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Summary

Four cruck blades with incomplete sapwood were initally sampled from the barn at Court Farm, Church Lane, Winterbourne, Gloucestershire (ST 641 808) in 1991 by Roland Harris. These were analysed by Jennifer Hillam of the Sheffield Dendrochronology Laboratory who produced a felling date range of AD 1326-68. To supplement and enhance this date range, these four cruck blades were re-sampled in March 2000 together with six additional primary-phase timbers, all ten retaining virtually complete sapwood. Although some degradation of the outer surface of some of the samples has produced a very narrow date range of one or two years, all were consistent with the latest precise felling date of spring AD 1342.

Keywords

Dendrochronology
Standing Building

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THE TREE-RING DATING OF
COURT FARM BARN, CHURCH LANE,
WINTERBOURNE, GLOUCESTERSHIRE

1. INTRODUCTION AND OBJECTIVES

In its original extent, the barn at Court Farm, Church Lane, Winterbourne (ST 642 809; Figs 1 and 2), was probably of 11 bays, and at least 143 ft (43m) long by 26 ft (8m) wide internally, although it might have stretched to 12 bays on symmetry grounds. It would also have had two great porches originally, but the building has now been reduced to 7 bays and one porch, with 6 roof trusses (Fig 3). The trusses are outstanding examples of raised crucks with strongly-elbowed cruck blades, raised about 9 ft (2.7m) off the ground and standing on timber pads built into the wall. The crucks carry arch-braced collars and rise to saddles supporting the square-set ridge piece 31 ft (10m) above the floor (Fig 4). One of the trusses is slightly shorter and employs a short king post above the saddle to support the ridge. There are two sets of purlins, with wind braces to the lower set. They are tenoned into the blades either side of the cross-entry, but are trenched into the backs of the crucks, or packing pieces, on the other trusses. Most of the original rafters survive. An interesting set of assembly marks survive on the cruck structure (Fig 5).

The building was initially sampled in 1991 by Roland Harris and cores were taken from four cruck blades. Despite multiple borings being taken, none of the sapwood was retrieved intact (Harris 1991). The cores were submitted to the Sheffield Dendrochronology Laboratory and the analysis was undertaken by Jennifer Hillam (Hillam 1991). All four samples were dated and an estimated felling date range of AD 1326-68 was produced, based on a sapwood estimate of 10-55 years (Hillam *et al* 1987). The summary of these results were published in the journal *Vernacular Architecture* (Hillam and Groves 1992).

During the intervening decade, the building continued to decay, and was supported by scaffolding internally and protected by an independent temporary roof. In advance of proposed grant-aided conservation work, the architectural significance of the building was reviewed by Dr Nat Alcock who recommended that additional tree-ring sampling be undertaken to try and ascertain a precise date for the felling of the timbers (Alcock 1997). The dating was commissioned by the Ancient Monuments Laboratory of English Heritage following a request from Mr Arnold Root, Historic Buildings Architect for the South West Regional Team. Thus, this report supersedes that of Hillam 1991.

2. METHODOLOGY

The roof was assessed for tree-ring dating, and given that a basic tree-ring chronology already existed for this building, the sampling strategy concentrated solely on those primary-phase timbers retaining complete sapwood. Sampling was carried out with a 16mm hollow coring bit and access was from the temporary support framework upon which boards were placed as required.

The dry samples were sanded on a linisher using 60 to 1200 grit abrasive paper, and were cleaned with compressed air, to allow the ring boundaries to be clearly distinguished. They were then measured under a x10/x30 microscope using a travelling stage electronically displaying displacement to a precision of 0.001mm, rounded to the nearest 0.01mm.

After measurement, the ring-width series for each sample was plotted as a graph of width against year on log-linear graph paper. The graphs of each of the samples in the phase under study are then compared visually at the positions indicated by the computer matching and, if found satisfactory and consistent, are averaged to form a mean curve for the site or phase. This mean curve and any unmatched individual sequences are compared against dated reference chronologies to obtain an absolute calendar date for each sequence.

Here this was accomplished by using a combination of both visual matching and a process of qualified statistical comparison by computer. The tree-ring curves were first matched visually, and then independently matched by computer. The ring-width series were compared on an IBM compatible 486SX computer for statistical cross-matching using a variant of the Belfast CROS program (Baillie and Pilcher 1973). A version of this and other programmes were written in BASIC by D Haddon-Reece, and latterly re-written in Microsoft Visual Basic by M R Allwright and P A Parker.

Once a tree-ring sequence has been firmly dated in time, a felling date, or date range, is ascribed where possible. With samples which have sapwood complete to the underside of, or including bark, this process is relatively straight forward. Depending on the completeness of the final ring, ie if it has only the spring vessels or early wood formed, or the latewood or summer growth, a *precise felling date and season* can be given. If the sapwood is partially missing, or if only a heartwood/sapwood transition boundary survives, then an *estimated felling date range* can be given for each sample. The number of sapwood rings can be estimated by using a statistically derived sapwood estimate with a given confidence limit. An accepted sapwood estimate for British and Irish oaks is given as between 10 and 55 rings with a 95% confidence range (Hillam *et al* 1987), as used in the previous analysis. A recent review of the geographical distribution of dated sapwood data from historic building timbers has shown that a 95% range of 9-41 rings is more appropriate for the southern part of England (Miles 1997a).

3. RESULTS

Altogether ten timbers were sampled, the locations and details of which are shown in Table 1 and Figures 6 - 9. In this report the trusses are numbered 1 - 6 from east to west following that used by Ferguson and Mann in 1992, whereas the numbering used in the previous tree-ring report (Hillam 1991) was A - F from west to east. The first four samples were taken from the same timbers sampled in 1991, but this time preserving the sapwood complete. These have been given the same sample numbers as those taken by Roland Harris, with those analysed by Sheffield being given the suffix 'a', and those taken as part of the current programme being given the suffix 'b'. A further six timbers were sampled from various sections of the structure, with purlins and collars being selected as well as crucks.

One sample from the north lower purlin in bay 5 (***wtb6a***) broke part way through the sapwood during coring, and a second sample (***wtb6b***) was taken to ensure the break was clean and the ring sequence was measured correctly. The ring measurements from these two were compared together and matched with a *t*-value of 4.74 and an overlap of 20 rings. The mean of these two sequences, ***wtb6***, was formed and this was used in all subsequent analysis.

Similarly, the ring sequences from the first four samples processed by Jennifer Hillam were combined with those with complete sapwood taken during the present dendrochronology programme into single sequences. Thus sample ***wtb1a*** matched with ***wtb1b*** with a *t*-value of 12.51 and an overlap of 106 rings, and combined to form the mean ***wtb1***. Sample ***wtb2a*** matched with ***wtb2b*** with a *t*-value of 14.34 and an overlap of 127 rings, and combined to form the mean ***wtb2***. Sample ***wtb3a*** matched with ***wtb3b*** with a *t*-value of 12.63 and an overlap of 115 rings, and combined to form the mean ***wtb3***. And finally, sample ***wtb4a*** matched with ***wtb4b*** with a *t*-value of 16.69 and an overlap of 107 rings, and combined to form the mean ***wtb4***.

Although all ten timbers sampled retained complete sapwood, the surface of the timber had degraded somewhat being exposed to the damp atmosphere, resulting in the surface being slightly 'furry' and soft. Whilst it is unlikely that no more than one or two rings were lost through this erosion, a felling date range of three years has been added to the last complete ring on these samples.

All ten samples matched together satisfactorily (Table 2) and were combined to form the site master ***WNTERBRN*** of 165 rings (Table 3). This was compared with the reference chronologies and found to date, spanning the years AD 1177-1341 (Table 4).

Generally, *t*-value matches greater than 10 between samples are considered to have originated from the same tree. As will be noted in Table 2, there are a number of matches which fall into this category. Although most of the timbers have been converted from heart-sawn or halved trees (Fig 10), the clustering of high *t*-value matches would suggest that two crucks along with two purlins and a collar might all have originated from the same tree, which is unlikely when comparing the shape of the timbers themselves. While it is quite possible that the two purlins ***wtb6*** and ***wtb8*** originated from the same tree, as did the two crucks ***wtb3*** and ***wtb5*** from truss 3, most of the other matches from the other timbers making up the site master exhibited higher than average correlation, typical of timbers originating from a single woodland of slow-grown unmanaged trees. Furthermore, the four actual same-tree matches which were produced by comparing the original samples processed by Jennifer Hillam with the duplicate samples taken from the same timbers, the *t*-values were all markedly higher, ranging from 12.5 to 16.69. Therefore, it was decided not to try and combine groups of high-matching samples before constructing the site master unless there was clear physical evidence of them having originated from the same tree.

4. CONCLUSIONS

Of the ten timbers sampled, three produced precise felling dates. Sample ***wtb6*** from the north lower purlin from bay 5 was felled during the winter of AD 1340/41, sample ***wtb1*** from the north cruck of truss 1 was felled during the summer/autumn of AD 1341, and sample ***wtb5*** from the north cruck of truss 3 was felled in the spring of AD 1342. The other seven timbers had complete sapwood which had suffered from some degree of slight surface erosion, three having been felled between AD 1339 and AD 1341, and four from between AD 1340 and AD 1342 (Fig 11). Therefore, given that the timber was used green, a construction date of during AD 1342 or immediately thereafter is proposed for the construction of Court Farm Barn.

The timbers were almost all found to have originated from slow-grown trees between 150 and 200 years growth, although some faster-grown timbers were noted but not sampled. This suggests that the slower-grown timbers which were sampled came from a single homogeneous woodland area, whilst the other faster-grown timbers came from a different source where the woodland was more managed.

The additional ten samples from the building has significantly increased the matches with the reference chronologies (Table 4), and has produced a well-replicated chronology for the Bristol / Forest of Dean area.

5. ACKNOWLEDGEMENTS

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Table 1: Summary of tree-ring dating

Sample number & type		Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges (AD)
COURT FARM BARN, CHURCH LANE, WINTERBOURNE, GLOUCESTERSHIRE										
† ***wtb1a***	c	N cruck T1 (Sheffield ***w1***)	1199-1311			113	1.42	0.76	0.238	
wtb1b	c	N cruck T1 (Oxford)	1206-1340	1317	23½C	135	1.52	0.56	0.211	
* ***wtb1***		mean of ***wtb1a*** + ***wtb1b***	*1199-1340*	*1317*	*23½C*	*142*	*1.52*	*0.67*	*0.210*	*Summer 1341*
† ***wtb2a***	c	S cruck T5 (Sheffield ***w2***)	1187-1313	1313	H/S	127	1.54	1.04	0.252	
wtb2b	c	S cruck T5 (Oxford)	1187-1338	1306	32	152	1.39	0.99	0.205	
* ***wtb2***		mean of ***wtb2a*** + ***wtb2b***	*1187-1338*	*1310*	*28*	*152*	*1.40*	*0.99*	*0.213*	*1339-1341*
† ***wtb3a***	c	S cruck T3 (Sheffield ***w3***)	1200-1316		H/S ?	117	1.34	0.60	0.247	
wtb3b	c	S cruck T3 (Oxford)	1202-1339	1308	31	138	1.44	0.47	0.227	
* ***wtb3***		mean of ***wtb3a*** + ***wtb3b***	*1200-1339*	*1312*	*27*	*140*	*1.40*	*0.51*	*0.224*	*1340-1342*
† ***wtb4a***	c	N cruck T5 (Sheffield ***w4***)	1208-1314			107	1.46	1.00	0.267	
wtb4b	c	N cruck T5 (Oxford)	1187-1338	1316	22	152	1.46	0.93	0.242	
* ***wtb4***		mean of ***wtb4a*** + ***wtb4b***	*1187-1338*	*1316*	*22*	*152*	*1.49*	*0.96*	*0.248*	*1339-1341*
* ***wtb5***	c	N cruck T3	1199-1341	1315	26¼C	143	1.52	0.55	0.184	Spring 1342
wtb6a	c	N lower purlin bay 5	1195-1340	1323	17C	146	1.12	0.68	0.181	
wtb6b	c	ditto	1321-1340	1320	20C	20	0.78	0.20	0.243	
* ***wtb6***		mean of ***wtb6a*** + ***wtb6b***	*1195-1340*	*1322*	*18C*	*146*	*1.11*	*0.68*	*0.179*	*Winter 1340/41*
* ***wtb7***	c	Collar T5	1224-1339	1308	31	116	1.50	0.75	0.212	1340-1342
* ***wtb8***	c	N lower purlin bay 6	1189-1338	1326	12	150	0.90	0.53	0.188	1339-1341
* ***wtb9***	c	N cruck T6	1195-1339	1306	33	145	1.07	0.46	0.276	1340-1342
* ***wtb10***	c	Collar T6	1177-1339	1322	17	163	1.05	0.75	0.236	1340-1342
† = *WNTERBR1* 4-Timber Site Master (Sheffield)			**1187-1316**			**130**	**1.59**	**0.90**	**0.198**	
*** = *WNTERBRN* Site Master**			**1177-1341**			**165**	**1.42**	**0.68**	**0.173**	

Key: *, † = sample included in site-master; c = core; = pith included in sample; ¼C, ½C, C = bark edge present, partial or complete ring: ¼C = spring (ring not measured), ½C = summer/autumn, or C = winter felling (ring measured); H/S bdry = heartwood/sapwood boundary - last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity

Table 2: Matrix of *t*-values and overlaps for components of ***WNTERBRN***

Sample:	***wtb2***	***wtb3***	***wtb4***	***wtb5***	***wtb6***	***wtb7***	***wtb8***	***wtb9***	***wtb10***
Last ring date AD:	1338	1339	1338	1341	1340	1339	1338	1339	1339
wtb1	8.92 / 140	6.31 / 140	7.07 / 140	6.98 / 142	8.12 / 142	6.47 / 116	7.20 / 140	7.71 / 141	6.11 / 141
wtb2		4.05 / 139	8.24 / 152	4.97 / 140	7.06 / 144	7.82 / 115	5.58 / 150	7.11 / 144	5.30 / 152
wtb3			9.85 / 139	11.40 / 140	8.39 / 140	8.13 / 116	8.14 / 139	9.80 / 140	5.89 / 140
wtb4				8.18 / 140	10.12 / 144	9.30 / 115	8.79 / 150	12.00 / 144	7.04 / 152
wtb5					5.94 / 142	6.72 / 116	5.98 / 140	9.52 / 141	5.94 / 141
wtb6						7.18 / 116	12.11 / 144	9.32 / 145	7.27 / 145
wtb7							5.98 / 115	10.87 / 116	7.75 / 116
wtb8								9.04 / 144	9.14 / 150
wtb9									9.01 / 145

Table 3: Ring-width data for site master curve

WNTERBRN AD 1177-1341 Court Farm Barn, Church Lane, Winterbourne, Gloucestershire - mean of samples ***wtb1*** - ***wtb10***

165 rings, starting date AD 1177

ring widths (0.01mm)

246	306	366	215	244	281	274	188	243	241
318	140	222	288	254	292	318	275	277	267
248	208	184	285	325	265	208	186	192	217
126	214	178	213	159	170	181	171	193	198
249	176	185	205	209	144	135	181	183	224
165	227	201	138	106	100	128	137	142	114
193	164	144	142	121	112	167	141	144	133
140	98	106	123	132	106	166	123	173	140
105	78	97	123	115	115	83	76	92	90
75	99	81	76	103	93	107	92	54	70
82	83	98	115	106	113	112	113	103	93
77	53	85	114	98	148	146	131	107	81
78	74	80	101	92	96	81	64	79	108
111	88	74	70	83	85	79	76	104	113
110	94	107	111	113	116	110	73	62	62
90	92	102	88	80	73	87	82	103	91
89	69	91	102	102					

number of samples in master

1	1	1	1	1	1	1	1	1	1
3	3	4	4	4	4	4	4	6	6
6	6	8	9	9	9	9	9	9	9
9	9	9	9	9	9	9	9	9	9
9	9	9	9	9	9	9	10	10	10
10	10	10	10	10	10	10	10	10	10
10	10	10	10	10	10	10	10	10	10
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10	10	10	10	10	10	10	10	10	10
10	10	10	10	10	10	10	10	10	10
10	10	10	10	10	10	10	10	10	10
10	10	10	10	10	10	10	10	10	10
10	10	10	10	10	10	10	10	10	10
10	10	10	10	10	10	10	10	10	10
10	10	10	10	10	10	10	10	10	10
10	10	7	3	1					

Table 4: Dating of old and new site masters against reference chronologies with *t*-values over overlaps

Reference chronology	Spanning (AD)	4 timber master at 1316 (Hillam 1991)	10 timber master at 1341
WBRADLEY *(Miles and Worthington 1997)*	1187-1318	6.90 130	8.44 132
RUDGE *(Tyers et al 1997)*	1124-1315	7.13 129	9.62 139
OXON93 *(Haddon-Reece et al 1993)*	632-1987	7.14 130	9.76 165
EASTMID *(Laxton and Litton 1988)*	882-1981	5.97 130	9.84 165
GLAST *(Bridge 1983)*	1095-1334	6.16 130	9.94 158
BRADFORD *(Groves and Hilliam 1994)*	1174-1324	8.37 130	10.11 148
EXCATH1 *(Mills 1988)*	1137-1332	7.77 130	10.21 156
WALES97 *(Miles 1997b)*	404-1981	5.92 130	10.29 165
BRDGEFM1 *(Miles and Worthington 1997)*	1195-1331	7.84 122	10.34 137
♣ ENGLAND *(Baillie and Pilcher 1982)*	404-1981	5.95 130	10.79 165
SENG98 *(Bridge 1998)*	944-1790	6.48 130	10.85 165
HANTS97 *(Miles 1997c)*	1041-1972	7.36 130	10.98 165
ENGCOMBE *(Groves and Hillam 1994)*	1157-1304	8.74 118	11.24 128
LONDON *(Tyers pers comm)*	413-1728	7.76 130	11.44 165

♣ = Component of WALES97

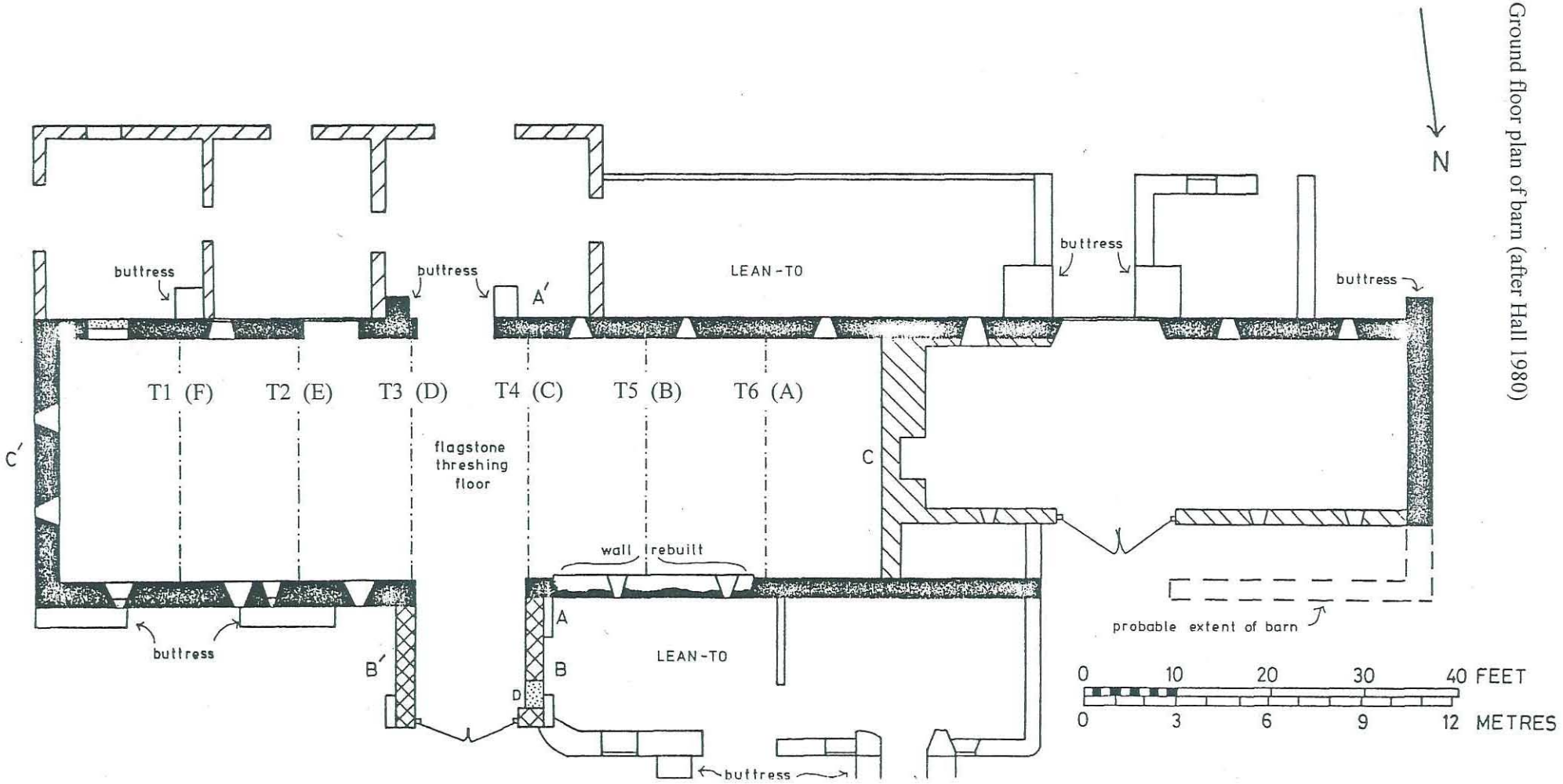
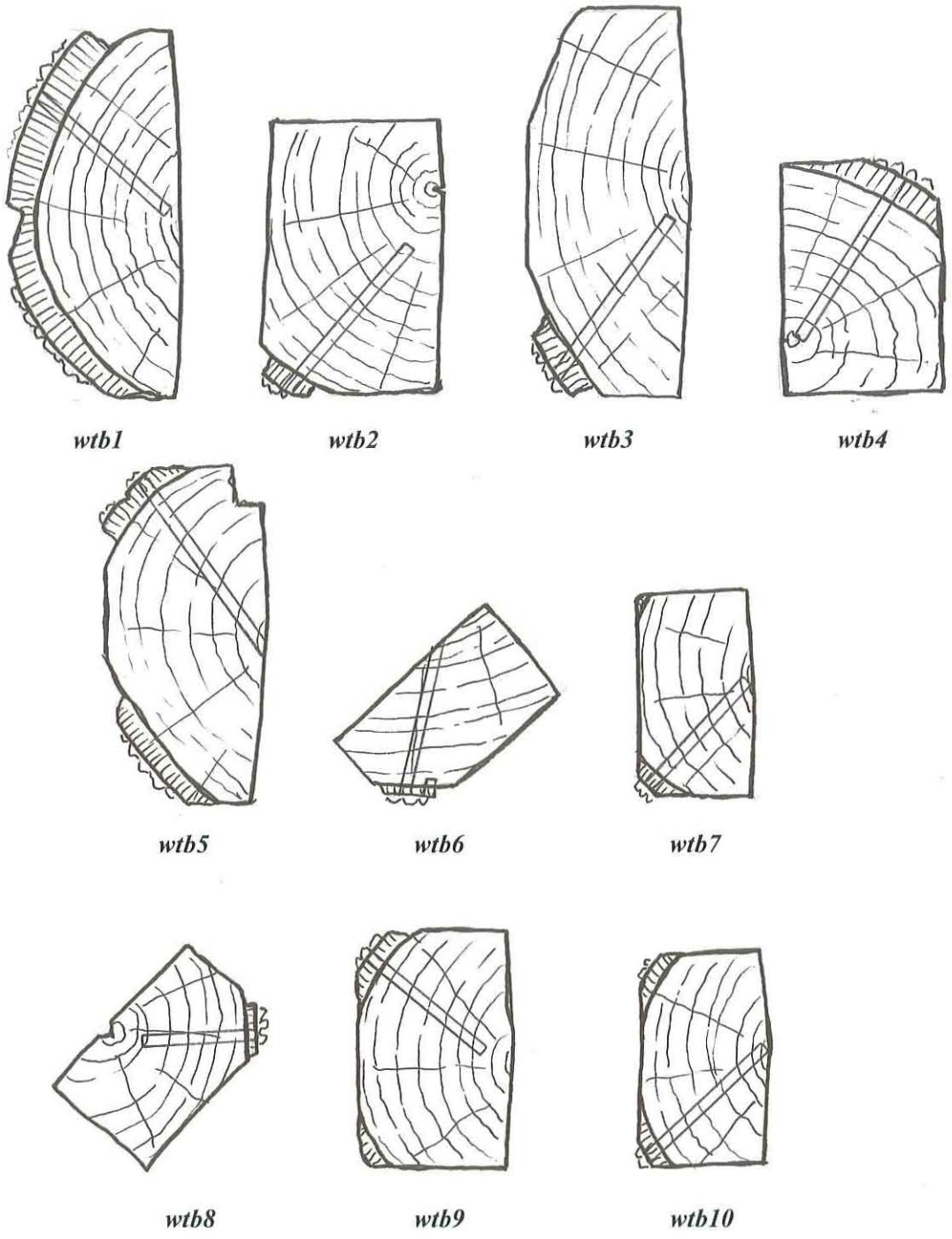


Figure 3: Ground floor plan of barn (after Hall 1980)

Figure 10: Sections of timbers sampled *(scale 1:8)*



Key: Heartwood
Sapwood
Bark edge

Figure 11: Dated samples in chronological position

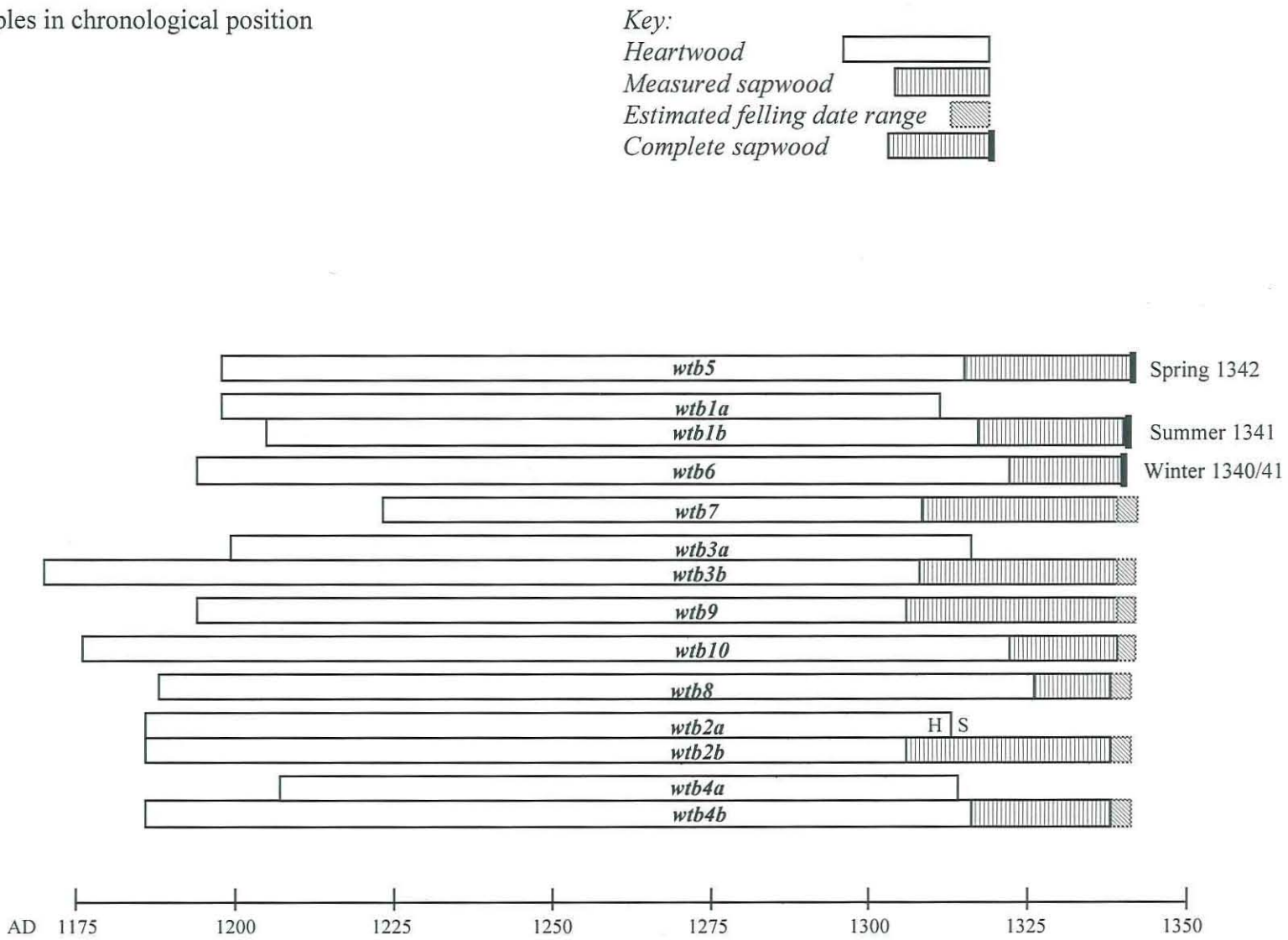
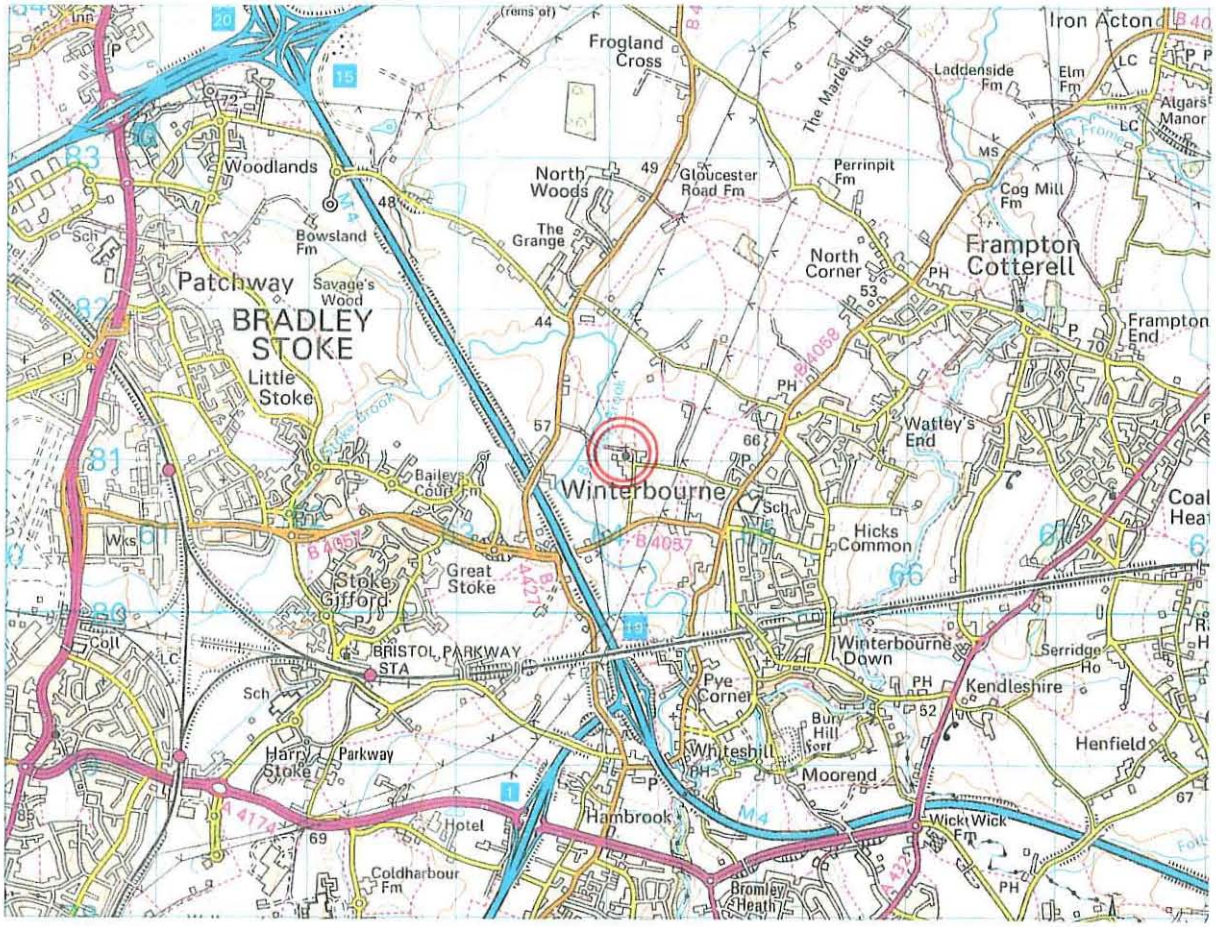


Figure 1: Site location plan (based upon the Ordnance Survey 1:50 000 map with the permission of The Controller of Her Majesty's Stationery Office, ©Crown Copyright)



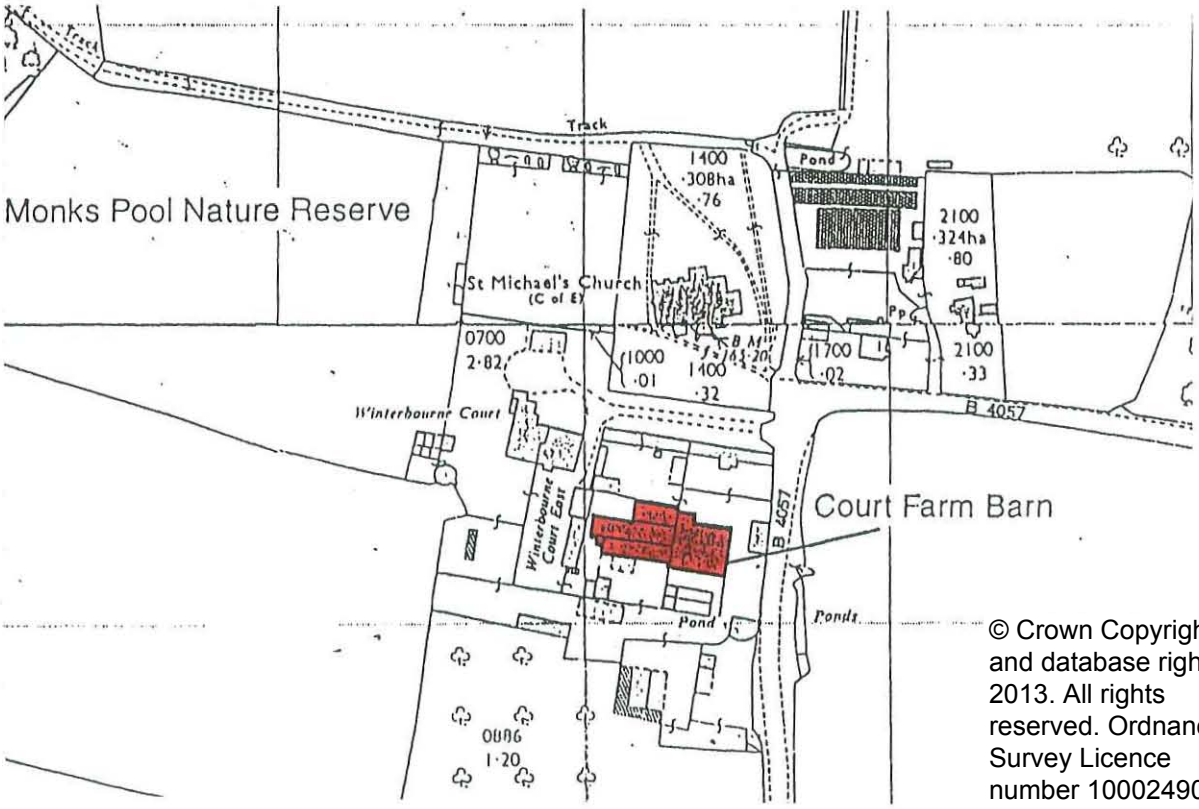


Figure 4: Interior of barn looking east (National Monuments Record, English Heritage)

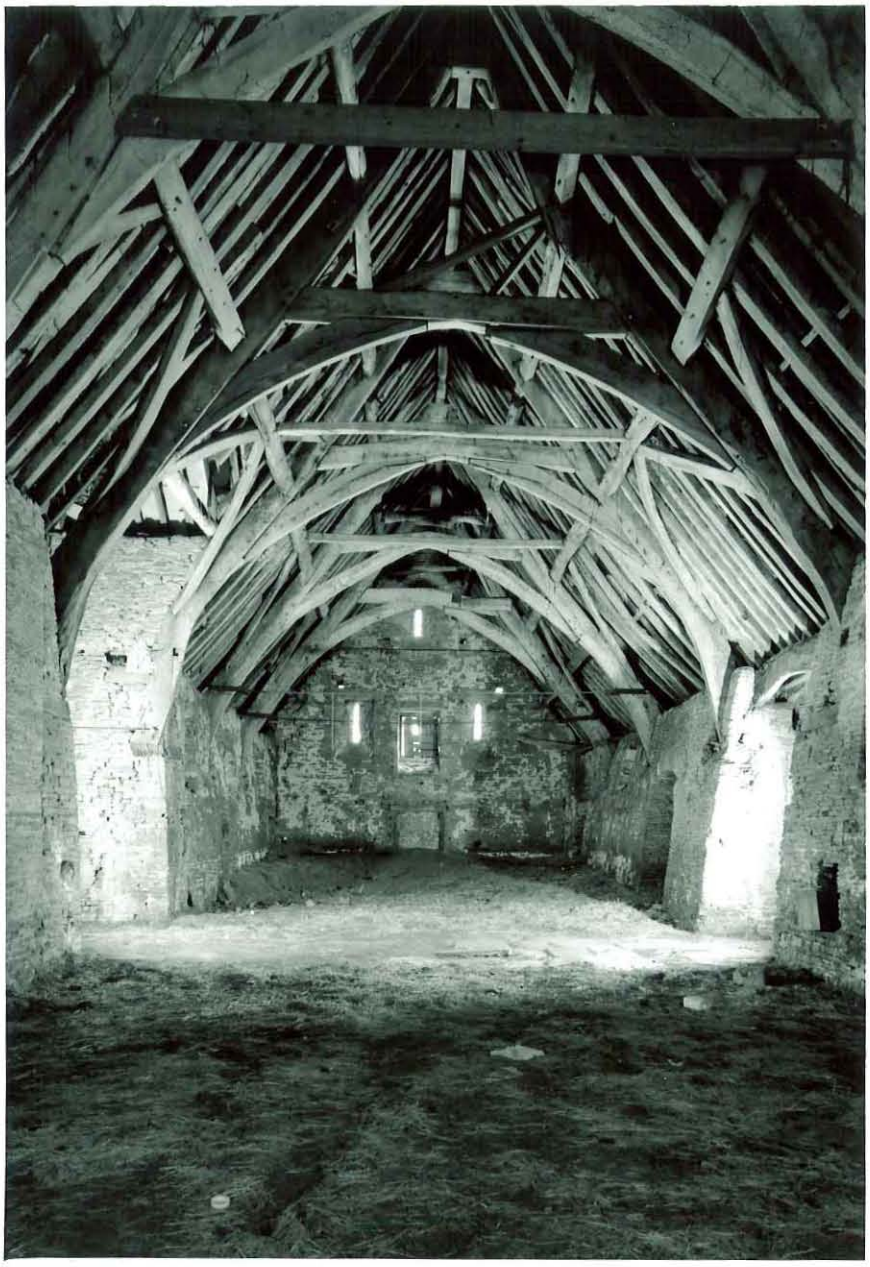


Figure 5: Recorded assembly marks on roof structure

Figure 6: West face of Truss 1, showing position of timbers sampled

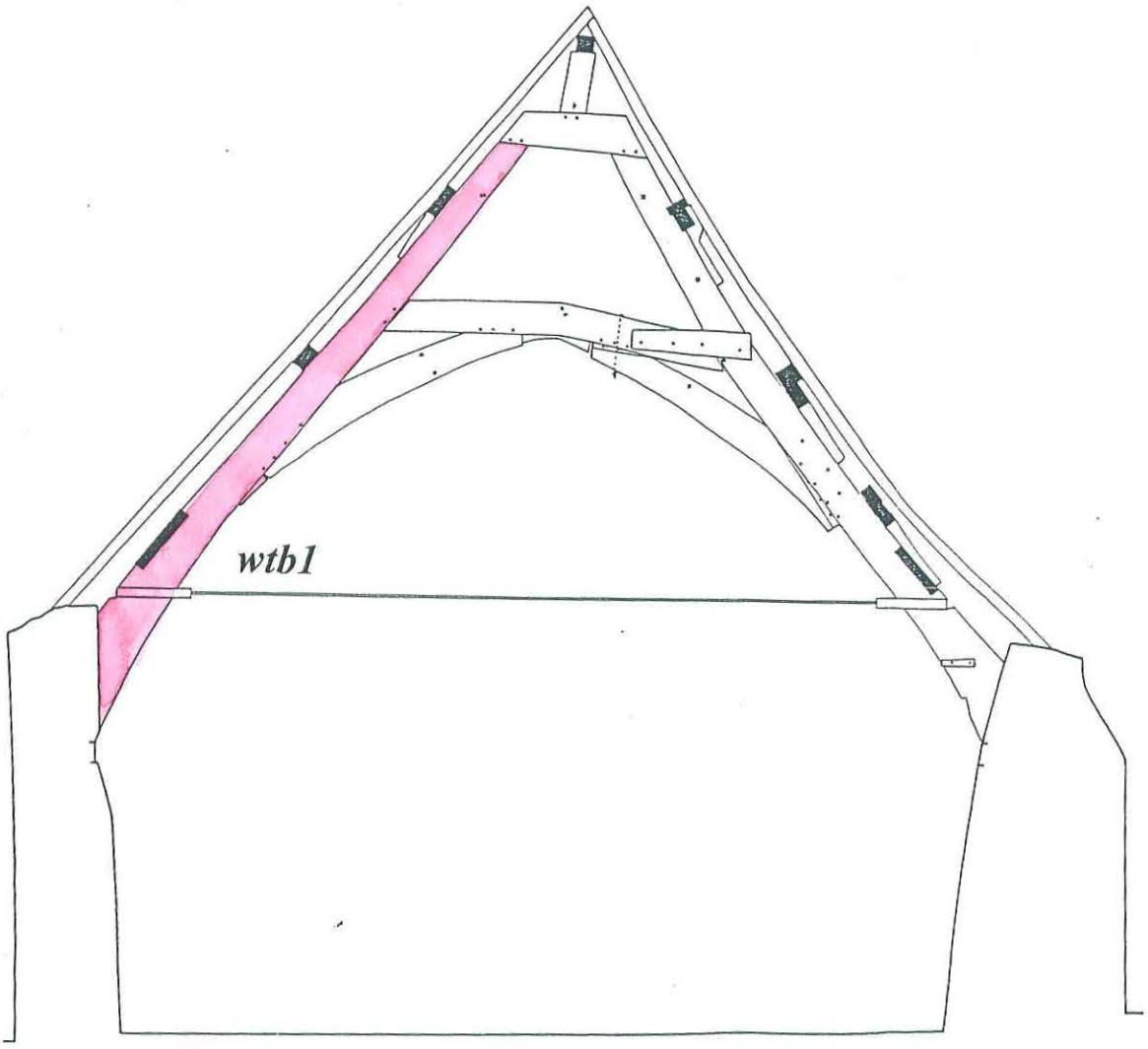


Figure 7: West face of Truss 3, showing position of timbers sampled

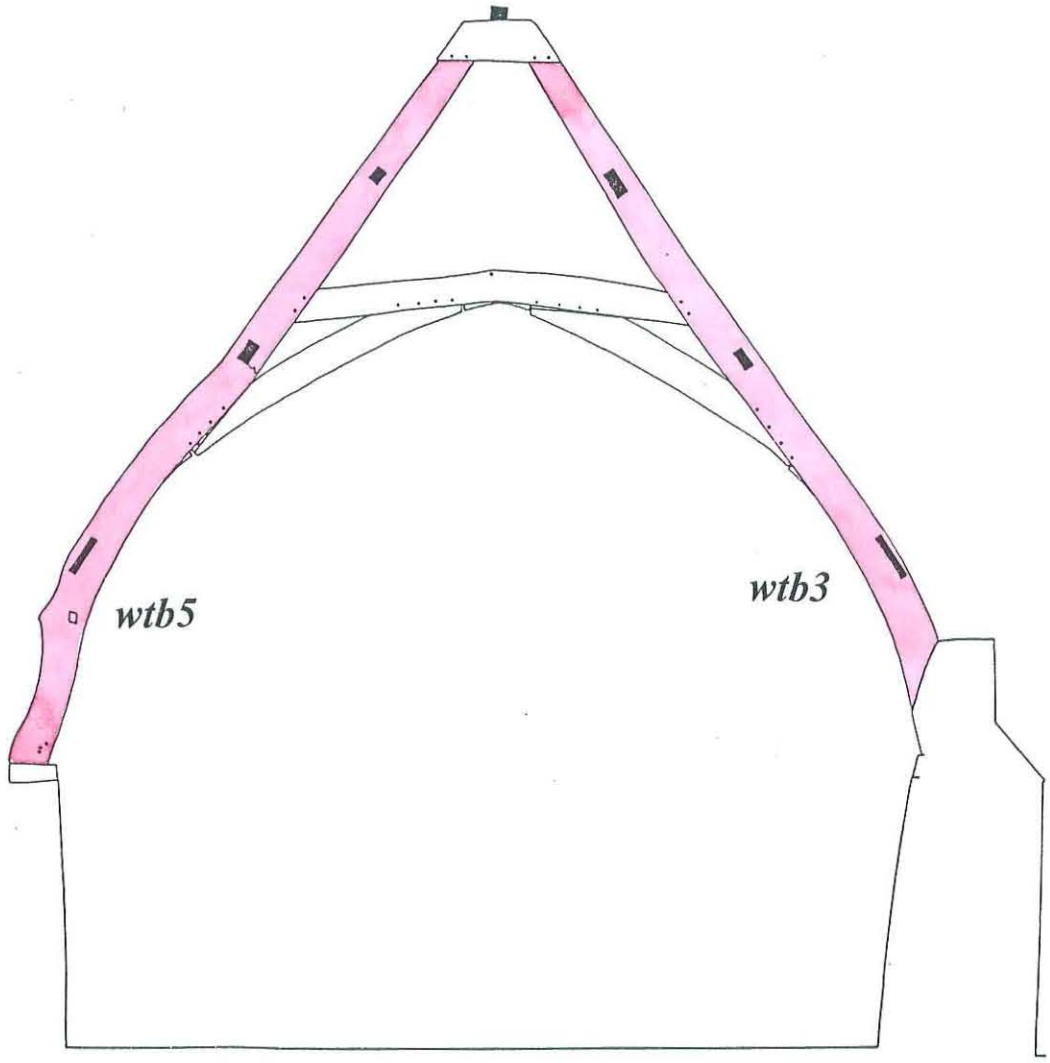


Figure 8: West face of Truss 5, showing position of timbers sampled

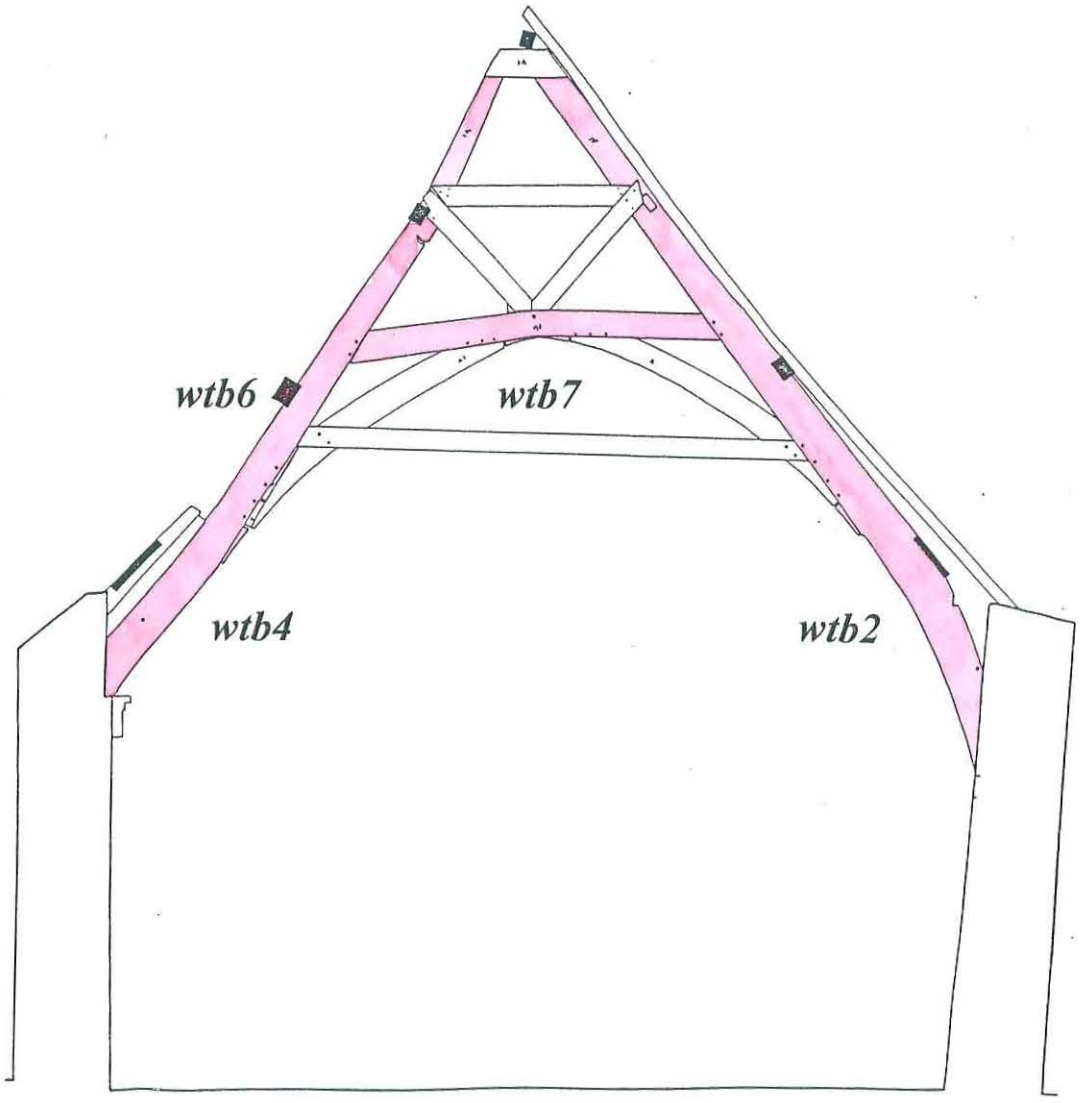


Figure 9: West face of Truss 6, showing position of timbers sampled