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Barn at Rook Hall Farm Yaxley Road Eye Suffolk

Tree-Ring Analysis of Oak Timbers

Martin Bridge and Cathy Tyers

Discovery, Innovation and Science in the Historic Environment

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SUMMARY
Assessment of dendrochronological potential was undertaken on the main barn and a number of outbuildings attached to it. Only the primary phase of the main barn proved to have suitable timbers of which 11 were sampled. Seven of the samples were successfully dated producing a site chronology spanning the period AD 1441–1522. One sample retained complete sapwood, this indicating that the timber was derived from a tree felled in winter AD 1522/23. The other dated timbers appear to form a coherent group, most likely felled at a the same time, or within a short period of time. It seems likely, therefore, that the barn was constructed, shortly after felling, in AD 1523 or within a year of two after this date.

CONTRIBUTORS
Martin Bridge and Cathy Tyers

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INTRODUCTION

The Grade II listed Rook Hall lies approximately midway between the village of Thornham Parva and the town of Eye in Suffolk (Figs 1 and 2). The barn, which is subject to being added to the Heritage at Risk Register, lies approximately 55m south-west of Rook Hall and is a Scheduled Monument (Fig 3). Very little is known about the barn, the only reference being in the old Field Monument Warden reports stating that it is a barn with a raised-aisle roof. It is, in fact, a two-tier queen-post roof, common to Suffolk and Norfolk, and thought to have evolved in the early sixteenth century to overcome the stresses found in large single-tier queen-post roofs like that at Crows Hall, Debenham (AD 1470s; Bridge unpubl) and Wingfield College Barn (AD 1527; Bridge 1998a) and eventually replaced by two-tier side purlin roofs in this area from the AD1560s onwards (Aitkens pers comm).

An Historic England Heritage at Risk repair grant was awarded towards the cost of temporary works needed to stabilise the structure, these works being implemented in June 2018. A dendrochronological survey was requested by Trudi Hughes, Historic England Heritage at Risk Surveyor, in order to enhance understanding and significance of this barn and, hence, inform decisions relating to its repair and long-term care of this barn. In addition, the dendrochronological analysis of this barn will help inform the timing of the evolutionary trend in relation to this roof type in the region.

METHODOLOGY

In the first instance, an assessment of dendrochronological potential was undertaken to ascertain whether the structure, or structures, under investigation contained any suitable timbers. Accessible oak timbers with more than 50 rings and, where possible, traces of sapwood were sought, although slightly shorter sequences could be considered if little other material is available. Those timbers judged to be potentially useful were cored using a 15mm auger attached to an electric drill. The cores were labelled and stored for subsequent analysis.

The cores were polished on a belt sander using 80 to 400 grit abrasive paper to allow the ring boundaries to be clearly distinguished. The samples had their tree-ring sequences measured to an accuracy of 0.01mm, using a specially constructed system utilising a binocular microscope with the sample mounted on a travelling stage with a linear transducer linked to a computer, which recorded the ring widths into a dataset. The software used in measuring and subsequent analysis was written by Ian Tyers (2004). Cross-matching was attempted 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 on the computer monitor to allow visual comparisons to be made between sequences.

This method provides a measure of quality control in identifying any potential errors in the measurements when the samples cross-match.

In comparing one sample or site master against other samples or chronologies, *t*-values over 3.5 are considered significant, although in reality it is common to find demonstrably spurious *t*-values of 4 and 5 because more than one matching position is indicated. For this reason, dendrochronologists prefer to see some *t*-value ranges of 5, 6, and higher, and for these to be well replicated from different, independent chronologies with both local and regional chronologies well represented, except where imported timbers are identified. Where two individual samples match together with a *t*-value of 10 or above, and visually exhibit exceptionally similar ring patterns, they may have originated from the same parent tree. Same-tree matches can also be identified through the external characteristics of the timber itself, such as knots and shake patterns. Lower *t*-values, however, do not preclude same-tree derivation.

Ascribing felling dates and date ranges

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 straightforward. Depending on the completeness of the final ring (ie if it has only the spring vessels or earlywood formed, or the summer growth or latewood) 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 an empirically derived sapwood estimate with a given confidence limit. If no sapwood or heartwood/sapwood boundary survives then the minimum number of sapwood rings from the appropriate sapwood estimate is added to the last measured ring to give a *terminus post quem* for felling (a felled after date).

A review of the geographical distribution of dated sapwood data from historic timbers has shown that a sapwood estimate relevant to the region of origin should be used in interpretation, which in this area is 9–41 rings (Miles 1997). It must be emphasised that dendrochronology can only date when a tree has been felled, not when the timber was used to construct the structure or object under study.

RESULTS

The original brief for dendrochronological work at this site included the various outbuildings attached to the original main barn, namely the lean-to west of the barn door, the cartlodge, the lean-to at the south-west corner, the stable at the north end, and the stable at the south end (Fig 4). The assessment concluded that the oak timbers thought to be associated with the primary construction of the main barn

had dendrochronological potential, albeit with the proviso that the estimated ring counts on the most promising timbers were relatively low, to borderline, suitability and many of the timbers were assessed as being fast-grown with too few rings. However, the oak timbers in the various additional structures were deemed unsuitable with too few rings for reliable dating purposes, as well as the presence of reused timbers and fast-grown elm timbers. Thus, it was decided, following discussions, to limit sampling to the main barn.

Eleven timbers in the main barn were deemed suitable and were, therefore, sampled. Details of the samples are given in Table 1 and their locations are shown in Figures 5–9. During sample preparation two, rook04 and rook05, were found to have too few rings for reliable dating purposes and these were, therefore, excluded from further analysis. The remaining nine samples were measured, the raw ring width measurements being given in the Appendix. Comparison of these nine series revealed that rook01 and rook02 cross-matched with a very high level of similarity (t = 9.9 with 64 years overlap) and the visual comparison suggested that they may well be from the same parent tree. These two series were, therefore, combined to make a single series, rook21m, for further analysis. Cross-matching between all but two of the remaining series was identified. However, although consistent, this was generally low (Table 2), though two other pairs of samples, rook03 and rook09, and rook07 and rook08, gave reasonable matches.

The individual and paired series were, therefore, compared to reference chronologies, which provided support for the low level intra-site cross-matching identified (Tables 3–5). Thus, in the first instance, five series (rook21m, rook03, rook07, rook08, rook09) were meaned together to form a working site master. Sample rook10 matched this working site master (t = 4.7 with 46 years overlap), as well as showing low consistent matching with several of the individual series, and was added in to the final site chronology. Thus, an 82-year long chronology ROOKBARN was produced dating to the period AD 1441–1522, the strongest matches being shown in Table 6. The relative positions of overlap of the individual dated series are shown in Figure 10.

Two series, rook06 and rook11, showed no intra-site cross-matching and could not be matched individually against the reference chronologies and so remain undated.

INTERPRETATION AND CONCLUSION

The sample from one of the seven dated timbers, rook03, retained complete sapwood and was, therefore, derived from a tree felled in winter AD 1522/23. Samples rook02 and rook07 both lost a small number of the outermost sapwood rings during sampling (Table 1; Figure 10) but these two, along with the other dated samples, appear to form a coherent group of timbers most likely all felled at the same, or very similar, time.

It seems likely, therefore, that this barn with its two-tier queen-post roof was built in AD 1523, or within a few years after this. This is of note in the context of Wingfield College barn, a large single-tiered queen-post roof, dated to AD 1527 (Bridge 1998a) only about 10km away.

The highest levels of similarity between the site chronology ROOKBARN and reference chronologies are generally with sites in East Anglia, most notably in Suffolk (Table 6). This suggests that it is likely that the timbers used in the primary construction of this barn are from relatively local woodland sources.

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FIGURES

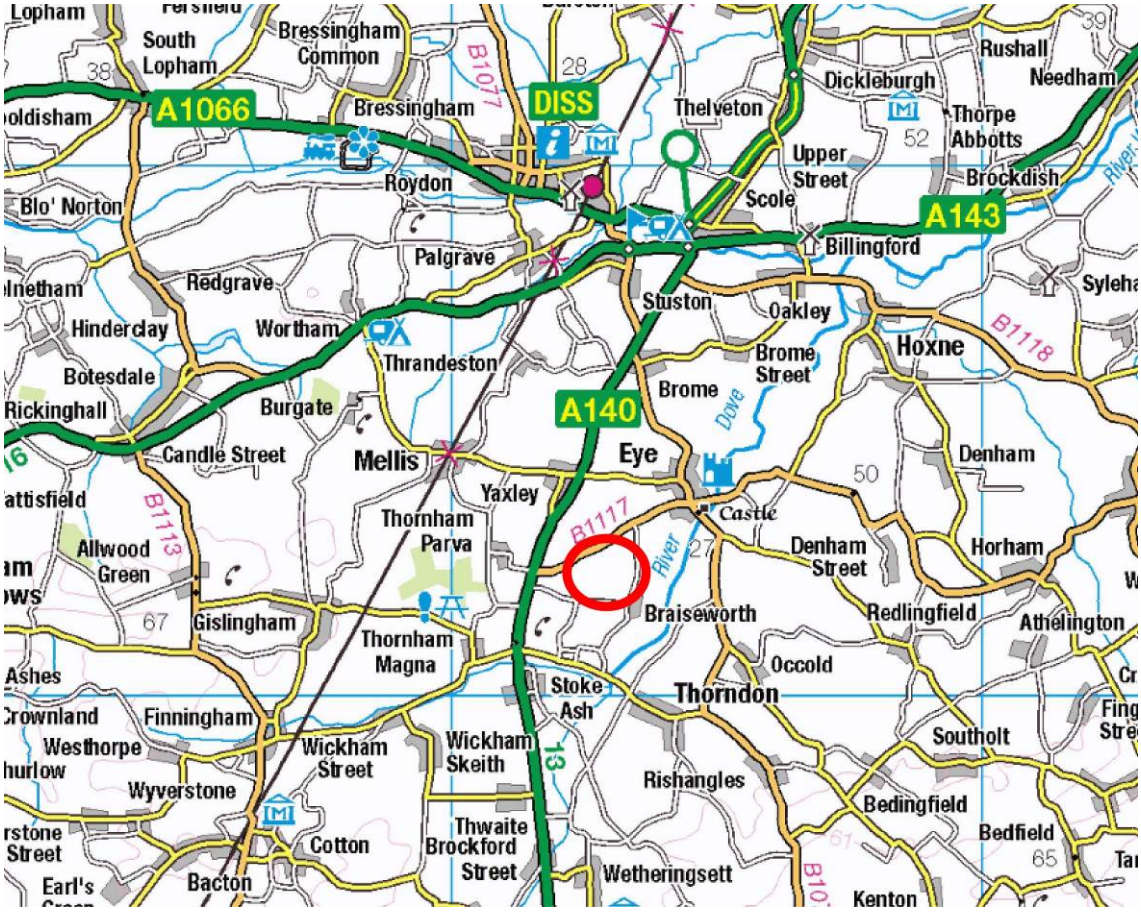

Figure 1: Map showing the general location of Rook Hall and the barn (red ellipse). © Crown Copyright and database right 2019. All rights reserved. Ordnance Survey Licence number 100024900

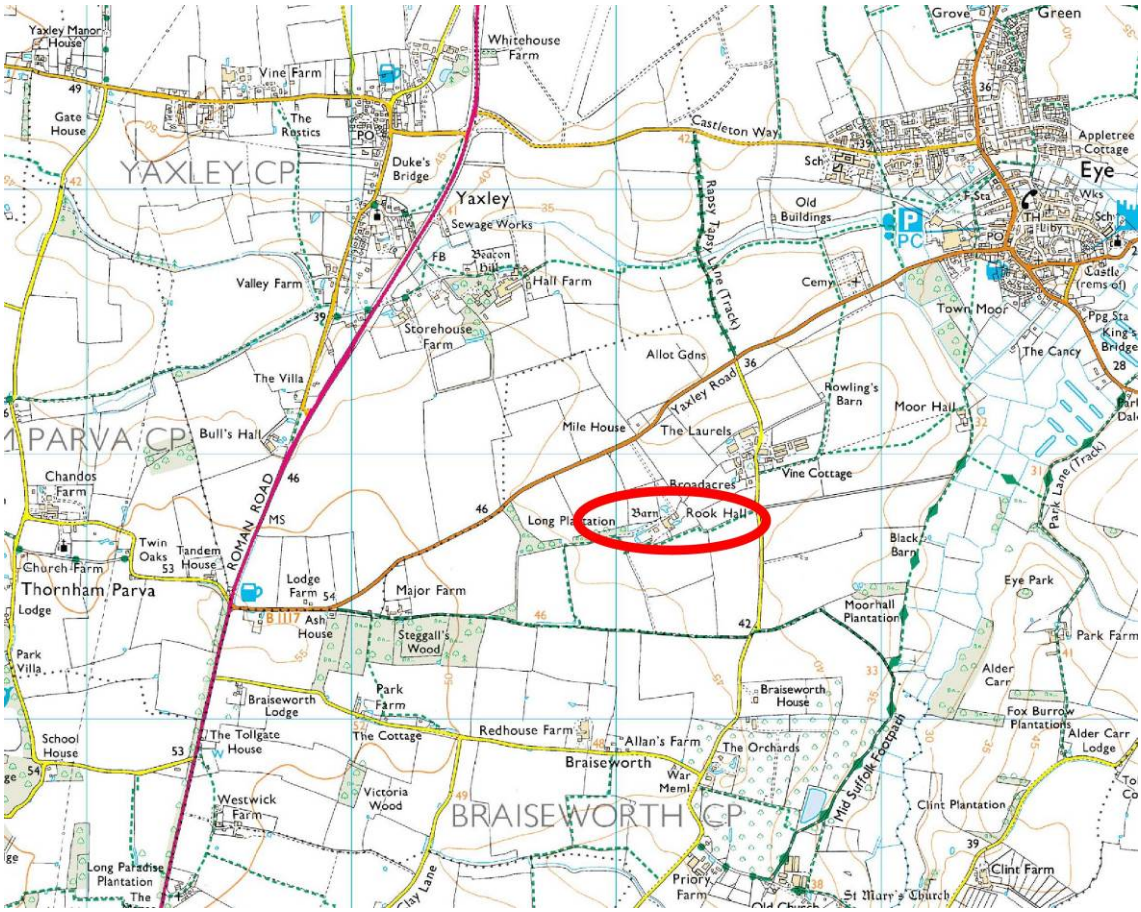

Figure 2: Map showing the location of Rook Hall and the barn (red ellipse) lying between Eye and Thornham Parva. © Crown Copyright and database right 2019. All rights reserved. Ordnance Survey Licence number 100024900

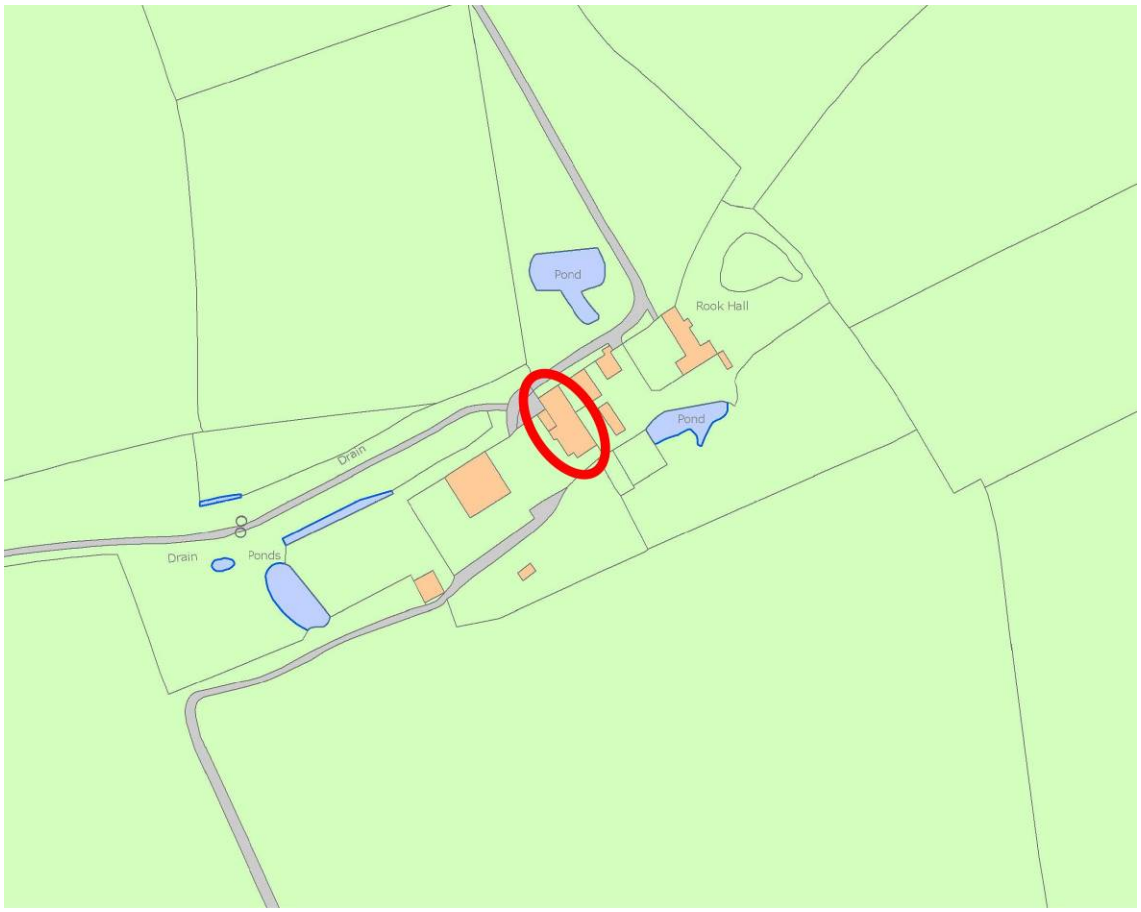

Figure 3: Map showing the detailed location of the barn (red ellipse) within the Rook Hall complex. © Crown Copyright and database right 2019. All rights reserved. Ordnance Survey Licence number 100024900

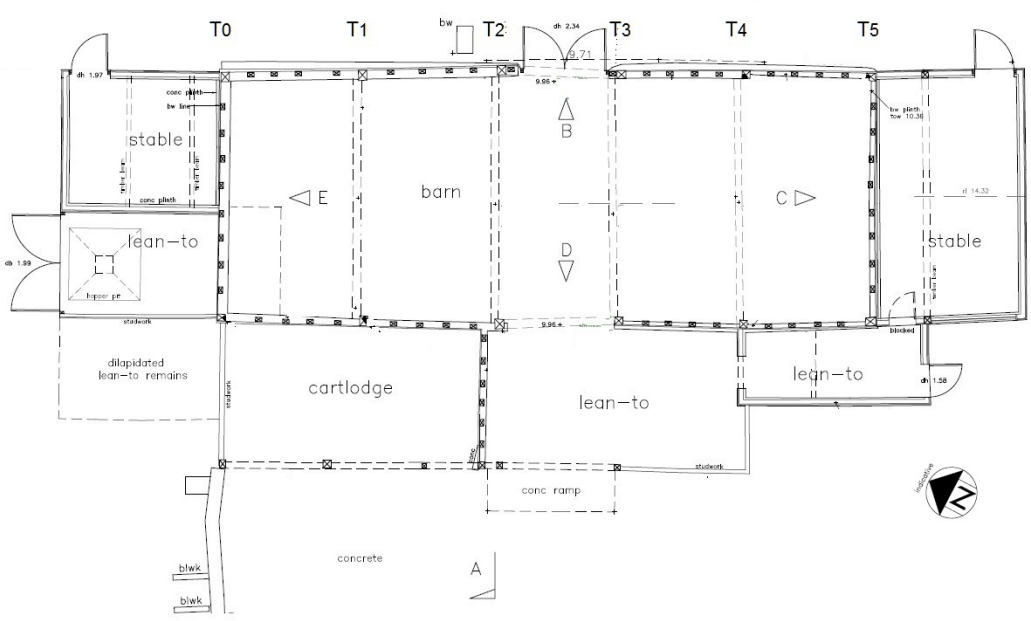

Figure 4: Plan of the barn and associated structures (adapted from original drawings supplied by Stuart Armitage, Morton Partnership)

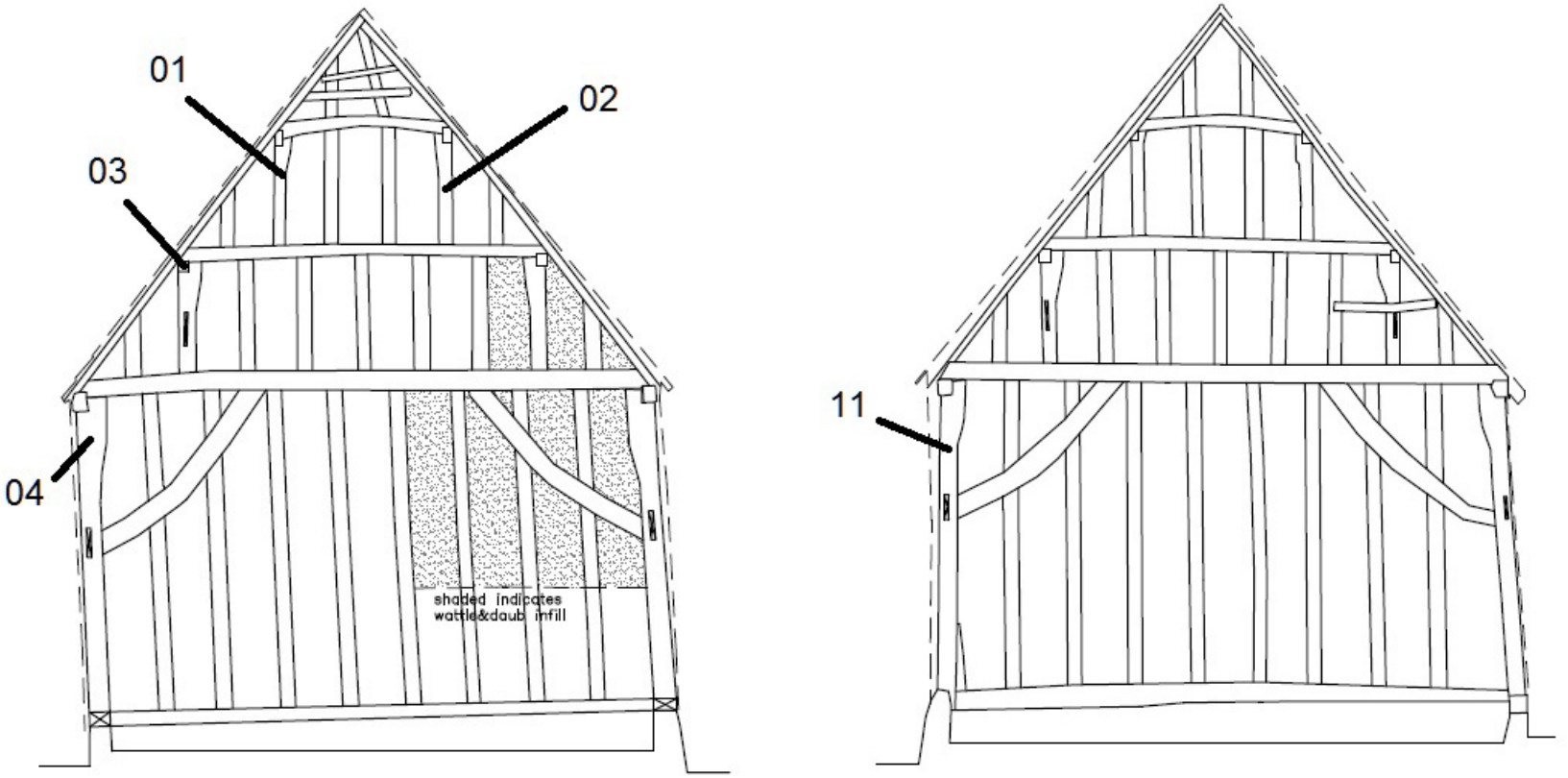

Figure 5: Drawings of the north wall (left) and south wall (right) showing timbers sampled for dendrochronology (adapted from original drawings supplied by Stuart Armitage, Morton Partnership)

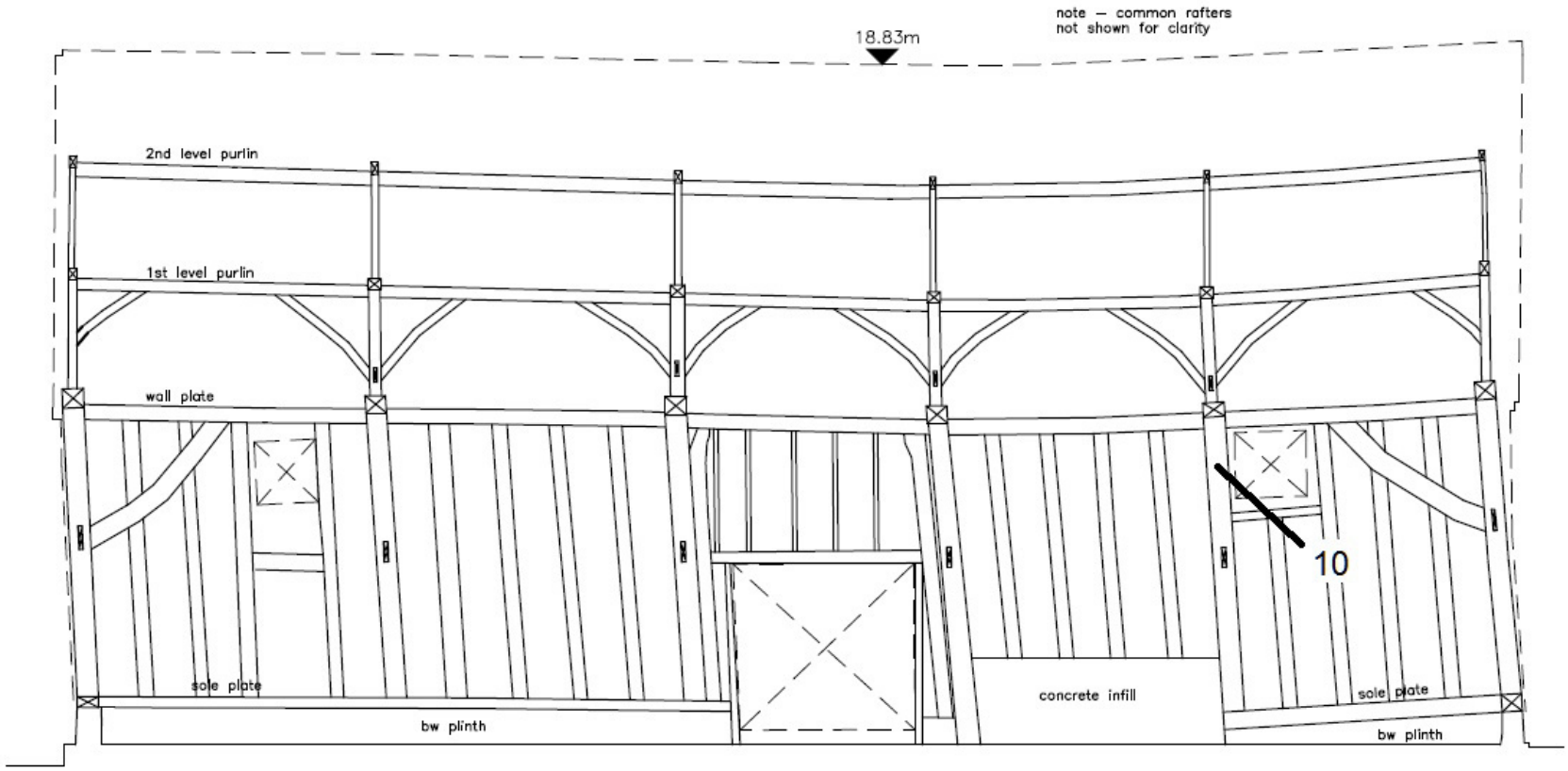

Figure 6: Drawing of the east internal wall showing timbers sampled for dendrochronology (adapted from original drawings supplied by Stuart Armitage, Morton Partnership)

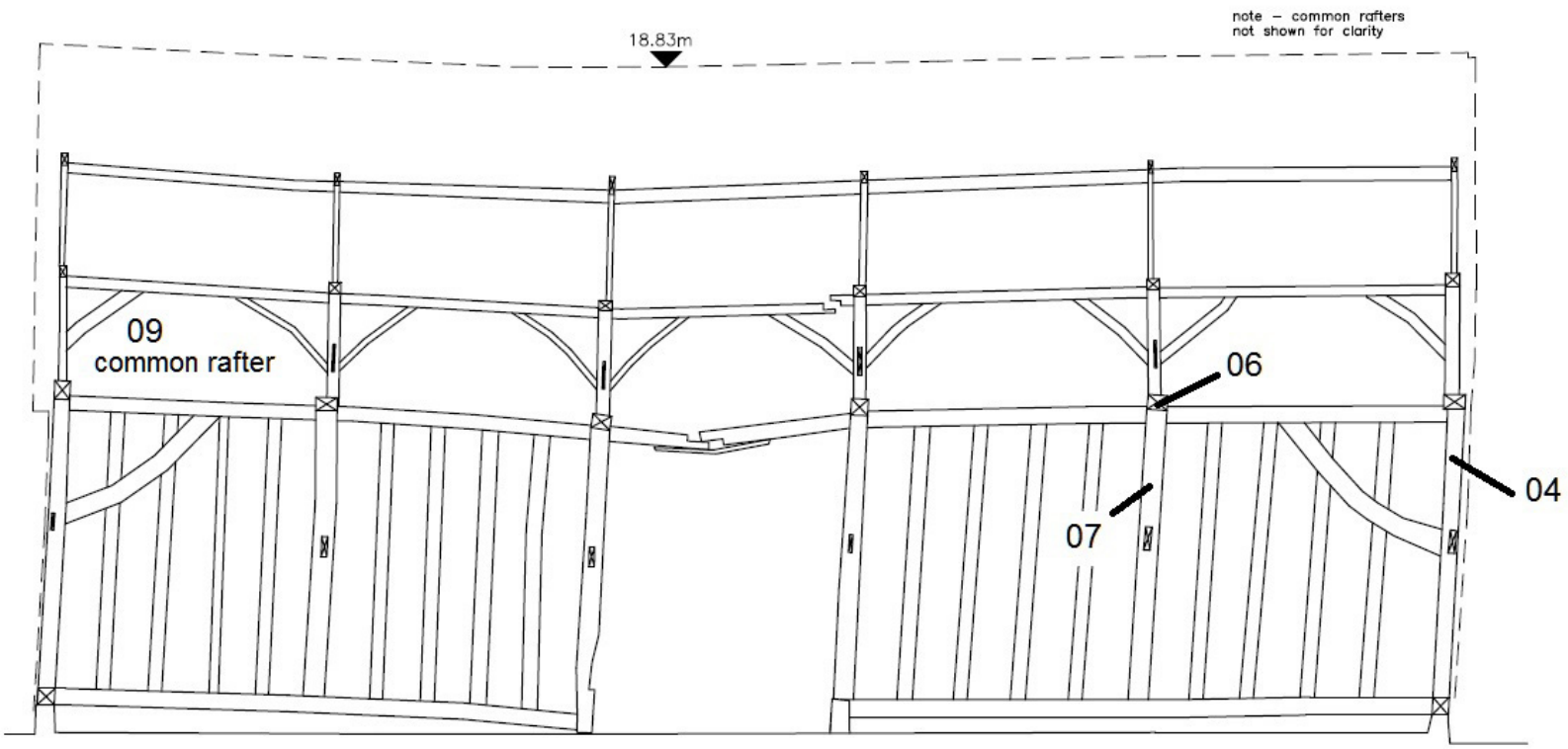

Figure 7: Drawing of the west internal wall showing timbers sampled for (adapted from original drawings supplied by Stuart Armitage, Morton Partnership)

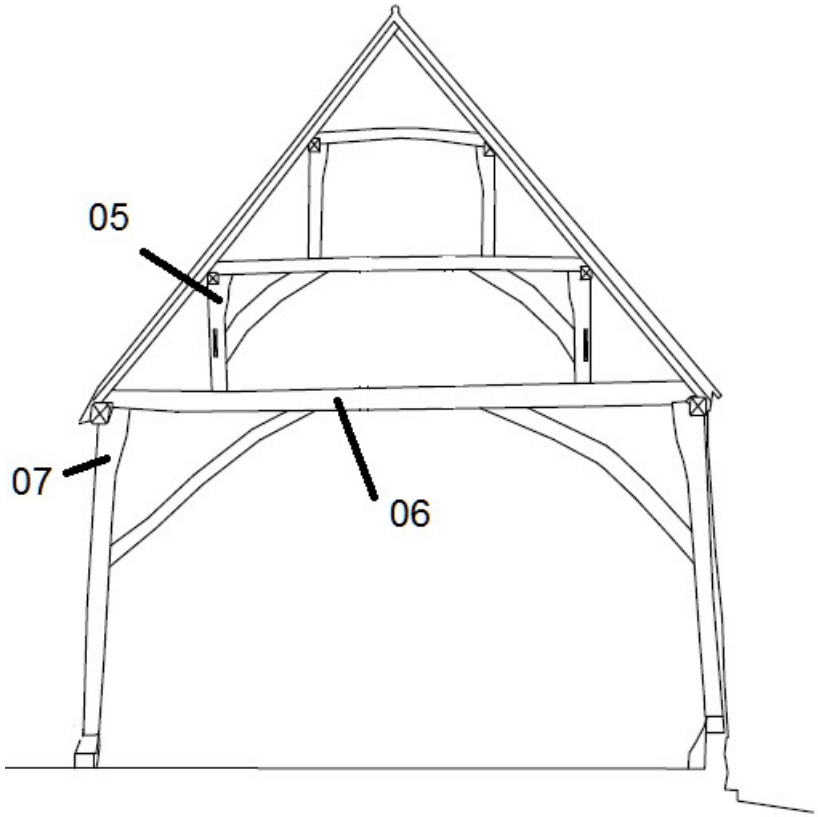

Figure 8: Drawing of truss 1 (T1) from the south showing timbers sampled for dendrochronology (adapted from original drawings supplied by Stuart Armitage, Morton Partnership)

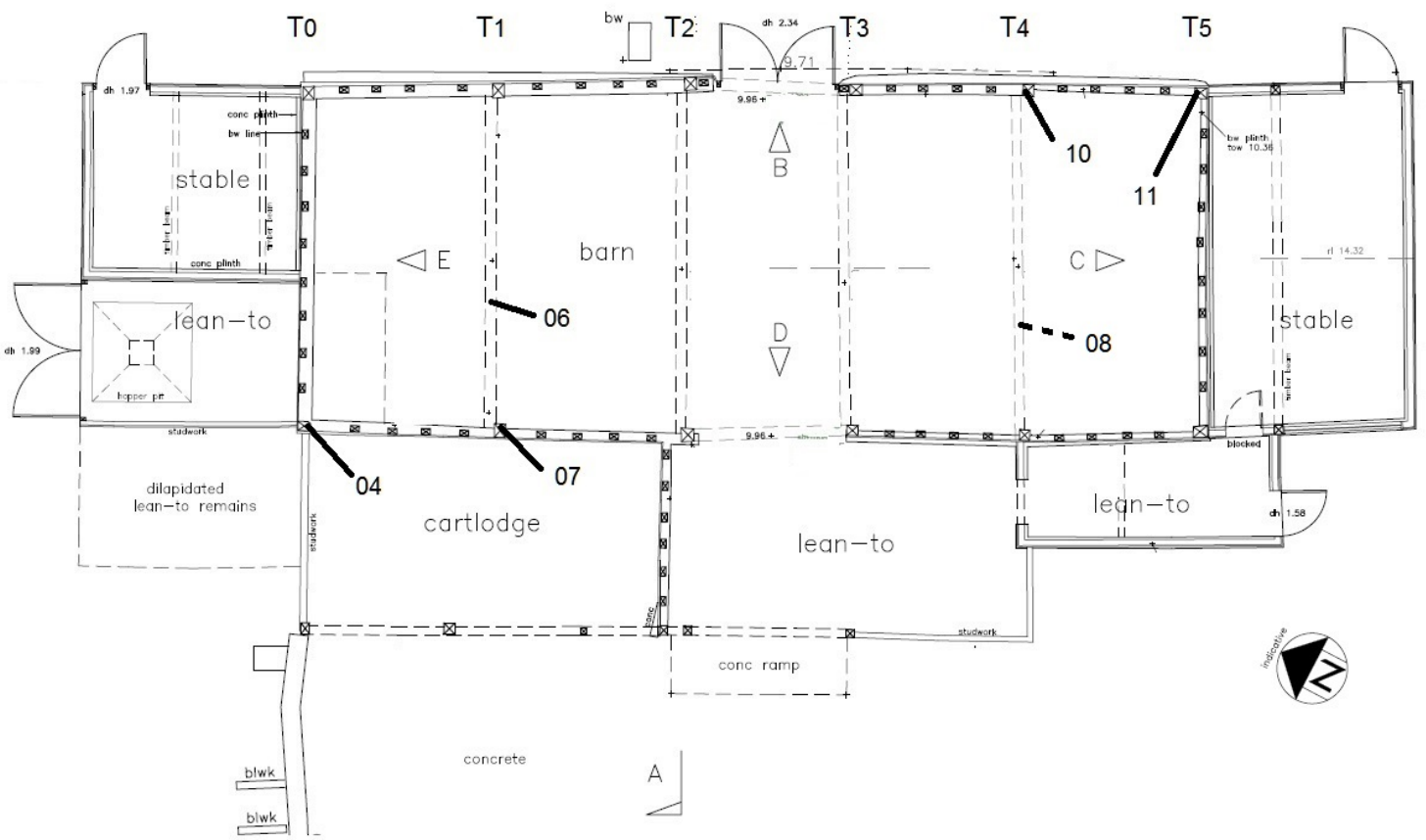

Figure 9: Plan of the barn and associated structures showing timbers sampled, or approximate locations of timbers sampled for dendrochronology (adapted from original drawings supplied by Stuart Armitage, Morton Partnership)

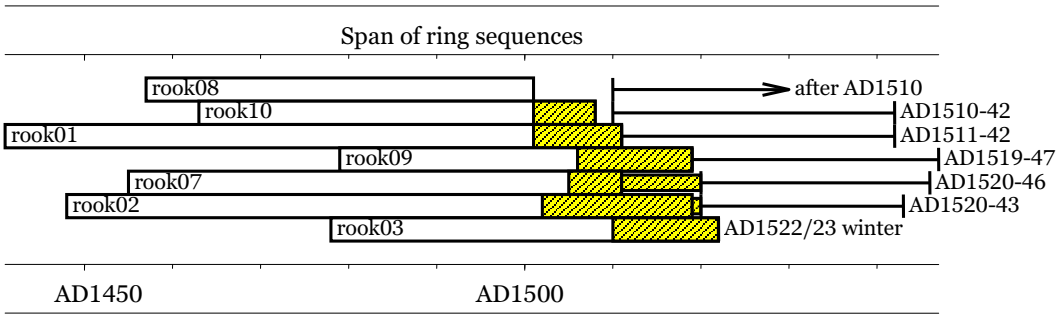

Figure 10: Bar diagram showing the relative positions of overlap of the dated sequences and the individual felling dates/date ranges. White bars represent heartwood, yellow hatched bars represent sapwood, and narrow sections of bar represent additional unmeasured rings

TABLES

Table 1: Details of the samples taken from the barn at Rook Hall, Yaxley Road, Eye, Suffolk

Sample number	Location	Number of rings	Date of sequence (AD)	Sapwood	Mean ring width (mm)	Mean sensitivity	Felling date/date range (AD)
rook01	North wall (T0) west upper queen post	71	1441–1511	10	1.72	0.24	1511–42
rook02	North wall (T0) east upper queen post	72	1448–1519	17+1NM	2.20	0.27	1520–43
rook03	Bay 0-1, west lower purlin	45	1478–1522	12C	2.11	0.27	Winter 1522/23
rook04	North West corner post	<40	-	1	NM	-	-
rook05	Lower west queen post, truss T1	<40	-	13C	NM	-	-
rook06	Tiebeam T1	71	-	h/s	2.85	0.25	-
rook07	West post, truss T1	57	1455–1511	6+9NM	3.05	0.17	1520–46
rook08	Lower west queen post, T4	45	1457–1501	-	2.67	0.23	After 1510
rook09	West common rafter, 5th from south end	41	1479–1519	13	2.42	0.31	1519–47
rook10	East post T4	46	1463–1508	7	4.08	0.25	1510–42
rook11	South east corner post	52	-	19C	3.20	0.24	-

Key:
C = complete sapwood, felled during the winter
h/s = heartwood/sapwood boundary
NM = not measured

Table 2: Cross-matching between the dated ring-width series

	t-values				
Sample	rook03	rook07	rook08	rook09	rook10
rook21m	1.5	2.0	2.9	2.4	0.6
rook03		3.3	2.3	4.3	4.2
rook07			4.3	3.2	3.1
rook08				2.6	3.2
rook09					3.3

Table 3: Dating evidence for rook21m, AD 1441–1519

Source region	Chronology:	Publication reference:	Filename:	Span of chronology (AD)	Overlap (years)	*t*-value
Suffolk	Broadway House, Debenham	(Miles *et al* 2009)	DEBNHM1	1497–1600	79	5.5
Suffolk	Otley Hall	(Bridge 2007)	OTYHALL1	1415–1587	79	5.5
Suffolk	Nettlestead Chace	(Miles *et al* 2007)	NETTLE1	1466–1562	53	5.0

Table 4: Dating evidence for rook87m, AD 1455–1511

Source region	Chronology:	Publication reference:	Filename:	Span of chronology (AD)	Overlap (years)	*t*-value
Norfolk	Abbey Farm Barn, Thetford	(Groves and Hillam 1993)	THETBARN	1461–1530	51	8.1
Suffolk	Hestley Hall, Thorndon	(Miles and Bridge 2011)	HESTLEY1	1399–1539	57	7.1
Suffolk	Wingfield College Barn, Eye	(Bridge 1998a)	WNGFLDBN	1451–1527	57	5.0

Table 5: Dating evidence for rook93m, AD 1478–1522

Source region	Chronology:	Publication reference:	Filename:	Span of chronology (AD)	Overlap (years)	*t*-value
Suffolk	37 High Street, Debenham	(Miles *et al* 2009)	DEBNHM6	1437–1524	45	6.8
Suffolk	Hestley Hall, Thorndon	(Miles and Bridge 2011)	HESTLEY1	1399–1539	45	6.1
Suffolk	Crow's Hall panelling, Debenham	(Miles *et al* 2007)	CROWSHL2	1404–1551	45	6.0

Table 6: Dating evidence for the site sequence ROOKHBRN, AD 1441–1522

Source region	Chronology:	Publication reference:	Filename:	Span of chronology (AD)	Overlap (years)	*t*-value
Suffolk	Crow's Hall panelling, Debenham	(Miles *et al* 2007)	CROWSHL2	1404–1551	82	8.2
Suffolk	37 High Street, Debenham	(Miles *et al* 2009)	DEBNHM6	1437–1524	82	8.2
Suffolk	Hestley Hall, Thorndon	(Miles and Bridge 2011)	HESTLEY1	1399–1539	82	7.6
Norfolk	Abbey Farm Barn, Thetford	(Groves and Hillam 1993)	THETBARN	1461–1530	62	7.6
Essex	Moyns Park, Birdbrook	(Tyers 1999)	MOYNS	1431–1606	82	6.9
Suffolk	Isaac Lord complex, Ipswich	(Bridge 1999)	ISAACLD	1420–1635	82	6.8
Essex	Gosfield Hall, Halstead	(Bridge 1998b)	GOSFIELD	1449–1537	74	6.8
Suffolk	Wingfield College Barn, Eye	(Bridge 1998a)	WNGFLDBN	1451–1527	72	6.5
Sussex	Warhams, Rudgwick	(Miles *et al* 2009)	WARHAM3	1342–1606	82	6.5
Suffolk	Otley Hall	(Bridge 2007)	OTYHALL1	1415–1587	82	6.4

APPENDIX

Ring width values (0.01mm) for the sequences measured

rook01

305	228	206	146	140	182	175	169	188	161
193	199	219	276	157	141	90	122	111	143
147	216	194	117	82	102	101	156	173	202
161	227	133	174	192	171	103	107	142	106
125	135	167	167	223	205	235	73	144	185
78	114	110	178	215	267	228	149	210	235
271	306	183	206	267	233	152	157	177	105
126									

rook02

245	325	187	199	218	239	352	146	122	91
93	111	172	151	284	296	224	195	178	262
300	301	208	233	250	152	246	292	216	169
174	173	142	177	215	211	231	337	259	268
66	122	179	112	142	107	225	204	344	178
188	174	199	254	416	253	317	271	305	247
287	370	194	247	234	278	232	274	272	120
176	173								

rook03

155	345	546	584	360	326	202	249	172	268
239	286	169	199	214	234	261	182	361	294
169	110	151	131	254	225	270	242	252	198
187	137	115	108	128	121	123	161	215	82
91	137	88	71	82					

rook06

386	260	297	260	216	214	207	245	267	248
275	183	113	117	191	282	202	96	70	69
55	49	42	80	223	364	384	278	282	406
445	407	423	356	389	467	273	225	257	333
405	344	364	250	284	217	260	353	276	290
246	182	187	103	208	346	543	446	437	327
340	237	550	480	640	417	357	272	321	315
285									

rook07

422	297	310	316	379	432	346	311	314	296
336	425	394	394	453	505	402	363	354	346
293	275	345	261	280	307	342	377	336	285
250	233	393	331	328	271	209	212	198	319
318	482	253	158	129	170	202	345	265	297
278	281	179	180	223	168	211			

rook08
256 177 247 246 192 268 258 328 551 510
524 461 449 513 439 454 376 394 443 248
191 269 314 309 290 301 266 181 141 144
191 134 152 129 53 80 64 159 168 384
271 147 119 119 109

rook09
408 405 391 177 327 250 207 410 454 290
339 198 134 196 221 238 246 302 248 123
75 78 111 294 251 257 215 297 222 281
290 194 155 165 120 235 326 238 92 216
242

rook10
509 453 392 596 645 555 484 600 648 799
736 876 873 602 551 633 825 730 759 363
273 215 191 264 593 373 441 208 276 262
259 400 305 494 300 172 128 79 70 90
97 151 98 129 128 162

rook11
361 491 433 557 428 359 322 376 540 192
171 250 323 367 405 352 525 419 390 348
397 394 302 393 352 539 387 321 247 135
55 85 160 234 274 293 220 265 291 249
283 324 320 306 310 311 215 394 314 274
215 190

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