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GODSFIELD CHAPEL, OLD ALRESFORD, HAMPSHIRE
TREE-RING DATING

SCIENTIFIC DATING REPORT

Daniel Miles

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GODSFIELD CHAPEL, OLD ALRESFORD, HAMPSHIRE

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SUMMARY

The Chapel at Godsfield, Old Alresford, Hampshire, is a small two-storey building of late fourteenth-century origins. Only the roof above the chamber at the west end and a number of large floor beams beneath the chamber were assessed for dendrochronological analysis, the roof over the eastern end having been lost at some earlier date. Eight samples were taken, but due to the fact that rings ranged in number between only 33 and 57, no reliable cross-matching or cross-dating was found.

CONTRIBUTORS

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ACKNOWLEDGEMENTS

The dating was commissioned by Stephen Trow, Ancient Monuments Inspector for English Heritage. Louise Bainbridge organised the site visit and provided plans and background information. Dr John Meadows and Cathy Tyers both made useful comments on an earlier draft of this report.

ARCHIVE LOCATION

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DATE OF INVESTIGATION

1998–2008

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INTRODUCTION

The Chapel at Godsfield, Old Alresford, Hampshire (SU 604 370; Figs 1, 2), is a small two-storey building aligned east-west. The walls are constructed of rendered flint rubble with stone dressings which are late fourteenth-century in style. At the east end is a larger room which is full height, whilst at the west end are two rooms, a kitchen at ground-floor level (Fig 3) with a chamber above accessed by a stair projection on the north side. Three arch-braced collar trusses survive to the chamber roof, with three common rafters in each of the two bays (Fig 4). Double wall plates and ashlar pieces are also employed in the roof. Only the roof above the chamber was assessed for dendrochronological analysis, the roof over the eastern end having been lost at some earlier date. A number of large beams also survive beneath the chamber floor and were accessible for analysis.

Figure 1: Map showing the location of Godsfield, Hampshire (circled)

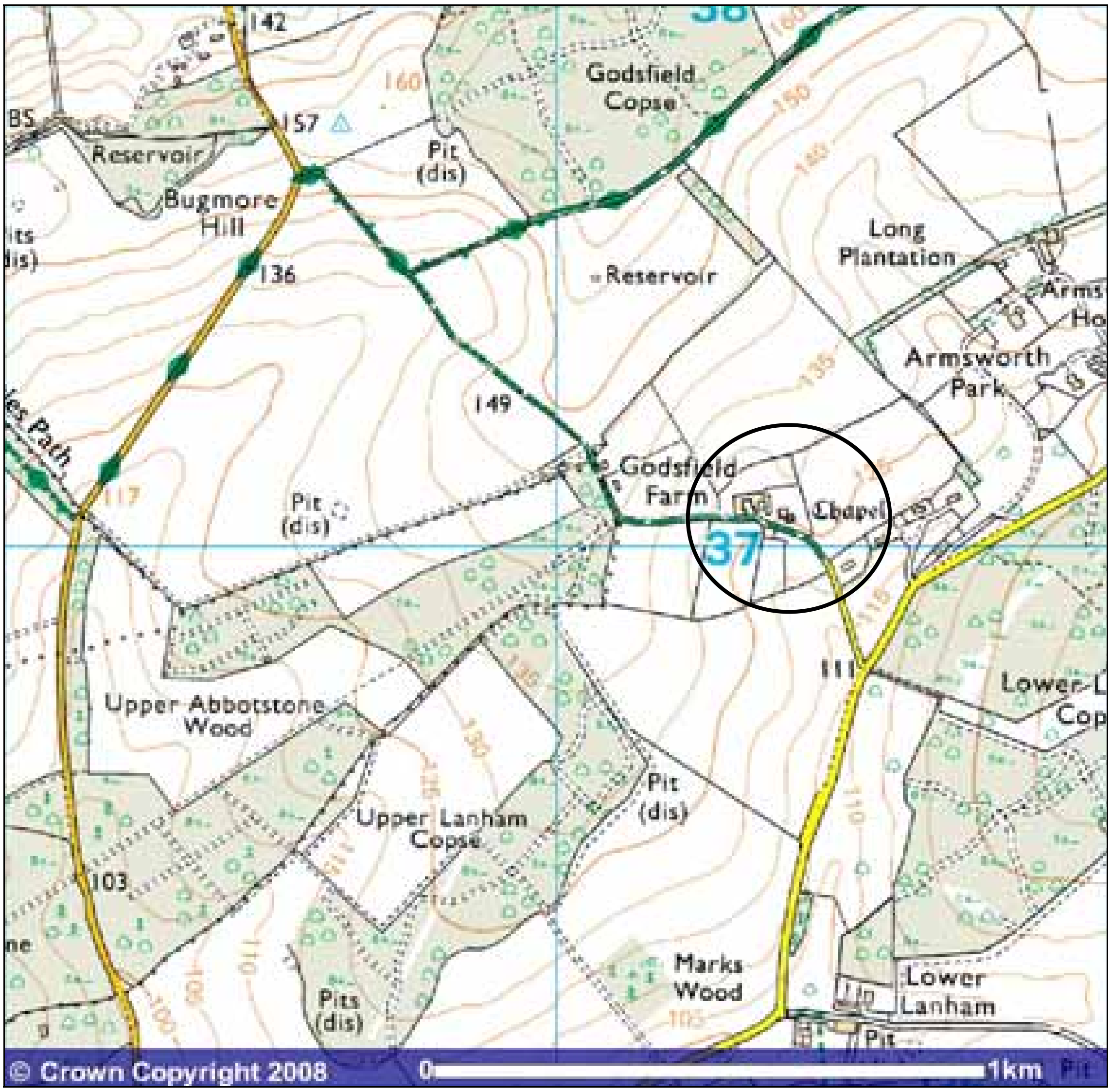

Figure 2: Map showing the location of Godsfield Chapel

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As part of a programme of repairs during 1998-9, the lath and plaster ceiling of the building was removed allowing access to the roof. Tree-ring analysis of the roof timbers and floor beams of this Scheduled Ancient Monument was commissioned by Stephen Trow, Inspector of Ancient Monuments for English Heritage, to assist in understanding development of the structure and to inform the progress of grant-aided repairs.

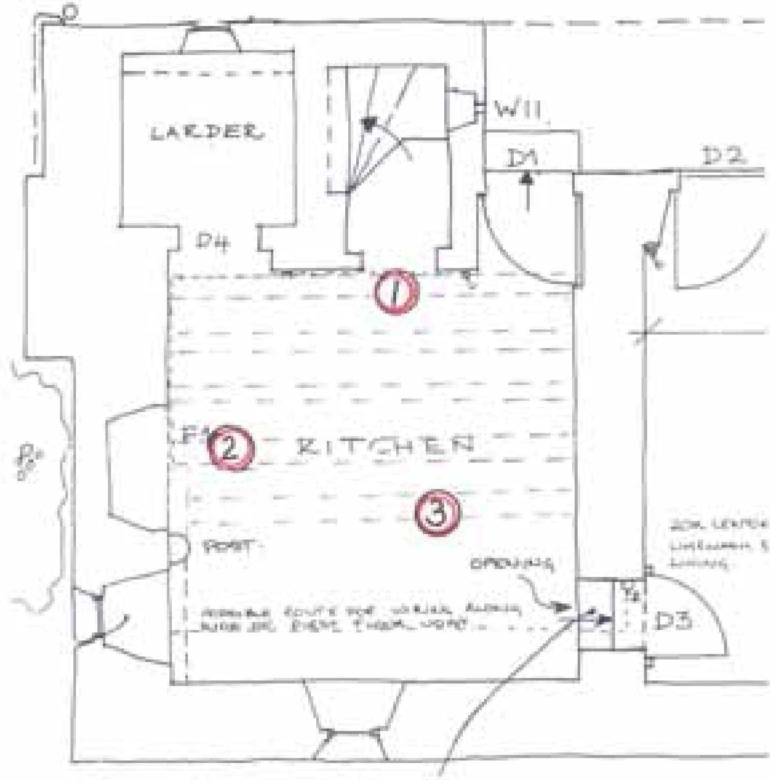

Figure 3: Plan showing ground-floor beams sampled (after Seymour and Bainbridge)

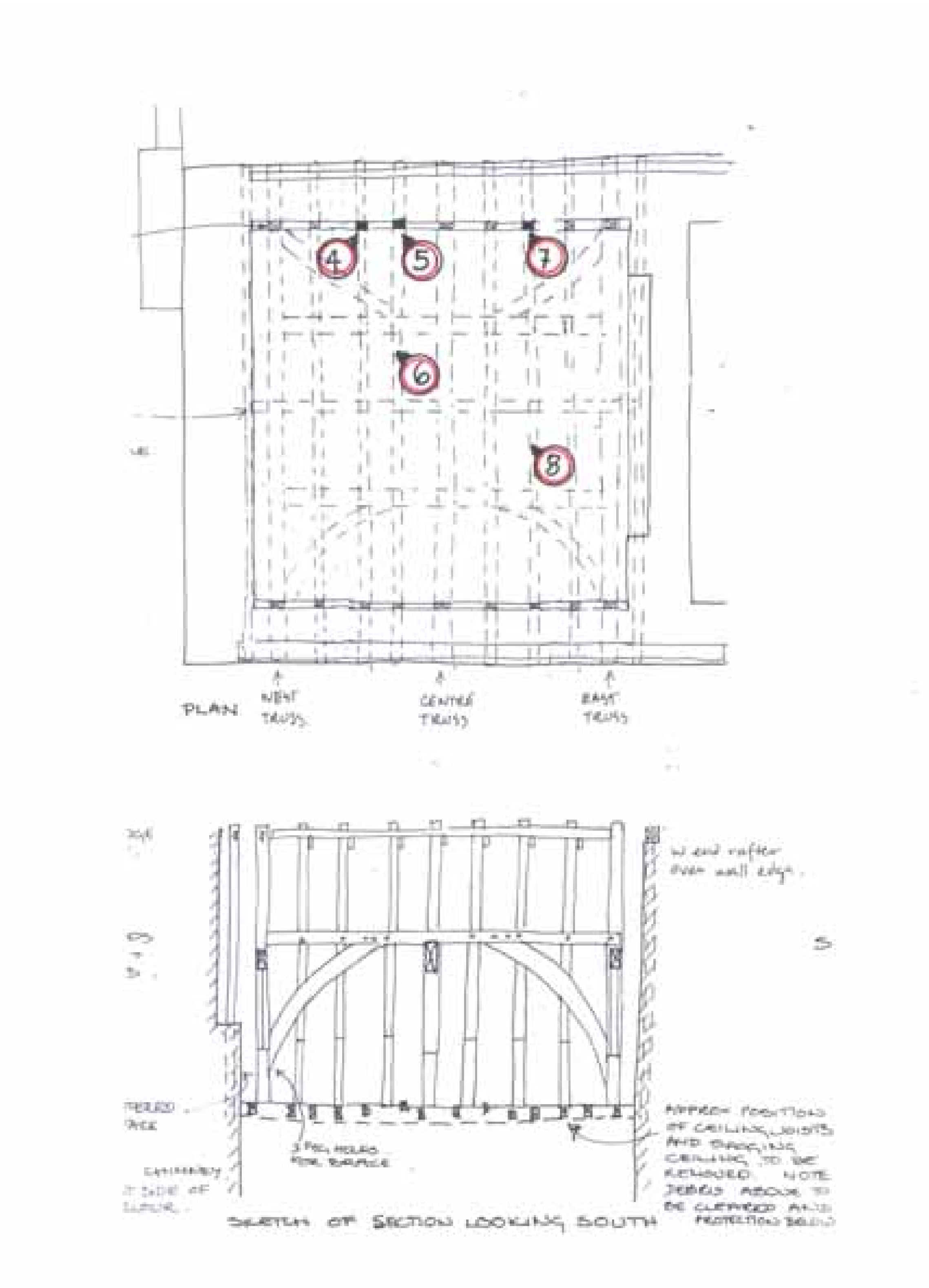

Figure 4: Plan showing first-floor roof timbers sampled (after Seymour and Bainbridge)

HOW DENDROCHRONOLOGY WORKS

The science of dendrochronology is based on a combination of biology and statistics (Baillie 1982; Schweingruber 1988; English Heritage 1998). Fundamental to understanding how dendrochronology works is the phenomenon of tree growth. In Britain, the European oak (*Quercus robur* and *Q. petraea*) is the most commonly-used species for tree-ring dating, and the most of the following relates to these species. Essentially, trees grow through both elongation and the addition of radial increments. The elongation takes place at the terminal portions of the shoots, branches, and roots, while the radial increment is added by the cambium, the zone of living cells between the wood and the bark. In general terms, a tree can be best simplified by describing it as a cone, with a new layer being added to the outside each year in temperate zones, making it wider and taller.

An annual ring is composed of the growth which takes place during the spring and summer until about October in Britain, when the leaves are shed and the tree becomes dormant for the winter period. For the European oak, as well as many other species, the annual ring is composed of two distinct parts – the spring growth or early wood, and the summer growth, or late wood. Early wood is composed of large vessels formed during the period of shoot growth, which takes place between approximately March and May, which is before the establishment of any significant leaf growth, and is produced by using most of the energy and raw materials laid down the previous year. Then, there is an abrupt change at the time of leaf expansion around May or June, when hormonal activity dictates a change in the quality of the xylem, and the summer, or late, wood is formed. Here the wood becomes increasingly fibrous and contains much smaller vessels. Trees with this type of growth pattern are known as ring-porous, and are distinguished by the contrast between the open, light-coloured early wood vessels and the dense, darker-coloured late wood.

Dendrochronology utilises the variation in the width of the annual rings as influenced by climatic conditions common to a large area. It is these climate-induced variations in ring widths that allow calendar dates to be ascribed to an undated timber when compared to a firmly-dated sequence. Sometimes more local factors such as woodland competition and insect attack can mask the general climatic signal in the ring patterns, therefore making them undateable. If a tree section is complete to the bark edge, a precise date of felling can be determined. The felling date will be precise to the season of the year, depending on the degree of formation of the outermost ring. Therefore, a tree with bark which has the spring vessels formed but no summer growth can be said to be felled in the spring, although it is not possible to say in which particular month the tree was felled. If the summer growth band is complete as well as the spring growth band, then the tree would have been felled during the winter period when the tree is dormant. More unusual are incomplete summer growth bands which would suggest a felling during the later summer or autumn periods (Fig 4). However, this determination can be somewhat subjective for if a particular ring is especially narrow, felling might actually been in the winter rather than the summer or autumn (Miles 2005).

Another important dimension to dendrochronological studies is the presence of sapwood. This is the band of growth rings immediately beneath the bark and comprises the living growth rings which transport the sap from the roots to the leaves. This sapwood band is distinguished from the heartwood by the prominent features of colour change and the blocking of the spring vessels with tyloses, the waste products of the tree's growth. The heartwood is generally darker in colour, and the spring vessels are blocked with tyloses. The heartwood is dead tissue, whereas the sapwood is living, although the only really living, growing, cells are in the cambium, immediately beneath the bark. The sapwood is distinguished primarily by the absence of tyloses in the spring vessels, which is usually matched by a lighter colour. Generally the sapwood retains stored food and is therefore attractive to insect and fungal attack, and therefore is often removed during conversion.

Sapwood in mainland Britain tends to be of a relatively constant width and/or number of rings. Determining what this range is with an empirically or statistically-derived estimate is a valuable aspect in the interpretation of tree-ring dates where the bark edge is not present (eg Miles 1997). The narrower this range of sapwood rings, the more precise the estimated felling date range will be.

METHODOLOGY: SAMPLING AND ANALYSIS

All timbers sampled were of oak (*Quercus* spp.) from what appeared to be primary first-use timbers. Those timbers which looked most suitable for dendrochronological purposes were selected. The timbers were sampled through coring, using a 16mm hollow auger. Details and locations of the samples are detailed in Table 1.

The samples were sanded on a linisher, or bench-mounted belt sander, using 60 to 1200 grit abrasive paper, and were cleaned with compressed air to allow the ring boundaries to be clearly distinguished. They were then measured under a x10/x30 microscope using a travelling stage electronically displaying displacement to a precision of 0.01mm. Measurements were arranged as a series of ring-width indices within a data set, with the earliest ring being placed at the beginning of the series, and the latest or outermost ring concluding the data set.

The ring-width series were compared on an IBM-compatible computer for statistical cross-matching using a variant of the Belfast CROS program (Baillie and Pilcher 1973) written in BASIC by D Haddon-Reece, and rewritten in Microsoft Visual Basic by M R Allwright and P A Parker. Whilst it may not be the best statistical indicator, Student's (a pseudonym for W S Gosset) *t*-value has been widely used amongst British and European dendrochronologists. The computer program calculates a *t*-value at each point of possible overlap between two ring-width series and highlights those over a minimum threshold. With oak, *t*-values over 3.5 are considered to be 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. Matches with *t*-values of 10 or more between individual sequences usually signify that the timbers concerned originated from the same parent tree.

The ring-width series for each sample was also plotted as a graph of width against year on log-linear graph paper. The graphs of each of the samples in the phase under study were then compared visually at the positions indicated by the computer matching and, if found satisfactory and consistent, averaged to form a mean curve. This has the advantage of detecting any measurement errors as well as averaging out the statistical 'noise' in individual ring-width series resulting from potentially highly localised growth factors. Such composite mean chronologies are much more likely to produce higher *t*-values and stronger visual matches when cross-matched against reference chronologies.

The principle behind tree-ring dating is a simple one: the varying width of a series of measured annual rings is matched to other, previously dated ring sequences to allow precise dates to be ascribed to each ring. When an undated sample or site sequence is compared against a dated sequence, known as a reference chronology, an indication of how good the match is must be determined. Although it is almost impossible to define a visual match, statistical comparisons can be accurately quantified, using Student's *t*-value. To confirm the dating of an undated sample or site sequence, dendrochronologists prefer to see some *t*-values of 5, 6, or higher, and for these to be well replicated from different, independent chronologies with local and regional chronologies well represented.

ASCRIBING AND INTERPRETING FELLING DATES

Once a tree-ring sequence has been firmly dated in time, a felling date, or felling date range, is ascribed where possible. For 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 early wood formed, or the latewood, a precise felling date and season can be given (see above). 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 a statistically derived sapwood estimate with a given confidence limit. A review of the geographical distribution of dated sapwood data from historic building timbers has shown that a 95% range of 9–41 rings is most appropriate for the southern counties of England (Miles 1997), which will be used here. 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 (Fig 5).

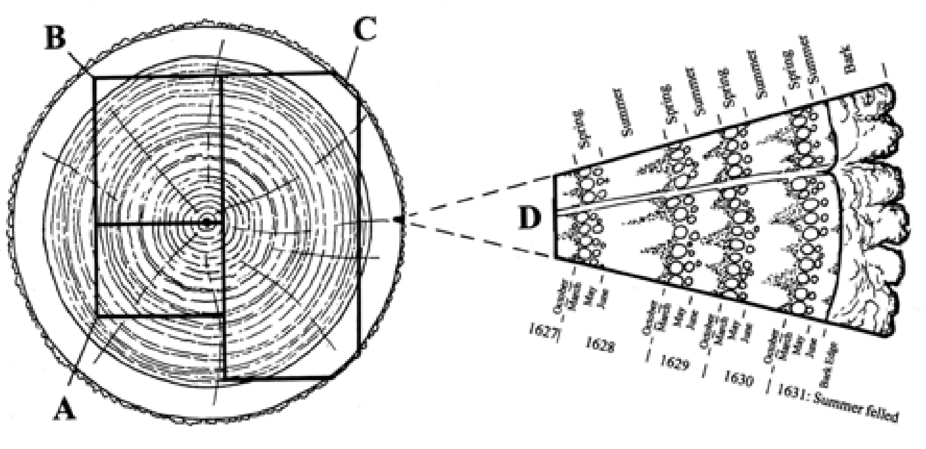

Figure 5: Section of tree with conversion methods showing three types of sapwood retention, resulting in A terminus post quem, B a felling date range, and C a precise felling date.

Enlarged area D shows the outermost rings of the sapwood with growing seasons (Miles 1997, 42)

ANALYSIS

The timbers comprising the ground floor ceiling in the present kitchen, and the roof timbers to the chamber above were assessed for dendrochronology. No early timbers survived from the eastern end of the Chapel. The majority of the timbers were found to be unsuitable for tree-ring dating, most having less than 30 growth rings. This included the three main structural roof timbers. However, eight timbers of marginal suitability were sampled – three of the large ground-floor ceiling beams (Fig 3), and five of the roof timbers to the chamber above (Fig 4). The roof timbers included three ashlar pieces and two common rafters.

None of the eight samples reliably cross-matched together, and therefore a replicated site master could not be constructed. The four longest rings sequences, which had between 50 and 57 rings, were compared with a large corpus of dated reference chronologies for Hampshire and further afield. However, no consistent absolute dating was found. Tree-ring analysis has therefore failed to provide any dating evidence and has been unable to ascertain whether the roof and floor beams investigated were part of the primary construction or later replacements.

REFERENCES

Baillie, M G L, 1982 *Tree-ring Dating and Archaeology*, London

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

English Heritage, 1998 *Dendrochronology: Guidelines on producing and interpreting dendrochronological dates*, London

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

Miles, D W H, 2005 *New Developments in the Interpretation of Dendrochronology as Applied to Oak Building Timbers*, unpubl DPhil thesis, Hertford College, Oxford Univ

Schweingruber, F H, 1988 *Tree Rings*, Dordrecht

Table 1: Summary of tree-ring dating

GODSFIELD CHAPEL, NEW ALRESFORD, HAMPSHIRE

Sample number	Sample type	Timber and position	Dates AD	H/S bdr	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/dates ranges (AD)
god1	c	Ground-floor beam		H/S		47	2.49	1.03	0.267	unknown
god2	c	Ground-floor beam		H/S		53	2.57	0.70	0.169	unknown
god3	c	Ground-floor beam		H/S		54	2.61	0.95	0.200	unknown
god4	c	Ashlar		H/S		45	1.99	0.68	0.188	unknown
god5	c	Ashlar		H/S		57	2.24	0.72	0.191	unknown
god6	c	Rafter		H/S		48	2.24	1.03	0.175	unknown
god7	c	Ashlar		H/S		33	3.34	0.74	0.125	unknown
god8	c	Rafter		H/S		36	2.18	0.76	0.156	unknown

Key: * = sample included in site-master; c = core; H/S bdry = heartwood/sapwood boundary - last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity