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Ancient Monuments Laboratory
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Summary

Two buildings on the site of Forty Hall, Enfield were investigated. The roof of the main house was found to be constructed from fast-grown oaks with short ring sequences. A 63-year chronology from this roof remains undated. Timbers from the stable block appear to have come from a variety of sources. Only three timbers from the roof dated. All three were tie beams and were found to have come from oaks felled between AD 1476 and 1499. This is much earlier than expected on stylistic grounds. A single re-used, moulded beam used as a floor joist also gave a date for its outer ring (without sapwood) of AD 1430. The ring-width sequences from three other roof timbers were combined to give a second chronology of just 70 years. This failed to date against the first site chronology or any other material. This, combined with the use of coniferous wood for two principal rafters, suggests a second, probably later, phase of renovation of the stable roof.

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Introduction

The site at Forty Hall, Enfield (TQ 3358 9859) includes a mansion house (now a museum) thought to be of early seventeenth century construction. A date of 1629 is included in plasterwork on a first-floor ceiling and, although this may not be a reliable source of information, it would fit the date suggested on stylistic grounds. The site also includes several outbuildings, amongst them a partially-converted stable block. The roofs of the main house and the stable block are the subject of this report, which represents a technical archive of the dendrochronological work carried out at the site at the request of Andy Wittrick of English Heritage. It forms only part of a group of wider studies at the site, and its conclusions may need to be modified in the light of further research.

Harwood (1996) notes how comparatively little is known about the history of the Hall, and remarks that if the hipped roof (Fig 1) is original it would be one of the first in England, making the house extraordinarily advanced for its date. There is some evidence for the re-use of timbers, but the principals and truss arrangement (Fig 2) are thought to be undisturbed (Wittrick pers comm).

The stable block, to the west of the house, is partly constructed of brick, with a timber roof thought to be seventeenth century. The building has lapsed into a state of disrepair, and access to some of the timbers was considered unsafe in the present condition. The following information is taken from an unpublished report on the building by Mr A. Wittrick of English Heritage. It has eight bays with seven surviving trusses, thought to be original, each bay being about 3.05m (10' 0") wide. The building is aligned approximately north-west to south-east. The trusses are designated A-A, B-B etc from the north-west gable end. The roof framing is of staggered butt-purlin construction, the joints between the principal rafters and purlins being double pegged. There was no original wind-bracing. The wall plates are joined using face-halved and bladed scarf joints with thick central halvings, secured with four edge-pegs (two passing through each tenon). The major timbers exhibit neatly chiselled carpenter's marks which follow in correct sequence. A floor in the building appears to have made use of a variety of re-used timbers, including one with a heavy roll-moulded profile.

Methodology

Sampling of the *in situ* timbers took place in February and March 1997, immediately following an assessment of their suitability for dendrochronological study. The timbers appeared to have sufficient numbers of rings, and several also showed sapwood surviving. Samples were removed using purpose-made 15mm diameter corers attached to an electric drill (a system developed from commercially available corers by Don Shewan at London Guildhall University). The holes were filled with softwood dowels glued in position with Evostick wood glue.

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. Those samples with more than 50 annual rings had their 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 an Atari desktop computer. The software used in measuring and subsequent analysis was written by Ian Tyers (pers comm 1992).

Suitably long ring sequences, usually those in excess of 50 years, were plotted on translucent semi-log graph paper 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. Statistical comparisons were made using Student's *t* test (Baillie and Pilcher 1973; Munro 1984). Any internal site mean sequences produced are then compared with a number of reference chronologies (multi-site chronologies from a region) and dated individual site masters in an attempt to date them. Any individual long series are also compared in the same way.

The *t*-values quoted below were derived from the original CROS program (Baillie and Pilcher 1973) in which *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 (Baillie 1982, 82-5).

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 likely felling dates of the trees used and then relate these in turn to the construction date of the phase under investigation. Where only heartwood is found on the sample, one can make allowances for the expected number of sapwood rings on the tree and add this to the date of the last available ring to give a date after which felling took place; one does not know how many heartwood rings may be missing in these cases. Where the heartwood/sapwood boundary is found, or some sapwood rings survive, a felling date range can be calculated using the best available estimate of the number of sapwood rings likely to have been on the original tree (Baillie 1982).

In this report, the sapwood estimate employed is a minimum of 10 rings and a maximum of 55 rings, representing the 95% confidence limits derived by Hillam *et al* (1987). Where bark is present, the year of felling will be the date of the last surviving ring. In such cases it is often possible to determine the season of cutting by looking at how much of the ring has been formed.

The dates derived for the felling of the trees used in construction do not necessarily relate directly to the date of construction of the roof. 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).

The timbers sampled in the roof of the house are shown in Figure 1. The typical truss arrangement of the roof of the stable block is shown in Figure 2.

Results

Forty Hall House:

Most of the timbers in the roof of the house had less than fifty rings and were therefore not measured. Three timbers which were measured crossmatched each other well (Table 2) and were combined to form a 63 year long chronology (Table 4). This short chronology failed to give consistent crossmatching against reference material and therefore remains undated.

Stable Block:

The ring-width patterns from three tie beams crossmatched (Table 2) and were combined to form chronology FORTY1 (Table 4). This chronology was dated to the period AD 1364 to 1475 by comparison with several reference and site chronologies (Table 3).

A second group of three timbers with relatively short ring sequences was also found to have good internal crossmatching (Table 2), and the sequences were combined to create a second chronology FORTY2. This chronology failed to crossmatch with FORTY1, nor did it give satisfactory crossmatching with reference or site chronologies; it therefore remains undated.

Three other individual timbers from the stable block yielded ring sequences longer than 50 years. One of these, FSB07, was from the moulded floor joist, clearly re-used. It did crossmatch with the dated chronology (Table 3), but was not incorporated into it since it is clearly from a different batch of timbers. Although a very short sequence from a single tree, it did give consistent crossmatching and was dated to the period AD 1369 to 1430.

The remaining sequences, FSB06 and FSB13 failed to crossmatch material from the site or elsewhere, and these too remain undated.

Interpretation

Sadly, this dendrochronological study has not been able to confirm whether or not the roof of the house is original. The timbers in all four ranges looked to be of similar character, their external appearance suggesting that they all derive from a single batch of timber. Further sampling is unlikely therefore to improve the evidence available.

The stable block is shown to have tie beams made from trees felled in a much earlier period than the suspected date of the roof. Assuming the three timbers to be from a single batch, the felling period can be deduced as occuring between the latest date for the earliest year of felling and the earliest date for the last year of felling from the sapwood estimates of the three timbers. This gives a range for the felling period from **AD 1476 to 1499**. If the timbers were primary and used soon after felling, this date-range suggests a time of construction much earlier than had been hypothesised on stylistic grounds. Further recording to investigate the possibility of reuse may assist in the interpretation of this building.

The second chronology (FORTY 2) includes sequences from a tie beam and principal rafter from the most westerly truss, along with a wall plate. If the roof was constructed from a single batch of timbers one might reasonably expect this chronology to crossmatch with FORTY 1. That no acceptable match can be demonstrated suggests that these timbers may be from trees felled in a different period, and/or a different location. The only sequence which retains the bark, FST13, from a wall plate on the north side of the building does not crossmatch with either of the two site chronologies, nor with other reference material. Although at first sight the roof looks to be of a single build, it may in fact have been renovated during its history. The use of coniferous wood in truss C-C also suggests a later origin for the wood and the use of a variety of sources.

The short sequence from the re-used moulded timber, used as a floor joist in the stable block, did not have any sapwood on it. All that can be said about its date therefore is that the tree from which it was formed was probably felled after AD 1440.

Acknowledgements

I would like to thank Mr Andy Wittrick (English Heritage) for his help on site, for making the arrangements to sample, and for supplying background information and drawings. Thanks are also due to my fellow dendrochronologists who continue to allow their unpublished chronologies to be used in work such as this. I thank also Ms Jennifer Hillam (Sheffield University) who made useful comments on an early draft of this report.

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Table 1: List of samples taken from Forty Hall, Enfield, London.

Sample No.	Origin of sample	Total number of years	Sapwood details	Average growth rate (mm yr^{-1})	Date of sequence	Felling date of sequence
HOUSE ROOF (WEST RANGE)						
FTH01	Upper collar into stack	>50		not measured		
FTH02	Secondary collar	>50		not measured		
FTH03	Principal rafter	59	1	1.55	unknown	
FTH04	Purlin	>50		not measured		
FTH05	Upper collar	>50		not measured		
FTH06	Secondary collar	>50		not measured		
FTH07	Principal rafter	>50		not measured		
FTH08	Principal rafter	>50		not measured		
FTH09	Dragon beam	59	-	1.37	unknown	
FTH10	Purlin	60	-	1.36	unknown	
FTH11	North-west corner rafter					
HOUSE ROOF (NORTH RANGE)						
FTH12	Purlin	>50		not measured		
FTH13	Secondary collar	>50		not measured		
FTH14	Purlin	>50		not measured		
FTH15	Secondary collar	>50		not measured		
FTH16	North-east corner post	>50		not measured		
STABLE BLOCK						
FSB01	Tie A	64	9	1.49	unknown	
FSB02	Principal rafter A	64	19	1.31	unknown	
FSB03	Wall plate A-B north	20		not measured		
FSB04	Principal rafter C north	conifer		not measured		
FSB05	Principal rafter C south	conifer		not measured		
FSB06	Post B south	65	9	1.45	unknown	
FSB07	Re-used floor joist	62	-	0.63	1369 - 1430	after 1440
FSB08	Tie C	99	20	0.91	1366 - 1464	1465 - 1499
FSB09	Wall plate D-E south	58	2	1.50	unknown	
FSB10	Wall plate D-E north	31	3	not measured		
FSB11	Tie E	84	9	0.82	1374 - 1457	1458 - 1503
FSB12	Wall plate south	47		not measured		
FSB13	Wall plate north	98	27 bark	0.60	unknown	
FSB14	Tie G	112	27	0.73	1364 - 1475	1476 - 1503

Table 2: Correlation between the timbers in chronologies Forty Hall Roof, FORTY1, and FORTY2. The values are *t*-values derived from CROS 73 (Baillie and Pilcher 1973).

Forty Hall Roof		
	FTH03 (59 yrs)	FTH08 (59 yrs)
FTH10 (60 yrs)	4.6	6.8
FTH03 (59 yrs)		5.8
FORTY1		
	FSB08 (99 yrs)	FSB11 (84 yrs)
FSB14 (112 yrs)	8.3	5.8
FSB08 (99 yrs)	-	7.9
FORTY2		
	FSB02 (64 yrs)	FSB01 (64 yrs)
FSB09 (58 yrs)	5.1	6.2
FSB02 (64 yrs)	-	5.7

Table 3: Dating of the site master chronology FORTY1 for oak timbers from the stable block at Forty Hall, Enfield, London

	Forty Hall stable block (FORTY1) AD 1364 to 1475	
Dated reference or site master chronology	*t*-value	Overlap (yrs)
London1175 (Tyers pers comm)	7.3	112
East Midlands (Laxton and Litton 1988)	6.1	112
Oxon93 (Miles pers comm)	5.1	112
Southwark (Tyers pers comm)	4.9	112
S. England (Bridge 1988)	4.6	112
Kent (Laxton and Litton 1989)	4.2	112
Sutton House, London (Tyers pers comm)	6.6	112
Abington Hall, Northants. (Pilcher pers comm)	5.9	103
George Hotel, Odiham, Hants. (Miles pers comm)	5.5	112
Upton Hall, Northants. (Pilcher pers comm)	5.5	88
Cowfold, Sussex (Tyers pers comm)	5.4	99
Palace Gate Farm, Hants. (Miles pers comm)	5.4	112
Mary Rose 'original' (Bridge unpubl)	5.2	112

Table 3 (continued)

	FST07 AD 1369 to 1430	
Dated reference or site master chronology	*t*-value	Overlap (yrs)
London1175 (Tyers pers comm)	5.8	62
Oxon93 (Miles pers comm)	4.8	62
Southwark (Tyers pers comm)	4.7	62
East Midlands (Laxton and Litton 1988)	4.4	62
Cowfold, Sussex (Tyers pers comm)	6.0	54
Upton Hall, Northants. (Pilcher pers comm)	5.0	43
Mary Rose 'original' (Bridge unpubl)	4.4	62
FORTY1	4.0	62

Table 4: Ring-width data for the site chronologies for oak from Forty Hall house and stable block, Enfield, London, showing how many samples contribute to the final chronology in each year.

Year	Ring widths (0.01mm)										Number of trees per year									
FORTY HALL ROOF																				
1	163	225	188	120	114	168	196	191	189	200	1	1	2	2	3	3	3	3	3	3
	173	156	178	187	168	161	181	226	184	154	3	3	3	3	3	3	3	3	3	3
	172	171	225	193	181	63	53	59	89	94	3	3	3	3	3	3	3	3	3	3
	84	105	112	164	121	108	96	114	118	110	3	3	3	3	3	3	3	3	3	3
	140	157	133	187	144	142	148	164	117	105	3	3	3	3	3	3	3	3	3	3
51	161	135	113	153	151	132	109	112	119	134	3	3	3	3	3	3	3	3	3	3
	104	86	108								2	1	1							
FORTY1																				
AD1364				197	214	137	149	144	175	101				1	1	2	2	2	2	2
	81	107	103	71	78	119	119	141	154	132	2	2	2	3	3	3	3	3	3	3
	124	130	90	91	105	131	124	114	86	62	3	3	3	3	3	3	3	3	3	3
	58	57	65	85	137	203	154	170	140	120	3	3	3	3	3	3	3	3	3	3
AD1401	87	63	67	91	99	133	100	106	85	60	3	3	3	3	3	3	3	3	3	3
	56	39	42	54	66	66	53	54	43	68	3	3	3	3	3	3	3	3	3	3
	80	65	80	79	58	44	58	93	82	45	3	3	3	3	3	3	3	3	3	3
	66	92	59	45	51	38	51	63	61	59	3	3	3	3	3	3	3	3	3	3
	56	63	89	84	53	44	48	61	66	73	3	3	3	3	3	3	3	3	3	3
AD1451	65	56	51	61	69	85	78	46	31	47	3	3	3	3	3	3	3	2	2	2
	45	36	47	48	69	55	53	45	35	37	2	2	2	2	1	1	1	1	1	1
	45	57	61	45	66						1	1	1	1	1					
FORTY2																				
1	293	229	160	95	107	147	130	196	180	190	1	1	1	1	1	2	3	3	3	3
	146	151	192	158	63	85	87	163	117	138	3	3	3	3	3	3	3	3	3	3
	128	106	112	134	221	212	193	180	139	201	3	3	3	3	3	3	3	3	3	3
	178	145	176	159	145	137	129	132	109	120	3	3	3	3	3	3	3	3	3	3
	156	115	170	159	131	120	152	178	139	218	3	3	3	3	3	3	3	3	3	3
51	147	233	175	119	127	194	156	134	116	125	3	3	3	3	3	3	3	3	2	2
	181	76	39	46	52	67	87	90	61	75	2	2	2	2	2	2	2	2	1	1

Table 4 (continued)

Year	Ring widths (0.01mm)									Number of trees per year
FSB06										
1	224	302	305	417	400	265	142	100	70	105
	138	211	202	235	173	168	154	155	200	201
	164	64	36	59	84	56	64	84	128	151
	159	194	134	173	179	175	181	154	164	127
	125	121	132	142	155	153	183	189	142	120
51	138	163	88	101	77	114	76	65	69	102
	74	66	72	71						
FSB07										
AD1369									135	126
	127	121	94	129	81	80	72	104	99	57
	56	73	52	52	54	67	76	68	61	55
	47	39	33	28	42	51	33	53	52	52
AD1401	56	56	74	73	67	92	67	109	74	76
	112	64	35	32	40	27	26	31	27	43
	45	30	46	45	50	31	58	66	54	60
FSB13										
1	81	100	140	146	92	81	97	70	97	125
	198	100	24	24	29	35	37	23	31	41
	39	69	79	163	119	109	83	120	114	125
	196	240	146	123	93	138	52	17	29	31
	31	41	37	45	47	35	34	30	23	41
51	49	49	35	19	25	27	32	32	31	25
	32	33	40	35	40	34	36	37	46	38
	49	48	56	46	25	25	22	42	42	35
	57	31	28	34	43	54	47	40	58	40
	49	32	37	35	62	58	46	46		

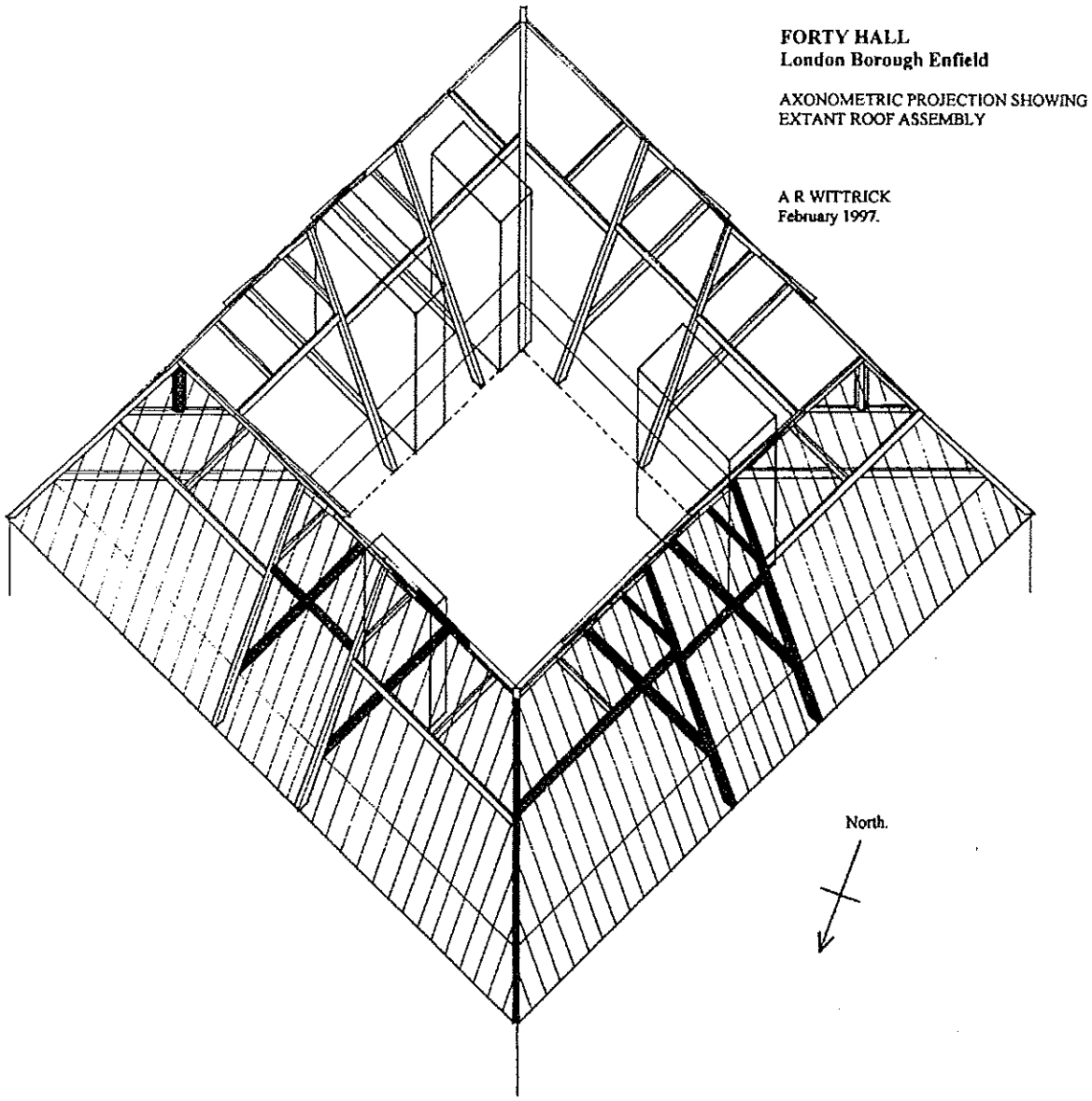

Figure 1: Drawing of the roof of Forty Hall showing the timbers sampled for dendrochronology (shaded).

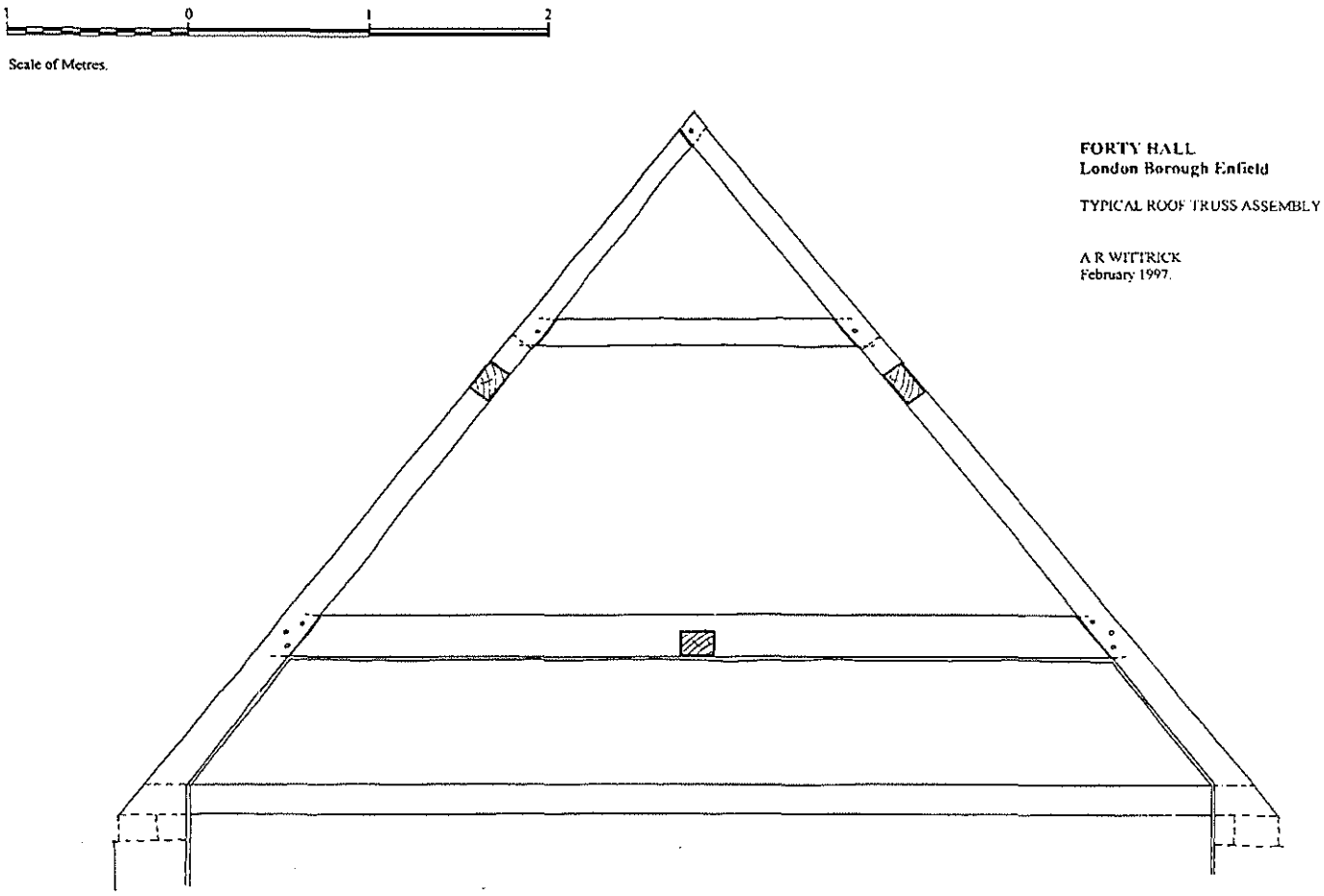

Figure 2: Drawing of a typical roof truss of Forty Hall.