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ST MARY'S CHURCH, TUNSTEAD, NORFOLK
TREE-RING ANALYSIS OF TIMBERS FROM THE NAVE ROOF

SCIENTIFIC DATING REPORT

Dr Martin Bridge

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NGR: TG 309 227

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SUMMARY

Twelve samples were taken from the nave roof. A sample from the principal rafter and arch brace of the same truss were found likely to have been cut from the same tree. A number of potential statistically identified matches between the samples were explored, but visual comparisons of the plots found these to be unacceptable, and all the timbers remain undated.

CONTRIBUTORS

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ACKNOWLEDGEMENTS

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ARCHIVE LOCATION

Norfolk Historic Environment Record
Norfolk Landscape Archaeology
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DATE OF INVESTIGATION

2006–8

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INTRODUCTION

This grade I-listed parish church (NGR TG 309 227; Fig 1) has a five-bay arch-braced roof to the nave, and a three-bay arch-braced roof to the chancel (Fig 2). Some of the nave roof timbers carry pencil markings and carvings which suggest dates of repairs in AD 1683, AD 1844, and AD 1848. The roof is undergoing grant-aided repairs and dating of the original timbers, thought possibly to be of fifteenth-century origin, was requested by the Historic Buildings Architect Ian Harper to inform those repairs.

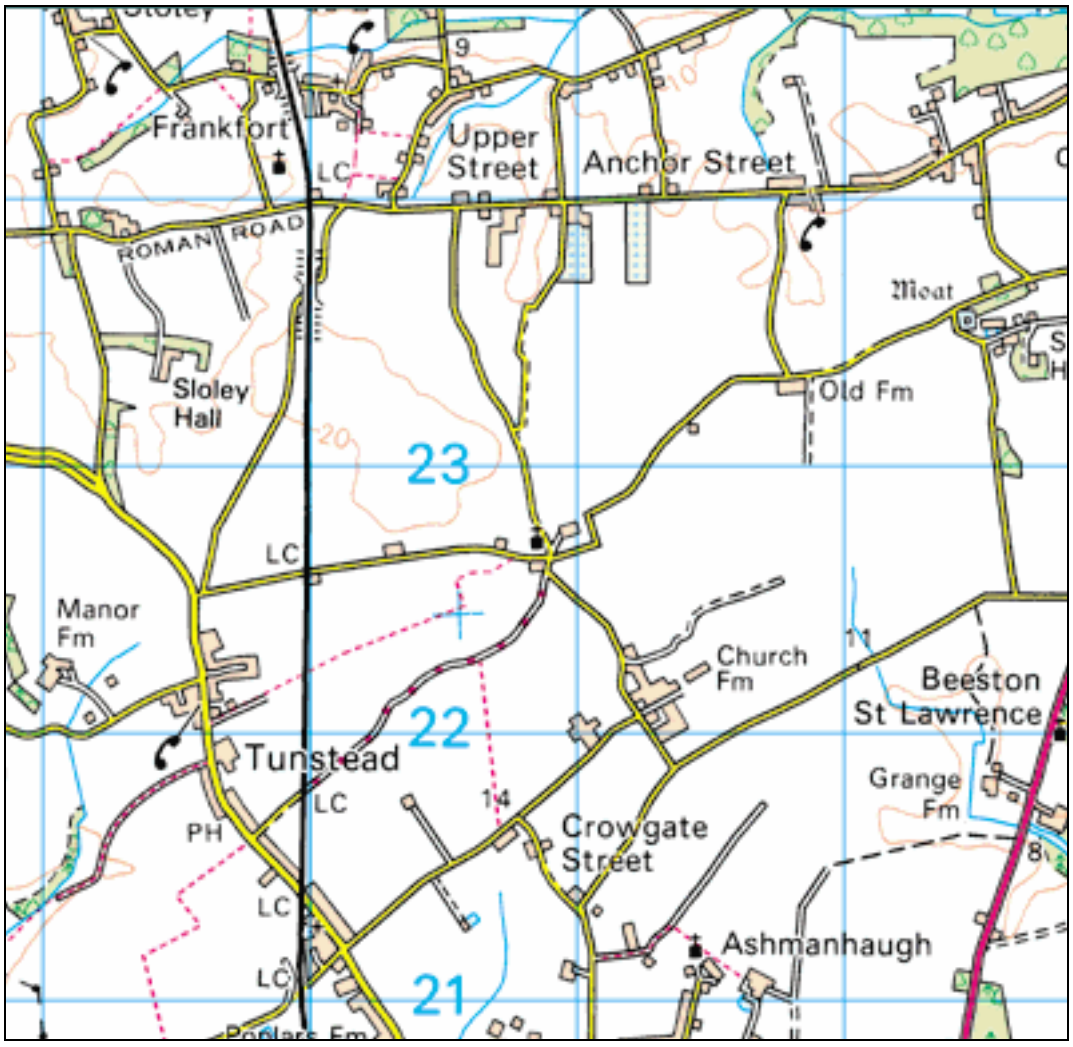

Figure 1: Map showing the location (centre) of the St Mary's Church, Tunstead, Norfolk

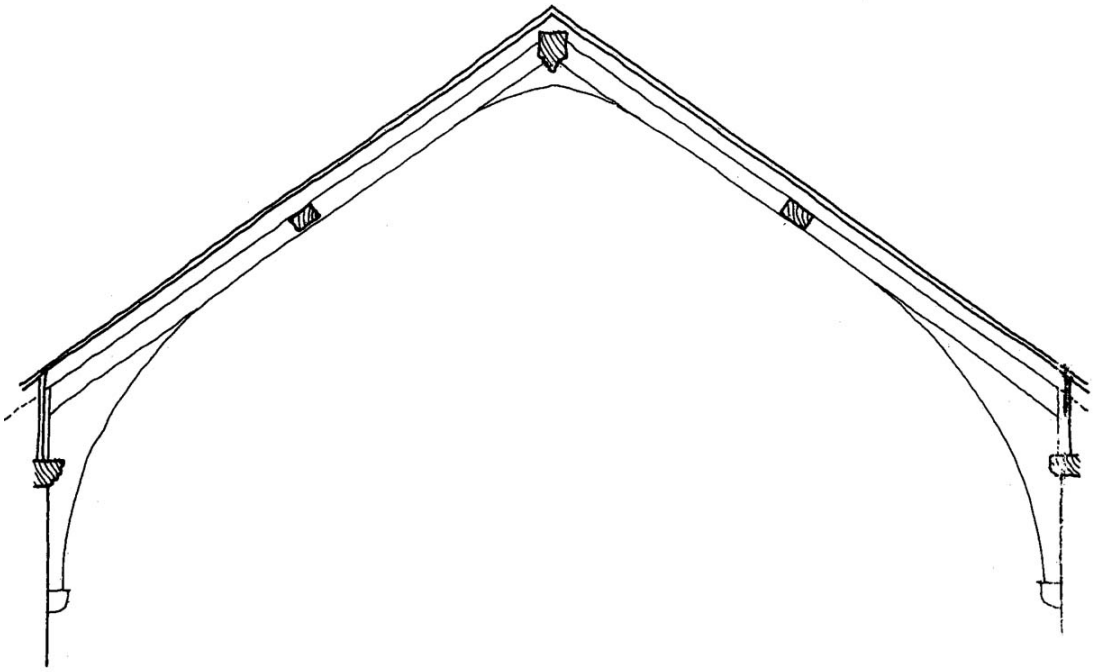

Figure 2: Form of the nave trusses, drawing supplied by Ruth Blackman

METHODOLOGY

The site was visited in 2006 during initial works to determine the extent of future repairs, and again in February 2008 when work was being carried out on the nave roof. The chancel roof, part of the original brief, was not investigated as no access was available. 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 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. Suitable 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 errors in the measurements when the samples cross-match.

In comparing one sequence or site sequence against another, *t*-values over 3.5 are considered significant, although in reality it is common to find *t*-values of 4 and 5 which are demonstrably spurious because more than one matching position is indicated. For this reason, it is necessary to obtain some *t*-values of 5, 6, and higher, and for these to be well replicated from different, independent chronologies and with local and regional chronologies well represented, unless the timber is imported. Where two individual sequences match with a *t*-value of 10 or above and visually exhibit exceptionally similar ring patterns, they most likely came from the same parent tree.

When cross-matching between samples is found, their ring-width sequences are averaged to form an internal 'working' site mean sequence. Other samples may then be incorporated after comparison with this 'working' master until a final site sequence is established. This is then compared with a number of reference chronologies (multi-site chronologies from a region) and dated individual site masters in an attempt to date it. Individual long series which are not included in the site mean(s) are also compared with the database to see if they can be dated.

The dates thus obtained represent the time of formation of the measured rings in each sample. These dates require interpretation for the construction date of the phase under investigation to be determined. An important aspect of this interpretation is the estimate of the number of sapwood rings missing. The sapwood estimate used in this area is based on those proposed for this area by Miles (1997), in which 95% of oaks contain 9–41 rings. Where complete sapwood or bark is present, the exact date of tree felling may be determined.

RESULTS AND DISCUSSION

Details of the samples taken, which were all oak (*Quercus* spp.), are given in Table 1, and their locations are shown in Figure 3. Cross-matching amongst the sample series showed great similarity between samples tst09 and tst12, the principal rafter and arch brace on the south side of truss 3 ($t = 14.6$ with 77 years overlap), and it is very likely that these timbers were cut from the same tree (Fig 4). The two series were averaged to form a new series, tst912m, used in subsequent analyses. Whilst there were other statistical matches between various of the series (Table 2), and these appear to be internally consistent within the group, close examination of the plots of these series raised concerns of the validity of some of these and hence it was not considered appropriate to average them to form a new site series. These series are also shown in Figure 4, where it can be seen that some of the sequences match each other well in places but do their own thing in other places. The measured series were individually compared with dated reference material from both the UK and elsewhere in Europe. Again, some potential matches were found, but a lack of replication and comparisons between the plots resulted in these matches being rejected. None of the timbers from this roof were therefore dated.

*Table 1: Details of oak (*Quercus *spp.) timbers sampled from the nave of St Mary's Church, Tunstead, Norfolk*

Sample number	Timber and position	No of rings	Mean width (mm)	Mean sens (mm)	Dates AD Spanning	H/S bdry AD	Sapwood complement	Likely felling date ranges (AD)
tst01	Principal rafter 2 south	76	2.16	0.17	undated	-	-	unknown
tst02	Tie beam 2	<40	NM	-	undated	-	-	unknown
tst03	Intermediate principal rafter, bay 3-4 south	<40	NM	-	undated	-	-	unknown
tst04	Tie beam 1	<40	NM	-	undated	-	-	unknown
tst05	Arch brace 2 south	<40	NM	-	undated	-	-	unknown
tst06	Purlin bay 1-2 north	66	2.04	0.27	undated	-	-	unknown
tst07	Common rafter 9, bay 1 north	62	1.67	0.14	undated	-	H/S	unknown
tst08	Principal rafter 3 north	98	2.00	0.27	undated	-	-	unknown
tst09	Principal rafter 3 south	87	2.67	0.24	undated	-	-	unknown
tst10	Principal rafter 4 north	91	1.63	0.25	undated	-	-	unknown
tst11	Intermediate principal rafter, bay 4-5 north	115	1.73	0.27	undated	-	H/S	unknown
tst12	Arch brace 3 south	100	2.33	0.22	undated	-	-	unknown

Key: H/S = heartwood/sapwood boundary; NM = not measured

Table 2: Statistical cross-matching between the samples that suggest the positions of the sequences illustrated in Figure 4.

Filenames	tst08	tst09	tst10	tst11	tst12
tst01	5.9	3.7	4.6	5.6	5.4
tst08		5.2	3.2	4.3	4.3
tst09			3.9	2.1	14.6
tst10				2.2	4.8
tst11					2.9

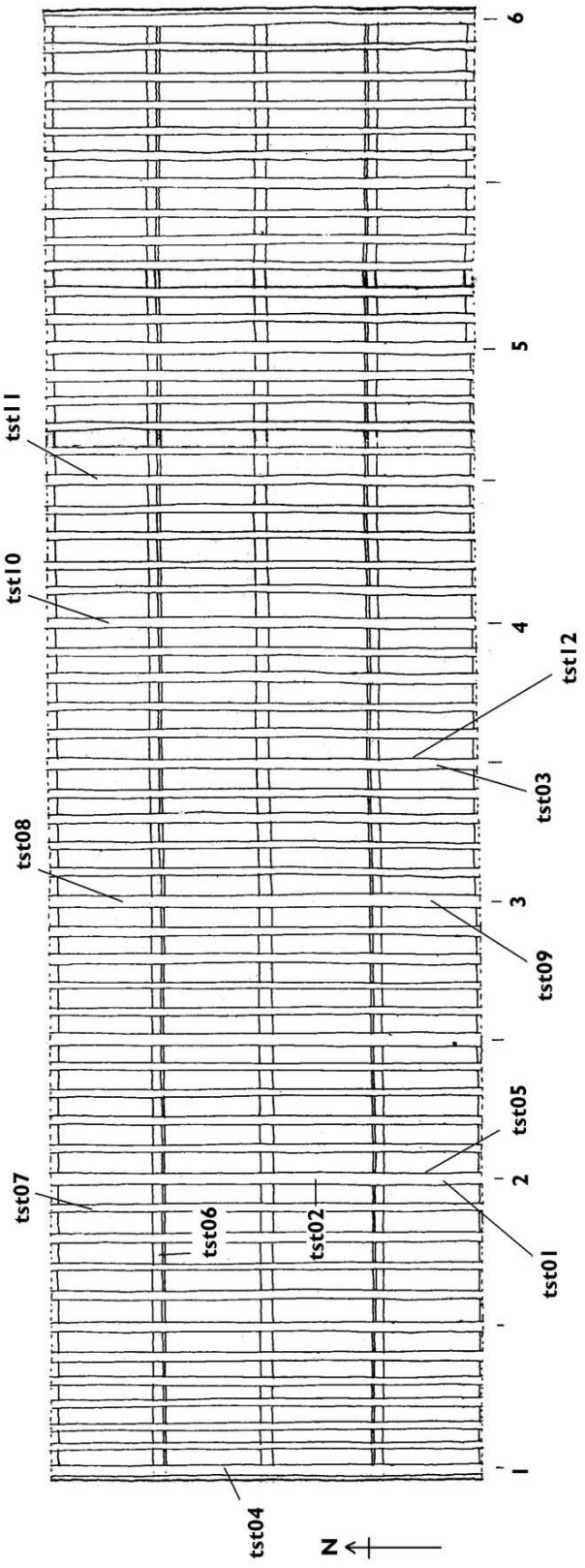

Figure 3: Plan of the nave roof showing the timbers sampled. Adapted from an original drawing supplied by Ruth Blackman

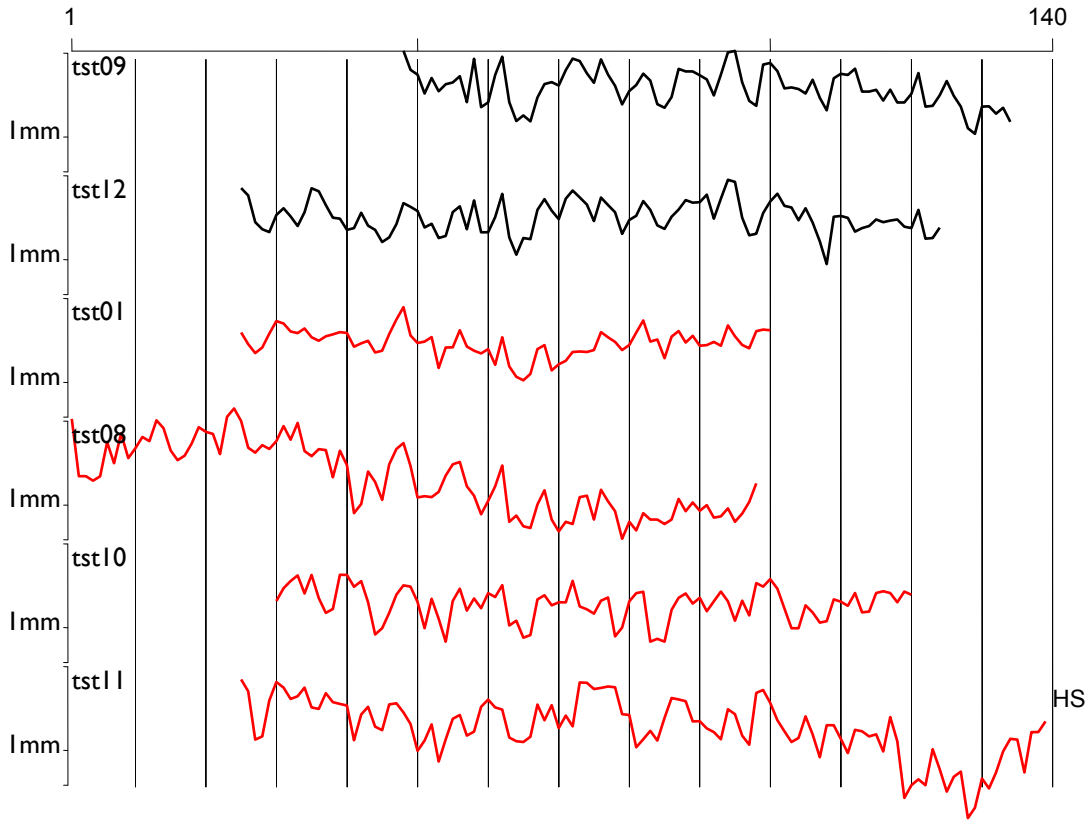

Figure 4: Plots of the two ring width sequences derived from the two timbers (tst09, tst12) derived from the same-tree and the potential matching positions of the other four timbers. The x axis is plotted in relative years, and the y axis is the width in mm plotted on a logarithmic scale

REFERENCES

Baillie, M G L, and Pilcher, J R, 1973 A simple cross-dating program for tree-ring research, *Tree Ring Bulletin*, **33**, 7–14

Hollstein, E, 1965 Jahrringchronologische von Eichenholzern ohne Walkande, *Bonner Jahrbuecher*, **165**, 12–27

Miles, D, 1997 The interpretation, presentation, and use of tree-ring dates, *Vernacular Architect*, **28**, 40–56

Salzman, L F, 1952 *Building in England down to 1540*, Oxford

Tyers, I, 2004 *Dendro for Windows program guide 3rd edn*, ARCUS Rep, **500b**