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Summary

Dendrochronological analysis of eleven arcade posts from the Great Barn at Ruislip, Greater London, produced a tree-ring chronology for the period AD 1145-1293. The timbers, mostly derived from unusually fast-grown oak trees, were felled between AD 1293 and AD 1328, making this the earliest standing timber-framed barn in Greater London so far dated by dendrochronology

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TREE-RING ANALYSIS OF THE GREAT BARN, MANOR FARM, RUISLIP, GREATER LONDON

Introduction

This document is a technical archive report on the tree-ring analysis of timbers from the Great Barn, Manor Farm, Ruislip (NGR TQ090877). It is beyond the dendrochronological brief to describe the building in detail or to undertake the production of detailed drawings. As part of a multifaceted and multidisciplinary study of the building, elements of this report may be combined with detailed descriptions, drawings, and other technical reports at some point in the future to form either a comprehensive publication or an archive deposition on the building. The conclusions presented here may therefore have to be modified in the light of subsequent work.

This medieval timber-framed aisled barn with seven bays is being assessed for listing purposes. The present list description gives a construction date of *c* AD 1600. However, although the barn was partially rebuilt in the seventeenth or eighteenth century, it displays several feature more consistent with a late thirteenth- or fourteenth-century construction date. For example Cherry and Pevsner (1991) note that the structure had the arcade posts, tie-beams, and aisle-ties connected by passing-braces that terminated at now removed aisle-posts, a form characteristic of the thirteenth and fourteenth centuries. They also note a further archaic feature - the straight braces between the arcade posts and plates. At the request of Richard Bond from English Heritage, it was agreed to attempt to obtain a date for the structure in order to provide information for the discussions on regrading. Current thought suggests that it may be the earliest surviving timber-framed barn in Greater London.

Methodology

No plans or other drawings were made available for this barn so a rough sketch was prepared of the typical truss type (Fig 1) and the trusses were labelled 1-8 from north to south (Fig 2). A brief survey identified those posts with the most suitable ring sequences for analysis. Those with more than 50 annual rings and some survival of the original sapwood and bark-edge were sought.

The most promising timbers were sampled using a 15mm diameter corer attached to an electric drill. The cores were taken from the timbers in the most suitable direction for maximising the numbers of rings for subsequent analysis. The core holes were left open. The ring sequences in the cores were revealed by sanding.

The complete sequences of growth rings in the samples that were selected for dating purposes were measured to an accuracy of 0.01mm using a micro-computer based travelling stage. The ring sequences were plotted onto semi-log graph paper to enable visual comparisons to be made between sequences. In addition cross-correlation algorithms (Baillie and Pilcher 1973; Munro 1984) were employed to search for positions where the ring sequences were highly correlated. These positions were checked using the graphs and, where these were satisfactory, new mean sequences were constructed from the synchronised sequences. The *t*-values reported below are derived from the original CROS algorithm (Baillie and Pilcher 1973). A *t*-value of 3.5 or over is usually indicative of a good match, although this is with the proviso that high *t*-values at the same relative or absolute position must be obtained from a range of independent sequences, and that these positions are supported by satisfactory visual matching.

All the measured sequences from this assemblage were compared with each other and any found to cross-match were combined to form a site master curve. These, and any remaining unmatched ring sequences were tested against a range of reference chronologies, using the same matching criteria: high *t*-values, replicated values against a range of chronologies at the same position, and satisfactory visual matching. Where such positions are found these provide calendar dates for the ring-sequence.

The tree-ring dates produced by this process initially only date the rings present in the timber. The interpretation of these dates relies upon the nature of the final rings in the sequence. If the sample ends in the heartwood of the original tree, a *terminus post quem (tpq)* for the felling of the tree is indicated by the date of the last ring plus the addition of the minimum expected number of sapwood rings which may be missing. This *tpq* may be many decades prior to the real felling date. Where some of the outer sapwood or the heartwood/sapwood boundary survives on the sample, a felling date range can be calculated using the maximum and minimum number of sapwood rings likely to have been present. Alternatively, if bark-edge survives, then a felling date can be directly utilised from the date of the last surviving ring. The sapwood estimates applied throughout this report are a minimum of 10 and maximum of 55 annual rings, where these figures indicate the 95% confidence limits of the range. These figures are applicable to oaks from the British Isles (Hillam *et al* 1987). The dates obtained by the technique do not by themselves necessarily indicate the date of the structure from which they are derived. It is necessary to incorporate other specialist evidence concerning the reuse of timbers and the repairs of structures before the dendrochronological dates given here can be reliably interpreted as reflecting the construction date of phases within the structure.

Results

Eleven of the sixteen arcade posts were selected for sampling (Fig 2 and Table 1). Sample **4** shattered during sampling and could not be used. Samples **1-10** inclusive had between 42 and 65 rings each and they had remarkably wide average ring widths of between 4.0mm and 6.6mm per year. Sample **11** from the west arcade post of truss 8 was completely different. It came from a slow grown oak tree with an average growth rate of only 1.3mm per year, and contained 140 rings. Detailed examination of the various joint housings in all the arcade posts during sampling showed that this timber had the same joints for the passing braces as the other posts and there seems no reason to doubt it is contemporaneous with the rest of the material. Three arcade posts were rejected for sampling since they contained too few rings, two other arcade posts were inaccessible behind a partition. No original aisle posts appear to survive in the structure, and the extant aisle ties and stylobates may not be part of the original structure. The stylobates, at least, include several obviously re-used timbers and later replacements.

The short sequences from **1-10** were compared with each other. Samples **1**, **2**, **3**, and **8** were found to match (Table 2) and were combined to form a 67 year master curve, RMF_T4. A weak link was found between this master and the sequence from sample **11** with RMF_T4 ending 9 years after **11**. In view of their very different growth trends it was decided to test RMF_T4 and **11** separately against a comprehensive collection of dated tree-ring chronologies from England in an attempt to identify a date for them. It was immediately apparent that the ring sequence from **11** dated to the period AD 1145-1284 inclusive (Table 3). RMF_T4 matched less well, but still matched consistently, to the period AD 1227-1293 inclusive. These matches confirm the weak match between RMF_T4 and **11**. The visual matches were also acceptable and in fact looked better than the computer matches might have indicated. It is possible that the standard algorithms cannot cope with the vast differences in growth rate and sensitivities exhibited by this material. As a result of these differences the two data-sets have not been combined, they are listed separately in Table 4. The remaining measured samples have failed to produce any visually and statistically acceptable matches and are thus undated by the analysis. This is probably due to the relative shortness of the ring sequences.

It is possible that **11** is derived from a different source to the other timbers. Alternatively, they may all be from the same source with **11** being subject to local extreme conditions of growth.

Interpretation

Sapwood was present on two of the dated samples and heartwood-sapwood transition on the other three (Fig 3). The range of heartwood-sapwood transitions is consistent with a group of timbers which were felled at the same time (Baillie 1982, 57), indicating that, despite the difference between **11** and the other timbers, they were probably felled at the same time. Applying the 10-55 year sapwood estimate to the dated samples gives a combined felling date range of AD 1293-1328. Since medieval timbers were usually felled as required and used green (Rackham 1990, 69), a construction date in the late thirteenth- to early fourteenth-century is indicated by the tree-ring results.

The result obtained suggests that the Great Barn at Ruislip is currently the earliest tree-ring dated standing timber-framed barn in Greater London, pre-dating those at Harmondsworth (*c* 1426 Tyers and Hibberd 1993a), and Upminster (*c* 1423-1440 Tyers forthcoming).

The trees used for all the accessible posts except that providing sample 11 are remarkably similar, and the posts are basically trees of boxed-heart conversion. In all cases the trees appear to be the right-way-up. This is an unusual feature since the use of wrong-way-up trees provides timbers more suitable for constructing the strongly jowled joints at the point of greatest weakness, that is the joint of the arcade posts, tie-beams, and arcade plates. The use of wrong-way-up trees has been identified at several barns that pre-date Ruislip (eg

Cressing Temple Wheat Barn (Stenning 1993)). A further notable feature of these posts is that the bottoms of the posts are nearly all close to box-quarters in section and implies an unusual amount of timber wastage was allowed in order to create the tall and relatively delicate arcade posts with such slight jowling. This is somewhat contrary to the normal expectations of great economy in timber utilisation associated with medieval buildings.

Acknowledgements

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Figure 1

A sketch of a typical truss. The figure is a composite of all the individual surviving parts and joint housings. The passing braces probably continued to the original aisle posts.

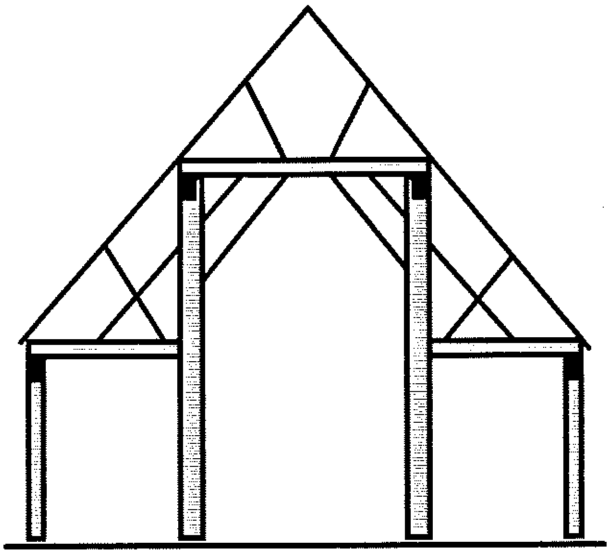


Figure 2

A sketch plan of the barn showing the truss numbering scheme used during sampling. The smaller numbers with arrows show the sample numbers and approximate direction of coring in each timber.

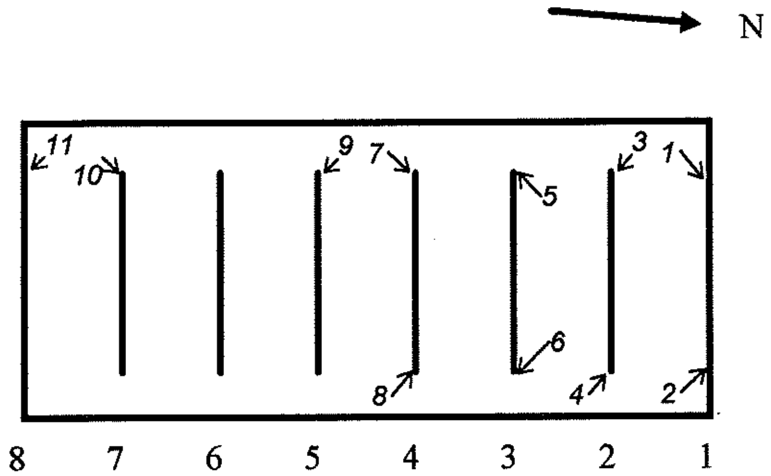
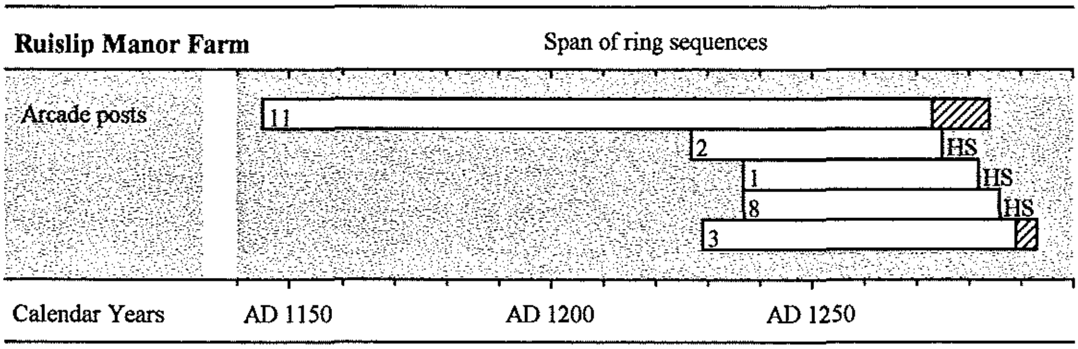


Figure 3

Bar diagram showing the positions of the dated sequences



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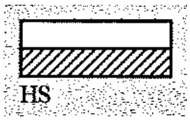

heartwood
sapwood
heartwood/sapwood boundary

Table 1

List of samples

Core	Origin of core	Total rings	Sapwood rings	mm/year	Date of sequence	Felled
1	Truss 1, west arcade post	46	h/s	4.59	AD 1237-AD 1282	AD 1292-AD 1337
2	Truss 1, east arcade post	49	h/s	4.03	AD 1227-AD 1275	AD 1285-AD 1330
3	Truss 2, west arcade post	65	4	5.09	AD 1229-AD 1293	AD 1299-AD 1344
4	Truss 2, east arcade post	-	-	-	-	-
5	Truss 3, west arcade post	42	7	6.64	-	-
6	Truss 3, east arcade post	44	0	6.28	-	-
7	Truss 4, west arcade post	42	?h/s	5.82	-	-
8	Truss 4, east arcade post	50	h/s	5.00	AD 1237-AD 1286	AD 1296-AD 1341
9	Truss 5, west arcade post	42	h/s	6.03	-	-
10	Truss 7, west arcade post	63	?h/s	5.92	-	-
11	Truss 8, west arcade post	140	11	1.33	AD 1145-AD 1284	AD 1284-AD 1328

Table 2

t-value matrix for the matching sequences. Values less than 3.0 are not given.

	1	**2**	**3**	**8**	**11**
1	*	6.5	5.1	4.7	4.0
	2	*	3.7	4.2	-
		3	*	6.0	-
			8	*	-
				RMF_T4	3.4

Table 3

Dating the barn. *t*-values with dated reference chronologies for sample **11**, and site master RMF_T4. All the reference curves are independent.

Area	**Reference chronology**	***t*-values** **11**	***t*-values** RMF_T4
London	BUF90 Bull Wharf (Tyers 1994)	4.0	-
	HOR86 (Tyers 1991)	6.0	4.1
	PWB88/VAL88 Fleet valley (Tyers and Hibberd 1993b)	8.4	-
	SWA81 Swan Lane (Groves and Hillam 1987)	3.6	-
	VRY89 Vintry House (Hibberd 1992)	5.8	-
	Trig Lane (Tyers 1992)	4.5	4.4
Berkshire	Windsor Round Tower (Miles pers comm)	3.3	4.5
Devon	Exeter EM (Mills 1988)	6.0	3.6
	Thorne (Groves unpubl)	-	4.7
Hereford	Hereford ALL (Tyers 1996)	5.1	3.5
Kent	Kent master (Laxton and Litton 1989)	4.6	4.7

Table 4a

Ring-width data from site master RMF_T4, dated AD 1227-1293 inclusive

date	ring widths (0.01mm)									no of samples									
AD 1227							502	618	426	309							1	1	2	2
	268	286	411	284	430	318	532	498	671	643	2	2	2	2	2	2	4	4	4	4
	504	606	675	430	481	524	635	453	469	420	4	4	4	4	4	4	4	4	4	4
AD 1251	462	444	578	470	587	528	487	461	557	563	4	4	4	4	4	4	4	4	4	4
	550	472	381	537	445	502	456	453	559	433	4	4	4	4	4	4	4	4	4	4
	440	380	470	417	349	303	412	366	458	507	4	4	4	4	4	3	3	3	3	3
	387	473	505	382	367	358	285	246	232	331	3	3	2	2	2	2	1	1	1	1
	253	474	385								1	1	1							

Table 4b

Ring-width data from sample **11**, dated AD 1145-1284 inclusive

date	ring widths (0.01mm)									
AD 1145					686	341	297	397	289	225
AD 1151	172	112	136	100	132	207	211	248	281	431
	198	271	239	345	278	193	239	205	472	231
	275	193	267	270	207	282	137	247	220	187
	140	184	135	92	122	131	207	118	161	175
	144	128	174	105	102	131	120	162	124	104
AD 1201	145	104	176	124	146	125	101	164	112	156
	152	85	108	75	94	72	65	83	90	53
	58	50	71	50	56	62	65	71	75	81
	59	55	48	53	70	46	60	60	56	53
	50	52	66	48	53	56	65	48	47	49
AD 1251	46	48	57	84	100	88	61	67	56	75
	60	88	77	96	79	85	80	112	118	83
	93	71	95	84	75	56	49	57	81	95
	75	118	102	95						