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Tree-Ring Analysis of Timbers from the Church of All Saints, Church Street, West Ham, London Borough of Newham

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Summary

Seven phases of roof construction were identified as being of interest in this grade I listed church. Two of these roofs were identified as being made of softwood and of likely nineteenth- or early twentieth-century origin. A single tie beam from the north aisle was felled in AD 1384 or soon thereafter, some decades before the aisle was thought to have been built. Although many timbers were investigated from other roofs, none of these had sufficient rings to be dated dendrochronologically.

Keywords

Dendrochronology
Standing Building

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Introduction

The church of All Saints, West Ham (NGR TQ 3941 8385; Fig 1) is a grade I listed building. It dates from the twelfth century onwards, having a seven-bay nave of mid thirteenth-century date, to which an eastward extension was added around AD 1400. A north chancel chapel was added around AD 1550. Recently there has been some question over the traditional interpretation of the dates of some of the roofs from stylistic evidence, and dendrochronological evidence for dating the roofs was sought to inform grant-aided repairs and help the understanding of the development of this church.

Seven phases of roof were identified to be assessed and, where appropriate, sampled. These were the nave roof, two phases identified in the north aisle roof, the south aisle roof, the chancel roof, and the roofs of the north and south chapels. Access to all roofs was facilitated by the whole structure being scaffolded and the lowest rows of roof tiles having been removed for inspection of the timbers as part of the ongoing repair programme.

Methodology

The site was visited on three occasions during July to September of AD 2002. On two of these occasions, Richard Bond (English Heritage) was present to help identify the main areas of interest and discuss the sampling strategy, whilst he was recording details of the structure. Access was available to the tie beams at the western end of the north aisle from internal scaffolding during the earliest period of this study, and the opportunity was taken for sampling those ties which appeared suitable. All subsequent work was from external scaffolding, and in each of the roofs it was only possible to see rafter feet and tie ends where the lowest rows of roof tiles had been removed.

Initially an assessment was made of each of the phases of the roofs in order to ascertain which areas might be useful for further analysis. Oak timbers with more than 50 rings, traces of sapwood, and accessibility were the main considerations in the initial assessment. Those timbers judged to be potentially useful were cored using a 15mm auger attached to an electric drill. The cores were glued to wooden laths, labelled, and stored for subsequent analysis.

The cores were prepared for measuring by sanding using an electric belt-sander with progressively finer grit papers down to 400 grit. Any further preparation necessary, eg where bands of narrow rings occurred, was done manually. Suitable samples had their tree-ring sequences measured to an accuracy of 0.01 mm using a specially constructed system utilizing a binocular microscope with the sample mounted on a travelling stage with a linear transducer linked to a PC. The software used in measuring and subsequent analysis was written by Ian Tyers (1999).

Ring series were plotted to allow visual comparisons to be made between sequences on a light table. This activity also acts as a measure of quality control in identifying any errors in the measurements when the samples crossmatch. Statistical comparisons were made using Student's *t*-test (Baillie and Pilcher 1973; Munro 1984). The *t*-values quoted below were derived from the original CROS program (Baillie and Pilcher 1973). Those *t*-values in excess of 3.5 are taken to be indicative of acceptable matching positions provided that they are supported by satisfactory visual matches, and give consistent matching positions.

When crossmatching between samples is found, the ring-width sequences are meaned to form an internal 'working' site mean sequence. Other samples may then be incorporated after

comparison with this 'working' master until a final site sequence is established, which is then compared with a number of reference chronologies (multi-site chronologies from a region) and dated individual site masters in an attempt to date it. Individual long series which are not included in the site mean(s) are also compared with the database to see if they can be dated.

The dates thus obtained represent the time of formation of the rings available on each sample. Interpretation of these dates then has to be undertaken to relate these findings to the construction date of the phase under investigation. An important aspect of this interpretation is the estimate of the number of sapwood rings missing. In this instance, the sapwood estimates are based on those proposed for this area by Miles (1997), in which 95% of samples are likely to have from 9 to 41 sapwood rings. Where bark is present on the sample the exact date of felling of the tree used may be determined. For a group of contemporaneous timbers, the sapwood estimate is added to the mean last heartwood ring date to obtain the likely felling date for the group.

The dates derived for the felling of the trees used in construction do not necessarily relate directly to the date of construction of the building. However, evidence suggests that, except in the re-use of timbers, construction in most historical periods took place within a very few years after felling (Salzman 1952; Hollstein 1965).

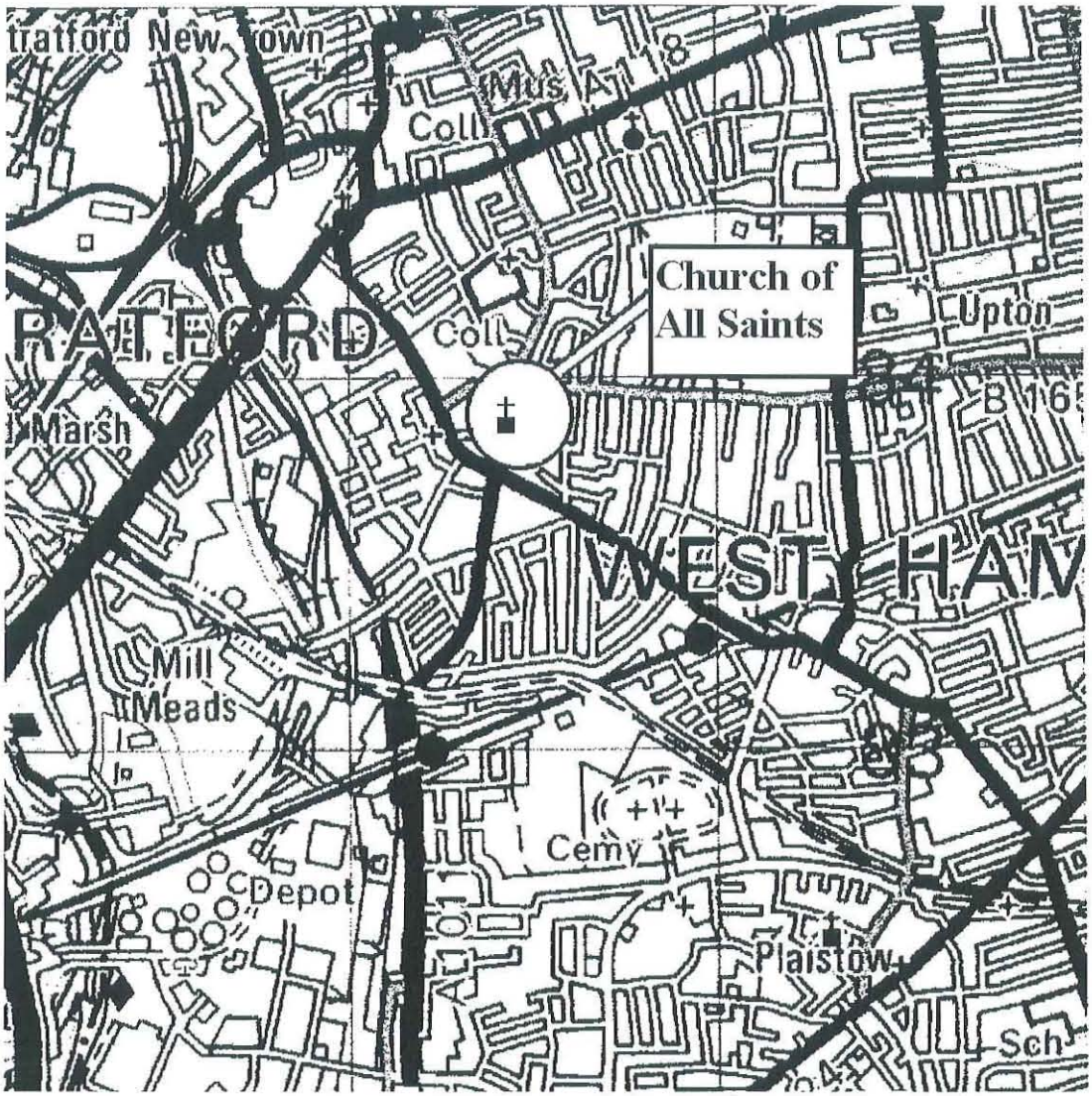

Figure 1: Map showing the general location of the Church of All Saints, West Ham

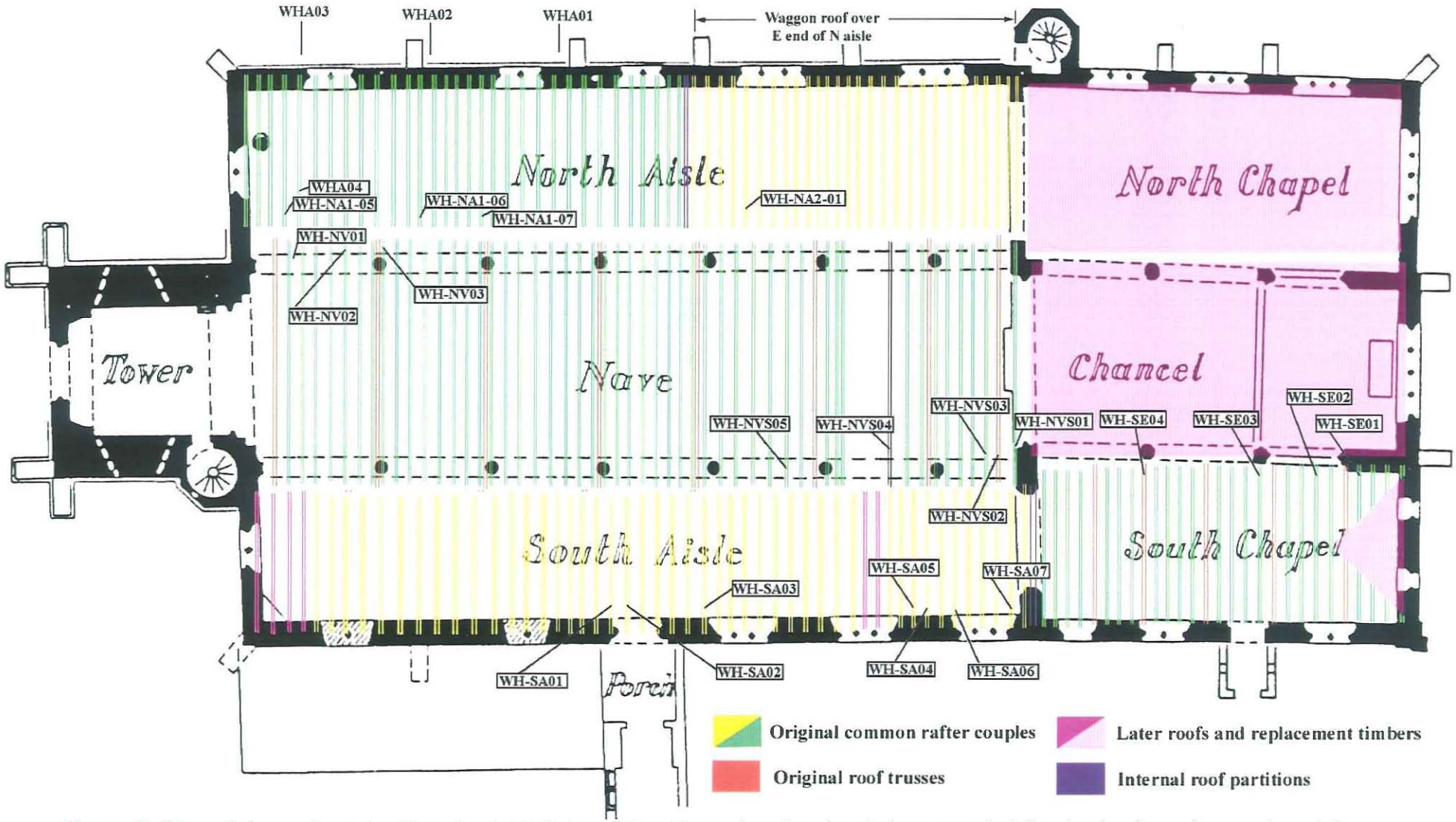

Figure 2: Plan of the roofs at the Church of All Saints, West Ham, showing the timbers sampled for dendrochronology, adapted from a drawing by Richard Bond, itself adapted from an original RCHME drawing

Assessment

The north chapel roof, along with the east hip of the south chapel were identified as being made of softwood, of likely nineteenth, or early twentieth-century origin, and were not studied further. The chancel roof was constructed from re-used medieval oak timbers with additional softwood elements, and this too was not studied further, because the timbers were considered marginal for dendrochronology, having few rings, and because any results from these re-used timbers would not add to an understanding of the history of this roof. All the subsequent timbers investigated were of oak (*Quercus* spp.).

The north aisle roof was known to be of two phases along its length, but during the assessment for this work, Richard Bond noted variation along the length of the south aisle roof, with the rafters being broader and flatter toward the west end, and a change in the direction of pegging at various parts along the roof. This roof was therefore also considered to be of two phases for subsequent investigation.

The north aisle has six internal tie beams, which for convenience were numbered from the west end. Numbers 5 and 6, at the east end, were higher and straighter than the others, and were boxed-in by the application of wooden panels to their outsides. These were not sampled. Ties 1 –3 were sampled (Table 1), but tie 4 was assessed as having too few rings to make sampling worthwhile.

It was very quickly realised that all the other timbers used in the various roofs were all marginal from the dendrochronological point of view, all having relatively few rings, except for some of the ends of the ties, but these mostly could not be sampled because of the lack of room between the rafters and the narrow spaces where tiles had been removed. Nevertheless, it was felt appropriate, following on-site discussions, to sample some of the more promising timbers to both confirm the initial assessment, and in the hope that with sufficient samples with borderline numbers of rings, internal crossmatching might provide long enough chronologies for dating.

Results

Table 1 lists the timbers sampled from the north aisle, which are identified on Figure 2. Table 2 lists the timbers sampled from the remaining roofs (see Fig 2).

Only two samples, both tie beams from the north aisle, had sufficient rings to warrant further investigation (WHA02 and WHA03). The series from WHA03 contained two phases of rapid decline in ring-width, followed by slow recovery, consistent with the parent tree having been managed throughout its lifetime, or some periodic environmental effect such as insect defoliation of the tree. This series did not match WHA02, nor could it be dated independently.

Series WHA02 also showed a phase of rapid growth decline followed by slow recovery (Fig 3) and it was suspected that this tree too may have been managed. WHA02 (Tie 2) had an average growth rate of 2.42 mm and was subsequently dated to the period AD 1289 – 1383 (see Table 3). With the outermost couple of millimetres being lost from the complete sapwood on coring, the interpreted date of felling for this sample is AD 1384, or very soon thereafter.

Careful comparison of the plots of this series and those against which it matched, demonstrated that many showed a similar rapid decline in growth in the late AD 1320s and in AD 1330-31, though this is less well marked in the multi-sample site chronologies than the single sample WHA02 (Fig 3). The data for WHA02 are given in Table 4.

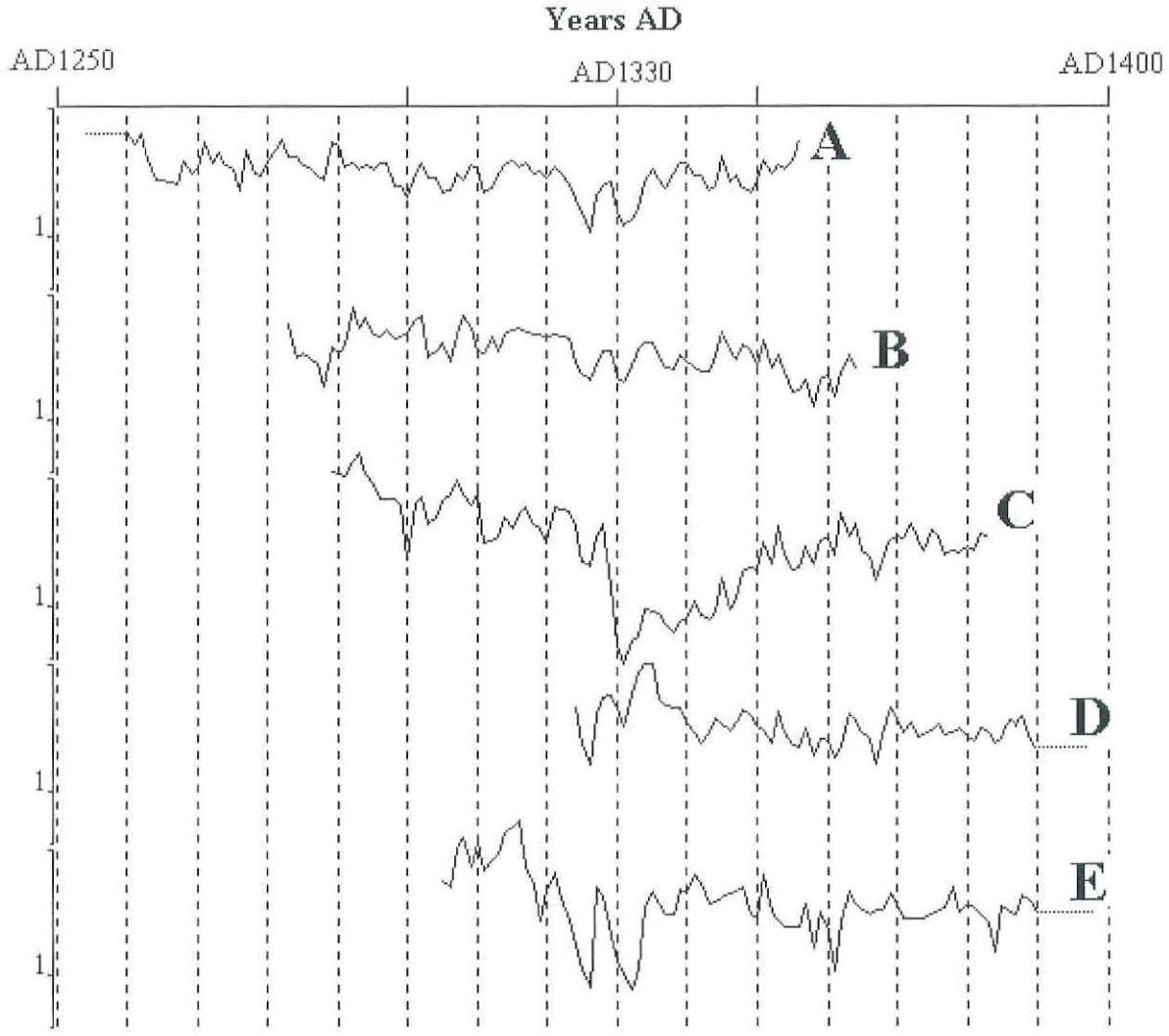

Figure 3: Ring-width plots of WHA02 (C) and other dated series, showing the rapid decline in growth in the late AD 1320s and AD 1330-31. The y axis (ring width in mm) has a logarithmic scale. A = Castle Acre, Norfolk (Tyers 2000), B = Little Wymondley, Hertfordshire (Bridge 2001b), D = Kingsbury Manor, Hertfordshire (Bridge 2002), and E = Saffron Walden, Essex (Bridge 2001a)

Table 1: Oak (*Quercus* spp.) timbers sampled from the north aisle at the church of All Saints, West Ham, London Borough of Newham. h/s is the heartwood-sapwood boundary. NA1 is the west end of the aisle, NA2 is the wagon roof at the east end of the aisle (see Fig 2). All rafters had rings starting within a few years of the pith

Sample number	Origin of core	Approx no of rings	Sapwood details
WHA01	Tie 3	41	-
WHA02	Tie 2	95	15
WHA03	Tie 1	110	h/s
WHNA1-04	Rafter 5 south	18	h/s
WHNA1-05	Rafter 4 south	27	h/s
WHNA1-06	Rafter 13 south	26	5
WHNA1-07	Rafter 18 south	18	h/s
WHNA2-01	Rafter 4 south	22	h/s

Table 2: Details of samples taken from the remaining roofs of the Church of All Saints, West Ham

Sample number	Origin of core	Approx no of rings	Sapwood details
North side of nave – numbered from west end			
WH-NV01	Outer wallplate, north side	35	h/s
WH-NV02	Rafter 6 north	33	h/s
WH-NV03	Rafter 9 north	22	h/s
South side of nave – numbered from east end			
WH-NVS01	Rafter 1 south	47	h/s
WH-NVS02	First principal rafter, south	35	h/s
WH-NVS03	Rafter 3 south	40	9
WH-NVS04	Rafter 8 south	31	h/s
WH-NVS05	Rafter 16 south	29	h/s
North side of south east chapel – numbered from east end			
WH-SE01	Rafter 4 north	35	h/s
WH-SE02	Rafter 6 north	18	h/s
WH-SE03	Rafter 9 north	20	h/s
WH-SE04	Principal rafter 4 north	44	4
South side of south aisle – numbered from west end			
WH-SA01	Rafter 23 south	20	3
WH-SA02	Rafter 24 south	16	h/s
WH-SA03	Rafter 30 south	19	h/s
WH-SA04	Rafter 46 south	23	h/s
WH-SA05	Rafter 45 south	32	h/s
WH-SA06	Rafter 48 south	30	-
WH-SA07	Rafter 52 south	22	-

Table 3: Dating of the oak sample WHA02

	WHA02 AD 1289 - 1383	
Dated reference or site master chronology	*t*-value	Overlap (yrs)
Hants97 (Miles pers comm)	4.5	95
London1175 (Tyers pers comm)	4.4	95
Odiham, Hampshire (Miles and Haddon-Reece 1996)	5.6	95
Castle Acre, Norfolk (Tyers 2000)	5.6	68
Kingsbury Manor, Hertfordshire (Bridge 2002)	5.5	60
Saffron Walden, Essex (Bridge 2001a)	5.4	79
Little Wymondley, Hertfordshire (Bridge 2001b)	5.4	76
Sutton House, Hackney, London (Tyers and Hibberd 1993)	4.7	65
Chicksands, Bedfordshire (Howard *et al* 1998)	4.5	95

Interpretation and Discussion

The single dated timber was felled several decades before the north aisle was thought to have been constructed. However, the date from a single timber needs careful interpretation. It may indeed indicate that the north aisle is older than had been thought, but further evidence needs to be sought to either support or reject this hypothesis. It could be that the timber was stockpiled before use, or was re-used from another location.

Once the remaining samples had been prepared it was found that none of them contained sufficient rings to justify subsequent analysis, and therefore no phases of these roofs were dated. This is an unusual situation with such a large number of timbers available from different phases of work. Although it is not uncommon for smaller structures of a single phase to have insufficient timbers for dating purposes, particularly in south east England, in high quality buildings with several phases, as in this case, one might reasonably expect to be able to date one or more phase of construction.

Acknowledgements

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Table 4: Ring-width data (x 0.01 mm) for the dated series WHA02, AD 1289-1383

520	507	502	594	662	513	446	377	375	379
346	176	358	380	277	299	362	396	468	396
347	409	220	223	236	294	264	312	339	275
259	219	339	329	317	270	172	165	237	274
127	61	48	64	68	95	92	89	79	71
80	85	104	87	84	93	140	95	110	151
158	157	218	166	269	184	157	161	205	166
221	229	187	311	235	272	196	183	138	171
232	241	230	277	231	195	251	233	188	198
193	206	194	239	231					