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Several roofs of this church were investigated. Dated timbers from the inner (east) north aisle roof, and inner (east) nave roof, along with a single wallplate from the outer (west) nave roof, appear to represent a single phase of construction. The likely felling date range of these timbers is in the period AD 1348-80. The remaining dated timbers from the outer (west) nave roof represent a second phase of roof construction, the likely felling date range of these timbers being in the period AD 1445-77.

Keywords

Dendrochronology
Standing Building

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Summary

Several roofs of this church were investigated. Dated timbers from the inner (east) north aisle roof, and inner (east) nave roof, along with a single wallplate from the outer (west) nave roof, appear to represent a single phase of construction. The likely felling date range of these timbers is in the period AD 1348–80. The remaining dated timbers from the outer (west) nave roof represent a second phase of roof construction, the likely felling date range of these timbers being in the period AD 1445–77.

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Introduction

This medieval parish church (NGR SU 646 151; Fig 1) was heavily restored in the late-nineteenth century, but retains a number of medieval roofs, and reconstructed roofs which may contain reused medieval timbers. A dendrochronological investigation of the accessible roofs was commissioned by English Heritage in order to help develop the chronology of the nave and aisle roofs as part of a wider recording study of the church, which is currently in receipt of grant-aided repairs.

The basic plan of the church (Fig 2) is based around a Saxon church of aisle-less nave and chancel which has had the addition of a two-bay north aisle in the late twelfth century, and a south aisle at around the same time. There have been several eastward extensions, notably to the chancel and both the north and south aisles, thought to be of thirteenth-century origin. This has created an 'inner nave' from the original chancel.

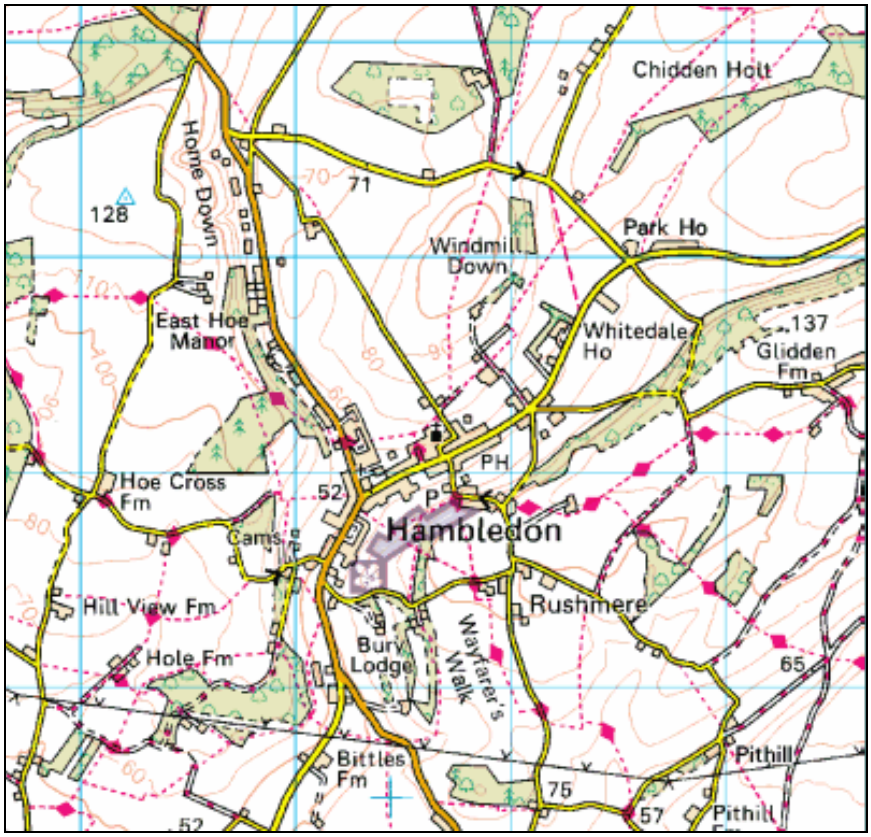

Figure 1: Map showing the location of the Church of St Peter and St Paul, Hambledon, Hampshire.

Methodology

The site was visited in July 2005. In the initial assessment, accessible oak timbers with more than 50 rings and traces of sapwood were sought. Those building 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 utilising a binocular microscope with the sample mounted on a travelling stage with a linear transducer linked to a PC, which recorded the ring widths into a dataset. The software used in measuring and subsequent analysis was written by Ian Tyers (1999). Cross-matching and dating was accomplished by a combination of visual matching and a process of qualified statistical comparison by computer. The ring-width series were compared for statistical cross-matching, using a variant of the Belfast CROS program (Baillie and Pilcher 1973). Ring sequences were plotted to allow visual comparisons to be made between sequences on a light table. This method provides a measure of quality control in identifying any errors in the measurements when the samples cross-match.

In comparing one sequence or site sequence against another, *t*-values over 3.5 are considered significant, although in reality it is common to find *t*-values of 4 and 5 which are demonstrably spurious because more than one matching position is indicated. For this reason, it is necessary to obtain some *t*-values of 5, 6, and higher, and for these to be well replicated from different, independent chronologies and with local and regional chronologies well represented, unless the timber is imported. Where two individual sequences match with a *t*-value of 10 or above, and visually exhibit exceptionally similar ring patterns, they most likely came from the same parent tree.

When cross-matching between samples is found, their ring-width sequences are averaged 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. This 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 measured rings in each sample. These dates require interpretation for the construction date of the phase under investigation to be determined. An important aspect of this interpretation is the estimate of the number of sapwood rings missing. The sapwood estimates used here are based on those proposed for this area by Miles (1997), in which 95% of oaks contain 9–41 rings. Where complete sapwood or bark is present, the exact date of tree felling may be determined.

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 reuse of timbers, construction in most historical periods took place within a very few years after felling (Salzman 1952; Hollstein 1965).

Results and Discussion

The outer (west) south aisle roof was investigated, but no timbers were assessed as having sufficient rings for dendrochronological dating, and therefore no sampling was undertaken in this roof. No access was available to the outer (west) north aisle roof. For the sampled areas of the outer (west) nave, the inner (east) north aisle and the inner (east) nave, roof areas, details of the samples are given in Table 1, and the locations or timbers sampled are illustrated, where possible, in Figures 2–9. Those timbers not illustrated are relatively easy to place: HMB13 is the equivalent brace to HMB10 at the other end of the tie; HMB17 is the tie against the west wall, just visible in the background in Figure 6; HMB23 and HMB24 are equivalent to HMB22 and HMB25, only on the truss to the west; and HMB26 is the equivalent post to the north post seen in Figure 8, only on the south side.

The inner (east) south aisle was not being worked on at the time of this visit, and was not readily accessible; it was therefore excluded from this study.

All timbers sampled were of oak (*Quercus* spp.). A number of samples had fewer rings than would normally be considered ideal for dendrochronology. They were, however, analysed as it was felt that the levels of replication at this site might allow shorter than usual sequences to be cross-matched successfully.

Cross-matching between the samples revealed that samples HMB 09 and 15, the two posts sitting on the ties in the inner north aisle and forming part of the partition wall between the aisle and the nave, were almost certainly from the same tree (t = 13.2). The two series were combined into a single sequence for subsequent analysis.

The remaining timbers fell into two broad groups, one of thirteen series, and one of six. The cross-matching amongst these groups is detailed in Tables 2 and 3. The larger group was combined into a site master sequence, HAMBLDN1, and the smaller group into a second site master, HAMBLDN2. One timber in the second group, HMB04, gave rather weak statistical matches with the other individuals, but its date was confirmed by it matching the working 5-timber mean of 1/2/6/29/31 with t=4.3 at the relevant date, and also matching individually to reference chronologies. In addition, the visual assessment of the plots confirmed that it was correctly positioned, and it was included in the site master.

The first site master was dated to the period AD 1269–1346, the dating evidence being presented in Table 4. The second site master was dated to the period AD 1343–1443, its dating evidence being shown in Table 5. The data for both series are shown in Table 6. The cross-matching positions of the dated timbers are shown in Figure 10, along with their interpreted likely felling date ranges.

It would appear that all the dated timbers from the inner north aisle and the inner nave roof, along with a wallplate in the outer nave roof, form a single group of timbers felled at the same time, and represent a single phase of construction. The mean heartwood-sapwood boundary date for this group of thirteen series is AD 1339 (including the possible heartwood-sapwood boundary on HMB19), giving a most likely felling date range of AD 1348–80. With no complete sapwood on the timbers, it is not possible to say whether the north inner aisle roof and the inner nave roof are exactly coeval, or whether one is a few years later than the other, but the fourteenth-century dates for them are a little later than had been suggested as their possible construction date in the thirteenth-century.

The wallplate in the outer nave roof could represent a reused piece of timber, or may be a remnant of a once coeval roof over this area, which was replaced at a later date. The outer nave roof was constructed from a group of timbers with a most likely felling date range,

based on a mean heartwood-sapwood boundary date of AD 1436, of AD 1445–77. This area may therefore have been roofed at the same time as the other areas investigated, and then re-roofed around a century later, or the present roof may just have incorporated a piece of fourteenth-century timber as a wallplate when built. Other studies of the fabric may throw more light on this issue.

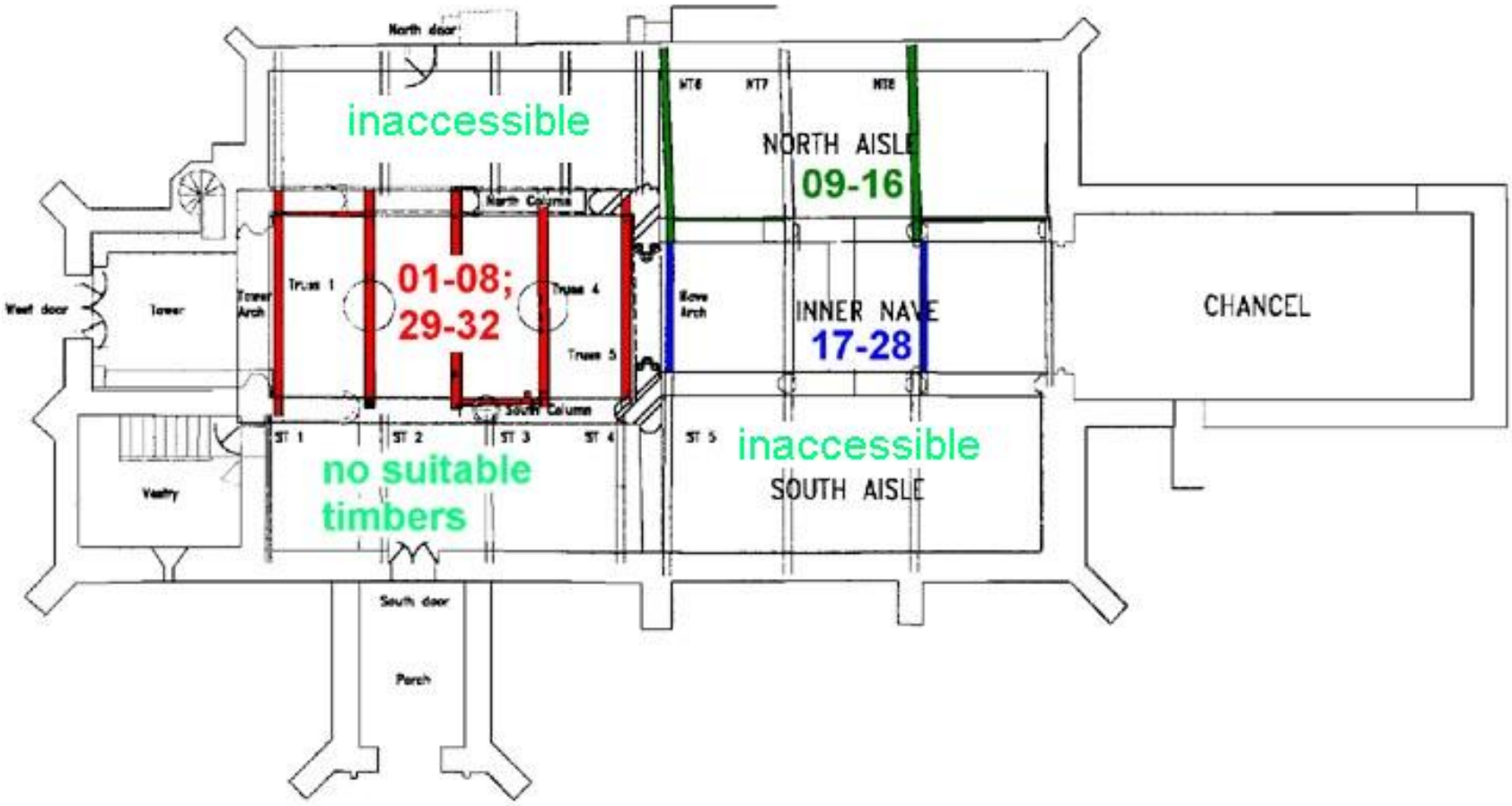

Figure 2: Plan of the church, showing the areas investigated and the sample numbers relevant to each roof

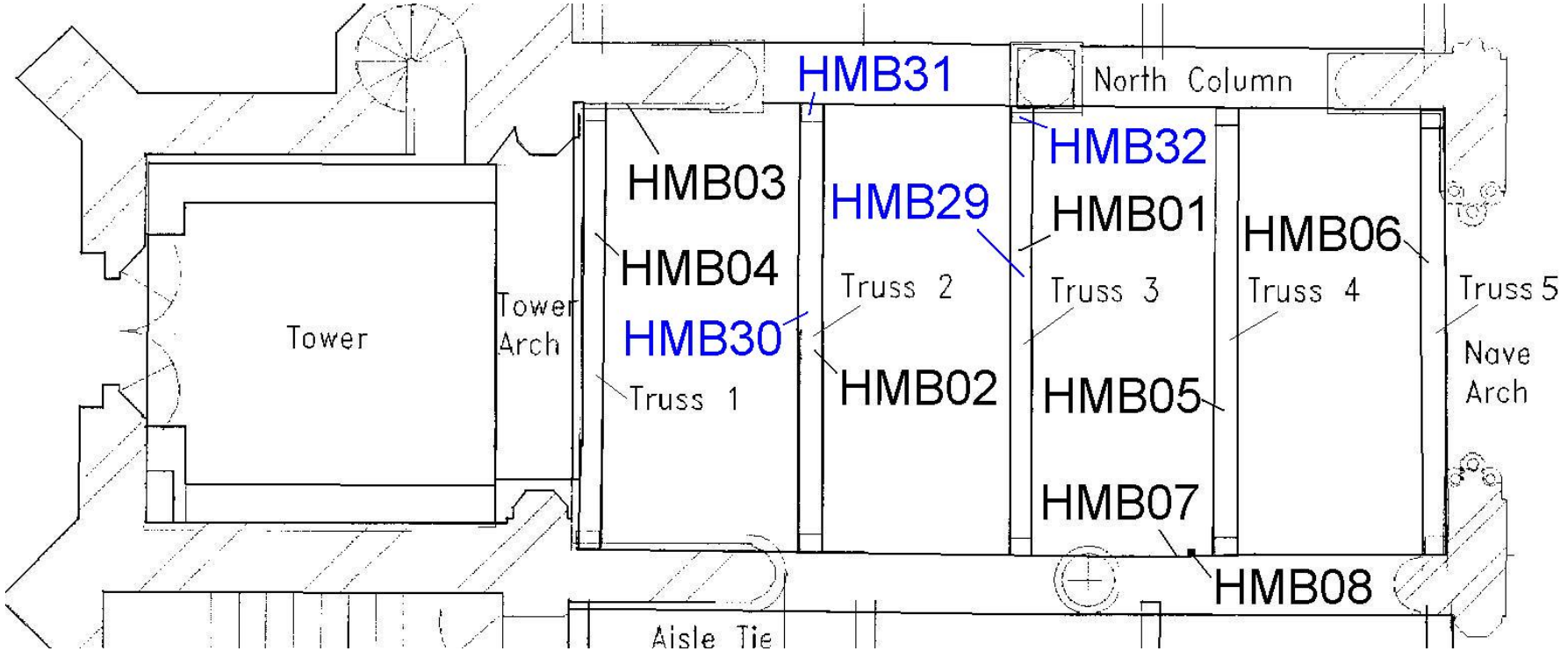

Figure 3: Plan of the outer (west) nave roof showing the locations of timbers sampled for dendrochronology. Those numbered in black are at tiebeam level, whilst those in blue are above tiebeam height. Adapted from an original drawing by G E Robertson

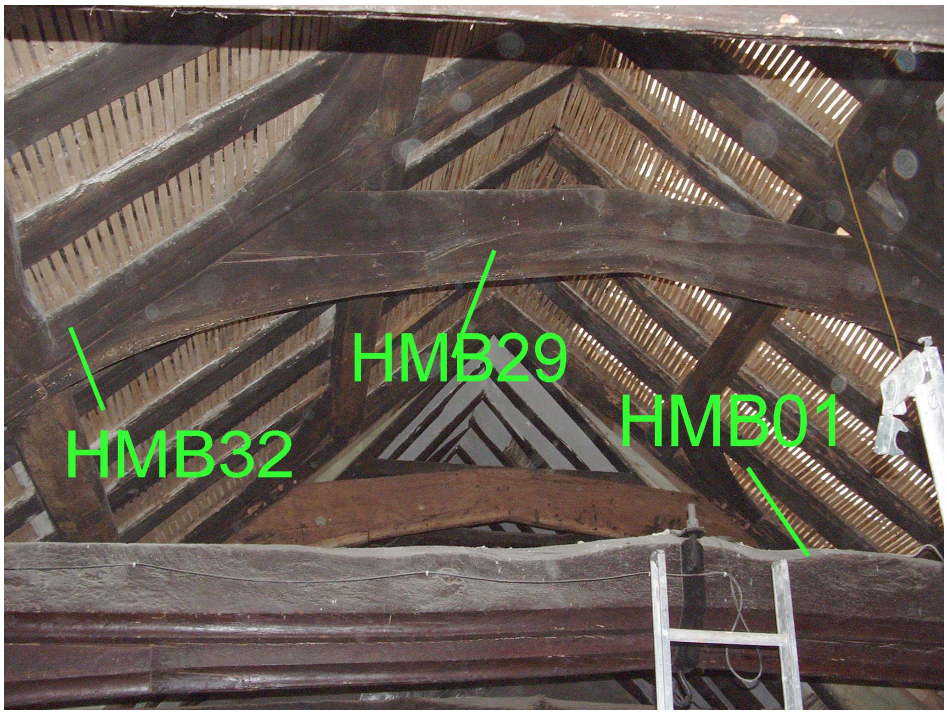

Figure 4: Outer nave roof, looking east, showing the timbers sampled from the middle truss

Figure 5: Inner north aisle roof, looking south-east towards the inner nave, showing timbers sampled

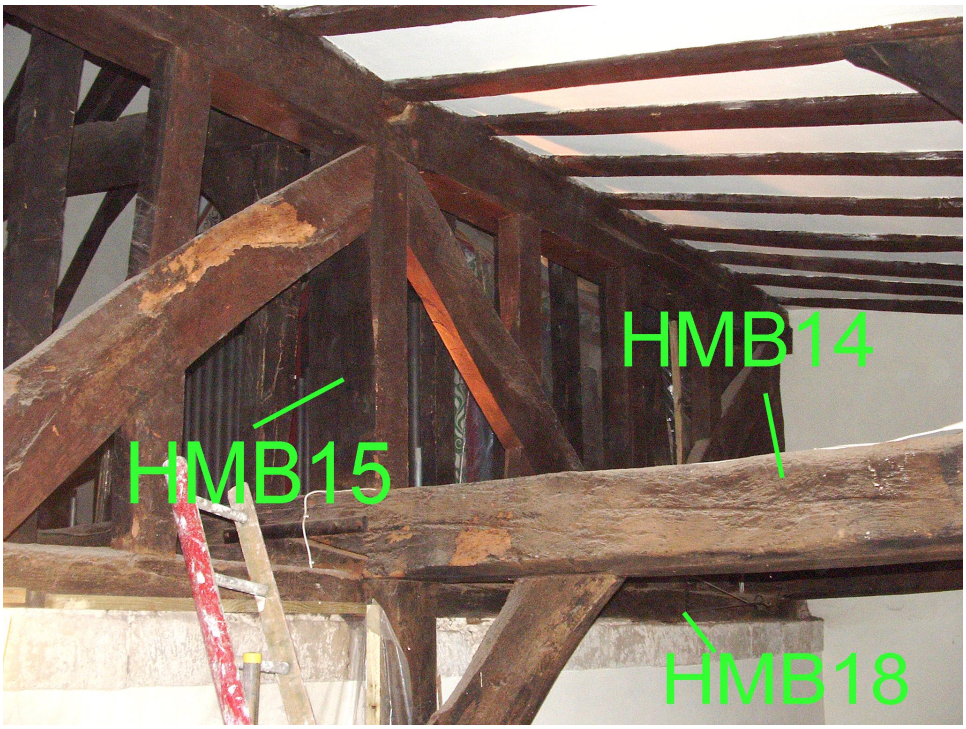

Figure 6: Inner north aisle roof, looking south-west towards the inner nave and organ, showing the timbers sampled

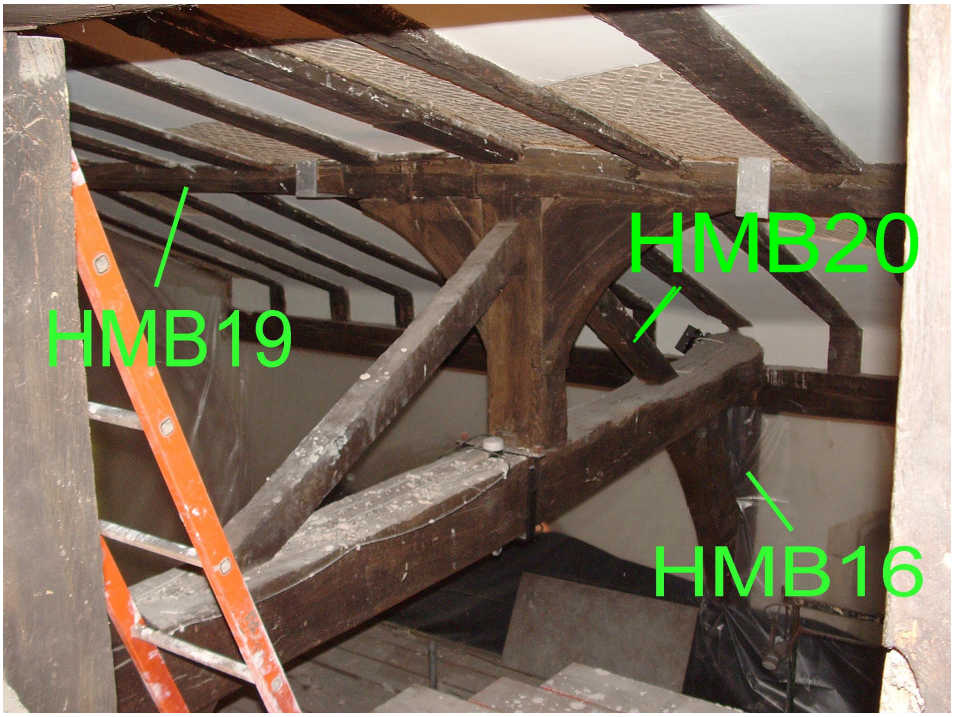

Figure 7: Inner north aisle roof looking north-west from the inner nave, showing timbers sampled

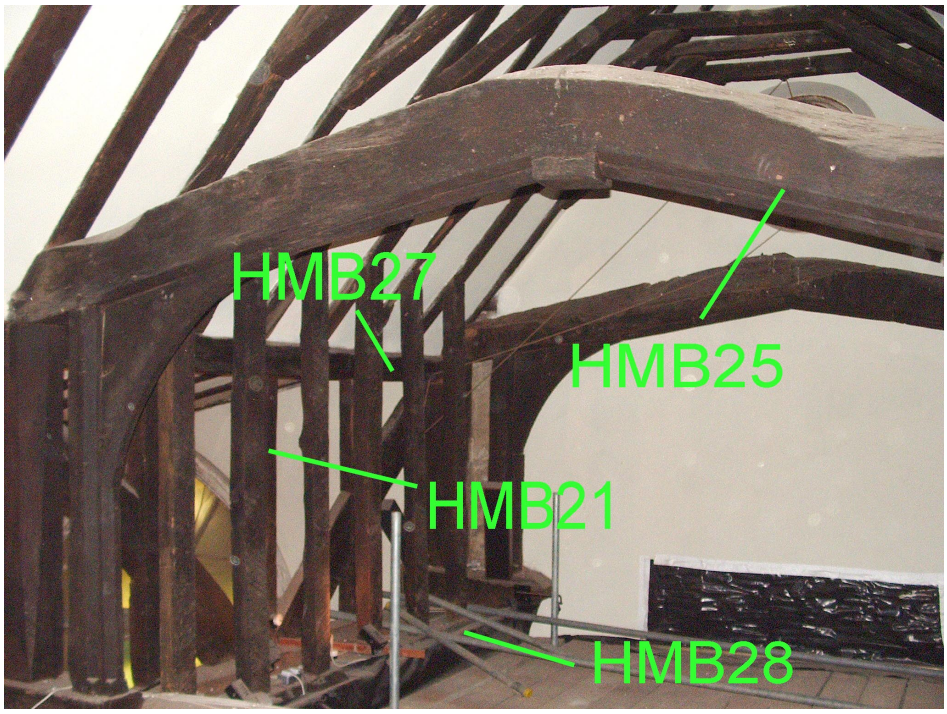

Figure 8: Inner nave, looking north-east, showing timbers sampled

Figure 9: Inner nave, looking north-east, showing the tiebeam sampled

Table 1: Details of oak (*Quercus* spp.) timbers sampled from the Church of St Peter and St Paul, Hambledon, Hampshire

Sample Number	Timber and position	No of rings	Mean width (mm)	Mean sens (mm)	Dates AD Spanning	H/S bdry AD	Sapwood complement	Felling seasons and dates/date ranges (AD)
Outer (west) nave roof								
HMB01	Tiebeam, truss 3	47	2.59	0.20	1396–1442	1442	H/S	1451–83
HMB02	Tiebeam, truss 2	58	3.36	0.21	1386–1443	1443	H/S	1452–84
HMB03	Inner wallplate, bay 1 north	98	1.95	0.18	undated		H/S	unknown
HMB04	Tiebeam, truss 1	56	1.49	0.25	1372–1427	1427	H/S	1436–68
HMB05	Tiebeam, truss 4	<45	NM	-	undated		H/S	unknown
HMB06	Tiebeam, truss 5	65	1.96	0.21	1378–1442	1440	2	1449–81
HMB07	Inner wallplate, bay 3 south	88*	1.74	0.24	1258–1345	1345	H/S	1354–86
HMB08	Ashlar piece, bay 3 south	77	1.40	0.20	undated		27	unknown
HMB29	Collar, truss 3	48	2.46	0.17	1385–1432	1432	H/S	1441–73
HMB30	Collar, truss 2	<45	NM	-	undated		H/S	unknown
HMB31	Principal rafter 2 north	88	2.02	0.25	1343–1430	1430	H/S	1439–71
HMB32	Principal rafter 3 north	<45	NM	-	undated		H/S	unknown
North inner (east) aisle roof								
HMB09	East post on east tie	67	3.44	0.28	1280–1346	1346	H/S	1355–87
HMB10	South brace to east tiebeam	59	2.42	0.14	undated		H/S	unknown
HMB11	South wallplate, east end bay	64	2.15	0.22	1273–1336	1336	H/S	1345–77
HMB12	East tiebeam	65	2.29	0.22	undated		H/S	unknown

* only the outer 62 rings of HMB07 were used in subsequent analysis as the early rings showed a marked growth decline

Continued..

Table 1 continued:

Sample Number	Timber and position	No of rings	Mean width (mm)	Mean sens (mm)	Dates AD Spanning	H/S bdry AD	Sapwood complement	Felling seasons and dates/date ranges (AD)
North inner (east) aisle roof - continued								
HMB13	North brace to east tiebeam	44	1.60	0.20	1295–1338	1338	H/S	1347–79
HMB14	West tiebeam	71	2.34	0.23	1269–1339	1339	H/S	1348–80
HMB15	Post on west tiebeam	62	3.10	0.20	1284–1345	1345	H/S	1354–86
HMB16	Post supporting north end of west tiebeam	<45	NM	-	undated		H/S	unknown
HMB17	Tiebeam at west end	54	2.41	0.27	1286–1339	1339	H/S	1348–80
HMB18	South wallplate at west end	64	1.50	0.19	1279–1342	1342	H/S	1351–83
HMB19	Purlin in west bay	50	2.42	0.26	1282–1331	?1331	?H/S	1340–72?
HMB20	North king-post brace on west tie	47	3.17	0.19	1290–1336	1336	H/S	1345–77
Inner nave roof								
HMB21	Central post, east bay	70	1.83	0.18	1274–1343	1343	H/S	1352–84
HMB22	East tie	<45	NM	-	undated			unknown
HMB23	West tie	45	2.13	0.19	1290–1334	1334	H/S	1343–75
HMB24	West upper tie	51	1.91	0.18	1290–1340	1340	H/S	1349–81
HMB25	East upper tie	<45	NM	-	undated			unknown
HMB26	South post to raised east end truss	55	1.94	0.19	1285–1339	1339	H/S	1348–80
HMB27	Upper wallplate at north east end	<45	NM	-	undated			unknown
HMB28	Lower wallplate at north east end	<45	NM	-	undated			unknown

Key: h/s bdry = heartwood/sapwood boundary - last heartwood ring date; mean sens = mean sensitivity. Sapwood estimate of 9–41 used (Miles 1997).

Table 2: Cross-matching between the dated timbers in site chronology **HAMBLDN1**

	t-values												
Sample	**HMB09**	**HMB11**	**HMB13**	**HMB14**	**HMB15**	**HMB17**	**HMB18**	**HMB19**	**HMB20**	**HMB21**	**HMB23**	**HMB24**	**HMB26**
HMB07o	4.1	4.5	4.3	5.0	3.1	4.7	3.6	-	5.2	**-**	4.2	-	3.1
HMB09		7.0	5.7	4.4	13.2	6.4	5.2	5.8	7.9	3.1	5.6	5.3	5.0
HMB11			4.6	6.7	6.0	4.3	3.8	4.0	6.5	4.2	5.0	5.0	4.6
HMB13				-	3.3	-	-	*	5.1	-	3.5	4.6	3.1
HMB14					3.2	-	3.3	-	4.4	-	4.5	4.4	-
HMB15						6.1	5.1	5.9	6.2	3.7	5.9	4.6	5.7
HMB17							3.8	5.0	6.9	-	4.6	-	4.7
HMB18								3.2	3.9	4.4	3.2	4.9	5.2
HMB19									4.4	-	6.2	3.4	6.4
HMB20										4.1	7.4	6.3	5.8
HMB21											3.9	6.0	4.1
HMB23												5.8	6.0
HMB24													5.1

Table 3: Cross-matching between the dated timbers in site chronology **HAMBLDN2**

	t-values				
Sample no	**HMB02**	**HMB04**	**HMB06**	**HMB29**	**HMB31**
HMB01	4.2	3.2	4.3	6.5	4.2
HMB02		3.6	4.5	4.0	6.7
HMB04			-	-	-
HMB06				4.2	5.7
HMB29					5.3

Key: - = no significant overlap

Table 4: Dating evidence for the site chronology **HAMBLDN1,** AD 1269–1346 (regional multi-site chronologies have the file name in **bold**)

County/ region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning: (yrs AD)*	*Overlap (yrs)*	*t-value*
London	Blackfriar's Wreck	(Tyers 1992)	BLFRIAR3	1267–1369	78	5.7
Berkshire	Round Tower, Windsor Castle	(Haddon-Reece *et al* 1990)	WINDSOR	1231–1354	78	5.5
Hampshire	Hampshire Master Chronology	(Miles 2003)	**HANTS02**	443–1972	78	5.5
London	London Master Chronology	(Tyers pers comm)	**LONDON**	413–1728	78	5.4
Surrey	Home Farm, Newdigate	(Bridge 1998)	NEWDIG1	1261–1483	78	5.3
Hampshire	Titchfield Tithe Barn	(Miles and Worthington 1998)	TITCH3	1311–1408	78	5.2
West Sussex	Snoxalls, Rudgwick	(Miles and Worthington 2002)	SNOXALL	1284–1337	54	5.2
Hampshire	Old Vicarage, Odiham	(Miles and Worthington 2000)	ODIHAMOV	1295–1395	52	5.1
Kent	Manor House, Fordwich	(Arnold and Litton 2003)	KMFASQ01	1264–1556	78	4.9
Hertfordshire	Priory Barn, Lt Wymondley	(Bridge 2001)	LWYMON1	1283–1364	64	4.8

Table 5: Dating evidence for the site chronology **HAMBLDN2,** AD 1343–1443 (regional multi-site chronologies have the file name in **bold**)

County/ region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning: (yrs AD)*	*Overlap (yrs)*	*t-value*
Somerset	Old Post Office, Luccombe	(Miles *et al* 2003)	LUCCOMBE	1380–1436	57	6.9
Herefordshire	Cradley Village Hall	(Miles *et al* 2004)	CRADLEY	1347–1530	97	6.8
Northern England	Northern England Master	(Hillam and Groves 1994)	**NORTH**	440–1742	101	6.5
Hampshire	Abbots Barton	(Miles and Worthington 1998)	ABTSBRTN	1387–1559	57	6.4
Devon	Prowse Barn	(Tyers *et al* 1997)	PROWSEBN	1380–1473	64	6.3
Hampshire	St Olaf's Pond Cottage, Wonston	(Miles and Worthington 1997)	STOLAFS	1376–1535	68	6.3
Hampshire	Great Hall, Winchester	(Bridge 2000)	WINCHGH	1379–1451	65	6.3
Shropshire	Newport Guildhall	(Miles and Haddon-Reece 1993)	NEWPORT2	1361–1545	83	6.3
Hampshire	Garden Cottage, West Meon	(Miles and Worthington 1997)	GARDENCT	1360–1440	81	6.2
Hampshire	Hampshire Master Chronology	(Miles 2003)	**HANTS02**	443–1972	101	6.2

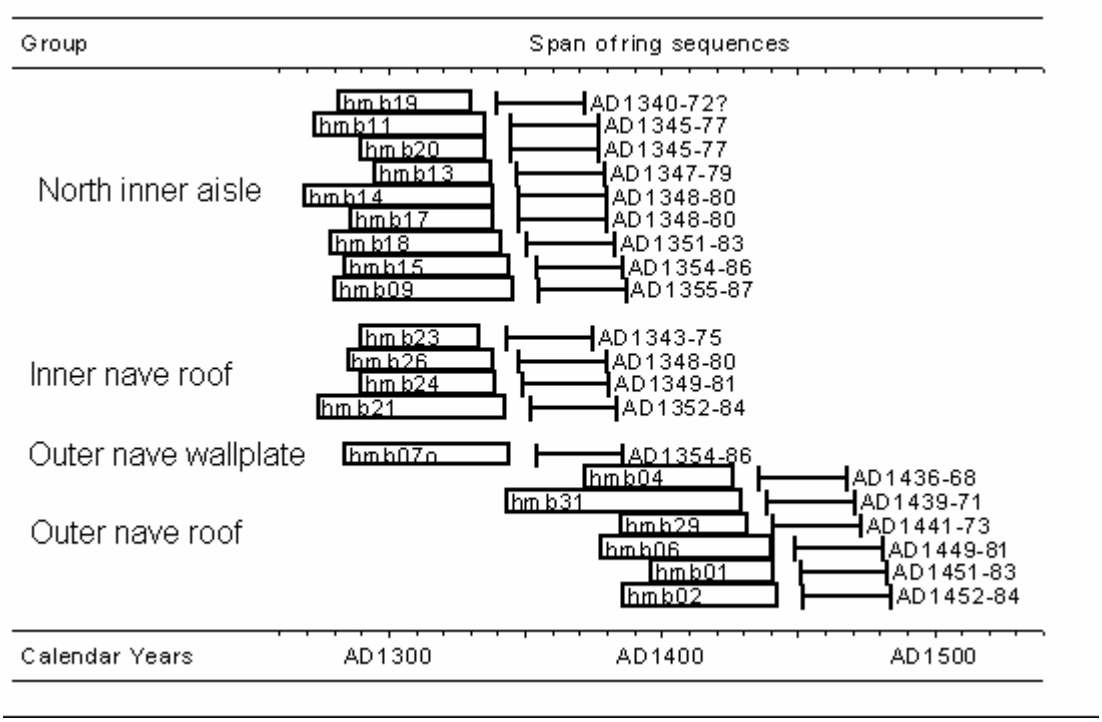

Figure 10: Bar diagram showing the relative positions of overlap of the dated timbers, along with their interpreted likely felling dates

Acknowledgements

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Table 6: Data for the two site chronologies formed from roof timbers at Hambledon church

Ring widths (0.01mm)										no of trees									
HAMBLDN1 AD 1269–1346																			
295	496	418	263	395	343	421	390	428	345	1	1	1	1	2	3	3	3	3	3
442	332	384	330	438	362	380	377	322	263	4	5	5	6	6	7	8	9	9	9
355	385	417	401	319	270	264	192	181	159	9	12	12	12	12	12	13	13	13	13
148	186	242	246	179	200	245	196	208	168	13	13	13	13	13	13	13	13	13	13
121	120	184	202	189	174	236	271	203	185	13	13	13	13	13	13	13	13	13	13
146	103	147	128	151	168	168	182	212	201	13	13	13	13	13	13	13	13	13	13
211	112	112	150	175	201	162	196	140	180	13	13	13	12	12	12	11	11	9	9
211	169	180	178	171	193	191	143			8	5	4	4	3	2	2	1		
HAMBLDN2 AD 1343–1443																			
409	502	266	211	181	211	103	59	290	127	1	1	1	1	1	1	1	1	1	1
182	109	88	108	88	95	75	59	78	98	1	1	1	1	1	1	1	1	1	1
109	120	70	143	115	162	176	139	123	183	1	1	1	1	1	1	1	1	1	2
148	158	124	131	169	282	292	298	237	268	2	2	2	2	2	3	3	3	3	3
251	276	315	399	377	305	288	257	288	204	3	3	4	5	5	5	5	5	5	5
245	216	248	307	246	281	320	304	298	247	5	5	5	6	6	6	6	6	6	6
272	270	333	259	225	239	199	196	197	214	6	6	6	6	6	6	6	6	6	6
212	212	215	181	208	259	152	274	190	154	6	6	6	6	6	6	6	6	6	6
263	248	233	195	153	218	193	151	179	256	6	6	6	6	6	5	5	5	4	4
199	164	174	115	110	132	134	136	174	207	3	3	3	3	3	3	3	3	3	3
195										1									