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Summary

Lower Brockhampton Gatehouse is one of a group of buildings located at the heart of a country estate now owned by the National Trust. The gatehouse bridges the partially-surviving moat which surrounds Lower Brockhampton House, a moated manor believed to originate in the late-fourteenth or early-fifteenth century. Ten samples from throughout the building were dated indicating felling of the parent trees in the mid-sixteenth century. Two samples retained the bark edge but gave slightly different felling dates. One, from a beam in the ground-floor ceiling, gave a felling date in the winter of AD 1542/3. Another, from a strut in the central roof truss, gave a felling date of winter AD 1543/4. The difference between the two dates could be a reflection of stockpiling with trees felled between six and eighteen months apart prior to their conversion and use in construction of the gatehouse. Alternatively, a number of trees could have been felled in the winter AD 1542/3, and construction commenced, and additional trees felled and converted, as required, including a tree in the winter of AD 1543/4 from which the timber employed as a strut in the central roof truss was derived. In either case, it would appear that construction could have been completed during or soon after the winter of AD 1543/4.

Keywords

Dendrochronology
Standing Buildings

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Introduction

This document is a technical archive report on the tree-ring analysis of oak timbers from Lower Brockhampton Gatehouse, near Bromyard, Herefordshire (NGR SO 687560). Analysis of the timbers was requested by Paul Stamper of English Heritage to elucidate the date of this grade I listed building (also a scheduled ancient monument and a building at risk) that has been the subject of major, English Heritage funded repairs.

The gatehouse is one of a group of buildings located at the heart of a country estate now owned by the National Trust (Fig 1). The gatehouse bridges the partially-surviving moat which surrounds Lower Brockhampton House, a moated manor believed to originate in the late-fourteenth or early-fifteenth century (Fig 2). The gatehouse (Fig 3) has traditionally been dated to the fifteenth century (Pevsner 1977) although recent reassessment has pointed to a later date *c.* AD 1530-40 based on the remains of carved spiral shafts flanking the arches, below the brackets of the jettied upper floor (Hall 1990). A staircase and balustrade are believed to be a later, seventeenth-century insertion.

It is beyond the dendrochronological brief to describe the building in detail or to undertake the production of detailed drawings. As part of a multifaceted and multidisciplinary study of the building, elements of this report may be combined with detailed descriptions, drawings, and other technical reports at some point in the future to form either a comprehensive publication or an archive deposition on the building. The conclusions may therefore have to be modified in the light of subsequent work.

Methodology

Methods employed at the Lampeter Dendrochronology Laboratory in general follow those described in English Heritage (1998). Details of the methods used for the dating of this building are described below.

An assessment survey identified those oak timbers with the most suitable ring sequences for analysis. Those with more than 50 annual rings and some survival of the original sapwood and/or bark-edge were sought. The dendrochronological sampling programme attempted to obtain cores from as broad a range of timbers, in terms of structural element types, scantling sizes, and carpentry features, as was possible within the terms of the request whilst also meeting health and safety requirements. Given the aesthetic nature of this National Trust owned property, particular care was taken to minimise the visual impact of sampling by careful selection of sampling sites and the plugging of all core holes with oak pegs.

The core samples were sanded with increasingly fine grit grades of paper using a random-orbital sanding machine, so that the ring sequences were clearly visible.

The complete sequences of growth rings in the samples that were selected for dating purposes were measured to an accuracy of 0.01mm using a micro-computer based travelling stage (Tyers 1999a). Cross-correlation algorithms (Baillie and Pilcher 1973; Munro 1984) were employed to search for positions where

the ring sequences were highly correlated. The ring sequences were plotted electronically and exported to a computer graphics software package (Coreldraw™) to enable visual comparisons to be made between sequences at the positions indicated and, where these were satisfactory, new mean sequences were constructed from the synchronised sequences. The *t*-values reported below are derived from the original CROS algorithm (Baillie and Pilcher 1973). A *t*-value of 3.5 or over is usually indicative of a good match, although this is with the proviso that high *t*-values at the same relative or absolute position must be obtained from a range of independent sequences, and that satisfactory visual matching supports these positions. Timbers originally derived from the same parent tree generally have *t*-values greater than 10.0. Lower values from timbers obviously derived from the same parent tree (eg on morphological grounds) are, however, quite common. It is the visual similarity in medium term growth trends of the samples that is the critical factor in determining 'same tree' origin.

All the measured sequences from this assemblage were compared with each other and any found to cross-match were combined to form a site master curve. These, and any remaining unmatched ring sequences were tested against a range of reference chronologies, using the same matching criteria: high *t*-values, replicated values against a range of chronologies at the same position, and satisfactory visual matching. Where such positions are found these provide calendar dates for the ring-sequence.

The tree-ring dates produced by this process initially only date the rings present in the timber. The interpretation of these dates relies upon the nature of the final rings in the sequence. If the sample ends in the heartwood of the original tree, a *terminus post quem (tpq)* for the felling of the tree is indicated by the date of the last ring plus the addition of the minimum expected number of sapwood rings which are missing. This *tpq* may be many decades prior to the real felling date. Where some of the outer sapwood or the heartwood/sapwood boundary survives on the sample, a felling date range can be calculated using the maximum and minimum number of sapwood rings likely to have been present. The sapwood estimates applied throughout this report are a minimum of 10 and maximum of 46 annual rings, where these figures indicate the 95% confidence limits of the range. These figures are applicable to oaks from the British Isles (Tyers 1998a). Alternatively, if bark-edge survives, then a felling date can be directly utilised from the date of the last surviving ring. The dates obtained by the technique do not by themselves necessarily indicate the date of the structure from which they are derived. It is necessary to incorporate other specialist evidence concerning the re-use of timbers and the repairs of structures before the dendrochronological dates given here can be reliably interpreted as reflecting the construction date of phases within the structure.

Results

A total of eleven samples were taken from timbers where bark edge, partial sapwood, or the heartwood/sapwood boundary survived. These samples were numbered **lbg01 - lbg11** inclusive (Table 1; Figs 4-7). Samples from the roof and first floor included elements of the central truss (**lbg03-4**), a single purlin (**lbg05**), first-floor wallplates (**lbg01-2**), and one of the posts to which the central truss was joined (**lbg06**). Five samples were taken from beams from the ground-floor ceiling/ first-floor floor (**lbg07-11**).

All eleven samples were measured and the resultant ring sequences compared. Crossmatching was identified between ten of the samples (Table 2). A mean sequence calculated for these matching samples (**LBG-T10**) and the sequence from the single, unmatched, individual sample (**lbg11**) were then compared with dated reference chronologies from throughout the British Isles and northern Europe. Table 3 shows the correlation of the mean sequence for **LBG-T10** with dated series at the dating position identified of AD 1368-1543. Table 4 lists the dated mean chronology and the relationships between the dated timbers are indicated graphically in Figure 8. The single, unmatched sample (**lbg11**) could not be dated.

Interpretation

All ten dated samples (Fig 8) indicate felling of the parent trees in the mid-sixteenth century. Two samples retained the bark edge but gave slightly different felling dates. Sample **lbg07**, from a beam in the ground-floor ceiling, gave a felling date in the winter of AD1542/3. Sample **lbg04**, from a strut in the central truss, gave a felling date of winter AD 1543/4. The felling date ranges for the eight dated samples with surviving heartwood/sapwood boundaries are all consistent with felling in the period AD 1542-4. Winter in this context is defined as the dormant period in the oak tree's life cycle (approximately October- March). Hence, the time difference between the two felling dates could be as little as six months or as much as eighteen months. This time difference could be the result of stockpiling with trees felled over a number of seasons prior to their conversion and use in construction of the gatehouse. Alternatively, a number of trees could have been felled in the winter or early spring of AD 1542/3, and construction commenced, and additional trees felled and converted, as required, including a tree in the winter of AD 1543/4 from which the timber employed as a strut in the central roof truss was derived. In either case, it would apear that construction could have been completed during, or soon after, the winter of AD 1543/4. This date is close to that of *c.* AD 1530-40 suggested by recent stylistic examination of the remains of carved spiral shafts flanking the arches.

Acknowledgements

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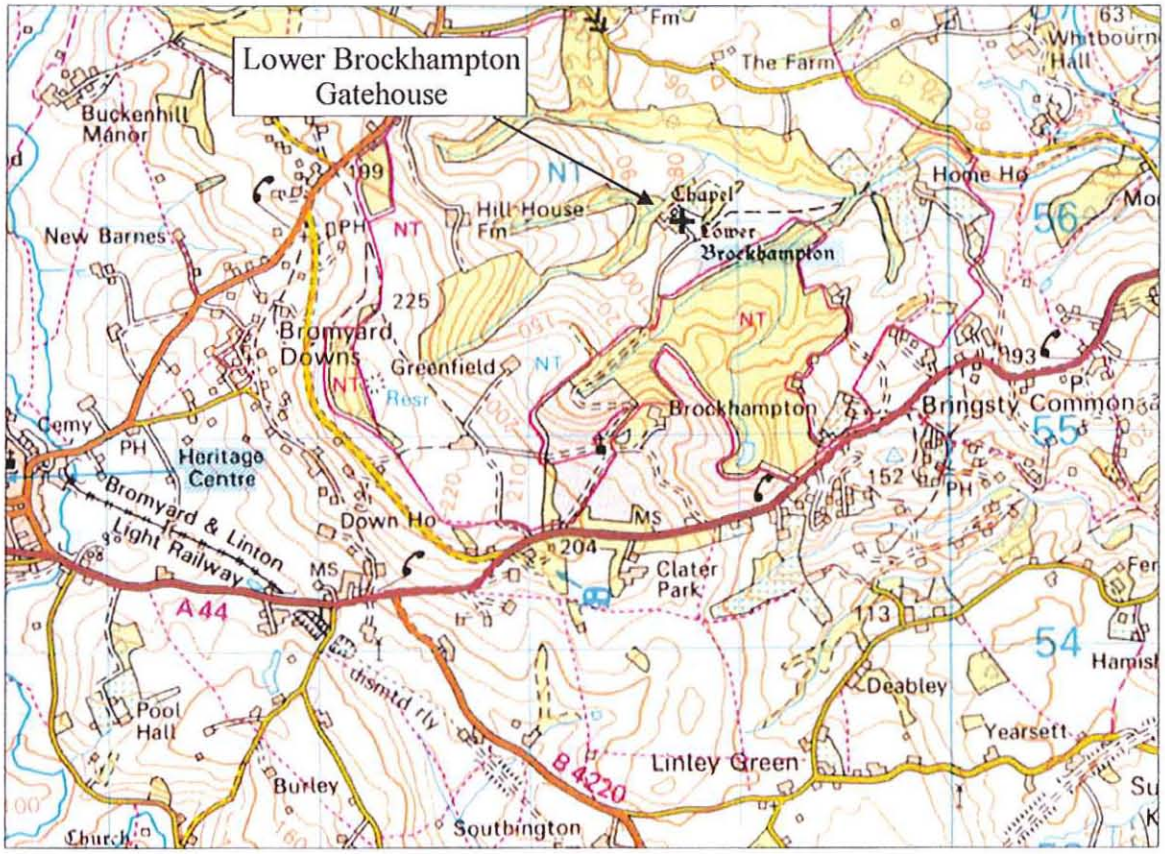

Figure 1 Location of Lower Brockhampton Gatehouse.

Figure 2 Lower Brockhampton Gatehouse (left foreground) and moat with Lower Brockhampton House in the background. View towards the north-west (the author)

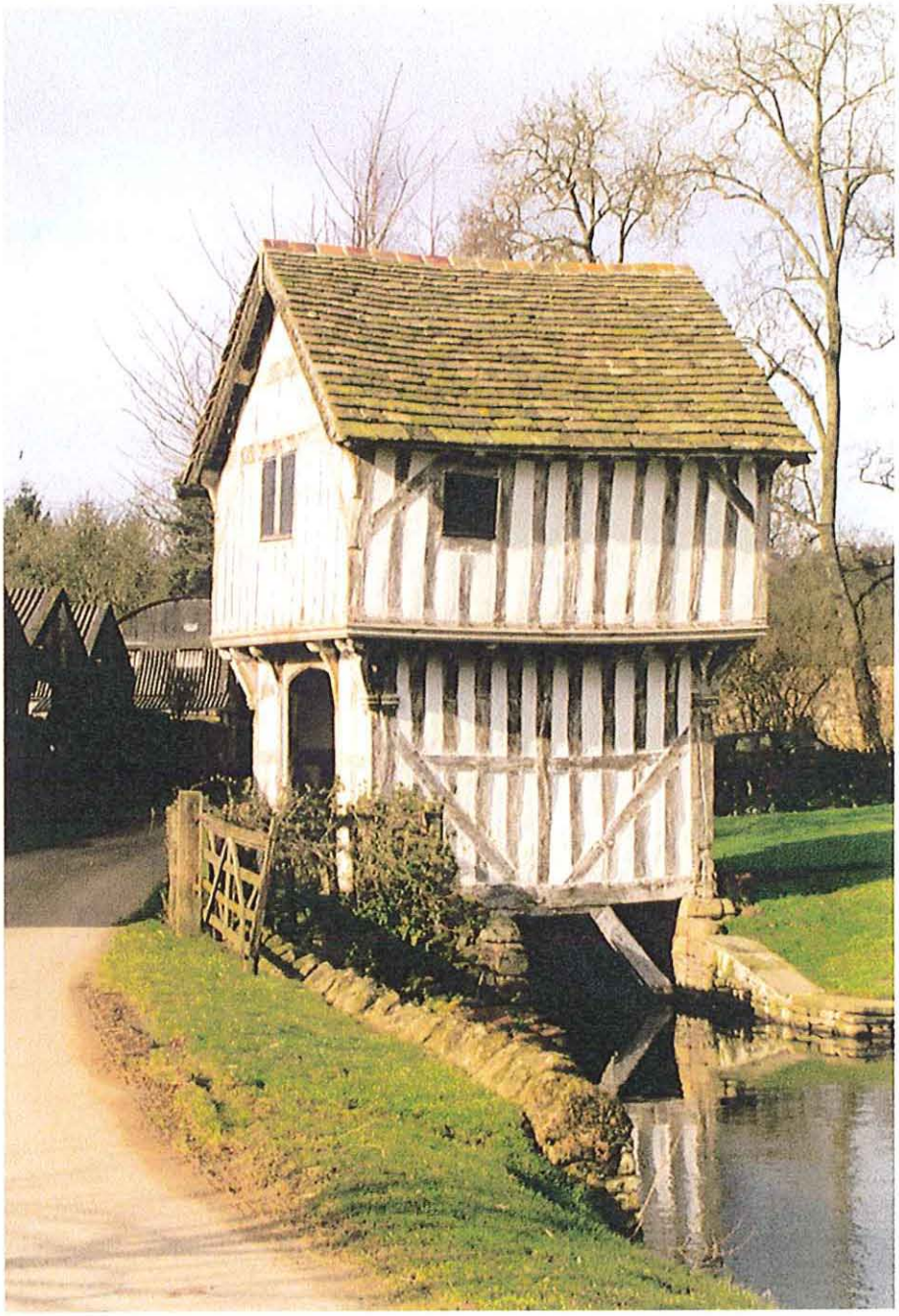

Figure 3 Lower Brockhampton Gatehouse (the author)

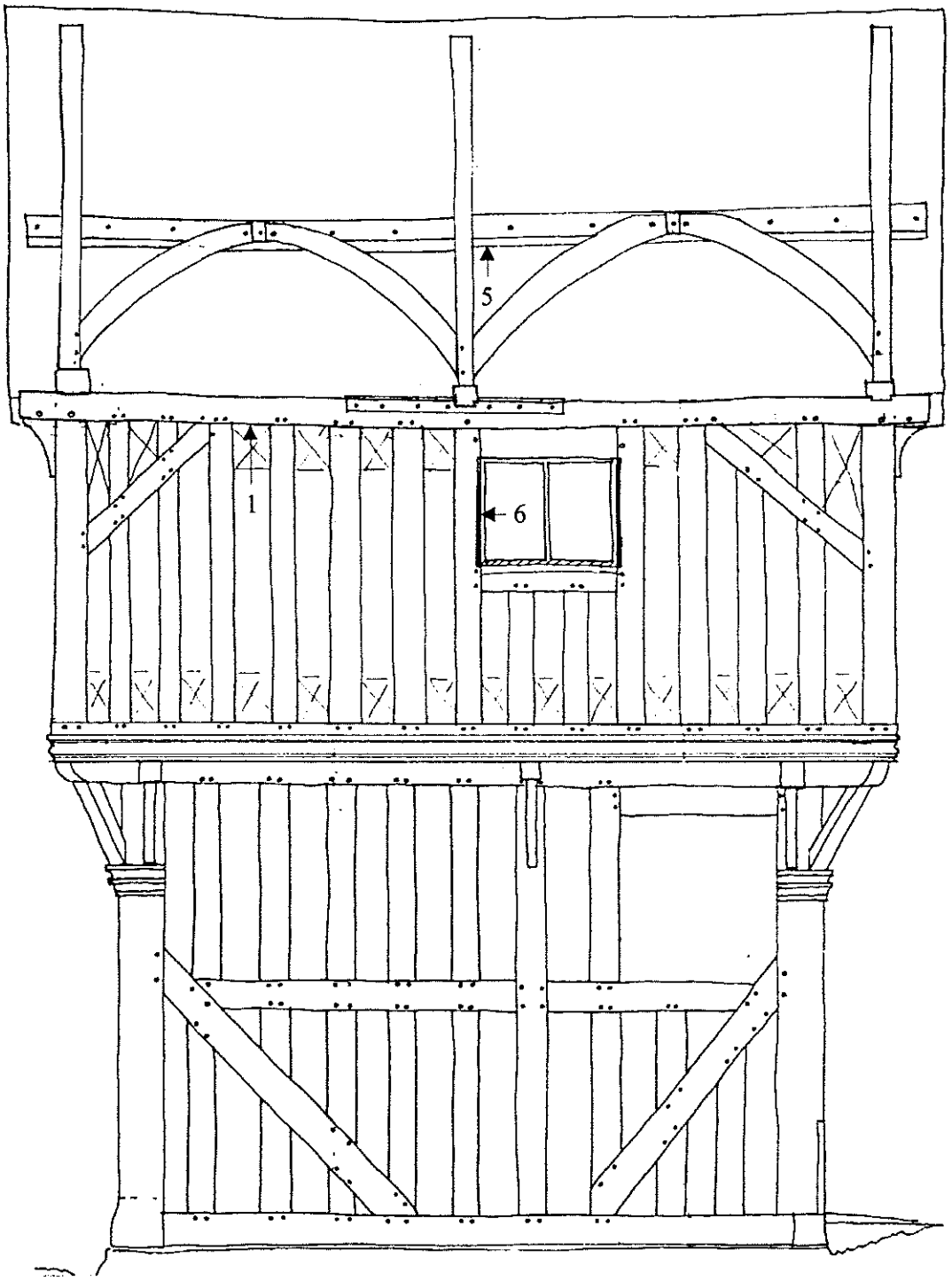

Figure 4 Lower Brockhampton Gatehouse: north-west facing elevation showing location of samples. Based on drawing by Wheatley Taylor Stainburn Lines, Chartered Architects

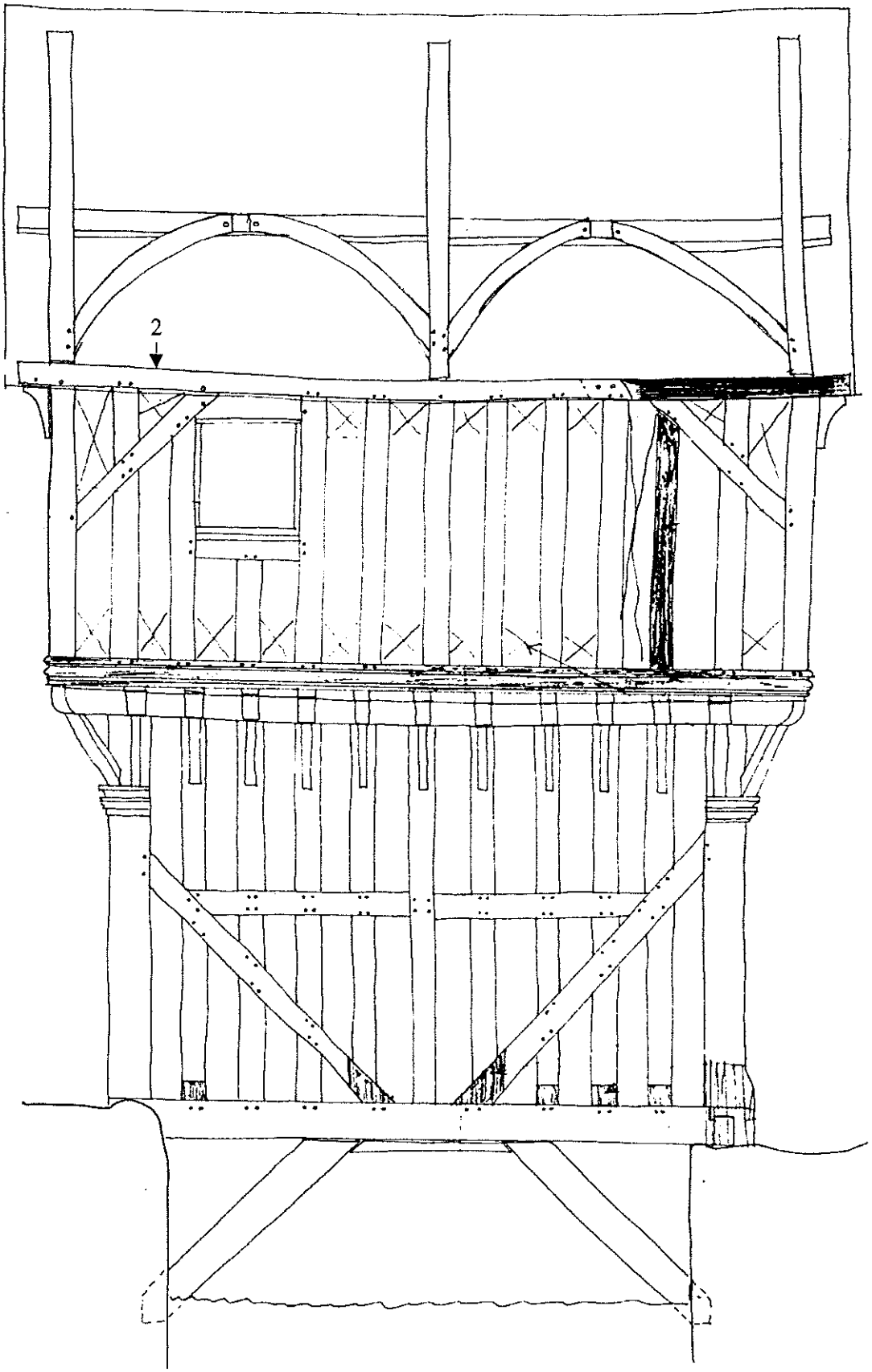

Figure 5 Lower Brockhampton Gatehouse: south-east facing elevation showing location of sample 2. Based on drawing by Wheatley Taylor Stainburn Lines, Chartered Architects

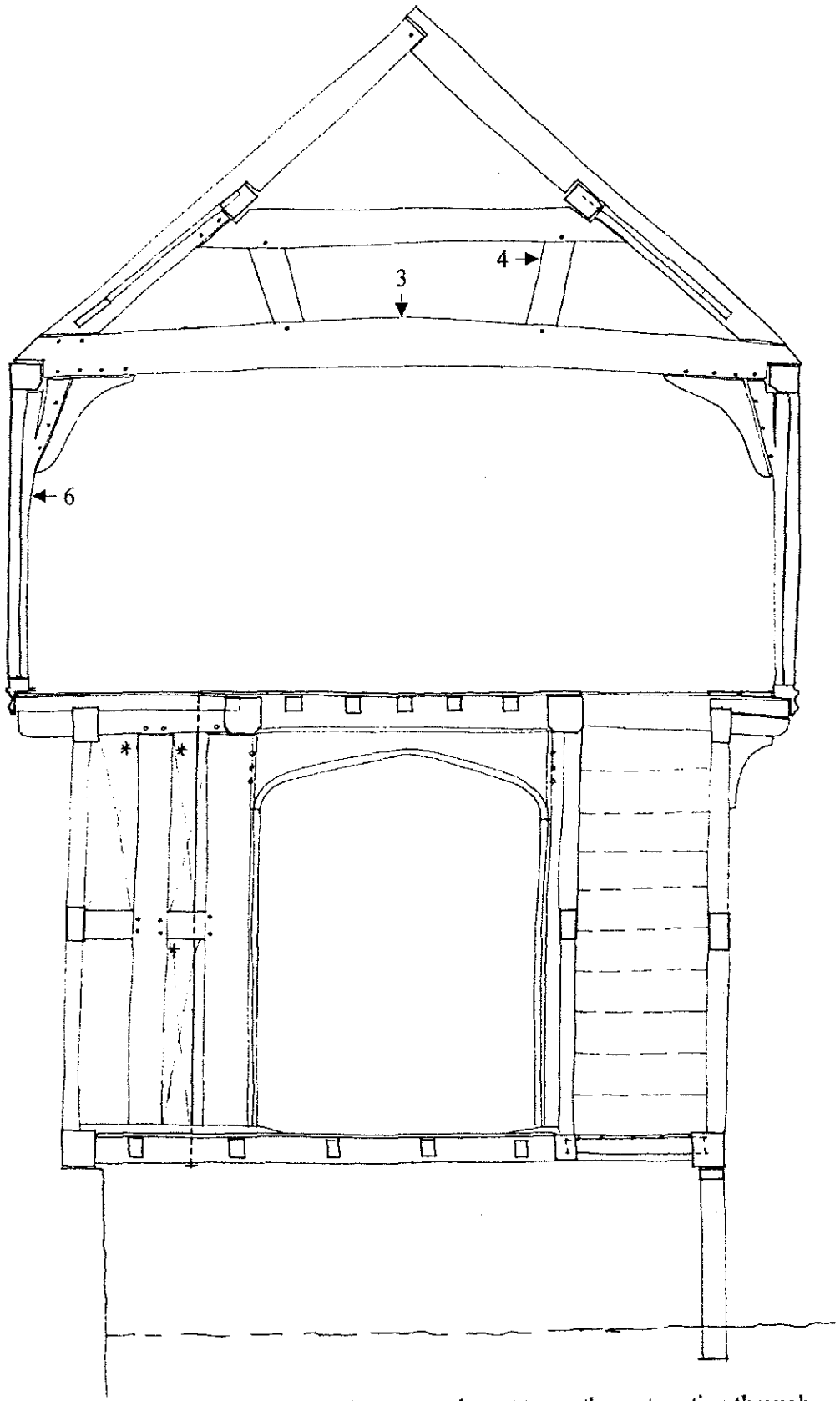

Figure 6 Lower Brockhampton Gatehouse: north-east to south-west section through central truss showing location of samples. Based on drawing by Wheatley Taylor Stainburn Lines, Chartered Architects

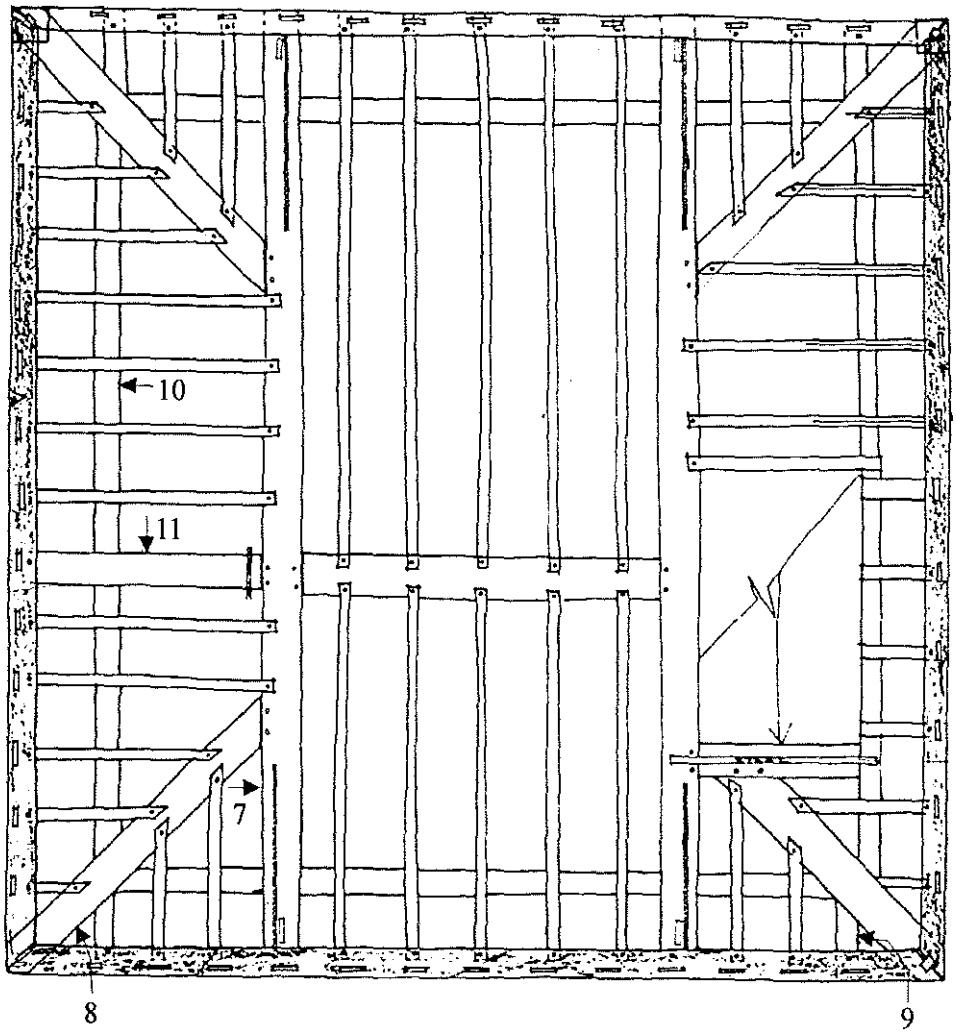

Figure 7 Lower Brockhampton Gatehouse: Plan of first-floor beams, joists and bressumers showing location of samples. Based on drawing by Wheatley Taylor Stainburn Lines, Chartered Architects

Figure 8 Bar diagram showing the chronological positions of the ten dated timbers. The felling periods are also shown.

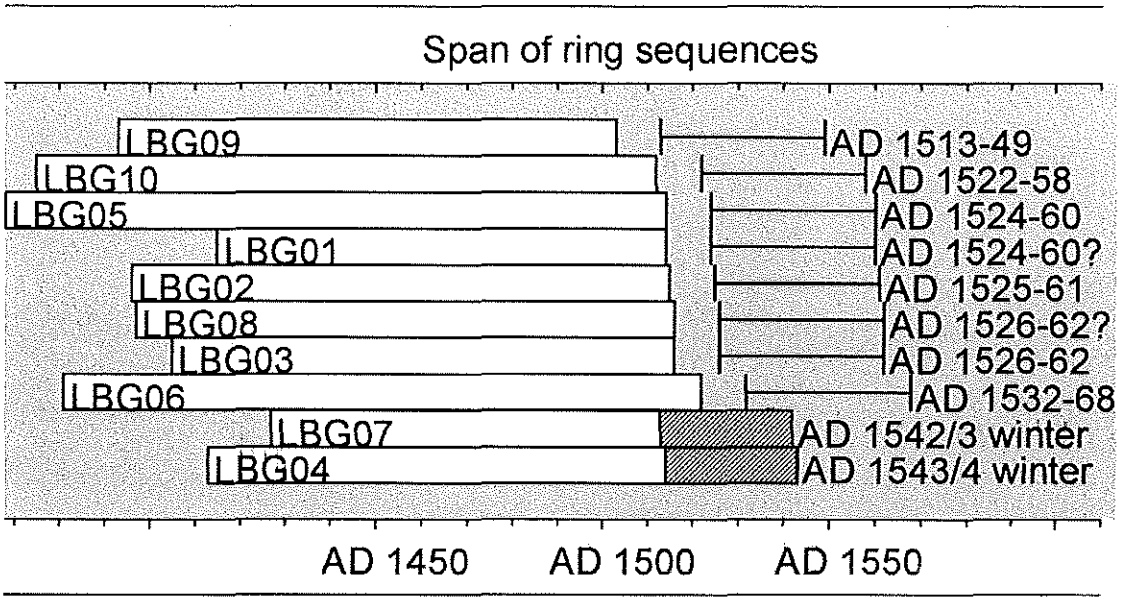

Table 1

List of samples

Core No	Origin of core	Cross-section size (mm)	Cross-section of tree	Total rings	Sapwood rings	ARW mm/year	Date of sequence	Felling period
lbg01	Wallplate, north-west wall, first floor	175 x 160	Quarter	100	+?HS	1.83	AD 1415-1514	AD 1524-60?
lbg02	Wallplate, south-east wall, first floor	170 x 160	Quarter	120	+HS	1.54	AD 1396-1515	AD 1525-61
lbg03	Tiebeam, central truss	270 x 160	Half	112	+HS	1.05	AD 1405-1516	AD 1526-62
lbg04	Strut, central truss	180 x 100	Quarter	131	29+Bw	1.34	AD 1413-1543	AD 1543/1544
lbg05	Purlin, south-west of central truss, north-west side	210 x 155	Quarter	147	+HS	1.42	AD 1368-1514	AD 1524-60
lbg06	Post, central truss, north-west wall	165 x 160	Quarter	142	+HS	1.09	AD 1381-1522	AD 1532-68
lbg07	Beam, ground-floor ceiling/ first-floor floor	255 x 235	Quarter	116	29+Bw	1.25	AD 1427-1542	AD 1542/1543
lbg08	Dragon beam, west corner	255 x 225	Whole	120	+?HS	1.11	AD 1397-1516	AD 1526-62?
lbg09	Joist, south corner	260 x 110	Half	111	+HS	1.07	AD 1393-1503	AD 1513-49
lbg10	Beam	165 x 150	Quarter	138	+HS	1.26	AD 1375-1512	AD 1522-58
lbg11	Beam	255 x 130	Quarter	74	+HS	1.58	Undated	

'Total rings' = all measured rings, +value means additional rings were only counted, the felling period column is calculated using these additional rings.
'Sapwood rings'= +HS heartwood/sapwood boundary, ?HS possible heartwood/sapwood boundary, +Bw = bark-edge winter felled
'ARW' = average ring width of the measured rings

Table 2

t-value matrix for samples **1** to **10**. \ = overlap < 15 years, - = t-values less than 3.00, * = empty triangle

Samples	lbg02	lbg03	lbg04	lbg05	lbg06	lbg07	lbg08	lbg09	lbg10
lbg01	6.01	-	3.46	-	3.56	-	4.73	6.89	4.11
lbg02	*	5.25	5.74	-	3.89	-	3.63	5.11	3.68
lbg03	*	*	4.47	3.82	3.58	-	4.92	-	3.38
lbg04	*	*	*	4.50	4.36	4.87	4.24	3.17	-
lbg05	*	*	*	*	5.07	8.19	3.85	3.16	-
lbg06	*	*	*	*	*	4.35	4.09	3.47	3.29
lbg07	*	*	*	*	*	*	-	-	-
lbg08	*	*	*	*	*	*	*	3.54	-
lbg09	*	*	*	*	*	*	*	*	-

Table 3

Dating the mean sequence **LBG-T10**, AD 1368-1543 inclusive. *t*-values with independent reference chronologies

Area	Reference chronology	*t*-values
East Midlands	East Midlands (Laxton and Litton 1988)	9.43
Gloucestershire	Mercer's Hall, Gloucester (Howard *et al* 1996)	10.49
Gloucestershire	Old Hat Shop, Tewkesbury (Nayling 2000a)	7.59
Herefordshire	16-18 Hightown/Booth Hall, Hereford (Boswijk and Tyers 1997)	11.48
Herefordshire	Dore Abbey Church (Tyers and Boswijk 1998)	8.57
Herefordshire	King's Pyon Barn (Groves and Hillam 1993)	7.64
Herefordshire	Lower House Farm Tupsley (Tyers 1997a)	8.45
Herefordshire	Mamble Church, phase B (Tyers 1996)	7.27
Herefordshire	Pembridge Belltower (Tyers 1999b)	7.96
Herefordshire	Penrhos Court, Kington (Tyers 1998b)	9.80
Herefordshire	St Bartholomews, Lower Sapey (Tyers 1995)	8.02
Herefordshire	The Mynde, Much Dewchurch (Nayling 2001)	7.65
Herefordshire	The White House, Vowchurch (Nayling 1999)	10.49
Shropshire	Bromfield Church (Nayling 2000b)	7.88
Staffordshire	Black Ladies, nr Brewood (Tyers 1999c)	8.92
Staffordshire	Sinai Park (Tyers 1997b)	8.92

Table 4

Ring-width data from site master **LBG-T10**, dated to AD 1368-1543 inclusive

Date	Ring widths (0.01mm)										No of samples									
AD 1368								174	238	235								1	1	1
-	208	201	226	201	209	188	144	139	171	131	1	1	1	1	2	2	2	2	2	2
-	115	120	105	93	100	128	109	124	117	123	3	3	3	3	3	3	3	3	3	3
-	106	102	105	88	87	125	110	132	137	161	3	3	4	4	4	5	6	6	6	6
AD 1401	150	138	180	142	123	114	109	123	167	133	6	6	6	6	7	7	7	7	7	7
-	123	137	137	122	141	122	138	142	100	141	7	7	8	8	9	9	9	9	9	9
-	141	154	176	149	167	159	140	183	177	168	9	9	9	9	9	9	10	10	10	10
-	160	187	144	151	168	158	133	124	112	123	10	10	10	10	10	10	10	10	10	10
-	129	121	137	155	140	132	134	146	127	124	10	10	10	10	10	10	10	10	10	10
AD 1451	150	133	134	143	141	151	160	155	118	126	10	10	10	10	10	10	10	10	10	10
-	124	123	135	100	111	126	133	119	134	148	10	10	10	10	10	10	10	10	10	10
-	130	112	100	121	164	123	118	98	124	126	10	10	10	10	10	10	10	10	10	10
-	134	115	121	127	118	126	128	116	110	145	10	10	10	10	10	10	10	10	10	10
-	120	97	109	111	110	140	117	99	120	101	10	10	10	10	10	10	10	10	10	10
AD 1501	94	102	89	94	100	99	97	90	104	102	10	10	10	9	9	9	9	9	9	9
-	120	124	114	95	103	92	101	106	134	108	9	9	8	8	6	5	3	3	3	3
-	115	124	101	117	108	112	109	119	100	109	3	3	2	2	2	2	2	2	2	2
-	138	105	108	100	135	133	110	134	124	141	2	2	2	2	2	2	2	2	2	2
-	150	107	102								2	2	1							