

# CHURCH OF ST PETER AND ST PAUL, EYE, SUFFOLK TREE-RING ANALYSIS OF TIMBERS FROM THE TOWER

SCIENTIFIC DATING REPORT

Martin Bridge



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**CHURCH OF ST PETER and ST PAUL,  
EYE,  
SUFFOLK**

**TREE-RING ANALYSIS OF TIMBERS  
FROM THE TOWER**

Dr M C Bridge

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## **SUMMARY**

An initial assessment of the timbers in the tower ruled out dendrochronological investigation of the bellframe on the grounds that the timbers did not contain sufficient numbers of rings to warrant sampling and analysis. The primary timbers of the belfry floor, along with their supporting framework and the secondary joists, were considered worthy of further investigation. A total of ten timbers was sampled, of which one sample was found to have too few rings to analyse, and one timber did not date. The remaining eight series matched each other and were found to form a group of timbers most likely felled at the same time, probably in the period AD 1466–c.70, showing that the supporting framework, primary beams, and secondary joists are all part of the same phase of construction.

## **CONTRIBUTOR**

Dr M C Bridge

## **ACKNOWLEDGEMENTS**

I would to thank the captain of the bells, Mr St John Perry, for his kind assistance in removing ceiling boards and providing a ladder, as well as giving access to the tower. I also thank Graham Pledger (English Heritage) for his introduction to the site and discussion about the work to be undertaken. The work was commissioned by Dr Peter Marshall (EH). Cathy Tyers (Sheffield University) and John Meadows (EH) are thanked for their comments on an earlier draft of this report.

## **ARCHIVE LOCATION**

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2010

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## INTRODUCTION

The church of St Peter and St Paul sits on the eastern side of the market town of Eye (Fig 1), where its exceptionally large tower dominates the skyline. The church is a grade I listed building comprising flint with ashlar dressings and brick. It is of mainly early fourteenth-century date, although it was heightened and reroofed in the late-fifteenth century. The tower and south porch were both added in the late-fifteenth century. The tower is of four stages, stepping down in size at each higher level, and is supported by diagonal polygonal buttresses. The belfry stage has two two-light Perpendicular openings to each face. Much of the church was restored in AD 1869. Proposed repair work to the bellframe led to the English Heritage bellframe specialist Graham Pledger requesting that the bellframe and associated elements within the tower be investigated dendrochronologically to establish their construction dates and hence inform the proposed work.



*Figure 1. Map to show the location of the church (based on the Ordnance Survey map with permission of the Controller of Her Majesty's Stationery Office, ©Crown Copyright)*

## METHODOLOGY

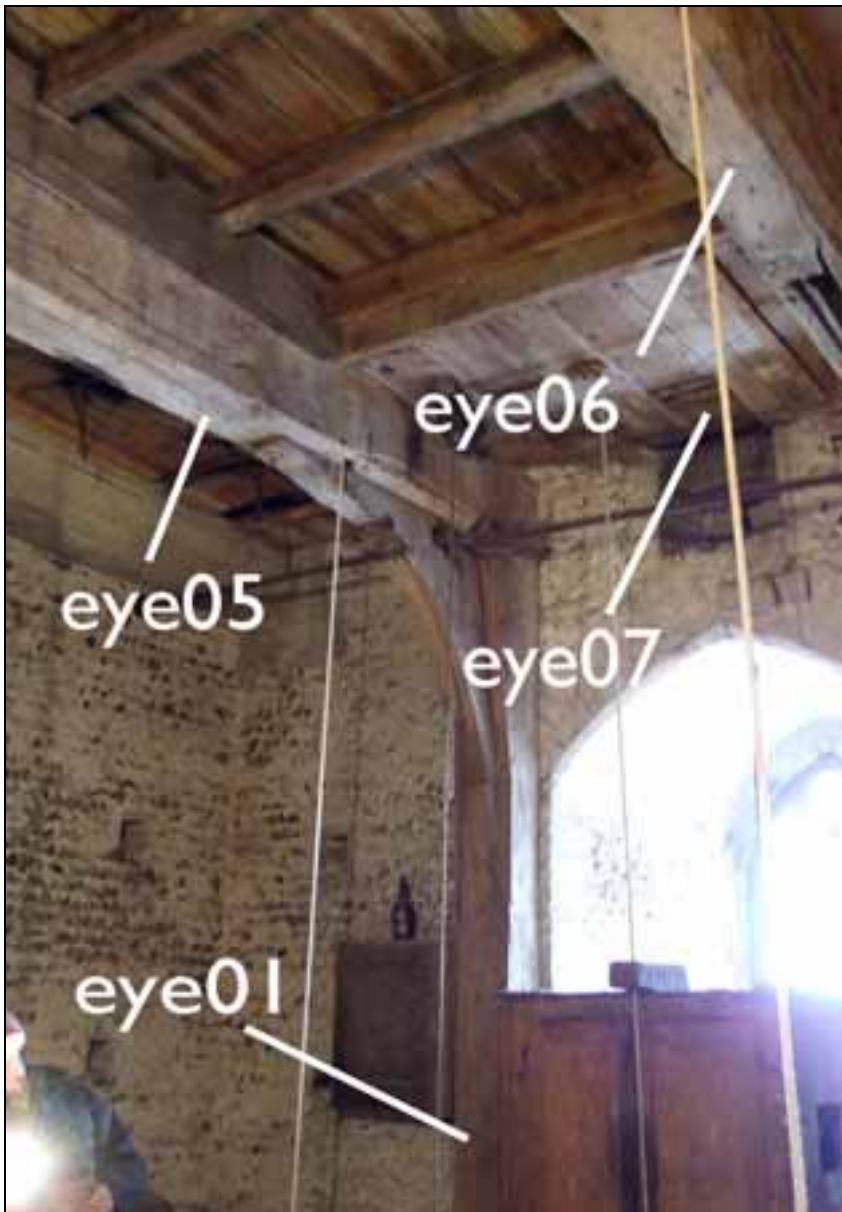
The site was visited in March 2010. In the initial assessment, accessible oak timbers with more than 50 rings and where possible traces of sapwood were sought, although slightly shorter sequences are sometimes sampled if little other material is available. Those building timbers judged to be potentially 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 removed were polished on a belt sander using 60 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 PC, 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 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 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  $t$ -values of 4 and 5 that are demonstrably spurious 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 do not preclude same-tree derivation, however.

### 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 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 an empirically derived sapwood estimate with a given confidence limit. If no sapwood or heartwood/sapwood boundary survives, then the

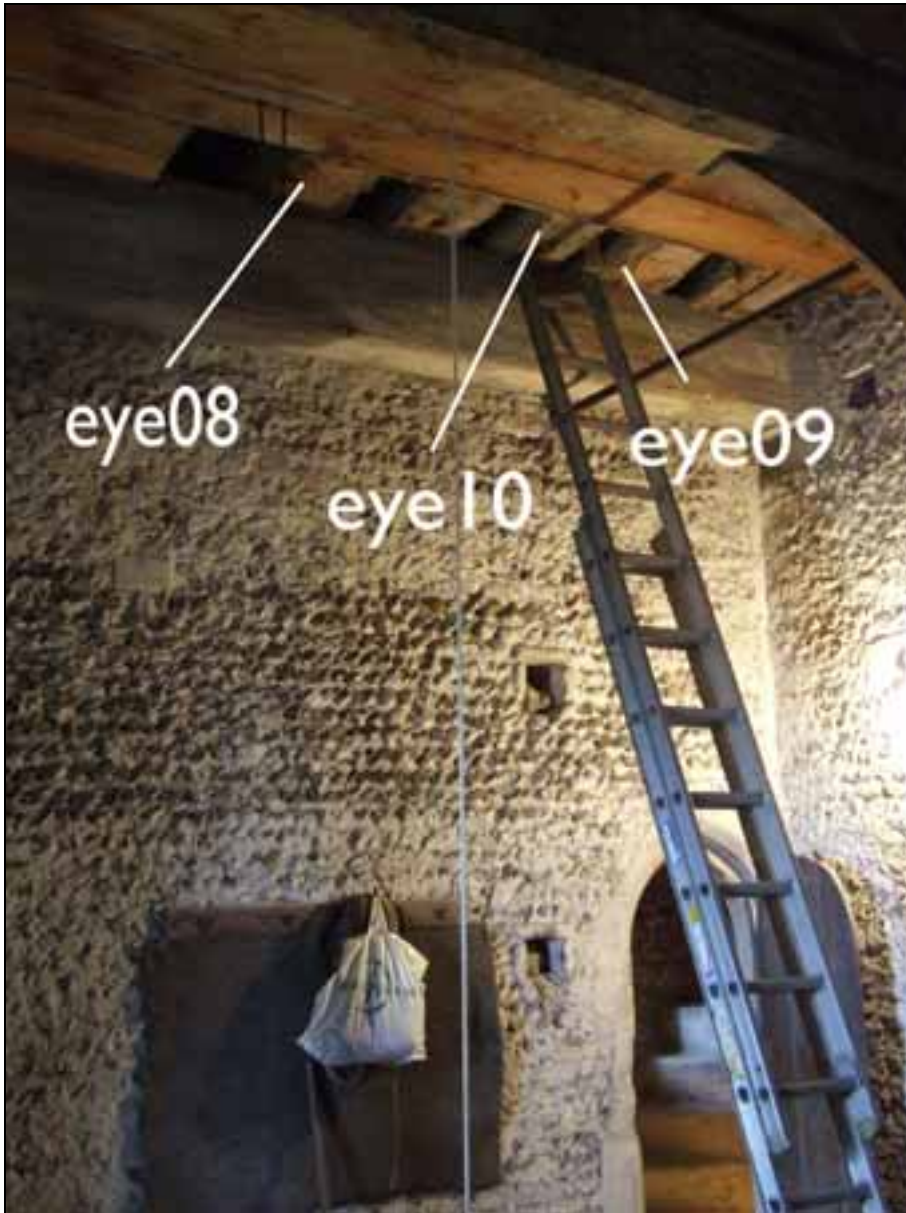
minimum number of sapwood rings from the appropriate sapwood estimate is added to the last measured ring to give a *terminus post quem* (*tpq*) or felled-after date.



***Figure 2. View of the belfry floor and supporting structure, looking south-west, showing some of the timbers sampled for dendrochronology***

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. For this region, the sapwood estimate used is 9–41 (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.





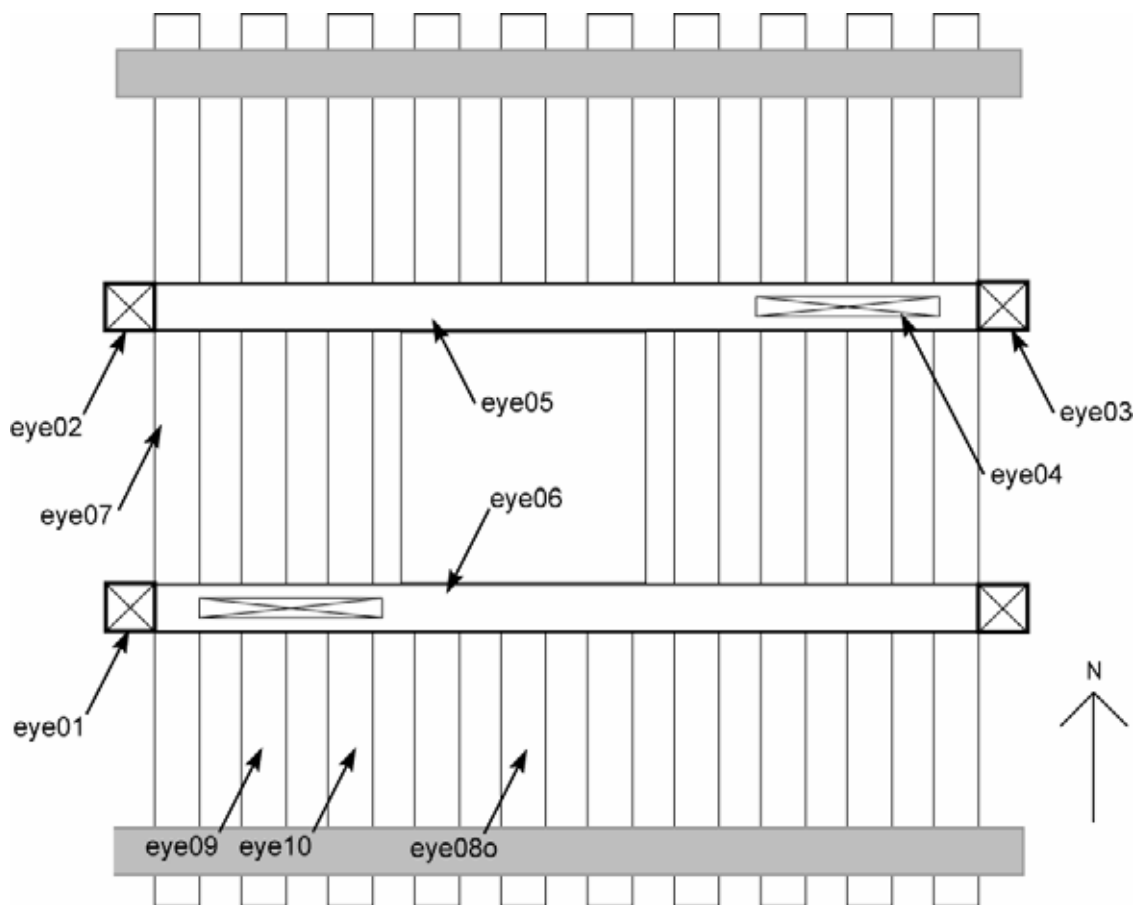
*Figure 3. View of the belfry floor, looking north-east, showing some of the timbers sampled for dendrochronology*

## RESULTS AND DISCUSSION

The key element of this investigation, the bellframe was assessed and rejected for sampling and analysis as all its timbers were judged to have too few rings to make dating by dendrochronology likely, although other associated elements within the tower were assessed as suitable. After confirmation with Graham Pledger and the Scientific Dating Team, timbers from the belfry floor and its supporting structure were sampled, including the two main east-west beams, some of the secondary joists resting on these beams, and



the posts supporting the primary beams (Figs 2–4). Table 1 details the timbers sampled and basic information about the ring series derived from them. Sample eye08 was found to have bands of very narrow rings in the inner section and was truncated so that only the outer 58 rings were used in further analysis, the edited series being called eye08o. The data for each sample are given in the appendix. One sample, eye04, was rejected from the analysis as it contained too few rings for reliable dating purposes. The remaining nine samples were compared. There was good cross-matching between eight of the samples (Table 2). Sample eye04 did not match the other series, nor could it subsequently be dated independently.



**Figure 4. Plan of the belfry floor, from below, showing the positions of the sampled timbers; shaded beams are in concrete**

Eight series were therefore combined at the relative positions of overlap indicated in Figure 5 to form the 106-year site chronology, EYE. This was subsequently dated to the period AD 1356–1461, the strongest matches being detailed in Table 3. The matches indicate that the timbers used were most likely from trees grown close to the location of Eye.

All the dated series retained the heartwood-sapwood boundary, and several had sapwood rings as well. They appear to form a single group of timbers most likely felled at

the same time, since they have overlapping felling date ranges and the structure appears to have been built as a single phase. Two samples were particularly useful in narrowing the range of likely felling dates. Sample eye01 retained 16 sapwood rings including the outermost ring below the bark, but these were detached from the main core, and thus it is possible that a few rings were lost from the start of the sapwood. Sample eye02 retained 26 sapwood rings, and a further five outer rings that broke off during coring. It was noted at the time of sampling that very little sapwood was lost from this core, and the outermost sapwood ring under the bark was present on the timber. Therefore it is possible to suggest a narrow range for its likely felling date. The other timbers, which retain less significant amounts of sapwood, have likely felling date ranges which agree well with these two samples (Fig 4; Table 1), and thus a narrow range of AD 1466–c.70 is proposed for the felling of the timbers investigated.

This result confirms that the primary and secondary members of the belfry floor and its support framework are all contemporaneous and that they were indeed felled in the late-fifteenth century, providing support for the accepted understanding of the chronological development of the church and also more precise dating evidence for the work in the tower. Further interpretative survey work may ascertain whether or not this late-fifteenth century date can also be applied to the actual bellframe.

**Table 1. Details of oak (*Quercus spp.*) timbers sampled from the tower, Church of St Peter and St Paul, Eye, Suffolk**

Sample	Timber and position	No of rings	Mean width (mm)	Mean sens (mm)	Spanning Dates AD	H/S bdry AD	Sapwood	Felling seasons and dates/date ranges (AD)
Supporting framework								
eye01	South-west post	81	2.27	0.28	1367–1447	1447	h/s (+16NM)	1463–c70
eye02	North-west post	106	1.25	0.28	1356–1461	1435	26 (+5NM)	1466–c70
eye03	North-east post	60	1.86	0.33	undated	-	10 (+4NM)	unknown
eye04	Brace to north-east post	<45	NM	-	undated	-	-	unknown
Primary east-west beams								
eye05	North beam	68	2.11	0.25	1380–1447	1447	h/s	1456–88
eye06	South beam	55	2.12	0.27	1399–1453	1445	8	1454–86
Secondary joists								
eye07	West-most joist in middle section	46	3.42	0.27	1399–1444	1444	h/s (+9NM)	1453–85
eye08o	5 <sup>th</sup> joist from west end, southern section	58	1.98	0.21	1393–1450	1450	h/s	1459–91
eye09	2 <sup>nd</sup> joist from west end, southern section	92	2.94	0.25	1368–1459	1452	7	1461–93
eye10	3 <sup>rd</sup> joist from west end, southern section	71	2.95	0.27	1384–1454	1454	h/s	1463–95

Key: NM = not measured; h/s = heartwood-sapwood boundary; uses sapwood estimate 9–41 from Miles (1997)

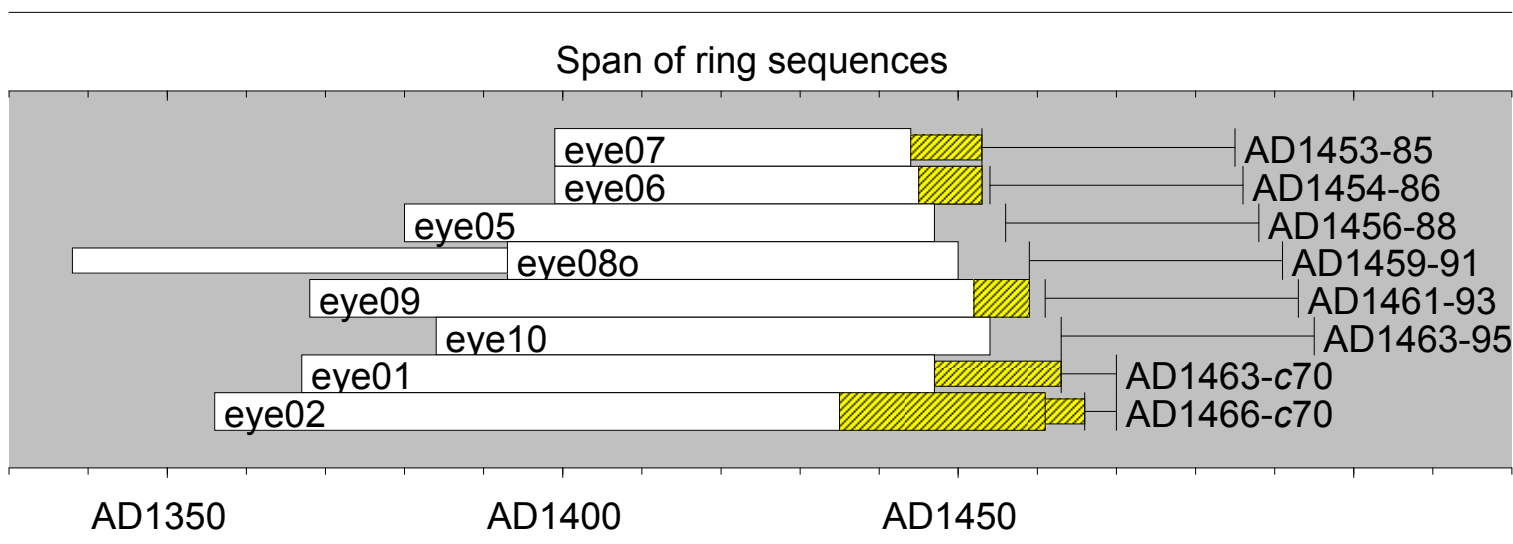


Figure 5. Bar diagram showing the relative positions of overlap between the dated series, along with their derived likely felling date ranges. Hatched sections represent sapwood rings and narrow sections represent additional unmeasured



**Table 2. Cross-matching between the dated series; t-values over 3.5 are considered significant**

SAMPLE No	<i>t-values</i>						
	eye02	eye05	eye06	eye07	eye08o	eye09	eye10
eye01	5.8	7.8	5.1	3.1	4.6	5.1	6.5
eye02		4.9	4.9	5.1	4.1	7.6	5.4
eye05			3.7	3.1	4.4	3.6	4.7
eye06				3.2	6.0	3.4	6.5
eye07					7.5	2.0	4.5
eye08o						2.2	6.4
eye09							4.7

**Table 3. Dating evidence for the series EYE, AD 1356–1461, file names in **BOLD** represent regional chronologies**

County/region:	Chronology name:	Short publication reference:	File name:	Spanning: (yrs AD)	Overlap (yrs)	t-value
East Anglia	ANGLIA03	(Bridge 2003)	<b>ANGLIA03</b>	944–1789	106	8.8
Essex	Falconer's Hall, Good Easter	(Bridge 1996)	FALCONER *	1324–1457	102	7.9
Essex	St Mary's, Saffron Walden	(Bridge 2001)	SAFFRON1 *	1305–1475	106	7.0
Suffolk	Otley Hall	(Bridge 2001)	OTYHALL1 *	1415–1587	47	7.0
Norfolk	Abbey Farm, Thetford	(Howard <i>et al</i> /2000)	THTASQ01	1332–1536	106	6.8
Suffolk	12 Aspoll Road, Debenham	(Miles <i>et al</i> /2009)	ASP03	1379–1445	67	6.8
Berkshire	8 Canon's Cloisters, Windsor	(Howard <i>et al</i> /2005)	WINDSOR4	1342–1467	106	6.4
London	London Master Chronology	(Tyers pers comm)	<b>LONDON</b>	413–1728	106	6.4
Essex	Thaxted Church Chancel	(Bridge 2005)	THXTDCH	1212–1404	49	6.1

\* = constituent of **ANGLIA03**

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## APPENDIX

Ring width values (units of 0.01mm)

### eye01

160	345	347	279	232	334	304	321	222	244
158	252	174	259	181	144	96	87	226	215
295	203	216	234	119	77	196	238	256	255
198	266	338	270	237	223	174	394	267	340
181	417	406	363	303	301	510	338	334	301
248	333	209	283	311	243	232	219	191	125
93	177	123	104	158	226	157	126	130	101
139	212	237	120	139	151	212	112	135	154
155									

### eye02

365	275	168	104	58	44	105	125	121	163
116	77	97	204	187	91	132	90	104	90
79	56	94	49	64	70	90	135	112	225
235	188	189	163	167	113	61	96	95	159
165	146	246	212	157	161	220	209	323	180
270	179	248	171	165	211	157	135	127	127
111	96	110	109	149	140	87	147	130	70
56	61	85	112	79	162	206	124	78	64
33	41	49	43	52	60	77	79	56	75
96	72	73	124	72	53	70	112	115	112
114	87	82	76	113	126				

### eye03

495	465	369	239	192	243	205	242	133	123
168	177	406	467	130	141	147	304	269	216
177	132	74	53	64	98	126	134	191	121
110	54	32	29	39	94	159	152	205	105
237	300	124	102	123	280	158	140	101	117
192	133	173	138	191	154	278	249	305	357

### eye05

357	232	188	171	112	232	175	199	275	324
363	179	121	246	222	262	439	255	257	315
284	285	246	255	315	342	367	213	338	351
147	203	192	258	279	234	142	108	176	170
174	201	217	202	242	136	91	89	138	159
142	195	255	145	155	117	111	163	236	270
148	185	169	163	103	110	97	112		

### eye06

441	381	245	320	234	454	396	350	351	523
420	308	232	174	402	213	313	244	138	144
159	181	221	179	204	203	144	86	102	122
182	125	141	219	200	135	172	105	209	194
148	158	164	160	212	103	130	138	144	106
146	98	78	117	165					

eye07

242	162	301	425	465	571	549	563	449	585
438	568	401	324	384	337	328	200	193	436
342	395	419	263	448	406	340	236	186	197
322	205	472	565	327	295	348	234	294	235
174	211	185	293	242	192				

eye08

129	116	134	121	89	96	127	82	133	238
186	62	50	34	24	35	58	77	101	70
119	106	44	33	34	33	71	136	141	134
69	46	48	38	33	39	62	36	30	30
46	67	49	85	42	29	42	65	83	112
159	101	100	51	65	134	159	268	298	245
393	331	321	262	276	275	341	337	340	292
386	392	358	328	212	309	249	263	182	120
197	178	167	204	166	195	241	208	142	112
166	241	139	188	225	172	115	134	119	171
156	111	105	89	91	64	59	45	41	51
41	40	55							

eye08o

134	159	268	298	245	393	331	321	262	276
275	341	337	340	292	386	392	358	328	212
309	249	263	182	120	197	178	167	204	166
195	241	208	142	112	166	241	139	188	225
172	115	134	119	171	156	111	105	89	91
64	59	45	41	51	41	40	55		

eye09

317	430	351	181	286	190	243	251	222	169
288	202	236	250	330	344	188	341	346	329
339	366	313	276	209	277	220	364	362	313
472	410	456	304	353	294	494	503	506	370
527	341	267	374	415	523	310	389	259	323
214	188	267	303	227	333	257	199	210	162
156	162	109	216	331	255	229	215	365	300
310	361	186	209	249	284	202	243	259	304
227	431	264	184	283	311	286	295	367	219
212	243								

eye10

230	288	318	581	530	379	255	297	194	262
309	411	354	315	269	258	195	177	233	220
380	360	469	215	400	396	386	423	384	641
417	326	195	147	232	240	301	402	272	259
329	267	178	214	307	365	258	391	399	310
125	174	158	209	304	265	192	212	239	249
126	200	242	290	214	408	207	187	325	342
34									





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