 15 and more than 50 sapwood rings. For example, the core CRO-A06 has only 9 sapwood rings and some have obviously been lost over time – either they were removed originally by the carpenter and/or they rotted away in the building and/or they were lost in the coring. It is not known exactly how many sapwood rings are missing, but using the above range the Laboratory would estimate between a minimum of 6 (=15-9) and a maximum of 41 (=50-9). If the last ring of CRO-A06 has been dated to 1500, say, then the estimated felling-date range for the tree from which it came originally would be between 1506 and 1541. The Laboratory uses this estimate for sapwood in areas of England where it has no prior information. It also uses it when dealing with samples with very many rings, about 120 to the last heartwood ring. But in other areas of England where the Laboratory has accumulated a number of samples with complete sapwood, that is, no sapwood lost since felling, other estimates in place of the conservative range of 15 to 50 are used. In the East Midlands (Laxton *et al* 2001) and the east to the south down to Kent (Pearson 1995) where it has sampled extensively in the past, the Laboratory uses the shorter estimate of 15 to 35 sapwood rings in 95% of mature oaks growing in these parts. Since the sample CRO-A06 comes from a house in Cropwell Bishop in the East Midlands, a better estimate of sapwood rings lost since felling is between a minimum of 6 (=15-9) and 26 (=35-9) and the felling would be estimated to have taken place between 1506 and 1526, a shorter period than before. (Oak boards quite often come from the Baltic and in these cases the 95% confidence limits for sapwood are 9 to 36 (Howard *et al* 1992, 56)).

Even more precise estimates of the felling date and range can often be obtained using knowledge of a particular case and information gathered at the time of sampling. For example, at the time of sampling the dendrochronologist may have noted that the timber from which the core of Figure 2 was taken still had complete sapwood but that none of the soft sapwood rings were lost in coring. By measuring into the timber the depth of sapwood lost, say 2 cm, a reasonable estimate can be made of the number of sapwood rings lost, say 12 to 15 rings in this case. By adding on 12 to 15 years to the date of the last ring on the sample a good tight estimate for the range of the felling date can be obtained, which is often better than the 15 to 35 years later we would have estimated without this observation. In the example, the felling is now estimated to

t-value/offset Matrix

	C45	C08	C05	C04
C45		+20	+37	+47
C08	5.6		+17	+27
C05	5.2	10.4		+10
C04	5.9	3.7	5.1	

Bar Diagram

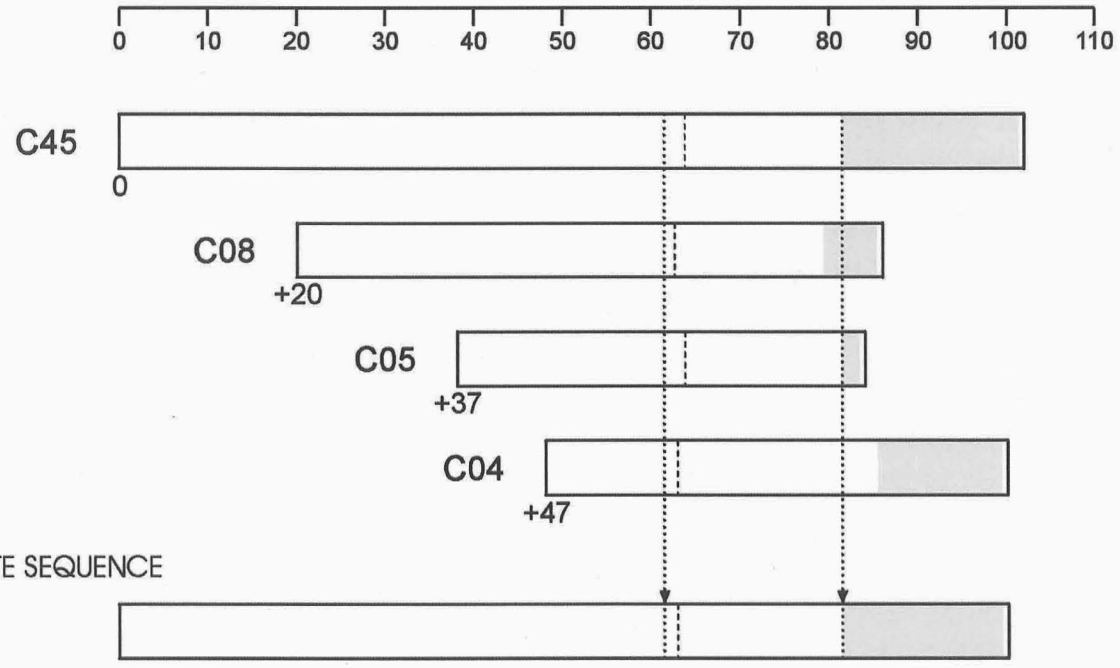


Fig 5. Cross-matching of four sequences from a Lincoln Cathedral roof and the formation of a site sequence from them.

The *bar diagram* represents these sequences without the rings themselves. The length of the bar is proportional to the number of rings in the sequence. Here the four sequences are set at relative positions (*offsets*) to each other at which they have maximum correlation as measured by the *t*-values.

The *t*-value/offset matrix contains the maximum *t*-values below the diagonal and the offsets above it. Thus, the maximum *t*-value between C08 and C45 occurs at the offset of +20 rings and the *t*-value is then 5.6.

The *site sequence* is composed of the average of the corresponding widths, as illustrated with one width.

have taken place between AD 1512 and 1515, which is much more precise than without this extra information.

Even if all the sapwood rings are missing on a sample, but none of the heartwood rings are, then an estimate of the felling-date range is possible by adding on the full compliment of, say, 15 to 35 years to the date of the last heartwood ring (called the heartwood/sapwood boundary or transition ring and denoted H/S). Fortunately it is often easy for a trained dendrochronologist to identify this boundary on a timber. If a timber does not have its heartwood/sapwood boundary, then only a *post quem* date for felling is possible.

5. ***Estimating the Date of Construction***. There is a considerable body of evidence collected by dendrochronologists over the years that oak timbers used in buildings were not seasoned in medieval or early modern times (English Heritage 1998 and Miles 1997, 50-55). Hence provided all the samples in a building have estimated felling-date ranges broadly in agreement with each other, so that they appear to have been felled as a group, then this should give an accurate estimate of the period when the structure was built, or soon after (Laxton *et al* 2001, figure 8 and pages 34-5 where 'associated groups of fellings' are discussed in detail). However, if there is any evidence of storing before use or if there is evidence the oak came from abroad (eg Baltic boards), then some allowance has to be made for this.

6. ***Master Chronological Sequences***. Ultimately, to date a sequence of ring widths, or a site sequence, we need a master sequence of dated ring widths with which to cross-match it, a Master Chronology. To construct such a sequence we have to start with a sequence of widths whose dates are known and this means beginning with a sequence from an oak tree whose date of felling is known. In Fig 6 such a sequence is SHE-T, which came from a tree in Sherwood Forest which was blown down in a recent gale. After this other sequences which cross-match with it are added and gradually the sequence is 'pushed back in time' as far as the age of samples will allow. This process is illustrated in Fig 6. We have a master chronological sequence of widths for Nottinghamshire and East Midlands oak for each year from AD 882 to 1981. It is described in great detail in Laxton and Litton (1988), but the components it contains are shown here in the form of a bar diagram. As can be seen, it is well replicated in that for each year in this period there are several sample sequences having widths for that year. The master is the average of these. This master can now be used to date oak from this area and from the surrounding areas where the climate is very similar to that in the East Midlands. The Laboratory has also constructed a master for Kent (Laxton and Litton 1989). The method the Laboratory uses to construct a master sequence, such as the East Midlands and Kent, is completely objective and uses the Litton-Zainodin grouping procedure (Laxton *et al* 1988). Other laboratories and individuals have constructed masters for other areas and have made them available. As well as these masters, local (dated) site chronologies can be used to date other buildings from nearby. The Laboratory has hundreds of these site sequences from many parts of England and Wales covering many short periods.

7. ***Ring-width Indices***. Tree-ring dating can be done by cross-matching the ring widths themselves, as described above. However, it is advantageous to modify the widths first. Because different trees grow at different rates and because a young oak grows in a different way from an older oak, irrespective of the climate, the widths are first standardized before any matching between them is attempted. These standard widths are known as ring-width indices and were first used in dendrochronology by Baillie and Pilcher (1973). The exact form they take is explained in this paper and in the appendix of Laxton and Litton (1988) and is illustrated in the graphs in Fig 7. Here ring-widths are plotted vertically, one for each year of growth. In the upper sequence of (a), the generally large early growth after 1810 is very apparent as is the smaller later growth from about 1900 onwards when the tree is maturing. A similar phenomena can be observed in the lower sequence of (a) starting in 1835. In both the widths are also changing rapidly from year to year. The peaks are the wide rings and the troughs are the narrow rings corresponding to good and poor growing seasons, respectively. The two corresponding sequence of Baillie-Pilcher indices are plotted in (b) where the differences in the immature and mature growths have been removed and only the rapidly changing peaks and troughs remain, that are associated with the common climatic signal. This makes cross-matching easier.

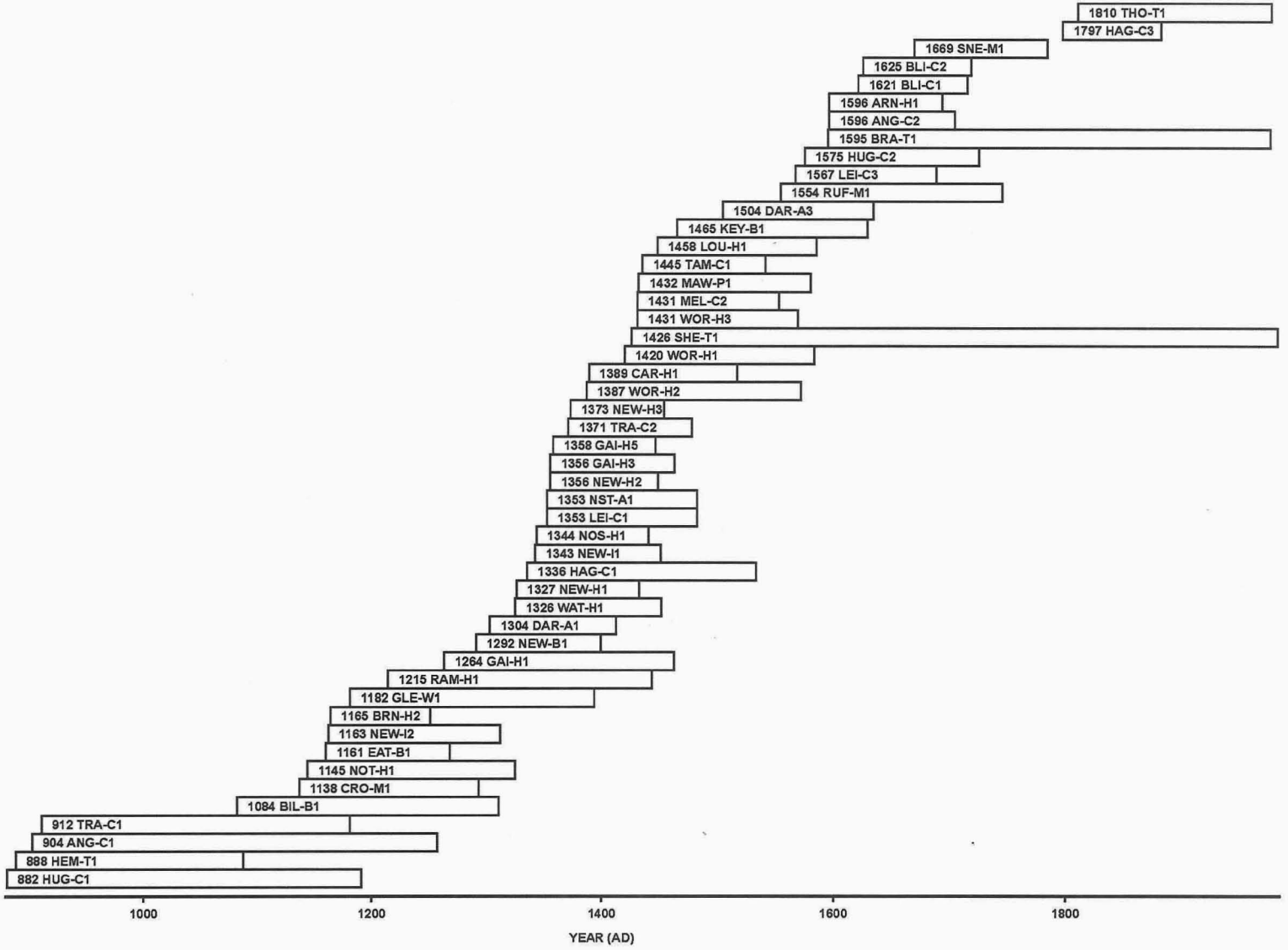
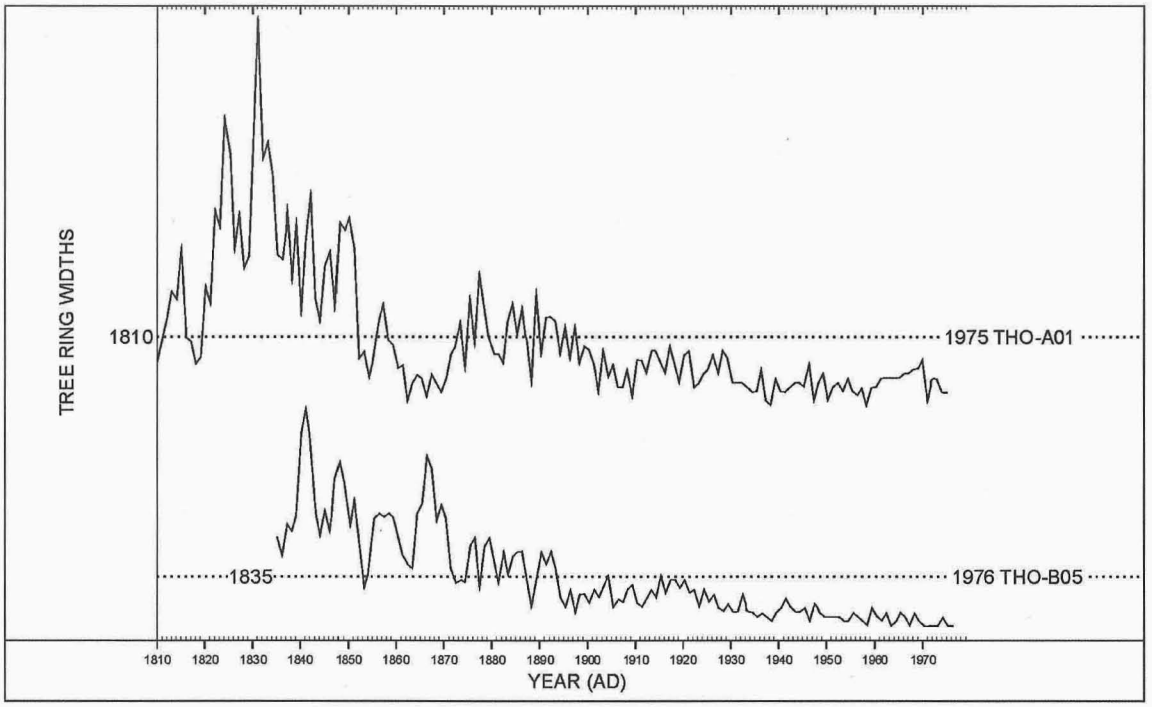


Fig. 6 Bar diagram showing the relative positions and dates of the first rings of the component site sequences in the East Midlands Master Dendrochronological Sequence, EM08/87

(a)



(b)

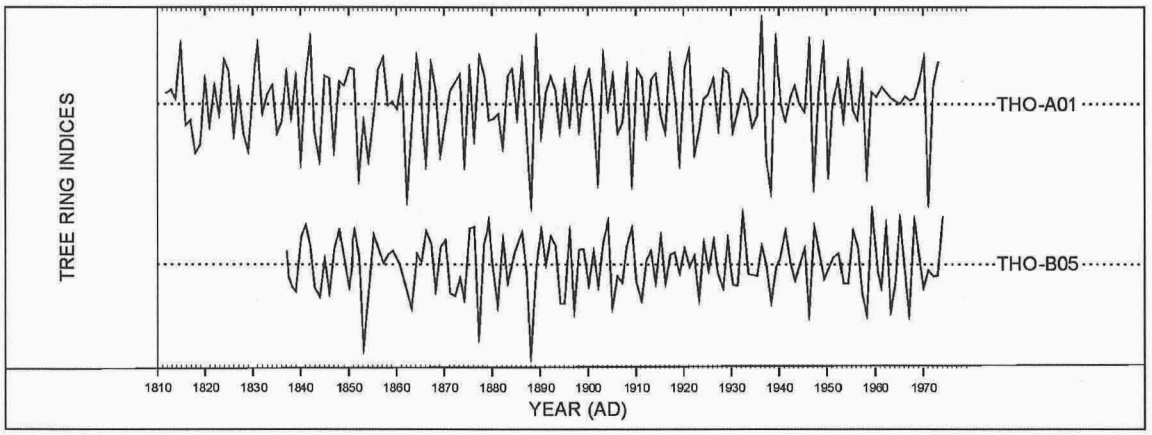


Fig 7. (a) The raw ring-widths of two samples, THO-A01 and THO-B05, whose felling dates are known. Here the ring widths are plotted vertically, one for each year, so that peaks represent wide rings and troughs narrow ones. Notice the growth-trends in each; on average the earlier rings of the young tree are wider than the later ones of the older tree in both sequences.

Fig 7. (b) The *Baillie-Pilcher* indices of the above widths. The growth-trends have been removed completely.

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