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Chapel Royal
Hampton Court Palace

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Royal Pew, Chapel Royal, Hampton Court Palace

HISTORIC BUILDING RECORDING AND INVESTIGATION

CONTENTS

Summary 1

1 Introduction 2
1.1 Project Background 2
1.2 Aims and objectives 3
1.3 Methodology 3

2 Historical Analysis 4
2.1 The Emergence of a Royal Palace 4
2.2 The Chapel Royal 5

3 Phase I - The Medieval Chapel 6
3.1 Documentary Sources 6
3.2 Archaeological Investigations 6

4 Phase II - Wolsey's Chapel (1514 –*c*.1529) 6
4.1 Documentary Sources 6
4.2 Pictorial Evidence 7
4.3 Archaeological Investigations and Observations 8

5 Phase III - Henry VIII (c.1529 – 1547) 10
5.1 Documentary Sources 10
5.2 Pictorial Evidence 12
5.3 Archaeological Investigations and Observations 13

6 Phase IV - Edward VI - James II (1547 – 1685) 18
6.1 Documentary Sources 18
6.2 Pictorial Evidence 20
6.3 Archaeological Investigations and Observations 20

7 Phase V - William and Mary (1689 – 1702) 21
7.1 Documentary Sources 21
7.2 Pictorial Evidence 22
7.3 Archaeological Investigations and Observations 22

8 Phase VI - Queen Anne (1702 – 1714) 27
8.1 Documentary Sources 27
8.2 Pictorial Evidence 27
8.3 Archaeological Investigations and Observations 27

9 Phase VI - Hanoverian Works (1714 – 1837) 28
9.1 Documentary Sources 28
9.2 Pictorial Evidence 28
9.3 Archaeological Investigations and Observations 29

10 Phase VII - Victorian Works (1837 – 1901) 29
10.1 Documentary Sources 29
10.2 Pictorial Evidence 30
10.3 Archaeological Investigations and Observations 30

11 Phase VII - The 20th Century 31

11.1 Documentary Sources 31
11.2 Pictorial Sources 32

12 Phase IX - The 21st Century 33

13 Conclusion 33
13.2 Summary of Known Phasing 33
13.3 Future works 34

APPENDIX I Bibliography .....

APPENDIX II Statement of Significance .....

APPENDIX III Dendrochronology Report .....

APPENDIX IV Historic Paint Analysis Report .....

APPENDIX V Paint condition Report .....

APPENDIX VI Historic Graffiti .....

APPENDIX VII Carpenters and Other Marks .....

APPENDIX VIII Minor Sub-Surface Explorations .....

LIST OF FIGURES

Figure 1 Site Location

Figure 2 Plan of Chapel showing location of areas studied

Figure 3 East elevation of the main pew structure

Figure 4 Plan of the main pew structure upper beam

Figure 5 West elevation of the main pew structure. (After D. Hart, 1990)

Figure 6 Phased west-facing elevation of the overall pew framework

Figure 7 Sections through the upper and lower beams of the front pew structure, south facing sections

Figure 8 South facing section through the whole pew framework

Figure 9a Winter Pew, first floor. East facing elevation - before removal of lower beam

Figure 9b Winter Pew, first floor. East facing elevation - Detail following removal of lower beam

Figure 10 Lady Chapel, first floor. West facing elevation

Figure 11 Detail of the late 17th century timber partition dividing the Royal and Winter Pews at first floor level, (north facing elevation)

Figure 12 West facing elevation of frame within hidden room and Thornhill void

Figure 13 Soffit of 16th century beam within Thornhill Void and detail of south face of central post (post 4) stub

Figure 14 East elevation of main pew structure showing location of paintwork traces recorded

Figure 15 Plan of hearth within Winter Pew

Figure 16 Isometric drawing showing visualisation of pew c. 1537

LIST OF PLATES

Plate 1 View of the east elevation of the Royal Pew prior to commencement of works

Plate 2 View of the east elevation of the Royal Pew following panelling removal in 2006.

Plate 3 View of the chapel in 1819 by C Wild. Note the whitewashed ceiling and casement windows.

Plate 4 View of the Royal Pew by James D Wingfield (1849). Note the partition between the Royal and Winter Pews.

Plate 5 St Georges Chapel, Windsor. External view of oriel window in chapel built for Catherine of Aragon in 1525.

Plate 6 St Georges Chapel, Windsor. Internal view of oriel window in chapel built for Catherine of Aragon in 1525.

Plate 7 Royal Pew, west elevation, detail of central section

Plate 8 Royal pew, west elevation, primary beams extending north into ante chapel wall prior to removal of brickwork

Plate 9 Royal Pew, west elevation, primary beams extending north into ante chapel wall following removal of lower quoin and brickwork

Plate 10 Royal Pew, west elevation, detail of tenon following removal of lower beam

Plate 11 Royal Pew, model room, primary phase doorways to Royal Pew. The left doorway was the entrance to the pew and the doorway on the right was for the vice stair leading down to the chapel. Note the difference in floor height.

Plate 12 Royal Pew, supporting octagonal column (south)

Plate 13 Royal Pew, surviving mortice for central main post (view east)

Plate 14 Royal Pew, further mortices and floorboard rebate surviving on the top surface of the upper primary beam

Plate 15 Royal Pew, detail of a mortice relating to the southern oriel window

Plate 16 Detail of carved trench (4) relating to the north oriel window

Plate 17 Royal Pew, detail of 17th century upright and iron brace attached to main pew structure

Plate 18 Royal Pew, detail of forelock used to attach 17th century upright to main pew structure

Plate 19 Royal Pew, lath and plaster and timber framework, south elevation of the south partition

Plate 20 Royal Pew, exposed timber framework, north elevation of north partition

Plate 21 Royal Pew, east elevation, detail of 'U' shaped straps to support floor joists

Plate 22 Royal Pew, east elevation, detail of foundry stamp on iron strap

Plate 23 Royal Pew, Lady Chapel, Detail of iron pipe set within lower beam

Plate 24 Royal Pew, east elevation, detail of re-used floorboards at the south end of the main structure

Plate 25 Royal Pew, Lady Chapel, detail of hidden mortice and rebate within quoin below

Plate 26 Royal Pew, east elevation viewed south; overall detail of lower softwood structure

Plate 27 Royal Pew, octagonal supporting column (south), detail of mortice for screen.

Plate 28 Royal Pew, octagonal supporting column (north), detail of marks on north face

Plate 29 Royal Pew, soffit of lower primary beam showing peg holes and mortice for earlier arrangement of supporting columns (south end).

Plate 30 Royal Pew, Lady Chapel west elevation, detail of brickwork of ante chapel wall

Plate 31 Royal Pew, west elevation (north) detail of brickwork in ante chapel wall

Plate 32 Royal Pew, west elevation (north), detail of beam in ante chapel wall following removal of brickwork

Plate 33 Royal Pew, ground floor, west elevation of ante chapel wall. Graffiti tracing.

Plate 34 Royal Pew, ground floor, west elevation of ante chapel wall. Detail of graffiti. See Appendix for detailed tracings.

Plate 35 Royal Pew, east elevation, detail of oriel corbel paintwork

Plate 36 Royal Pew, east elevation, detail of paintwork on upper beam at location of post 2

Plate 37 Royal Pew, east elevation, detail of paintwork on post 5

Plate 38 Roof space over the Royal Pew, south elevation showing brick detail and King post truss.

Plate 39 Roof space over the Royal Pew, north elevation showing the brick detail and king post truss.

Plate 40 Roof space over the Royal Pew, south elevation, detail of top of king post and iron strapping

Plate 41 Roof space over the Royal Pew, east side, detail of re-used timbers as primary purlin.

Plate 42 Roof space over the Royal Pew, detail of forelocks used on one of the king posts

Plate 43 Roof space over the Chapel Royal, detail of the 17th century king post at the west end of the Chapel Royal forming part of the overall framework of the Royal Pew structure

Plate 44 Roof space over the Chapel Royal, detail of the 17th century truss in the north west corner of the Chapel Royal roof space forming part of the overall framework of the Royal Pew structure

Plate 45 Roof space over Chapel Royal. View to the south showing details of truss and 'U' support

Plate 46 Roof space over Chapel Royal, detail of moulding on underside of truss at the south end

Plate 47 Hidden room above Winter Pew, east elevation, quoins and plastered wall before removal of plaster

Plate 48 Hidden room above Winter Pew, rise of floor in north east corner

Plate 49 Hidden room above Winter Pew, detail of truncated stone moulding for window in north east corner

Plate 50 Hidden room above Winter Pew, east elevation, following removal of plaster

Plate 51 Hidden room above Winter Pew, east elevation following removal of plaster, reduced Tudor wall plate

Plate 52 Hidden room above Winter Pew, east elevation following removal of plaster, rebates on post 3 for possible arch

Plate 53 Hidden room above Winter Pew, east elevation following removal of plaster, top of post 2

Plate 54 Void over Thornhill ceiling, east elevation supporting braces and remains of Pew structure central post (post 4)

Plate 55 Void over Thornhill ceiling, east elevation substantial re-used timber running in front of east elevation

Plate 56 Void over Thornhill ceiling, view to the north revealing surviving elements of the former plaster ceiling

Plate 57 Void over Thornhill ceiling, detail of ceiling moulding fixing point on former plaster ceiling. The lines are scored and the central boss location is marked with red paint

Plate 58 Void over Thornhill ceiling, west elevation reset brace (south) with empty mortices and paint traces

Plate 59 Void over Thornhill ceiling, detail of paint on inside of northern brace with nails and looping evidence for material fixing

Plate 60 Void over Thornhill ceiling, red and white paint traces on soffit of beam

Plate 61 Void over Thornhill ceiling, rebates for possible arch detail on post 3

Plate 62 Void over Thornhill ceiling. Surviving Tudor post and 17th century supporting post strapped in front of it (north side). The Tudor post is chamfered on the closest edge and is recessed in two places halfway up the photograph

Plate 63 Royal Pew, Lady Chapel, in situ Tudor ceiling

Plate 64 Royal Pew, Lady Chapel, cut floor joist mortice at end of upper beam

Plate 65 Royal Pew, Winter Pew, detail of hearth showing forelock

Plate 66 Royal Pew, ground floor ante chapel, underside of hearth within Winter Pew

Plate 67 Royal Pew, Winter Pew, window cut by inserted ceiling

Plate 68 Royal Pew, lifting of the floorboards on the south side of the ante chapel. Detail of floor joist and marble floor tiles

Plate 69 Royal Pew, 19th century plan of raised seating within the Winter Pew, Royal Pew and Lady Chapel

Royal Pew, Chapel Royal, Hampton Court Palace

HISTORIC BUILDING RECORDING AND INVESTIGATION

SUMMARY

Oxford Archaeology was commissioned by Historic Royal Palaces to work with Martin Ashley Architects at the Royal Pew in the Chapel Royal, Hampton Court Palace, Surrey. The investigation and recording work was required as a condition of Scheduled Monument Clearance during exploratory works to ascertain the current structural integrity of the Royal Pew and during the resulting building repair works.

The work was carried out in three phases with phase 1, consisting of initial investigation works, undertaken between October 2005 and January 2006. Further investigation was undertaken during Autumn 2006 with recording of three Tudor windows within the antechapel and watching briefs during investigation of the hearth within the Winter Pew and Dendrochronology sampling within the roof. The final phase took place between June 2007 and October 2007 with ongoing watching brief and investigation work during repairs to the pew structure.

The Royal Pew is a historically significant element of The Chapel Royal and, in turn, Hampton Court Palace. The Chapel has been altered and reordered on numerous occasions since the early 16th century, both as a result of the personal wishes of the monarch and as a consequence of the changing religious doctrine over the course of the Chapel's history. The investigations not only revealed the complicated nature of the structure of Royal Pew but also identified the major phases of construction for the pew as a whole.

A programme of Dendrochronology sampling allowed accurate dates to be assigned to some elements of the Royal Pew and the roof structure above. The truss directly above the pew was dated to 1633-4 which could possibly make the truss one of the few surviving examples of Inigo Jones carpentry. In addition to the phasing of its construction history it was possible to make an extensive record of graffiti drawn or carved by craftsmen working at the Chapel Royal throughout its development. The discovery of traces of the Tudor paint decoration on the timberwork of the Royal Pew structure provided important information on the decoration of the pew in the 16th century.

1 INTRODUCTION

1.1 Project Background

1.1.1 Oxford Archaeology was requested by Historic Royal Palaces to undertake building recording and investigation at the Royal Pew, Chapel Royal, Hampton Court Palace. Hampton Court Palace is a Scheduled Ancient Monument (Surrey, no: 83). The project had two main stages - the investigation of the structural integrity of the Royal Pew and the remedial works following a consultation and investigation period.

1.1.2 The first stage took place between October 2005 and January 2006. The purpose of the historic building recording, in addition to a separately commissioned structural survey undertaken by Hockley & Dawson (consultant structural engineers), was to provide a basis of understanding to inform proposals for future repair works. The historic building recording was undertaken as a series of watching briefs, when specific structural areas were revealed. The architect was Martin Ashley Architects and the Structural Engineers were Hockley & Dawson. Dendrochronology sampling of the pew structure was undertaken by Dan Miles of Oxford Dendrochronology Laboratory. The archaeological recording was undertaken by Andy Miller from Oxford Archaeology, assisted by Jane Phimester, with additional input by Julian Munby. An historic building investigation and record report was issued by Oxford Archaeology in June 2006.

1.1.3 Further recording of the Tudor windows within the ante chapel north elevation was undertaken during December 2006 as well as watching brief services of the hearth within the winter pew. This recording was undertaken by Alison Kelly, Jon Gill and Mary Saunders of Oxford Archaeology. Further dendrochronological sampling was undertaken within the roof structure by Dan Miles with archaeological recording of the sampling by Alison Kelly of Oxford Archaeology.

1.1.4 The next phase of recording work took place between April and December 2007. The purpose of the historic building recording was to provide recording and interpretation during further opening up caused by the structural repair works. Further opportunities for investigation, particularly within the 'hidden room', were also carefully recorded. The investigations were mostly carried out with Andrew Harris from Martin Ashley Architects. Dan Miles and Tim Tatton-Brown visited the Pew twice during the course of works to advise on the interpretation. Further experts were appointed following the discovery of Tudor paintwork decoration on the exposed timbers. Catherine Hassall examined samples of the paintwork and, where possible, compared the paintwork to dated paintwork elsewhere within the Palace. Jon Burbidge of Granville & Burbidge examined the extent of the painted surfaces and undertook a condition assessment of the paint fragments. Both of these reports are included within this report as appendices IV and V. The archaeological recording was undertaken by Alison Kelly, and Julian Munby, Head

of Buildings Archaeology at Oxford Archaeology, oversaw the archaeological recording and interpretation.

1.1.5 This report is designed to supersede the Oxford Archaeology report of June 2006 in order to provide a full account of the historical and fabric analysis of the Royal Pew following the investigation.

1.1.6 The historical analysis is based upon research undertaken by Kent Rawlinson, Curator of Historic Buildings at Hampton Court Palace and a full version of his 'Chapel Royal, Hampton Court Palace (Royal Pew) - Summary Statement of Significance' can be found in Appendix II. For reasons of clarity this report is presented using the same phases defined within the statement of significance. Areas which require further discussion outside of the main report text are also presented within the Appendices.

1.2 Aims and objectives

1.2.1 The purpose of this investigation was to:

- Understand the nature of the fabric during all periods of its use, considering both its structural character and its development through history
- Inspect and record all areas of exposed fabric
- Create an ordered archive of work records for deposition with Historic Royal Palaces

1.3 Methodology

1.3.1 Oxford Archaeology undertook a watching brief on removal of panelling, panel framing, flooring and during repair works within the area of the Royal Pew, hidden room and chapel roof space. The brief for the level of recording for the initial phase of investigation was set out in the Oxford Archaeology Written Scheme of Investigation (September 2005).

1.3.2 The architects made available the results of a previously commissioned photogrammetric survey (undertaken prior to the removal of panelling) of elements of the Chapel Royal including the Royal Pew. Scale drawings by Martin Ashley (Architects), Hockley and Dawson (Engineers) and Daphne Ford (English Heritage) were also used as the basis for some of the survey.

1.3.3 A full photographic record of all the areas and structures under consideration was made, where accessible, during the course of the investigative works. General photography was undertaken with a Pentax MZ-M SLR using 35mm film (black & white and colour slides) in addition to extensive digital images taken using a Nikon 5600 compact digital camera. Both allow for high resolution to publication standards. A variety of scales was used in some of the images, as appropriate.

1.3.4 Scale drawings were produced at a suitable scale (usually 1:10) on archivally stable permatrace. Any graffiti or other marks revealed were recorded on acetate at a scale of 1:1. The paint traces on the east face of the upper and lower pew beams were also recorded on acetate at a scale of 1:1. Other areas of paintwork which were fully accessible were also recorded photographically.

1.3.5 Any brickwork recorded during the investigation was compared to the Hampton Court Brick Typology devised by Daphne Ford for English Heritage (1991).

2 HISTORICAL ANALYSIS

2.1 The Emergence of a Royal Palace

2.1.1 The Knights Hospitallers acquired the manor of Hampton in 1236 and used the land as a grange. The only known buildings at this time were a great barn or hall and a stone camera. The first known occupant other than the knights was John Wode who obtained a lease for the court, the exact date of which is unknown. Alterations to the building during his time may have included the extension of the residential part of the dwelling by means of a tower. Wode died in 1484 with no heir, and it was not until 1494 that the manor was re-leased.

2.1.2 The next occupant of Hampton Court was Sir Giles Daubeney, who in 1494 acquired and eighty-year lease. The freehold of Hampton Court was unobtainable by Daubeney but he did however obtain a new 99-year lease in 1505. This new lease was much improved allowing him to enlarge the property. Daubeney died in 1508 and when his son came of age in 1514 he immediately gave up the lease to Thomas Wolsey, then the Bishop of Lincoln, but soon to become Archbishop of York and a Cardinal.

2.1.3 As with Daubeney's lease Wolsey's gave permission for alterations to be made to the fabric of the buildings. During his time at the palace Wolsey carried out many alterations and new builds and amongst his earlier works was the construction of the ranges that form Base Court in 1514-1522. Henry VIII, who acquired Hampton Court in 1527/9, continued this building of the palace as he embarked upon a building programme that shaped much of the Tudor palace we see today. During this time existing buildings were removed or adapted and decorated for royal use.

2.1.4 Among the later works that are recorded, the major programme of alterations was carried out by William III, who commissioned Sir Christopher Wren to rebuild Hampton Court in 1689. Wren's original plan was to rebuild the whole of the Tudor palace, keeping only the Great Hall. Lack of time and money meant that Wren concentrated his efforts on rebuilding the King and Queen's apartments on the south and east sides of the palace.

2.1.5 After Williams death in 1702 the Palace was little used by subsequent monarchs although improvements and alterations to the palace fabric continued. The last

reigning monarch to use Hampton Court was George II in 1737. After his succession in 1760, George III decided not to live at Hampton Court leaving the palaces many room unoccupied. It was decided that the lodgings and other rooms in the palace should be divided up into apartments for grace and favour residents who were granted free residency by the monarch.

2.1.6 In 1837 Queen Victoria declared that Hampton Court Palace should be open to all her subjects and the Palace became a tourist destination and visiting antiquarians and artists began to write about and draw the palace on a grander scale than previously done. Parts of the Tudor Palace were gradually restored with the removal of 18th century casement windows amongst some of the building works at this time. Changes to the palace in the 20th and 21st centuries have primarily involved the conservation and restoration of the building fabric as well as the presentation of the palace to visitors.

2.2 The Chapel Royal

2.2.1 The Chapel Royal at Hampton Court Palace has a T-shaped plan and is constructed of brick with stone dressings. At the west end of the chapel there is a timber-framed pew inserted at first-floor level occupying the whole of the ante chapel (Plate 1). Originally divided in two, the pew is now tripartite, with six room divisions:

	South	*Centre*	*North*
West	STAIR	VESTIBULE with entrance from Gallery	MODEL ROOM
East	LADY CHAPEL	ROYAL PEW (Thornhill void over)	WINTER PEW (Hidden Room over)

2.2.2 The main entrance is now in the centre, but the two original doors from the gallery were at the north and south ends; the Model Room has two Tudor doorways, one leading to the gallery outside and one which led to the adjacent vice stair (Plate 11). There is a fireplace centrally located on the northern elevation between high level windows with Tudor style chimneys on the roof above. It is assumed these features were duplicated on the southern wall. The Lady Chapel has a window in the east wall, while the Winter Pew and Model Room have windows in the south wall.

2.2.3 The brickwork of the chapel has been identified as Type B Wolsey phase bricks, a brick type used for structures built later in Wolseys' occupation of the Palace, such as the east range of Clock Court (Ford 1991). Archaeological investigations of the brickwork of the east facing elevation of Chapel Court (Oxford Archaeology 2008) and the discovery of the Chapel East window in 1981 (Curnow 1984, 12) suggest the exterior of the chapel was decorated with ruddling and painted diaperwork. The

brickwork has a cream coloured mortar with small to medium lime inclusions and is generally laid in an English bond.

2.2.4 It has been suggested (Thurley 2003, 34) that the key to understanding the plan of Hampton Court lies with the consideration of its chapel, although very little is known about the earliest phases of its construction. A thorough search of the archives enabled the Curator of Historic Buildings, Dr Kent Rawlinson, to produce a list of relevant sources in his Statement of Significance (attached as Appendix II). Much of the documentary sources information in the following section of the report is taken from this document. The chapel construction is broken down into the same phases used within the statement of significance. No additional historic research has been commissioned as a result of the discoveries.

3 PHASE I - THE MEDIEVAL CHAPEL

3.1 Documentary Sources

3.1.1 A chapel is mentioned in the extent of the grange of the Knights Hospitaller dated 1338 and it is probable that this chapel was used by John Wode and Charles Daubeney although there is no other evidence for this in documentary sources.

3.2 Archaeological Investigations

3.2.1 It is likely that the present chapel stands in the same location as the medieval chapel, although this cannot be confirmed without intrusive archaeological investigation. No evidence for the medieval chapel was found during the recent Chapel investigations although some possible footings for the pre-Wolsey chapel are noted in the north western corner of the chapel on the historical analysis ground floor plan developed by Daphne Ford for English Heritage (1996). Further evidence for other medieval buildings has recently been discovered during archaeological excavations in Base Court. It is possible that the medieval chapel location may be confirmed in any future below-ground investigations.

4 PHASE II - WOLSEY'S CHAPEL (1514 –*C.*1529)

4.1 Documentary Sources

4.1.1 A chapel and some furnishings are present in the lease that Wolsey acquired from the Knights Hospitaller in January 1514 and the early building accounts for Wolsey suggest that he continued to use the medieval chapel with references to the repair of the chapel door (Colvin 1970, 128)

4.1.2 The body of the chapel and its adjoining cloisters are constructed with Wolsey Type B brick (c.1521 - 1525) although it is uncertain when work had begun (possibly after the Emperor Charles V's visit in 1527). The only reliable known fact

is that when Henry VIII assumed responsibility for the building works at the palace in 1529 the chapel was still being completed. The 'new' chapel was of considerable size being approximately 30m long with an ante-chapel 15m wide although this was only half the size of Eton College chapel and significantly not as large as some of the college chapels at Oxford such as Magdalen or Merton. The new chapel also employed a very specific T-shaped design with choir and transept but no nave, developed in Oxford, e.g. Magdalen College, of which Wolsey was a fellow). The carpentry was probably designed by Humphrey Coke who, along with William Vertue, had worked on several of the Oxford Colleges and would later become the Kings Chief Carpenter (Harvey 1987, 65).

4.1.3 The main variation to this well-established pattern was the inclusion at the west end of the chapel of a first-floor pew connected to the main body of the chapel by twin spiral stairs (vices), but primarily accessed from the gallery on the principal (first) floor of the Palace. This replicated a convenient design not unknown in private chapels (e.g. the Archbishop's of Canterbury's palace at Knole), and previously employed by Wolsey in the construction of the royal pew in the chapel at Eltham in 1519, where it had also been constructed for easy access by the king and queen to the main body of the chapel on specific feast days (Thurley 1993, 196).

4.1.4 There is currently little evidence for the original internal appearance of the chapel although there are eight windows lighting the choir, beneath which tapestries would have hung above the stalls. Windows at ground level lighted the ante-chapel. Many of the windows were restored in 1891, the only full original example being currently hidden behind the organ. The east window of the chapel is of great architectural significance and this was hidden behind the reredos until rediscovered in 1981 (now visible externally from the east). The window occupies most of the east wall and comprises a pair of six-light windows with four-centred heads and a single, linked square-head light centrally placed. The whole is covered by a single hood-mould (Curnow 1981, 11). Little is known of the style or construction of the chapel and ante-chapel roof during this phase, although it is thought that the ceiling would have been of a shallow construction, supported by tie-beams from above and similar to the barrel-vaulted ceiling constructed at York Place in 1528 by Wolsey and drawn by Wren in 1676 (Thurley 1993, 37).

4.2 Pictorial Evidence

4.2.1 The only image we have of the chapel at this time is the design for the stained glass in the east window by Erhard Schön and his workshop from around 1520-1529. The design for the lower east side shows figures who are thought to represent St Katherine, St Henry, St George, a kneeling girl (Princess Mary?), a Queen (Catherine of Aragon) and a King (Henry VIII).

4.3 Archaeological Investigations and Observations

The front support of the Pew

4.3.1 The pew consists of two substantial principal timber beams lying horizontally, one on top of the other, and spanning the width of the chapel at the junction of the choir and Ante-Chapel (Figure 3, 4, 5 & 7, plate 2). The upper beam is in three sections and the lower beam is of a single length. The lower beam is built into the chapel walls and has mortices for the primary ceiling joists of the Ante-Chapel. The upper beam carries the mortices for the pew primary floor joists of the Pew (Plate 7). There are various mortices on these beams which relate to later alterations by Henry VIII and strengthening repairs in the 18th century. The two oak beams are approximately the same size, with a maximum cross section of the lower beam of 0.28 x 0.35m and the upper beam of approximately 0.28 x 0.33m. They are square in section, but the lower beam has, at a later stage, had a substantial rebate roughly cut into it on its lower front (east) edge of approximately 0.08 x 0.10m. The beams are currently partially supported by two slightly tapering octagonal columns, also of later date.

4.3.2 There is some debate as to whether the pew was divided into two closets in Wolsey's time. The twin adjoining stairs reflect the chapel design at Eltham Palace (constructed 1519-1522) which had two closets (Thurley 1993, 196). However it is felt that the division of the pew is part of the Henrician works of 1536. This is further discussed in § 5.3.4.

4.3.3 The lower beam has a regular series of mortices for the common joists of the ground-floor ceiling (Figure 5, plates 8 & 9). These have sloping edges for the diminished haunches of the joist tenons. The upper beam has a similar row of mortices for the common joists of the first floor. A rebate for the original floorboards (0.06 - 0.08m wide) is present running along the upper edge of the principal upper beam (this rebate is 0.75m above the current floor levels in this area). This arrangement is an early example of separate provision for floor and ceiling in a manner that was not widespread before the 17th or 18th century.

The North end of the Great Beams

4.3.4 The upper and lower primary beams of the Royal Pew extend into the ante chapel walls at both north and south ends on the first floor (Figure 9a & 9b, plates 8 – 10). At this floor level, the west facing elevation of the wall at the north end (Winter Pew) measures 1.05 x 3.48m (max) with chamfered stone quoins at the edge adjacent to post 1. The quoins measure 0.19 x 0.25m - 0.62 x 0.33m with the lower ones being covered with graffiti (Plate 33 & 34) - the graffiti is discussed further within Appendix VI. The top three visible quoins at this level appear to have had their face removed whilst the bottom five have chamfered south faces. They are closely set with a thin layer of white / grey mortar visible between them. To the left of the quoins the face of the wall was covered in a pale, mid grey, fine to medium

grained render with areas of exposed primary phase brickwork. The brickwork covering the lower section of this wall had several phases of repair and renewal apparent, and across the whole of this area only one skin of bricks had been laid to cover the beams. At the extreme northern end of the wall are two infill patches of brick which align with the mortices on the upper beam. This would appear to be an extension of the support for the floor joists of the pew.

4.3.5 Removal of brickwork around the north end of the beams to inspect their condition revealed that the upper and lower beam ends were encased with sheet lead and are set within Wolsey Type B bricks (Figure 9b). Further removal of brickwork and a quoin stone in the Winter Pew revealed a void approximately 0.08m long between the top of the upper beam and the brickwork above. This void had traces of organic fill within and a separate piece of lead sheeting was laid across the top of the beam, presumably a remnant from the lead sheet that covers the beam ends. Above the void and forming the base of the brickwork above was a row of four glazed tiles set approximately 0.18m back from the face of the nearby post. The tiles measured 0.22m square and were set with the glazed face against the brickwork above. There were two yellow glazed tiles and two a mottled brown/black colour and these were set alternately. The size and colour of the tiles were similar to other 16th century tiles found in Henry VII's Chapel at Westminster Abbey (J. Munby, pers. comm.) and it is possible that these are from an early floor surface of the chapel that has been used as infill.

4.3.6 Repairs to the lower beam necessitated the removal of frassed woodwork at the north end of the pew. During removal it was discovered that the upper beam has a diminishing tenon set within the lower beam (Figures 9a & 9b, Plates 8 – 10). The tenon is approximately 0.6m long and 0.10m deep and its presence, presumably also matched at the south end of the pew structure, means that the upper beam could have acted as a form of brace which provides valuable support for such a wide span. Removal of the beam end also revealed structural failure of the lower beam at the point of contact with the quoin below. A hitherto unseen hidden mortice (approx. 0.20 x 0.17m) at this point may be a reason for this failure (Figure 9b). It is possible that this is a mortice for a post relating to a later remedial support. The mortice overlaps the quoin by 0.05m, however this may be due to shrinkage or movement of the lower beam. The adjoining quoin also has a rebate roughly cut into it and this is probably part of the early 18th century works and is discussed more fully in § 8.3.6.

The South end of the Great Beams

4.3.7 The west facing elevation at the south end measures 2.75 x 3.75m with stone quoins (measuring 0.18 x 030m - .044 x .0.43m) adjacent to post 7 (Figure 10, plates 30 – 32). No trace of graffiti was seen on any of the surfaces that were accessible suggesting this area had mostly remained covered. Paint analysis by Catherine Hassall (Appendix IV) suggests that the quoins in the Lady Chapel were always

painted with a white distemper along with the adjoining plaster wall. To the right of the quoins the face of the wall was covered in a pale, mid grey, fine to medium grained render. Two distinct areas of brickwork were visible in this elevation: the characteristic Wolsey Type B red brickwork (0.22 x 0.05 - 0.06m) laid horizontally over the lower beam (and seen behind the plasterwork above). There is a distinct break in the brickwork at the end of the beams at which point the upper beam has been shortened as the end mortice for the floor has been cut. Adjacent to this is a much later mixed infill of yellow, red and grey brick and half bricks (0.10 x 0.06m - 0.21 x 0.06m) presumably put in place with the insertion of a late 19th / early 20th century heating pipe. A 0.21m gap at the far south end of the elevation (cut for access to the heating pipe?) shows that behind the inserted pipe the substantial primary phase wall still exists. As with the north end of the beam there is also a hidden mortice on the underside of the lower beam (Plate 25), although there has been no structural failure at this point.

Dendrochronology

4.3.8 Dendrochronological sampling was undertaken by Dan Miles from the Oxford Dendrochronology Laboratory and his report is included in this report as Appendix III. The lower beam was dated to spring 1525 which is consistent with the potential Wolsey construction phase for the pew. The composite structure of the beams and the fact that both ends are encased in Wolsey Type B brickwork suggest that the upper and lower beams are of the same date. One other timber (post no. 3) was also dated as having been felled in Winter 1526/6. However, using evidence of the carpenter's marks and the seasoning of the upper beam, it is believed that the structure above the pew composite beams is of a later Henrician phase, while using timbers felled at the same time as the upper and lower beams. Several other timbers also produced dates ranging up to 1536, although it was not possible to obtain exact dates for these (Miles 2007).

5 PHASE III - HENRY VIII (C.1529 – 1547)

5.1 Documentary Sources

5.1.1 Minor building works undertaken shortly after Henry VIII acquired Hampton Court from Wolsey suggest that the chapel was newly constructed and only small additions and alterations, including the installation of new carved stalls, were made during the period 1529-1535. However, one larger project in 1534 saw the addition of the vestry to the south eastern corner of the chapel. In 1531 reference is made to a 'new chapel' indicating that decoration and alterations were completed at that time, the works appear to have been mainly glazing. (Rawlinson 2005, 2)

The Hammer-Beam Ceiling/Roof

5.1.2 A second phase of works during this period began in 1536 with the division of the Royal Pew and the replacement of the ceiling. The Royal Pew was refitted whilst the chapel ceiling was under construction. The original pew had probably been a single space and the works of 1535-6 saw it divided into two 'Holyday Closets' complete with oriel windows overlooking the main part of the chapel. The timber screen dividing the two closets was carved, painted, gilded and glazed. These Holyday Closets were for use on Sundays and special feast days only as the King would normally use the Privy Closet in the royal accommodation for prayer on a daily basis (Thurley 2003).

5.1.3 The new elaborate timber vaulted ceiling was carpentered by a team of Hampton Court carpenters over nine months in 1535 at a works yard in Sonning, Berkshire and later transported by boat and erected at Hampton Court (Thurley 2003, 63). The design of the chapel ceiling has been attributed to William Clement, later commissioned to design and construct Nonsuch Palace (Thurley 2003, 63). There has been some discussion as to whether this ceiling was originally one designed by Humphrey Coke and intended for Cardinal College (now Christ Church) in Oxford (Harvey 1943, 55). Thurley disagrees as it would have been recorded on inventories made after Wolsey's downfall (Thurley 2003, 63) and although the timber may have been cut by Wolsey's men and not used until 1535 this is unlikely as Colvin states that felling was taking place at Sonning in 1532 suggesting supplies of timber there were running low (Colvin 1970, 135).

5.1.4 The chapel ceiling was in place at Hampton Court by the summer of 1536 and there is a record of the painting of the Chapel ceiling and the oriel windows of the royal pew by John Hethe and Henry Blankeston: *'For payntyng gyltyng and varnesshyng of the vought in the Kynges New Chappyl:-Payd to John Hethe and Henry Blankeston of London, gylders and paynters, for gyltyng and garnesshyng of the vought in the Chappell with great arches bourd, great pendaunts, wyth angells holdyng schochens wyth the Kynges armes and the Quenes, and wyth great pendantts of boyes pleying wyth instruments, and large battens set wyth antyk of leade gylt, wyth the Kygnes wordde also gylt wyth fyne golde and fyne byse, sett out wyth other fyne collers and for castyng of the antyk and letters of the lead, and for the pyn nayll, with all other necessaryes belowngyng to the forsayd chappell rowf; wyth two great bay wyndowes of the Kynges and Quenes holyday closettes, for the sides next unto the Chappell, garnesshyd and guylte wyth the Kynges armes and the Quenys, with beests guylte wyth fyne golde and byse, sett owt wyth other fynes collers, in all, by convencion - £457'* (Salzman 1952, 166).

The Royal Chapel of 1520 at Guines

5.1.5 There is also a more lengthy description of the Royal Chapel erected as part of Henry VIII's accommodation for the Field of the Cloth of Gold in the temporary palace at Guines (Pas de Calais) in 1520. The contemporary account in Hall's

Chronicle[1] clearly describes the lavishly furnished King's and Queen's closets and the use of painted cloth to decorate the interior.

5.1.6 *'Also to the same palais wes rered a Chapell with two closettes, the quire of the saied Chapell filed with clothe of golde, and thereon frete ingrailed bent clothes of Silke, all was then silke and golde. The autars of this Chapell were hanged with riche revestre of cloth of gold of Tissue, embroudered with pearles. Over the high aultare was hanged a riche Canaby of merveilous greatnes, the aultare was appareled with five paire of Candelsticks of golde, and on the aultare an halpas and thereon stode a Corpus domini, all fine golde, and on the same halpas stoode twelfe Images of the bignes of a childe of foure yeres of age all gold : And all the Coopes and Vestmentes so riche as might be prepared or brought in the citie of Florens, for all the copes and vestementes wer but of one pece, so woven for the purpose, cloth of Tissue and poudered with redde Roses purled with fine golde : the Orfrys sette with pearles and precious stones. And all the walles and deskes of his Chapell was hanged with right Clothe of golde, and three ryche greate Crosses were there ready to be borne at festival times, and basyns and Sensers, Gospellers, Paxes, Crewetes, holy Water vessels, and other ornamentes all of gold.*

Also in the fyrst Closet was a traverse for the kynges person of cloth of golde : And within that the kynges place and Chaire, with Cusshins of clothe of golde : before the traverse was an altare of presence, which Aultare was adourned with clothe of brouderie, and riche Pearles and precious stones, set in goldesmithes woorke of fine golde. On the aultare was a deske or halpace. Wereon stoode a patible of the Crucifix of fine golde, with an Image of the Trintee, an Image of oure Lady, and twelve other Images all fine golde, with Basens, Crewettes, Paxes and other Ornamentes, the said Closet was hanged with Tappettes embroudered with riche worke frete with pearles and stones, the roffe of the same Closet was siled with woorke of Immouled, gylte with fine Golde and Senapar and Bice.

The seconde Closette was for the quenes persone, in whiche was a traverse of riche clothe of golde, the aultare so richely appareled, that there lacked neither Pearles nor Stones of riches : on the aultar were twelve grete Images of golde, the Closet hanged with clothe of gold all other jewelles Missall, I suppose never suche like were seen, and the rooffe of the same closet was filed with like worke the kynges closet was as is before rehersed. (Whibley 1904, 84-85)

5.2 Pictorial Evidence

5.2.1 Again we are limited in the pictorial evidence. There are two depictions of the christening of Prince Edward in 1537. One shows the christening procession and does not show any architectural detail, the second image shows the mount on which the christening font was placed which stood within the chapel for the christening.

1 Edward Hall, *The union of the two noble and illustre famelies of Lancastre and Yorke……* (1550), part reprinted by Whibley (1904).

This is 'exploded' to show the detail and depicts a decorated font with canopy above on top of the octagonal mount. Two sets of three doors with locks are shown on a double wall of timber screens, which open onto steps which lead up to the font. The exact location for this font within the Chapel is unclear and the temporary nature of the structure is unlikely to have left any archaeological traces.

5.3 Archaeological Investigations and Observations

The Front Wall of the Pew

5.3.1 The upper beam carries four timber posts which have carpenter's assembly marks of numbers 1, 3, 5 and 7 in roman numerals (Figure 3). At either end is a post rising against the side wall and two more timber posts divide the front of the pew into three forming the Winter Pew, King's Pew and what was the Queen's Pew (now lady chapel) to the south. These two posts are each 0.38 x 0.18m with a height of 6.90m extending up into the roof space above the Thornhill ceiling where they are tenoned into the Tudor wall plate (Figure 12).

5.3.2 This division into three parts was not original, and Henry's pew was rather divided into two. On the top face of the upper beam, centrally located, is the mortice for a substantial central post that divided the Royal Pew into two compartments (Figure 4, plate 13). The mortice measures 0.41 x 0.05m with a depth of 0.09m, and while the majority of this post has been removed, the upper section can still be observed as a surviving stub in the small space above the Thornhill painted ceiling (Figure 12 & 13, plate 54). The post rises to the topmost horizontal beam at the level of the wallplate. The pew upper beam also has two smaller mortices measuring 0.19-0.21 x 0.04 x 0.06m situated between posts 1 and 3 and posts 5 and 7 (Figure 4). These indicate the location of posts 2 and 6. The upper section of post 2 can be seen on the west elevation within the hidden room above the winter pew (Figure 12, plate 53) and it is assumed the upper section of post 6 remains in situ in the frame within the lady chapel, however this was unseen. Investigation has shown that the removed sections of posts 2 and 6 were reused as lintels during 18th century refurbishment works and this is discussed more fully in § 7.3.4.

5.3.3 In addition to the mortices for the removed posts, at least nine further smaller mortices are present in the top face of the upper beam, all positioned approximately 0.03 - 0.04m from the east edge with average dimensions of 10 x 3 or 4cm and with a depth of 5cm (Figure 4, plate 14). These must have been for studs infilling the frame. Empty double mortices on posts 1 and 7 and on the lintels (formed using removed sections of posts 2 and 6) suggest the infilling was only for the lower part of the frame in these sections with a possible window or carved screen above.

5.3.4 As discussed previously, Dendrochronological sampling of the upper and lower beams produced a date of Spring 1525. Sample HCP2, taken from the base of post no. 3, produced a date of Winter 1525/6. Further samples taken from the remaining posts (nos. 1, 3, 5 and 7) and lintels produced dates of up to 1536. The four

remaining posts have numeric carpenters marks scribed at the base of the east face; however there are no accompanying marks on the receiving upper beam (Figure 3). This is somewhat unusual and would normally suggest the timbers have been reused, however the four posts are set in numerical order suggesting this is not the case. On further inspection by Dr. Dan Miles it was noted that the upper beam had already distorted when the mortice for an infill stud at the south end of the beam was cut, suggesting the upper beam had seasoned after its insertion into the wall and before the mortices were cut. It is therefore suggested that the timbers were felled at the same time as the upper and lower beams, but not placed in their current position until the 1536 building works. It is possible that the posts were used elsewhere within the chapel and then resited during the works of 1536, however, there is no evidence for this (Miles 2007).

The Choir Ceiling/Roof

5.3.5 The roof structure over the main body of the chapel consists of a multiple hammer beam arrangement which is separated from the roof over the Ante-chapel (and hence Royal Pew) by an inserted 17th century truss. A series of arched braces forming the hammer beam roof are slotted into recesses in the brickwork on both sides of the roof space approximately 0.50m deep.

5.3.6 The samples from the vaulted timber ceiling produced a combined felling date of 1529-1542 which is consistent with the documented construction date of 1536 (Miles 2007). The samples also matched the reference chronologies used suggesting the origin of the timber was Berkshire, Oxfordshire or North Hampshire. This is consistent with the documentary references to the prefabrication at Sonning in Berkshire.

The Ante Chapel Roof

5.3.7 Within the antechapel roof space on the gable walls at the north and south end, the outline of a low hipped roof can be seen in the brickwork (Plates 38 & 39). This has a slightly shallower angle and is visible beneath the existing 17th-century roof. It is likely that the roof orientation would have been the same as seen today with rafters spanning from east to west. There are Tudor tiles on each elevation which probably form a slip. The tiles are 0.20m square, black/brown coloured and glazed and appear to be the same as seen above the upper main beam of the pew. The gable walls have sections of flat brickwork which have the imprint of boards and the poor construction suggest the walls were constructed from the outside (A. Harris pers. comm.). The brickwork appears to be of Type B Wolsey date and the mortar is very similar to the primary phase mortar although detailed analysis would confirm this. It is probable that this roof, with a similar pitch to that of the Great Watching Chamber, replaced the earlier roof using materials from the earlier phase. Both gable ends have repair patches and later inserted chimneys which date to the 18th century.

Top of the Pew Frame

5.3.8 Plaster removal on the west elevation of the frame within the hidden room (Figure 12, plates 50 - 52) and study of the frame seen within the Thornhill void shows that the wallplate is in at least 2 sections with potentially a further unseen joint concealed in the framework above the Lady Chapel. The visible sections of post at the upper levels (i.e. posts 1, 2, 3, 4 and 5) are tenoned into this topmost beam, and a gap at the top of post 2 is probably due to the failure of support in this area. It is not known if the truncated post 2 is tenoned into the lintel below. The central sections of the posts within this area have been cut (the cut measures approximately 0.64m) to produce an angle on the edge, presumably to accommodate decorative spandrels which would have been visible within the Royal Pews below.

5.3.9 Above the central post (post 4) stub is also a large rebate, presumably cut to receive a major post for the ante chapel roof frame above. The mortice for the foot of this large post is visible in the top surface of the main Tudor wall plate measures 0.41 x 0.05m with a depth of 0.09m, and indicates a central post size of approximately 0.30 x 0.40m (Figure 12).

The Oriel Windows

5.3.10 The soffit of the wall plate (Figure 13) has two sets of three pegholes either side of the central post stub. It is thought that these relate to projecting canopies which sat above each oriel window. There are also four visible small mortices (0.10 x 0.2 x 0.4m) either side of the central post which may be for studs that also infilled the frame at this point. The Tudor wall plate has been cut away on the top of the section seen within the hidden room (Plate 51). This is part of the 17th century works discussed further within § 6.3.1.

5.3.11 Rebates within the Tudor posts running 1-1.7m from the top of the posts could also be seen from within the hidden room and Thornhill void (fig 12). The rebates on posts 3 and 5 can be clearly be seen. These are partly angled and there are many nails and nail holes within the rebates. It is likely that these are related to the upper part of the two oriel windows. The rebates on posts 1 and 2 were less clearly seen as plaster removal had not taken place in this area, however it is possible that these rebates are for the head of windows or arch detail that may have been beside the central oriel windows.

Support for the Oriel Windows

5.3.12 Exposure of the outer (east) elevation of the lower principal beam revealed four small (and now blocked) horizontal mortices measuring 0.13 x 0.06m (Plate 15). Their depth was at least 0.08m but difficult to confirm as a result of the extensive rot within the lower beam. They are all positioned approximately 0.05m below the top of the lower beam, 0.38m below the top surface of the whole structure. They do not appear to be angled (chase mortices) but would seem to be related to extended

support for the oriel windows (Figure 3). These four mortices in the lower principal beam appear to be symmetrically arranged around the centre point of the whole structure (i.e.: to either side of the lost central post). All four mortices are aligned vertically with the position of angled trenches in the top face of the upper beam (Figures 3 & 4, Plate 16). These trenches are angled with a maximum length of 0.26m, a width of 0.06 - 0.08m at the splayed end (east facing) and a maximum depth of 0.03m. Viewed in plan each has two small square recesses in its splayed half and a central circular recess 25mm in diameter in the other half, with four further square holes arranged symmetrically around it. It is reasonable to infer that these all formed part of the structure for the oriel windows, taking iron fittings that allowed the windows to jut out over the Chapel Royal. It is also of note that in plan the two most northerly mortices are splayed outwards, whilst the southerly pair both splay inwards (i.e. all turn towards the north). The general arrangement is not unusual for the structural fixing of a feature such as an Oriel window (e.g. the Golden Cross, Oxford, of c.1540), but the angle of the supports is curious, though it would still work none the less.

5.3.13 Neither the horizontal mortices nor the splayed trenches can immediately demonstrate the form of the oriel windows, however a surviving timber oriel window in St Georges Chapel at Windsor Castle inserted *c*.1925 by Henry VIII for the use of Catherine of Aragon (Plates 5 & 6). The Windsor oriel is richly decorated with decorated panels and carved woodwork and it is thought that is was originally painted to resembled the adjoining stone oriel (Thurley 1993, p92).

Paint evidence for the Oriel Windows

5.3.14 Further analysis of the pew structure revealed traces of painted decoration . The paintwork recorded on the east elevation of the main pew structure can be seen in figure 14 and plates 35 & 36. Further analysis of the paint was undertaken by Catherine Hassall and this report is included as Appendix IV. A condition survey of the paintwork was undertaken by Granville & Burbidge and this is included as Appendix V. The paint traces on the upper and lower beams were recorded on acetate at a scale of 1:1.

5.3.15 A white gesso or distemper preparation can be seen on the upper and lower beams clearly outlining the position of the oriel windows and beneath the location of posts 2 and 6. This preparation is roughly applied suggesting this was merely a cutting in of a base layer of paint around an ornamental fixture already attached to the pew. There are patches of black paint which appears to have been painted over the white acting as a base for the decorative paintwork - which is the same technique used on the ceiling mouldings. There are traces of other colours: azurite blue, gold/orange and red lead, which can be seen on top of the white and black. These appear to be unintentional drips and splashes of paint probably created by painters during the decoration of the chapel during this phase of works. The shape of the paintwork shows that the each oriel had a curved, moulded frame to the underside which

stretched from the outer edge of the posts 3/5 and presumably met centrally underneath post 4, however this area has the later inserted truss and so could not be seen. The paint traces beneath the position of posts 2 and 6 shows linear attachments, possibly for the fixing of the *'... Kynges armes and the Quenys, with beests guylte with fine golde…'* mentioned in the record of the decoration of the ceiling and pew (§ 5.1.4).

5.3.16 Within the voids of this paintwork are several nails and nail holes. The majority of the posts lintels within the pew frame have a faint trace of white paint along the edges of the timbers; again this is probably where something fixed to the frame has been painted. The only intentional painted decorations visible are patches of white distemper with a black undercoat above and with azurite blue paint over this (Plate 37). On the east facing elevation this painted decoration appears as a 'band' in several locations and the position of nails above and below suggest that this paintwork infilled areas of the pew frame that were visible after the main decoration (possibly painted cloth mounted on battens) was hung. Post 7 also has a clear patch of blue and white at the same height on the inner face and traces of blue and white can be seen in the cross beams, although these were resited during the 17th century works.

Other Paintwork in the Pew

5.3.17 Within the Thornhill void traces of a bright red on white were found on the underside of the Tudor wall plate (Plate 60). This paintwork could be seen between the edge of the timber adjacent to the lath and plaster wall and the empty mortices for struts and therefore it can be assumed that the wall was screened off at the time of painting. Further paintwork could also be seen on the braces in this elevation. The braces run diagonally between posts 3 and 5 and the central post stub (post 4). Each brace is formed of two timbers adjoining each other and on the northern brace the timbers appear to be later in date and have no paint traces. On the outer edge of the southern brace there is white gesso or distemper beside a row of nails and the edge of the paint has a scalloped shape probably formed by a cloth covering had been stretched by the nails (Plate 59). The inner timber has a similar line of white paint on the west face with a clear void where there is an empty mortice, possibly for a post. On the underside of this timber is a large patch of visible white with some nails within a void suggesting the presence of a batten, below this the white has mostly flaked off and beside this an unpainted section can be seen. Unlike on the adjoining timber there are no obvious nails or nail holes, however it is possible that material covered this part but was glued rather than nailed to the timber. A sample taken from this timber was found to include a fibre, probably linen, although it could not be determined if this was a later contamination (Hassall, 2008). From the presence of the paint traces we can ascertain that the timber used for the southern braces (Plate 54) were probably present in the 16th century structure, however the timbers are clearly no longer in situ and so can tell us little of the form of the canopy over the oriel windows.

5.3.18 The underside of the pew lower beam was noted to have a roughly applied layer of white gesso (Plate 29). This paint was also seen under UV light to be present on the surface which includes the mortices for the central earlier arrangement of columns. The presence of paint on these surfaces tell us that the columns were not in situ at this time and were probably added later before being replaced with the octagonal columns which we see today. No paint traces were noted within the mortices at the outermost edge of the pew, adjacent to the quoins in the antechapel wall below, suggesting either these posts were in situ at the time of decoration or the decoration did not extend to the outer ends of the lower beam soffit.

Other discoveries

5.3.19 The ceiling decoration within the Royal Pew during this phase can be ascertained from the in situ moulded ribs on the ceiling within the Lady Chapel (Plate 63). Within the Thornhill void the location of the decorative ribs on the remaining plaster ceiling can be seen (Plate 56 & 57). Although the ribs have been removed the pattern of ribs can be seen on the plaster due to the application of a white distemper to the ceiling after the mouldings were fixed. This white distemper is thought to be part of the original ceiling decoration (Hassall 2008, 4). Some red painted symbols can be seen at the junctions of the ribs, adjacent to fixing points which tell us the ceiling was originally marked out before being fixed (Plate 57). There is a definite void within the plaster at the point aligned with the location of the central post 4 suggesting the plaster ceiling was originally laid in two either side of the timber partition between the King's and Queen's closets. Some fragments of removed ceiling moulding are held in storage at Hampton Court Palace and the painted decoration on these were analysed and compared to the paint samples taken from elsewhere in the Pew. It was discovered that the size used was the same mix to the orange paint used on the east elevation of the lower beam, thus placing the ceiling moulding within this phase.

5.3.20 Other small works belonging to this phase have been noted in earlier investigations by English Heritage. There is an Henrician culvert located beneath the 18th century vestry stairs (Ford 1996) and a niche beneath the west elevation of the Wolsey east window on has been infilled with Henrician brickwork (Curnow 1984).

6 PHASE IV - EDWARD VI - JAMES II (1547 – 1685)

6.1 Documentary Sources

6.1.1 Journeying though England in 1597-99, Paul Hentzner described the chapel: *'The chapel of this palace is most splendid, in which the Queen's closet is quite transparent, having its window of crystal.'* (1797). Documentary evidence from this phase tells us of further alterations that were made to both the Chapel Royal during the early reign of Elizabeth I. Four large pillars (that were painted and gilded) and twenty-four balusters were constructed for the Chapel Royal in 1566-7,

possibly to be interpreted as a baldacchino with an altar rail. During 1567-1570 there were works to the outer roof of the chapel and in 1592-3 the chapel was partly refitted and this included paving within the Holyday Closets. Further small works to the chapel are noted in 1605-6. In 1619-23 a quantity of repairs to the chapel structure were undertaken including: replacement of plasterwork and substantial repairs to the roof. The Queens Holyday Closet was possibly refitted in 1631-32 (Rawlinson 2005), but references to the roof works in the 1630s indicated by Dendrochronology have not yet been identified.[2]

6.1.2 During 1643 Parliament passed an ordinance for the seizure of the king's property and Edward Carte replaced Inigo Jones as Surveyor of the King's Works. Expenditure on royal houses was very low and the only work of note during this time was the defacing of the royal chapels including Hampton Court. A Parliamentary tract of 1645 describes this:

6.1.3 '*Sir Robert Harlow gave order...for the pulling down and demolishing of the Popish and superstitious pictures at Hampton Court, where this day the Altar was taken down, and the table brought into the body of the Church, the Rails pulled down, and the steps levelled; and the Popish pictures, and superstitious Images that were in the Glasse Windows, were also demolished, and Order was given for the new glazing them, with plain glass; And among the rest, there was pulled down the picture of Christ nailed to the cross which was placed right over the Altar, and the pictures of Mary Magadelene and others weeping by the foot of the cross; and some other such Idolatrous pictures.'* (Thurley 2002, 250)

6.1.4 The new organ inserted by Charles I in 1637-8 was removed and destroyed by the fanatics. At this point only the Tudor ceiling survived untouched with the chapel containing only a pulpit standing on a deal table and twelve long forms, at the time of the 1659 inventory. The chapel was the location for Cromwell's daughter Mary's marriage to Thomas Belayse, Lord Fauconberg in November 1653 (Thurley 2002, 255).

6.1.5 Following the restoration of the monarchy, a major episode of work was begun internally at Hampton Court Palace in 1662 in preparation for Charles II's and Catherine of Braganza's honeymoon. These works included the upgrading of the Chapel Royal with the erection of boards beneath the windows for the hanging of tapestries, a 6 x 4m altar with a 6m long rail, two forms in the choir and a new organ loft. Unlike at Whitehall, the Royal Pews at Hampton Court had not been stripped out by Cromwell's men and so little work was needed (Thurley 2002, 263). A large cupboard was removed from the Queen's side and desks were made for both hers and the King's pews. The King's Pew was also provided with a chair, stool, benches and a traverse curtain of crimson velvet fringed with gold and silver (Thurley 2002, 257). In 1675, the Whitehall Tudor pew was refitted to form a

2 P.R.O. Pipe Office Declared Accounts for Works E351/3267 (Michs 1633-34) and /3268 (Michs. 1634-35) would be the most likely sources.

central room for the King with two side closets - an arrangement that would later be employed in the Royal Pew at Hampton Court (Thurley 2002, 263).

6.2 Pictorial Evidence

6.2.1 There are no images showing the chapel during this phase.

6.3 Archaeological Investigations and Observations

The Ante Chapel Roof

6.3.1 Dendrochronological sampling of the ante chapel roof truss directly above the pew (accessed from within the roof space over the fan vaulted ceiling of the chapel main) and various timbers within the ante chapel roof produced a construction date of 1634-5 (Appendix III). This is significant because it would place the antechapel roof structure within the period when Inigo Jones was Surveyor of the Kings Works (1615-1643) and there are few surviving examples of his carpentry (Yeomans 1986, 85). As yet references to this replacement of the roof have been unidentified in building accounts of this period. Several of the purlins on the east and west sides of the ridge line and a number of rafters appear to be reused from an earlier period and moved from their original locations (Plate 41). A sample was taken from a principal rafter within the ante chapel roof and this dated to 1619 and therefore this was probably part of the repairs and rebuild documented during 1619-23 and thereafter reused in the new roof construction of 1634-5.

6.3.2 The ante chapel roof measures approximately 12.25 x 16.45m with the configuration of the roof consisting of four bays (3.60 – 3.65 x 12.25m) with the ridge orientated north-south along the longer dimension unlike the main roof of the chapel which runs east-west (Plate 38 – 42). Five king-posts sit on the five primary tie beams, measuring in section 0.28 x 0.27m. On close inspection it was observed that on the east side of the roof the primary tie beams swell substantially to lap over the north-south Tudor wall plate. The wall plate itself has to span the unsupported gap between the chapel walls above the front of the pew and here it also forms the tie beam of the single king-post truss at the west end of the roof of the main chapel. The wall plate has been greatly reduced on the upper face at the northern end as seen within the hidden room (Plate 51). This truss in turn picks up the trusses and joists of the Ante-chapel roof structure on its west side. The truss itself does not appear to be attached to any of the Tudor structure below but may well have been at some point in the past.

6.3.3 Several standard carpenter's marks were observed on many of the timbers within the Ante Chapel roof space. These were incised marks made with a 2" chisel rather than a race knife and the markings denote the individual trusses.

6.3.4 To the west of the Ante Chapel roof space is the separate roof of the main chapel. Within this roofspace, the top and central sections of the 17th century truss were partially visible, as were the majority of the iron straps and ties put in place to assist

in the supporting of the truss and adjacent joists (Plate 43 - 45). It was also possible to see some moulding detail on the side of the truss at the south end (Plate 46). The main north- south lower section of the truss (and the 16th century posts beneath it) were predominantly hidden. It was possible however to establish that at both ends of the truss there was at least a 40-50mm gap between the underside of the lower horizontal element of the truss and the known 16th century posts below, showing that there is no structural relationship between them, and that the tie is probably of the 1630s.

6.3.5 Substantial use has been made of iron strapping, typical of later roofing techniques and perhaps contemporary with that seen on the east and west elevations of the primary beams of the Royal Pew. Within the ante chapel roof, straps have been applied vertically on the sides of the king posts and on either side of several struts, attached to the primary rafters and holding up the primary joists using forelocks to secure the 'U' shaped strapping (Plate 42). This structural use of iron in carpentry is of special interest occurring in work carried out under Inigo Jones.

7 PHASE V - WILLIAM AND MARY (1689 – 1702)

7.1 Documentary Sources

7.1.1 There are two key periods of works during this phase. New pews were set up in the body of the chapel in 1689 and a major refitting began in March 1690, with the Tudor closets of the royal pew being removed and replaced by a single pew for the joint monarchs, with separate side rooms. Anew floor was inserted 0.75m lower than the earlier one, supported from below by eight columns and half columns against the walls. A total of three closets were now constructed at first floor level overlooking the chapel with three ante-rooms behind them. The central ante-room had a new 3m high door fitted providing access to the chapel gallery. Approximately 20m of 'Italian moulding' and 6m of 'compass moulding' were fixed around the openings of the three closets that overlooked the chapel.

7.1.2 During 1694-96 Wren was also asked to consider the introduction of an altarpiece (the reuse of a marble altarpiece from the Catholic chapel at Whitehall approximately 6m tall). This however remained in storage and was not installed, until 1706 when Queen Anne commissioned a timber one. Grinling Gibbons completed the woodwork of the Royal Pew whilst the decorated Tudor ceiling of the chapel gallery was taken down and the ceiling plastered.

7.1.3 The second phase of works occurred between 1698-1700 and included the lowering of the ceiling in the northern most compartment overlooking the chapel and the insertion of a fireplace to create a 'winter' closet. The southern vice stair was demolished as well as further refitting of the closets. The new staircase that was inserted into the south-west compartment of the pew, replacing the Tudor spiral staircase, was possibly inserted during this phase or as part of phase VI.

7.2 Pictorial Evidence

7.2.1 There are no images showing the chapel in detail during this phase.

7.3 Archaeological Investigations and Observations

The New Partitions

7.3.1 The documented phase of work from 1689 involved the making of three rooms by subdivision of the pew through insertion of timber-framed walls with panelling. These were of relatively light construction using timber uprights with a lath and plaster covering prior to the affixing of the panelling. The removal of the panelling during the course of recent works has clearly revealed this construction both at floor level and in the framework at ceiling height (Figure 11, plates 19 & 20). Removal of floorboards between the royal pew and winter pew revealed a supporting floor beam had a series of small empty mortices. It is in the same position as the current opening within the partition and the mortices indicate that this partition had at some point closed off the winter pew at this location. The partition frame has many of the timbers used marked with III scribed using a race knife .

7.3.2 It is also postulated that at this time the two oak intermediate posts at the front of the pew (0.37 x 0.18m laterally) were strengthened by being sandwiched between a pair of oak planks (0.10 x 0.35m max.), employing iron bolts (Figure 3). The front wall of the pew was then in turn joined to the framing of the inserted walls by two further substantial timber uprights (0.32 x 0.32m laterally) with angled iron braces attached to both sets of uprights (Figure 5, plate 17). The braces were fixed at an approximate height of 2.30m above floor level on the north and south sides of the timber uprights on top of the pew, and angled upwards to a height of 2.80m on the inner upright timbers to the west. Of particular note is that these two additional timbers to the west of the main face of the pew have unused mortices on their upper west faces that do not appear to have been employed at any stage in the configuration of the pew so far observed. It can also be observed that the upper primary beam of the Royal Pew was also bolted to both of the inserted uprights (to the west) using a 0.75m long forelock bolt (Plate 18). The change from the use of forelock bolts to screw thread bolts is thought to have taken place in the late 17th century (as noted by Cecil Hewett at St Paul's Cathedral) and so it is not unsurprising to find them still in use here.

7.3.3 Observation of the west elevation of the upper beam of the main pew structure has revealed conclusive evidence for the deliberate lowering of the floor of the Royal Pew, probably during this phase. Several 16th century floorboards were visible below the new floor surface, presumably used as packing (Figure 3, plate 24).

7.3.4 It was observed during the works that the soffit of the lintels above the winter pew (between posts 1 and 3) and Lady Chapel (between posts 5 and 7) had double mortices of a similar size to the empty mortices visible on the side faces of posts 1

and 7. The presence of white paint and splashes of coloured paint suggest that these cross beams were part of the Henrician pew construction. The lintel above the winter pew was also dated using Dendrochronology to 1498-1530. It is suggested that the removed post sections were reused above the pew to form the lintels. It is also possible that the timber lintels for the Tudor windows on the ground floor were also part of the reused timbers.

The 'Hidden Room'

7.3.5 Located above the Winter Pew is a hidden room formed through the insertion of a ceiling which cuts the Tudor stone window (Plate 67). The north elevation of this room includes the top 0.50m of the Tudor window which is made up of two sets of six window lights. Running along the width of the window are vertical wooden boards approximately 20cms high. Horizontal timbers, the outermost with a rounded edge, lay across the vertical boards. From this flat surface further boards covered with paper slope upwards towards the window and the stone mullions are cut to accommodate these boards. Wooden rafters provide support from underneath and there is lath and plaster to the underside. The plaster contains hair and probably has a construction date of 16th/17th century (Plate 47 & 48).

7.3.6 The plain west stud wall of the hidden room also crudely butts up against the west end of the upper set of lights, leaving a gap between the end of the wall and the window. The lower light at this point has a rough wood insert blocking it. Additionally within this room stone mouldings have been cut through both at ceiling height on the west side (the moulding having been removed almost all the way across to the east side), along with some of the vertical mouldings on the east side (Plate 49).

7.3.7 Small exploratory holes in the ceiling revealed a typical riven lath and plaster ceiling (laths approximately 30mm wide), and the underside of the predominantly late 17th century floor joists from the main roof space above. Similar interventions into the floor also appeared to show a predominance of late 17th century floor joists running north/south across the room with approximate dimensions of 0.12 x 0.08m. Although it was possible to glimpse potentially earlier joists below this level that were not readily accessible during the course of works.

The 'Thornhill Void' above the new Royal Pew

7.3.8 Within the void above the inserted Thornhill ceiling the structure of the Thornhill ceiling and the partition wall separating the top of the pew frame with the main part of the chapel can be seen (Figure 12, plate 54). Posts 3 and 5 have a continuation of the supports joined to each side during this phase. From these posts rise two sets of double braces. Of the two braces the north brace was 0.17m wide and the south thicker at 0.22m wide with at least eight mortices cut into it, all with dimensions approximately 8 x 8mm. The brace behind this and adjacent to the lath and plaster also has mortices cut into it although it was not possible to observe these in any

detail. The south brace has clear traces of white paint as seen on the Tudor posts below suggesting this brace and possibly the rear south brace are formed of reused Tudor timbers from the Henrician phase structure (Plate 58). It is unlikely that these are in situ. The majority of the timber work visible in this elevation is softwood, notably the studs in between the main braces. The thin studs show residual evidence for at one stage having supported lathe and plaster either in this position or elsewhere, whilst the plaster skim over the Chapel Royal side of the stud work can be partially observed. The arched timber framework for the plaster of the Thornhill ceiling was only partially visible under the modern fibrous wool insulation material.

The Winter Pew

7.3.9 During the course of exploratory works floorboards were also raised from the floor of the Winter Pew. Substantial cracks had been observed in the ceiling of the ante chapel at ground floor level on the north side. In the north east corner of the Winter Pew is a fireplace and it was suggested that this might be the cause of the cracking below. An area of flooring 0.90 x 1.84m was lifted which revealed two elements, the end of the floor joists on one side and the hearth structure and support on the other. The floor joists were of a fairly simple arrangement that had been either truncated or deliberately constructed on the north side to accommodate the hearth base. There was what appeared to be a main floor joist 0.10m wide running east - west with five north - south secondary joists arranged at right angles 0.07 - 0.08 wide. Two thinner east -west joists were also fixed over the main joist, 0.03 - 0.04m wide and 1.55m + long. The depth down to the ceiling layer below was approximately 0.12m. All of the joists appeared to be of softwood construction.

7.3.10 Of more interest was the hearth structure beneath the fireplace (Figure 15, plates 65 – 66). This was a red brick platform slightly arched in the centre, 1.12m long and 0.42m wide, butting up against the floor joists to the south and the Winter Pew wall to the north. A total of 13 lines of brick could be identified (0.20 x 0.07m) all set as stretchers except for the central line at the top of the arch that was constructed using half bricks set east-west. At either end of the brick arch there were areas of grey stone, 0.35 x 0.40m that appeared to butt the arch and perhaps support it from underneath although this was not conclusive. Also of note was an iron strap, 0.01m wide x 1.50m, slightly curved and fixed into the stone blocks at either end. It runs along the east face of the exposed arch and appeared to have been inserted to prevent any movement of the brick arch to the south. On the basis of observation of the relationship between the hearth and the brick walls of the Winter Pew to the north and east the whole structure seems to be cantilevered solely out of the north-east corner of the room, with further support from iron ties fixed into the exterior wall.

7.3.11 A brick built chimney breast slopes upwards above the hearth towards the window (Plate 67). The chimney is built using rose/brown coloured bricks (0.06 x 0.21-

0.21.5 x 0.10m). The bond varies but is mostly English bond and the brickwork appears to be all one phase with no sign of repairs. The mortar used is creamy and hard with gritty texture with some penny roll pointing. The size and colour of the bricks used to construct the hearth suggest these are typical Wren stock bricks of late 17th/early 18th century which are contemporary with the date for the works to the winter closet. The stone window reveal on the north elevation has weathered moulding with some parts fractured off. The cinquefoil design for the head of the lights is visible within the hidden room.

Ante Chapel Windows

7.3.12 Removal of panelling on the ground floor north ante chapel window exposed the north western jamb which, unlike the stone Tudor north eastern jamb, is built of brick. The bricks are in varying shades of pinkish grey with small pebble inclusions. The mortar is creamy coloured with lime inclusions although an accumulation of dust has made the mortar appear grey in colour. There are penny rolling lines upon the flat pointed mortar. The bond is irregular, presumably to fit the small area. There is a small patch of roughly applied mortar and fragmentary bricks at the base adjoining the window jamb.

7.3.13 The antechapel window on the ground floor is only 5 lights wide whereas it would have originally been 6 lights wide. The brick measurements (0.06 x 0.21-0.22 x 0.10m) and types are very similar to the brickwork within the winter pew and this suggests the brick reveal was probably done at the time of construction of the fireplace in the winter pew above. The exterior wall at this point shows the window has been infilled using Wren stock brick (Type I) which has a late 17th/early 18th date and therefore is consistent with these works (Ford 1991 and Oxford Archaeology 2008). The opposite window has also been altered in this manner although was not investigated at the time of survey. On the ground floor, the north eastern reveal of the northern window is 57cm deep and of stone construction probably part of the primary construction, with saw marks down each side where moulding had been removed prior to the fixing of panelling.

The Column Supports

7.3.14 Underneath the main horizontal structure of the pew are two octagonal, roughly-cut pinewood columns tenoned into the main structure above and currently supporting most of the downward load of the Royal Pew structure (Figure 3, plates 27 & 28). The two columns are set on circular stone plinths with a width at ground floor level of 0.34 - 0.36m tapering off to a width of 0.26 - 0.28m where they reach the lower face of the main lower beam of the Royal Pew. The overall height of the columns at this point is 4.02m. These columns were clad in panelling that were temporarily removed as part of the investigative works, and due to the roughness of their construction it can be reasonably inferred that they were never meant to be visible. It is possible that the history of structural instability of the Royal Pew may in part

be related to this episode of refitting and the inadequate nature of the foundations dug for the plinths that ultimately support the columns and the Royal Pew frame at the front (Rawlinson pers comm.).

7.3.15 The north column had a noticeable cut mark all the way around at a height of 0.21m and all eight faces below this level had been chamfered to take some form of fitting or panelling around the base as described below. At a height of 1.51m above the current floor level a wedge 0.25m high and 0.11m deep had been cut into the column with a width of 0.33m at this point (Plate 27). This corresponds with a similar size slot at the same height in the south column and with two slots in the stone quoins at the north and south sides of the ante chapel (Plate 25). Presumably these were to secure a screen or other structure at both ends. It is assumed that these are retaining slots for a cross beam or screen of some form that was in place earlier in the history of the Royal Pew, but certainly no earlier than the late 17th/early 18th century when the columns are likely to have been inserted as part of the refitting of the pew. White chalk marks 'A' and 'B' can be seen on the upper section of the column on the west elevation whilst various other horizontal and vertical chalk marks were observable elsewhere on all sides. The south column only had a partially chamfered bottom edge at a height of 0.17m and also an identical slot to that of the north column at a comparable height. White chalk letters were also visible on the upper part of the shaft on six of the eight faces, labelled 'D', 'E', 'G', 'H', 'I', 'J' and 'K' oddly leaving out 'F' and 'C' or ' L'. On the east faces of both columns the slots for the screen had subsequently been filled, each with three blocks of timber of both hard and softwood. On the lower 1.20m of the north elevation (three faces) were a variety of heavy tool marks diagonally cut across the column and above that a deliberate criss-cross of ten carved, deep cuts 6 - 7mm wide, cut solely within the confines of the central face of the north elevation (Plate 28). These are commonly known as Baltic timber marks, which refer to the shipping marks made on timbers to be transported showing their origin and destination, size and quality etc. Baltic marks were also been noted on the softwood beams supporting the panelling on the ante chapel ground floor. The use of Baltic timber was common throughout, but not confined to, the 18th and 19th centuries suggesting these columns are an early use of imported timber. Baltic marks are further discussed in Appendix VII.

7.3.16 Of significant interest in relation to the past construction and current arrangement of the chapel and the two columns is the width of the entrance to the aisle directly below the Royal Pew, which is 4.63 m. Investigation of the soffit of the lower structure has revealed two sets of peg holes that may possibly relate to the tenons fixing earlier columns in a position much closer together. Although not closely accessible, further investigation of the underside also revealed a mortice in the horizontal plane behind each set of peg holes (0.10m from the face of the lower beam) with approximate dimensions of 0.36 x 0.04m and a depth of 0.12m. If this is

correct it would give an earlier aisle width at this point of approximately 1.90m suggesting a previously very different arrangement of this part of the Chapel Royal (Figure 3).

8 PHASE VI - QUEEN ANNE (1702 – 1714)

8.1 Documentary Sources

8.1.1 Queen Anne commissioned Wren to design a new altarpiece, which was based on the design for the Queen's Chapel at Somerset House. The new large altarpiece covered a large portion of the eastern wall of the chapel and consequently the stained glass windows were blocked in. It is known that the total cost for this work in addition to making other improvements was £2,735 9s 4d and also included panelling of the walls, ante-chapel and the staircase linking the royal pew with the ante-chapel. The new staircase that was inserted into the south-west compartment of the pew, replacing the Tudor spiral staircase, was possibly inserted during this phase or as part of Phase V.

8.1.2 Other works included the construction of new box pews and pulpit. Thomas Highmore was paid £194 to paint the vaults of the ceiling in white lead, paint the walls white and repaint and gild the two Tudor panels either side of the west door. The ceiling of the central closet installed by William III, that had previously been left blank, was also painted by Thornhill and the trompe l'oeil windows were painted by Thomas Hopson. A new organ was installed and considerable renovation and replacement work was undertaken on the windows and casements of the chapel, particularly glazing. Elements of the chapel ceiling were also refashioned (Thurley 2003, 218-9). The main part of the chapel was repaved with black and white marble laid on Portland stone.

8.2 Pictorial Evidence

8.2.1 We have some images dated around 1710 which depict the decoration of elements of the chapel. There are two sketches depicting the Thornhill designs for the ceiling of the Royal Pew and the east end of the chapel. There is also Wren's design for the reredos. This sketch shows two options: one with double flanking columns, decorative carvings and scroll decoration and another with single flanking columns and less ornate decoration. The more ornate design was the one executed.

8.3 Archaeological Investigations and Observations

8.3.1 Within the pew the lower south quoin has a black painted skirting (also seen on the ground floor ante chapel north wall) and paint analysis suggests that this is part of the last phase of decoration (Appendix IV).

Support for the Great Beams

8.3.2 The east and west elevations of the pew have support trusses that were added to the failing main beams on both east and west elevations (Figures 3 & 5). These consisted of three pairs of oak planks in truss formation - two sets diagonally angled at north and south ends, both measuring 4.02 x 0.07 x 0.24m, rising at the sides to a central horizontal set measuring 1.86 x 0.07 x 0.24m. They are attached to the face of the upper and lower principal beams and bolted onto them with three bolts through each of the angled sets and two bolts (0.42m in length) through the horizontal set, with screwed nuts. The oak planks on the west elevation stand proud of the primary beams having been attached directly to the surface, whilst those on the east elevation have been placed in an angled trench cut to take the three members (Figures 3 & 4).

8.3.3 The advanced decay of the beams on the east elevation is still prominent today and it is likely that this is one of the main reasons the truss was deemed necessary in the first instance. The nuts are circular (0.06m diameter) with opposing notches cut out of the perimeter to assist in their tightening – a style of fastening not seen until the 18th century. It can also be proposed that at this point the floor joists lost their support and were hooked up with iron straps that are nailed to the principals (and also to the truss planks). There are nine such 'U' shaped hook straps visible in the east elevation of the Royal Pew, two either side of the two softwood octagonal columns, three positioned between them and one to the north and south (Plate 21). The straps are 0.11m wide with a height in excess of 0.26m (the upper parts not being visible in elevation). Towards the upper end of the strap it splays out on both sides. The straps also appear to correspond to the approximate positions of other sets of vertical straps visible attached to the west face of the lower primary beam. One strap adjacent to the southern octagonal post has an unidentified foundry stamp (Plate 22).

9 PHASE VI - HANOVERIAN WORKS (1714 – 1837)

9.1 Documentary Sources

9.1.1 The documented evidence for the chapel in the phase mainly relate to minor maintenance works. In 1727 the Ante Chapel was paved with lozenges of black and white marble and there was partial relaying of flooring in 1780. The pews were renewed or replaced in 1781 and the entrance armorials were repainted in 1800. Small window repairs took place in 1807 and 1817.

9.2 Pictorial Evidence

9.2.1 There is one image of the chapel interior during the later part of this phase. It is an illustration by Charles Wilde from WH Pyne's 'History of the Royal Residences' (1819) which depicts an empty chapel, with a lone female kneeling at a free

standing pew. The ornate ceiling is clearly whitewashed between the ribs and pendants and the early 18th century casement windows with decorative medallions on the reveals are depicted (Plate 3).

9.3 Archaeological Investigations and Observations

9.3.1 Removal of the ante chapel south column base revealed marble floor tiles which may be part of the paving of the chapel undertaken in 1727 (Plate 68). The removal is further discussed in Appendix VIII.

9.3.2 The five major additional support beams (Figure 6, plates 54 - 58) running north-south overhead across the Thornhill void were possibly inserted during this phase. They are clearly reused as they show mortices for either floor or ceiling joists.

10 PHASE VII - VICTORIAN WORKS (1837 – 1901)

10.1 Documentary Sources

10.1.1 During 1845 a major survey of the Chapel Roof took place and large areas of the timber roof were found to be in poor condition and were subsequently replaced. A series of plans, elevations and sections dated 1845 (PRO WORK 34/77 - 34/83) are seemingly connected with this work. Following the repair of the roof, the vault ceiling was also repaired, re gilded and re painted at this time with the white lead paint of the boards between the ribs and pendants painted blue with gold stars (Thurley 2003, 289). Replacement of the 18th century casement windows with windows based on an original Tudor window found behind the organ loft was proposed but not undertaken due to financial constraints. However further repair works within the ante chapel included repairs to the ceiling, wainscot and the relaying of marble paving. For this work access to parts of the pew which had been converted into grace and favour accommodation (the Haunted Gallery lodgings) was necessary.

10.1.2 An 1845 plan of the upper part of the chapel (PRO WORK 34/80) indicates the model room behind the winter pew to be part of the Haunted Gallery lodgings occupied by Hon. Mr and Mrs Berkley Paget. These lodgings remained occupied until the death of a later resident, Mrs Julia Buchanan, died in 1900, after which the rooms were used as a store until the haunted gallery was opened to the public in 1918. Recommending the space be removed from grace and favour use, Ernest Law described the lodgings bedroom as being 'absolutely in the Royal Pew' (Parker 2005, 142). A later plan of 1852 (PRO WORK 34/604) shows a staircase and a further partition wall adjacent to the west wall of the model room forming part of this apartment.

10.1.3 A dividing screen infilling the archway between the Winter and Royal Pews is depicted on the 1852 plan (PRO WORK 34/604) but not on the 1845 plan (PRO WORK 34/80) suggesting this was done during the main works to the chapel at this time. This screen is also depicted in Wingfields painting discussed below.

10.1.4 The Chapel was not open for viewing by tourists at this time, however could be seen during services. Because of this the level of seating proved inadequate for the grace and favour residents who complained about having the share pews. A plan of 1852 shows the allocation of pews with the chapel (PRO WORK 34/604), proposals for the increase in seating were put forward (Plate 69), but not implemented, including additional raked seating within the Royal Pew and adjoining closets (PRO WORK 34/605 and 34/606). Eventually, Anthony Salvin produced designs for the rearrangement of seating in the chapel 1866/68 and this scheme was carried out (Rawlinson 2005, 6).

10.1.5 Following complaints from the chaplain in 1890, the 18th century windows in the chapel were replaced with Tudor style windows based on a surviving original behind the organ. Despite objections by the Society for the Protection of Ancient Buildings concerning the replacement of the casement windows, the project went ahead sometime in late 1893/early 1894 (Rawlinson 2005, 6)

10.2 Pictorial Evidence

10.2.1 A drawing of the chapel interior used in Jesse's 'Hampton Court' (1839) shows the whitewashed vaulted ceiling and the 18th century casement windows prior to restoration works.

10.2.2 James D Wingfield's 1849 painting 'The Royal Pew in the Chapel Royal' (plate 4) shows the pew prior to the installation of raked seating. The doorway between the Royal Pew and Winter Pew is not depicted, instead there is a screen with a high level opening partially screened with a privacy curtain. The curtains installed at the front of the pew to protect the privacy of the grace and favour ladies can also be seen.

10.2.3 An image from an article in *Twickenham Local History* shows the interior of the chapel facing west after the rearrangement of seating and before the replacement of the 18th century windows. Two early photographs of the chapel (c.1897 and c. 1900) show the central pews in front of the altar added in 1866. Both images also show the presence of the medallions within the window reveals and it is possible this could be shadowing left on the stonework following their removal. This detail can also be seen on a photograph from *The Graphic* dated 1918, however the image may be earlier in date.

10.3 Archaeological Investigations and Observations

10.3.1 Removal of the floor covering within the pew revealed nail marks on the floorboards. This, along with discolouration on the panelling and signs of fixings on the panelled door revels are all that remains of the seating scheme inserted into the pew in 1866-68. It would appear that there were 4 tiers of raked platforms within the royal pew and these extended across the front of the winter pew and lady chapel. The lower step was curved adjacent to the winter pew fireplace and the seating was accessed by a flight of stairs from the west door of the royal pew.

10.3.2 A series of members supporting the fascia were replaced, probably in the early 19th century, with softwood uprights (of a yellow colour), fixed with hand-made nails (Figure 3, plate 26). The lower of the timber members had dimensions in cross section of 0.14 x 0.10m and spanned the width of the Royal Pew at this point in two lengths. Behind it (west) were at least two further horizontally set softwood supports, again spanning the width of the structure in several sections. There were 24 short upright members above this with average dimensions of 0.09 x 0.35 x 0.06m although not all were observable. These formed part of the framework of this later addition and were attached to the underside of the lower primary beam of the Royal Pew structure.

10.3.3 Several posts forming the structural roof above the chapel main ceiling have 'VR' burnt into them indicating the scale of replacement that took place in this area. The inserted floor above the ceiling is mostly made of reused boards, which include a timber door and sections of skirting boards.

10.3.4 During the works as length of rolled tin pipe (0.045-0.05m in diameter) was discovered inserted into the lower beam. The pipe was viewed on the east elevation and had been inserted beneath the position of post 7 in a diagonal downwards direction (Plate 23).

10.3.5 Archaeological survey and recording during brickwork and stone repair and replacement in 2006 revealed that concrete lacing pieces were inserted into the external walling during the window replacement of 1893/1894. The primary phase brickwork was reused with the addition of some new bricks. (OA 2007). Within the hidden room it can be seen that most of the upper mullion and cinquefoil of the window was probably replaced at the same time as the rest of the chapel windows, however a small amount of original stonework remains in situ.

11 PHASE VII - THE 20TH CENTURY

11.1 Documentary Sources

11.1.1 The chapel gallery in the royal pew was made accessible to the public in March 1919, despite considerable opposition from the chaplain and residents of the time.

11.1.2 In 1920 an extensive structural survey of the roof structure (HRP 3 0802005/5) was colour coded to indicate primary oak and replacement timbers. In 1927 the chapel roof was examined and found to have large areas of dry rot and death watch beetle. Extensive survey documents survive including plans and details of the roof trusses and pendants (PRO WORK 34/1578-1582). Repair works were undertaken in 1929 both to the roof and to the Grinling Gibbons altar carving which was also found to have damage from death watch beetle. The method of repair for the pendants is documented in PRO WORK 34/1586).

11.1.3 Two further drawings of the Chapel roof and ceiling were produced by the Department of the Environment (Ancient Monuments Branch) in 1973 showing plans, sections and details of the moulding (125A AS1/1 Sheets 1 and 2). The substantial conservation and remodelling undertaken within the chapel in 1973 included the repainting of the chapel ceiling, removal of central pews and some choirstalls and the relaying of parts of the marble floor (Rawlinson 2005, 7). It is likely the raised seating within the Royal pew was removed during this work.

11.1.4 In 1981 works to install a lift revealed the southern half of the east window of Wolsey's Chapel, this was extensively recorded by Daphne Ford and is researched and discussed in Peter Curnow's paper (1984). In 1983 English Heritage identified and recorded a culvert running east to west under the 18th century vestry staircase and this is shown on the Historical Analysis developed by Daphne Ford (1996).

11.1.5 A project was undertaken in 1990 to address the 'reopening' of certain areas along with restoration works to make more historical sense of the King's Apartments and the Great Hall, Great Watching Chamber, 'Haunted' Gallery and Chapel. Several drawings were produced of the areas of the west elevation of the Royal Pew that were uncovered at this time including two plans and two elevations (Hart 1990), one of which has subsequently been used by OA in the production of this report. The royal pew was partially refurbished and the chapel as whole stands predominantly as it was under Queen Anne.

11.2 Pictorial Sources

11.2.1 The opening of the Chapel to the public was featured in an article in *The Illustrated London News* of 25 May 1918. The accompanying drawings include one which shows the steps and raked seating within the Royal Pew.

11.2.2 The chapel paintwork was also restored during the 1929 works and is depicted in a photograph showing the restoration of the painting above the altar carving (EH H2557). A photograph of the model room taken in 1948 shows the upper walls covered in tapestry and paintings hung on the 18th century wainscoting.

11.2.3 Several other photographs of the chapel in the 20th century can be found within the archives. One dated 1955 (G5787/6) shows extensive scaffolding erected within the main body of the chapel, presumably for further repainting of the ceiling, however this work does not appear to be documented in the statement of significance. Two images of the Royal Pew dated 1971 and 1973 clearly show the 1866 raised seating was still in situ within the Royal Pew, Winter Pew and Lady Chapel at this time.

12 PHASE IX - THE 21ST CENTURY

12.1.1 During maintenance works in 2004, removal of panelling on the staircase within the ante chapel revealed a large charcoal drawing of a fish which probably dates to the 16th century and was part of a larger design scheme (Rawlinson 2005, 7).

12.1.2 However the main works currently within this phase have been the structural and archaeological investigation and repair works which form the basis of this report.

13 CONCLUSION

13.1.1 The series of investigations undertaken at the Royal Pew between October 2005 and September 2007 have provided a considerable amount of new information regarding the historical phasing of this most complicated structure. Unexpected evidence for the early arrangement of double pew with twin oriel windows has been uncovered, and an episode of re-roofing under Inigo Jones has been identified by Dendrochronology. Phases of construction and re-ordering of the Chapel Royal and Royal Pew documented in historic building accounts and from other sources have been corroborated, whilst light has now been shed on areas that were previously contentious. Analysis has also provided us with more personal insights into some of the craftsmen who have worked there. There are however, still certain aspects of the Royal Pew's construction history that are open to debate and speculation.

13.1.2 *Central postholes on underside of lower beam* - Two sets of peg holes in the soffit of the lower beam indicate that there were once columns in this position. It has been suggested by Andrew Harris (pers. comm.) that these columns were put in to support the failing pew structure as the northernmost mortice is positioned directly underneath a large shake in the lower beam. As discussed previously the soffit of the lower beam has white paint traces running roughly but consistently along. In the location of the these columns the paint is not entirely visible to the naked eye but can be seen with a UV light indicating the columns were inserted post 16th century however the location suggests this was done prior to the insertion of the 17th century octagonal columns.

13.1.3 *The Oriel Windows* – The exact appearance of the oriel windows cannot be ascertained from the evidence uncovered however it is thought that they would probably have been similar to the Windsor Oriel which was constructed for Katherine of Aragon in around 1525. The isometric visualisation (figure 16) uses the decoration of this oriel as a basis for the oriels at Hampton Court.

13.2 Summary of Known Phasing

13.2.1 The 16th-century Chapel at Hampton Court was at ground-floor level, but had a 'pew' or gallery at first-floor level so that the Chapel could be entered from the principal floor. It is now clear from the tree-ring dating that this was built by Wolsey, and there are substantial remains of the main timber framing of the pew from this period. There are indications of the oriel windows that fronted the royal

pew, but their precise form and location is uncertain. There are small traces of painted decoration which give some indication of the colours and location of paintwork, however the overall decorative scheme is unknown.

13.2.2 Documented work in the reign of James I may be represented by surviving floor joists and boards, possibly representing a lowering of the Tudor floor level (Figure 3). Dendrochronology evidence has shown that the truss directly above the pew structure and the remainder of the Ante chapel roof is part of works undertaken during Inigo Jones term as Master of the Kings Works, making the truss an important surviving example of his work.

13.2.3 A major rebuilding took place in the late 17th century when the pew was divided into three, with octagonal timber posts added below to support the partition walls above, and the bay windows and three posts of the Tudor pew removed with some timber reused as lintels for the winter pew and lady chapel. This phase was marked by the use of the forelock bolt to tie the new timbers to the old. At this point in the 17th century a further major programme of work was also undertaken in the roof space above the Chapel Royal and the adjacent Ante-Chapel.

13.2.4 During the next phase screw bolts were used, in a series of repairs probably carried out in the middle or later 18th century. The principal beams supporting the Tudor pew were failing, and oak 'trusses' were bolted to each side, while at the same time the floor joists were hooked up with iron straps (Figures 3 & 4).

13.2.5 Later changes are few, but a substantial amount of softwood repairs to the front of the pew are likely to be of early 19th-century date (Figure 3). The seating was reorganised in the mid 19th century to accommodate the increase in visitors and grace and favour residents and this work included the addition of raked seating within the royal pew structure. The model room was also used as part of grace and favour accommodation in the Haunted Gallery apartment at this time. The late 19th century saw the replacement of the chapel casement windows with Tudor style windows.

13.2.6 The 20th century works included repair works to the chapel ceiling and the reordering of the chapel for visitors to the palace, including the removal of raked seating.

13.3 Future works

13.3.1 The roof structure above the pew should be investigated further to enable a fuller understanding of this hitherto unknown phase of the Royal Pew construction. The placing of this work within the time of Inigo Jones working as Master of the Kings Works makes this an important surviving feature.

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Oxford Archaeology
April 2009

APPENDIX I BIBLIOGRAPHY

Published Sources

Colvin, H (ed) (1970)	*The History of the Kings Works* Vol IV: 1485-1660
Colvin, H (ed) (1976)	*The History of the Kings Works* Vol V: 1660-1782
Colvin, H (ed) (1973)	*The History of the Kings Works* Vol VI: 1782-1851
Curnow, P (1984)	'The East Window of the Chapel at Hampton Court Palace' in *Architectural History*, 27 p 1-14.
Hall, E/Whibley, C (ed) (1904)	*The Lives of the Kings. Henry VIII by Edward Hall*, edited by Charles Whibley (reprint of Hall's Chronicle 1550 edn).
Harvey, JH (1943)	'The Building Works and Architects of Cardinal Wolsey' in *Journal of the British Archaeological Association* Vol 8 (3), 44-59.
Harvey, JH (1987)	*English Mediaeval Architects: A Biographical Dictionary Down to 1550*
Hentzner, P/ Walpole, H (ed) (1797)	*Travels in England : during the reign of Queen Elizabeth to which is now added, Sir Robert Naunton's Fragmenta regalia*
Jesse, E (1839)	*A summer's day at Hampton court, a guide to the palace and gardens.* London.
Kisby, F (2001)	'When the King goeth a Procession: Chapel Ceremonies and Services, the Ritual Year, and Religious Reforms at the Early Tudor Court, 1485-1547' in *The Journal of British Studies* Vol 40, 44-75
Parker, S (2005)	*Grace & Favour : A Handbook of who lived where in Hampton Court Palace, 1750 to 1950.* Historic Royal Palaces: Surrey
Salzman, LF (1992)	*Building in England down to 1540 : a documentary history*. Oxford : Clarendon Press.
Smith L (1997)	'Compass, Cut Circle and Daisy Wheel' in *The Mortice and Tenon* Issue 5, 3-5
Thurley, S (1988)	'Henry VIII and the Building of Hampton Court: A Reconstruction of the Tudor Palace' in *Architectural History* Vol. 31, 1-57.

Thurley, S (1991) 'The Domestic Building Works of Cardinal Wolsey' in *Cardinal Wolsey : Church, State and Art*. S.J. Gunn and P.G. Lindley (eds), 76-102.

Thurley, S (1993) *The Royal Houses of Tudor England*. Yale University Press: New Haven and London.

Thurley, S (2002) 'The Stuart Kings, Oliver Cromwell and the Chapel Royal 1618-1685'. *Architectural History* XLV, 248-50.

Thurley, S (2003) *Hampton Court: A Social and Architectural History*. Yale University Press

Yeomans, D (1986) 'Inigo Jones's Roof Structures' in *Architectural History*, Vol 29, 85-101.

Unpublished sources

Burbidge, J (2007) *Condition assessment of paint fragments discovered on the balcony beam and elsewhere: Chapel Royal, Hampton Court Palace*. Granville & Burbidge report dated 17th October 2007 (Unpublished survey report)

Hart, D. (1990) *Royal Pew, Chapel Royal, Hampton Court Palace (west elevation)* D. Hart, English Heritage.

Ford, D. (1991) *Hampton Court - Elevations and Brick Typology* D. Ford, English Heritage.

Ford, D. (1996) *Hampton Court Palace - Historical Analysis* D. Ford, English Heritage.

Hassall, D (2008) *The Royal Pew, Hampton Court Palace: An Examination of Paint Traces Found on Original Surfaces*. January 2008 (Unpublished survey report)

Miles, D.W.H. (2007) *The Tree-Ring Dating of the Chapel Royal, Hampton Court Palace*. Oxford Dendrochronology Laboratory Interim Report 2007/37

Oxford Archaeology (2007) *Chapel Court North Facing Elevation, Hampton Court Palace.* Unpublished survey report.

Oxford Archaeology (2008) *Chapel Court East Facing Elevation, Hampton Court Palace.* Unpublished survey report.

Rawlinson, K (2005) Chapel Royal, Hampton Court Palace (Royal Pew) Summary Statement of Significance (Unpublished research statement)

APPENDIX II STATEMENT OF SIGNIFICANCE

Chapel Royal, Hampton Court Palace (Royal Pew) Summary Statement of Significance

by Kent Rawlinson
Curator of Historic Buildings, Hampton Court Palace
July 2005

Chapel Royal, Hampton Court Palace (Royal Pew)
Summary Statement of Significance

Kent Rawlinson (Curator of Historic Buildings, Hampton Court Palace)
July 2005

This summary *Statement of Significance* was produced to support an application for scheduled monument clearance (to be submitted to the DCMS) proposing the removal of sections of late-17th century panelling enclosing the 'Royal Pew' in order to facilitate structural investigations.

Careful removal of this panelling is an appropriate response to the structural problems exhibited by the Royal Pew. The removal of this panelling – under the controlled conditions proposed – poses only a very minor (and necessary) risk to the architectural, archaeological or historic significance of the Royal Pew.

The proposed works are required to ensure the ongoing protection and use of this unique element of the Chapel Royal. In addition, the proposed removal of panelling will expose substantial portions of sixteenth-century, and later, fabric to archaeological investigation, thus providing an invaluable opportunity to better record and understand the chapel's architectural development.

1. Summary History & Significance

There appears to have been a chapel continuously on the present site since 1338 (at the latest). The construction of the present chapel was begun for Cardinal Wolsey, probably in the later phase of his occupancy (1514-28), and completed or remodelled for Henry VIII (most significantly between 1535-6).

The majority of the existing structure dates to two main building phases (I & II, see below), although the interior of the chapel was substantially remodelled by William III & Mary II, and further by Queen Anne, between 1689 and 1712 (phases V & VI). These works also included the renewal of all (or most) of the buildings windows.

Various works and repair programmes were undertaken during the course of the 18th and 19th centuries to ensure the structural stability of the building, as well as to provide necessary refinements and services. The building was refenestrated, according to a version of the original 16th-century scheme, in 1894.

The western section of the chapel consists of a 'Royal Pew'; otherwise referred to as the 'Holyday Closet(s)' or 'King's' or 'Queen's' 'Closet(s)'. This structure is contemporary with the chapel constructed for Thomas Wolsey. It was substantially remodelled by Henry VIII and later enclosed and remodelled in the late-17th and early-18th centuries by Christopher Wren and Grinling Gibbons.

As it exists today the framework of the Royal Pew retains substantial elements of both 16th-century and later-17th century timberwork which stands within a structural envelope of 16th-century brick and stonework. It is significant both as a rare extant example of a western gallery in a private, and in this instance royal, chapel; and also as an example of how the leading architects and designers of the late-17th and early-18th centuries chose to modify and adapt such a historic gallery for contemporary royal use. The Royal Pew is unique in so much as it combines these two qualities.

The Chapel Royal has been in continuous use as a chapel since before 1338, and as a Chapel Royal since the early-16th century.

2. Summary of Building Phases (Chapel Royal & Royal Pew)

This *summary* description of the building phases of the Chapel Royal is based upon extant building accounts, descriptions and works of secondary analysis (see part IV – *Summary Bibliography*).

Although unreferenced in this summary, it is intended that the structural engineers and archaeologists, appointed to undertake the proposed survey work, will both be provided with a fuller, referenced, version of this documentary summary and proposed phasing, to help inform their analysis of the extant structure.

PHASE I (The Medieval Chapel)

1338 An *extent* of the grange of the Knights Hospitaller dated 1338 records the presence of a chapel.

Although there is no documentary evidence to demonstrate that this chapel was maintained by John Wode and Giles Daubeney, this is probable.

In turn, a chapel and some limited chapel furnishings are listed in the text of the lease of Hampton Court which Wolsey acquired from the Knights Hospitaller in January 1514. It is likely that the present chapel, first constructed by Wolsey, occupies broadly the same position as this medieval chapel.

PHASE II (Thomas Wolsey's Chapel)

1514-15 **Maintenance of the medieval chapel**

Wolsey's building accounts for the year 1515 record three separate entries concerning the use and repair of a chapel door. These are suggestive of continued use and maintenance of the medieval chapel Wolsey inherited from Daubeney.

1515-28 **A new chapel**

The evidence of building accounts for Henry VIII's work at Hampton Court strongly imply that he inherited a newly constructed chapel to which his workmen made additions and alterations.

There is no documentary evidence to indicate the date when work on Wolsey's new chapel was begun. However, the type of brickwork employed in this phase, when compared with other extant 16th-century brickwork at Hampton Court, tentatively suggest an initial date of construction relatively late in Wolsey's period of residency.

The plan and structural envelope of the present chapel – despite much renewal of both brick and stone work – primarily date to this initial phase of construction.

The chapel employed an inverted T-plan. The main single-story vessel of the chapel opens at its western end into a wider two-storied section, which accommodates a western gallery on the first-floor and an ante-chapel on the ground-floor. In the 16th and 17th centuries this western gallery was most commonly referred to the 'Holyday Closet(s)' or 'the King's' or 'the Queen's Closets'.

PHASE III (Henry VIII)

1529-35 **Minor building works**

Some minor alterations and repairs were undertaken within the chapel, principally glazing works. These works either completed or modified the initial phase of building initiated by Wolsey.

A vestry was constructed, adjoining the southern wall of the chapel, in late 1534.

In July-August 1531 reference is made for the first time in either Wolsey or Henry VIII's building accounts to a *new Chapel*.

1535-1536 **New ceiling**

An elaborate timber-vaulted ceiling (extant, though much restored) was prefabricated and then introduced into the main vessel of chapel. The prefabrication work took place at Sonning (Berkshire) over a period of nine months. Elements of the roof were individually

transported by river to the palace, where mouldings, additional elaborations, gilding and painting were completed on site.

This ceiling is solely decorative being suspended from a queen-post roof above. It appears to have replaced a flat ceiling constructed for Wolsey.

1536 **Refurbishment of Holyday Closets**

Roughly concurrent with the fabrication and installation of the new ceiling, the western gallery (Holyday Closet) was remodelled. Due to the sparse nature of the pre-Henrician sources it cannot (yet) be demonstrated if Wolsey's western gallery was originally subdivided into two Holyday Closets, or whether this subdivision was undertaken as part of these works.

This subdivision of the gallery into a pair of rooms provided a Holyday Closet of the king (most probably on the northern side) and a Holyday Closet of the queen (most probably on the southern side), both of which had a view into the main vessel of the chapel (to the east).

Entries in Henry VIII's building accounts refer principally to work constructing a bay window in each Holyday Closet; the glazing of a partition between the two closets; and the furnishing of the closets.

1536 **Refurbishment and reglazing**

As part of the above refurbishment additional works were undertaken.

These included: the partial re-glazing the chapel's east window; the paving (or re-paving) of the chapel; the manufacture of new choir-stalls; the creation of a new organ loft; and minor alterations to the large armorials situated at the western entrance to the chapel.

1538 Installation of a new organ.

PHASE IV (Edward VI – Charles II)

1567-70 Extant building accounts refer to 'painting and gilding fowre grete postes in the chappell…' Although this has been considered to refer to the structure of the Holyday Closets, it more likely indicates the construction of form of *baldacchino*, or freestanding canopy, around the high altar.

1567-70 Elements of the outer roof of the chapel were rebuilt.

1575-76 Reference is made to the construction of new *travesses* in the chapel.

1592-3 Some refitting of the chapel for Elizabeth I, including the paving of the Holyday Closets.

1605-6 Minor maintenance and refitting of the chapel. These works included: the creation of a new *leaning place* for the queen in the Queen's Holyday Closet; the introduction of new pews and altar rails.

1619-23 **Significant repairs undertaken to the chapel**

These included substantial repairs to the roofs (including that above the Holyday Closets); replacement of decayed plasterwork and the repairs to the woodwork of the altar table.

1631-32 **Refitting of Queen's Holyday Closet(?)**

Refitting of either the Queen's Holyday Closet or the privy closet (elsewhere within the royal apartments) for the performance of music: *setting up a Gallery with ralyes and ballisters in the Queens Chappell for the Musicke there; making a payre of stayres to it and bourding the floors thereof; and setting up a new Deaske for the Singers there*.

1636-8 Construction of a new organ.

1643 **Chapel stripped**

The chapel is stripped of religious images and artworks by Parliamentary troops after an order is issued for: *the pulling down and demolishing of the popish and superstitious pictures*. In addition the altar is repositioned and the rails and steps before it levelled.

1662 **Chapel refurnished**

Refurnishing and refitting of the chapel. Rich new fittings introduced into the chapel, including a new altar table, new rails, pews and tapestries. An organ, previously in the Great Hall, is installed in the chapel.

1662-1689 Minor repair works carried out throughout this period to boarding, pews etc.

PHASE V (William III & Mary II)

Major and minor works to the chapel appear to have been undertaken throughout the reigns of William & Mary. Two periods of substantial remodelling appear to have been *c* 1689-91 and *c* 1698-1700.

The loss of the any detailed building accounts from the years 1698-99 makes a clear understanding of the process by which the 16th-century Holyday Closets were repartitioned to create six distinct spaces difficult to establish.

1689-91 **Remodelling of Royal Pew (first phase**)

The first major phase of remodelling under William & Mary is undertaken. This work appears to have included the panelling of much of the interior and some remodelling of the Holyday Closets.

The Board of Works accounts include references to:

- *glazing in the Chappell Closett* (October 1689)

- *Working the foundations of the Collumns in the Kings Chappell* (March 1689/1690)

- *Labourers clearing timber & Rubbish out of the Chappell* (March 1689/90)

- *compass barcketting & pticoning & ceeling joysts in Chappell closet* (March 1689/90)

- *Making more foundations in the Kings Chappell for the halfe collumnes; working up two windows att the West end of the Chappell Closetts and cutting out a door way into the Cloyster 9 ft high by 5 ft wide and 5 brick thick* (March 1689/90)

- *Plaistering the lower Ceeling in the Ante-Chappell and lathing two coves ceelings in the Chappell Closetts* (April 1690)

- *Shoreing the foundations of the Chappell* (October 1691)

- *Rendering a chimney in the Chappell Closetts* (December 1691)

- *Laying a Hearth in the Queens Closett att the Chappell to dire the painting worke* (December 1691)

These references strongly imply that by the end of 1691 a major phase of the conversion of a pair of Holyday Closets into a Royal Pew composed of six distinct spaces had been undertaken.

1690 A new organ installed.

1694-6 Reconstruction of a marble altarpiece from Whitehall palace in the chapel under the supervision of Grinling Gibbons. Gibbons also provided decorative woodwork (*cornishes, mouldings, picture frames, Architrave, Freese, Subbase and other carvings*) for the chapel.

1698-1700 **Remodelling of Royal Pew (second phase**)

The second major phase of remodelling under William & Mary is undertaken.

It is reported in a letter to the Earl of Shrewsbury (18 January 1700) that '*the Chapel at Hampton Court is now near finished*.'

Works in these years included:

- The lowering of part of the ceiling and the provision of an additional chimney to create a 'winter closet' in part of the former 'King's Holyday Closet' (1699)

- The demolition of the southern 16th-century vice stair (1700-1)

- Further refitting of the Holyday Closets

The Board of Works accounts include references to:

- *William Beach fitting side hinges for the Chappell closets* (December 1699)

- *Grinling Gibbons for 59 ft 10 in the Coved Cornish 2 members enricht in the Kings Chapell Closett* (June-October 1699)

- *Cutting part of a window in the room over the Chapel* (March 1699/1700)

- *Joyner work done in the side closet to the Chaple* (April 1700)

- *Josiah Key for casements to the rooms over the Chapell* (May 1700)

Celia Fiennes (visiting the palace *c* 1703) wrote:

…the Chapel is refitting… the roof is fretwork painted & gilded so is the Queens closet & galleries in each side for her ladies; the roof and altar the same with crown in the old form like a Corronet shape as King Henry's great old crown is. The pillars are carved like stone but are all of wanscoates as are the seats without paint or varnish.

1699 In addition to building works (see above) the chapel is also refurnished in this period with new furniture, carpet and books.

PHASE VI (Queen Anne)

Few detailed building accounts exist for the period after 1703.

1710/11 **Refurbishment of chapel (including redecoration of Royal Pew)**

The *fitting up H.M's Chapel at Hampton Court with all convenient speed* ordered.

Subsequent works appear to have included:

- The blocking up of the eastern windows and the introduction of a large timber altarpiece (to an initial design by Hawksmoor).

- Replacement of the Tudor windows with casements.

- The painting of some areas, including the ceiling above the central room in the remodelled 'Royal Pew', by James Thornhill. Additional painted schemes, including *trompe l'oeil* windows by Thomas Hopson.

- Introduction of the existing staircase linking the 'Royal Pew' with the ante-chapel beneath (it is also possible that this staircase predates this phase and was introduced under William & Mary).

- Some re-panelling of the chapel and ante-chapel (seemingly associated with introduction of the staircase).

- Repaving of the main vessel of the chapel with black and white marble (laid on Portland stone).

- The refurbishment of the 'Royal Pew' with an armchair of crimson velvet and a Persian carpet. Similar furnishings were introduced throughout the chapel.

1711-12 A new organ.

PHASE VII (Hanoverian)

Only minor maintenance works appear to have been undertaken during the period *c* 1730 to *c* 1845. These included:

1727 The repaving of the ante-chapel with hexagons and lozenges of black and white marble.

1780 Partial relaying of flooring.

1781 Renewal of some pews.

1800 Repainting of Henry VIII and Jane Seymour's armorials at the western entrance

1807 & 1817 Window repairs.

PHASE VIII (Victorian)

1845-7 **First major restoration**

A major restoration programme was undertaken, which concentrated in particular upon the chapel roof. A substantial amount of the roof structure was found to be decayed and was subsequently removed, repaired, repainted and re-gilded.

Repairs were also undertaken to the structure of the *Ante-Chapel* according to the following references:

- *Ceiling panels to Ante-Room and Staircase to be cleaned and painted… Also diagonal marble squares to be taken up, excavated, and the bottom concreted. Portions of the ceiling have been discovered to be quite rotten* (Work 19/302, 28 January 1847)

- An estimate was requested for: *making good all the decayed wainscot in the Ante-Chapel and of columns therein and probable cost of taking up the marble paving of the Ante-Chapel and relaying it on a bed of concrete* (Letter Books of the Board of Works, 17 May 1847)

- *Occupants of apartments above ceiling of Ante-Chapel to be prepared to remove furniture to allow floors to be taken up to get at decayed timbers.* (Letter Books of the Board of Works, 12 July 1847)

- *Work on general and re-embellishment of Chapel and Ante-Chapel now in progress* (Letter Books of the Board of Works, 13 September 1847)

1847 Refenestration of chapel, along Tudor lines *proposed*, but no undertaken.

The architect Edward Blore was involved in specifying a scheme of redecoration following the above repair works.

1851 Use of the 'Royal Closet' restricted to members of the royal family by the Board of Works.

1866-68 Anthony Salvin produces designs for re-seating the chapel. Services were held in the Great Watching Chamber whilst this scheme was implemented.

1890 Chaplain claimed of the early 18th-century windows that, that '*these lights are a very poor substitute for the windows which originally occupied these positions. They are also extremely unsightly and totally out of character with the building*.'

1894 **Restoration of chapel windows**

Chapel windows all renewed to the form of extant 16th-century mouldings in the organ loft, despite protest of the SPAB. The *trompe l'oeil* windows and views were, however, retained at their request.

1899-1902 Renovation of the organ over a period of three years

PHASE IX (20th Century)

1909 Electricity provided for the *ante-chamber to Royal Pew*.

1918 Members of the general public first admitted to the chapel, including the Royal Pew, as visitors (rather than worshippers) for the first time.

1927 The chapel roof was found to be riddled with rot and deathwatch beetle:

- *a number of timbers had decayed owing to dry rot and action of wood-boring beetle* (Work 19/586, 19 July 1927)

- *Periodic examinations have been made of the space between the Tudor ceilings and the trusses. Dry rot has been extended to the ornamental carvings* (Work 19/586, 12 December 1927)

1928 Electric lights provided for the choirstalls.

1929 Electric lights provided for the Royal Pew.

1929 **Second major restoration**

Emergency repair work undertaken on the chapel roof between January and December. The decay was found to be worse than anticipated and also to have effected the Gibbons

screen:

- *The general state of the structural timbers and decorative features is considerably worse than was anticipated* (Work 19/586, 3 May 1929)

- *Examination has shown that a considerable portion of the Grinling Gibbons altar carving has been so attacked by wood boring beetle that a mere shell is left in many cases* (Work 19/586, 3 May 1929)

The paintwork of the ceiling was also restored at this time.

1973 **Substantial conservation and remodelling**

A major works programme in the chapel was undertaken which included: the redecoration of the chapel ceiling; the removal of the central pews; the partial relaying of the marble floor; the removal of some choirstalls; and the introduction of newly designed desks for choristers.

1981 **Discovery of sixteenth-century east window**

The southern-most half of the double east window of Wolsey's chapel, blocked as part of the works of 1710-12, was uncovered.

1983 An Henrician culvert running east-west under masonry of the Wren vestry staircase was identified and recorded by English Heritage.

1986 Plans and estimates for improvement to the underground heating produced by the PSA.

1987-9 New heating and lights designs proposed by PSA (a variant of these presumably implemented).

Structural engineers, Hockley & Dawson, appointed to undertake an investigative survey and report on condition of the structure of Royal Pew.

1990 Inner-face of the Royal Pew opened up at first-floor level and a drawn and photographic record produced. Sixteenth-century timbers were identified which remain evidence of earlier floor and lower-ceiling levels.

PHASE X (21st Century & Current Structural Investigations)

2004 Maintenance work in ante-chapel revealed a large pencilled drawing of a fish on the inner side of the western wall of the chapel, to the left of the west door. The style appears sixteenth-century. This is probably part of a larger scheme.

Preliminary structural investigations

Structural investigations in the Royal Pew reveal significant movement of the internal structure.

As a result elements of 16th-century plaster and stonework were exposed at ground-floor level in the ante-chapel. These surfaces were graffiti-ed and retained partial evidence of limewashing(?). Sockets, possibly for a screen separating the chapel from the ante-chapel, were also identified.

The cause of the structural movement could not be identified from visual inspection without the removal of further panelling.

3. Significance of the Royal Pew

Architectural Significance

The Chapel Royal at Hampton Court is of the greatest architectural significance, being one of the very last royal, or indeed private, chapels to be constructed prior to the English Reformation.

Architecturally, it should be related *primarily* to the class of medieval private (or household) chapels as a whole, not solely to other royal or episcopal chapels. In common with many medieval private chapels

the Chapel Royal has one main vessel (which is best interpreted as a structurally undivided chancel and nave) and a western gallery which overlooks this vessel.

Unusually, in this instance, the western gallery and its ante-chapel beneath, take the form of a structurally distinct element slightly wider than the main vessel to which it attaches. The Chapel Royal therefore appears an amalgam, drawing upon the model both of medieval household chapels and of T-plan collegiate chapels common in Oxford (as at New College and Merton). Such an individual arrangement may be the particular result of the patronage of Thomas Wolsey, whose intention at Hampton Court was certainly to build a *royal* chapel to provide for Henry VIII and his queen, rather than simply an episcopal chapel for his own use.

The form of the eastern window built for Wolsey – a pair of large six-light windows joined by a single central light – appears to be unique. It may in its strong division into two portions reflect, or be intended to relate to, the disposition of the large western gallery, the original internal arrangement of which is unknown.

The nature and impact of the various programmes of restoration and conservation undertaken in the Chapel Royal over the course of the 19th and 20th centuries are also significance in their own right.

Historical Significance

The historical significance of the Chapel Royal as the combined result of the patronage, or design, of Thomas Wolsey, Henry VIII, Christopher Wren, Nicholas Hawksmoor and Grinling Gibbons, cannot be overstated.

The Chapel Royal has been associated with eminent court clergymen, as well as with many celebrated court musicians. Of the latter, notable examples are William Byrd, Thomas Morley, Thomas Tallis, Christopher Tye and Orlando Gibbons.

In the course of its history the Chapel Royal has been the location of many historically significant events, amongst which were:

- The confirmation of the 'Truce of Hampton Court' (1528)
- The baptism of Edward VI (15 October, 1537)
- The funerary procession of Jane Seymour (October, 1537)
- The announcement of Catherine Howard's infidelity to Henry VIII (King's Holyday Closet, 2 November 1541)
- The marriage of Henry VIII and Catherine Parr. (Queen's Holyday Closet, 12 July, 1543)
- Ceremonies attending the reception of the French ambassador (1546)
- The marriage of Mary, daughter of Oliver Cromwell, to Thomas, Viscount Falconberg (17 November, 1657)
- The baptism of William, Duke of Gloucester, son of Princess Anne (27 July, 1689)

The chapel continues as an active Chapel Royal to this present day.

4. Summary Bibliography

Primary

Henry VIII Building Accounts

Pipe Roll & Audit Office Declared Accounts

Accounts, Ordinary & Extraordinary 1660-1703

Board of Works Accounts 1778-1814

Board of Works Letters Books

Heath Archive 29 – Chapel Royal References
[Transcriptions of buildings accounts etc. held in *Historic Royal Palaces* archive]

Secondary

Burbidge, J 2004. Chapel Royal, Hampton Court Palace. Conservation of Paint on Stone Quoin [Conservation Report]

Curnow, P 1984. 'The East Window of the Chapel at Hampton Court Palace', *Architectural History,* 27: 1-14

Foyle, J 2003. An Archaeological Reconstruction of Thomas Wolsey's Hampton Court Palace. 2 Vols. Unpublished PhD Thesis, University of Reading

Foster, P. *The Hospitallers at Hampton Court in 1338 – Income and Land Use* (Twickenham Local History Society Paper No. 26)

Foster, P. *The Hospitallers at Hampton Court in 1338 – Expenditure* (Twickenham Local History Society Paper No. 30)

Heath, G D 1979. *The Chapel Royal at Hampton Court*. Papers of the Borough of Twickenham Local History Society 62, Twickenham

Thurley, S 2002. 'The Stuart kings, Oliver Cromwell and the Chapel Royal 1618-1685'. *Architectural History* XLV, 248-50

Thurley, S 2003. Hampton Court A Social and Architectural History. Yale University Press, New Haven & London

APPENDIX III DENDROCHRONOLOGY REPORT

Interim Report 2007/37

The Tree Ring Dating of the Chapel Royal, Hampton Court Palace, Middlesex

by Dr D W H Miles FSA
Oxford Dendrochronology Laboratory
December 2007

Oxford Dendrochronology Laboratory
Interim Report 2007/37

The Tree-Ring Dating of the Chapel Royal, Hampton Court Palace, Middlesex

Dr D W H Miles FSA

Summary:

HAMPTON COURT, The Chapel Royal (TQ 158685)

(a) Gallery and partition *Felling dates:* **Spring 1525** and **Winter 1525/6**

(b) Henry VIII timber fan-vaulted ceiling to Chapel Royal

Felling date range (OxCal modelled): **1529-1542** (unrefined 1521-1553)

(c) Ceiling and roof to Ante-Chapel

Felling dates: **Winter 1633/4**, **Spring 1634**, and **Summer 1634**

(a)Upright studs 1525(20C), 1502(7), 1494(H/S), 1470; Horizontal beam over gallery (1489(H/S); Lower main beam 1524(37¼C), Side panel (later repair) (0/1); (b) Tiebeam 1509(h/s); Binders (2/3) 1516(h/s), 1513(h/s); Rib support joists (2/3) 1514(h/s), 1513(h/s); Ceiling board 1492, 1477; (c) Tiebeams 1633(23C, 14½C); Principal rafters (3/4) 1633(14¼C), 1632(17), 1618(22¼C); Timbers reset as intermediate principal rafters 1632(14), 1625(5); Raking struts (2/4) 1633(21C), 1631(22¼C + 1 or 2 NM); Ceiling joists 1584(17C), 1615(h/s), 1589; King post(01/). *Site Masters* (a and b) 1376-1525 HMPTNCT1 (*t* = 8.7 ABTSBRTN; 8.7 SHALFRD2; 8.4 HANTS02); (c) 1498-1633 HMPTNCT2 (11.3 HANTS02; 10.1 OXON93; 8.9 CHAZEY1)

Three major periods of construction were identified in the Chapel Royal at Hampton Court. The first was first by Cardinal Wolsey between 1514-28 which produced a T-shaped plan similar to collegiate chapels such as Magdalen and New College, Oxford. A major gallery support beam dating to spring 1525 is clearly part of this first phase. Seasoning evidence has demonstrated that other timbers felled by Wolsey in the winter of 1525/6 were not used until the Palace was acquired by Henry VIII who divided the gallery into the Holyday Closets for the King and Queen. The second major phase of construction to be carried out by Henry VIII around 1535-6 is the elaborate timber fan-vaulted ceiling was constructed over the main body of the chapel. The reduced felling range of 1529-1539 for the timbers compares well with the documented construction date of 1535/6.

Of perhaps greater importance is the discovery that the entire ceiling and roof structure to the ante-chapel were by Inigo Jones. The felling dates of 1634/5 place it firmly during the time when Jones was Surveyor of the King's Works between 1615 and 1643. A number of reused timbers were found to have been incorporated in the roof construction, one from 1619 relating to earlier repairs by Jones between 1619 and 1623.

Date sampled: 17th January, 5th October, and 6th November 2006

Owner & Commissioner: Historic Royal Palaces

Historical Research: Kent Rawlinson for HRP and Oxford Archaeology

Summary published: Miles, D H, Worthington, M J, and Bridge, M C, 2006 Tree-ring dates, *Vernacular Architecture* **37**, and Miles, D H, Worthington, M J, and Bridge, M C, 2007 Tree-ring dates, *Vernacular Architecture* **38**, (forthcoming)

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December 2007

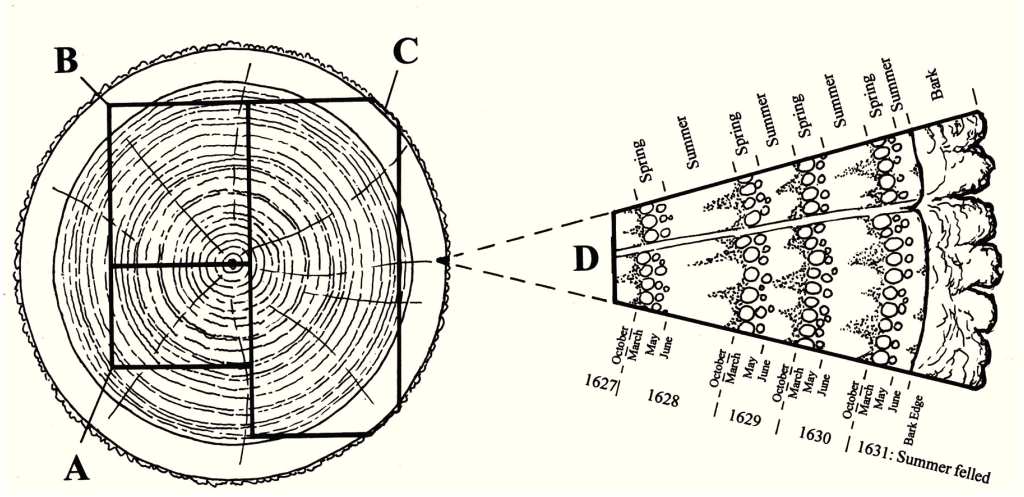
How Dendrochronology Works

Dendrochronology has over the past 20 years become one of the leading and most accurate scientific dating methods. Whilst not always successful, when it does work, it is precise, often to the season of the year. Tree-ring dating is well known for its use in dating historic buildings and archaeological timbers to this degree of precision. However more ancillary objects such as doors, furniture, panel paintings, and wooden boards in medieval book-bindings can sometimes be successfully dated.

The science of dendrochronology is based on a combination of biology and statistics. Fundamental to understanding how dendrochronology works is the phenomenon of tree growth. Essentially, trees grow through the addition of both elongation and 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 November when the leaves are shed and the tree becomes dormant for the winter period. For the European oak (*Quercus robur* and *Q. petraea*), 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 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, as opposed to other more local factors such as woodland competition and insect attack. 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. If a tree section is complete to the bark edge, then when dated 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.



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)

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. In European oak (*Quercus robur* sp), the difference in colour is generally matched by the change in the spring vessels. Generally the sapwood retains stored food and is therefore attractive to insect and fungal attack once the tree is felled and therefore is often removed during conversion.

Sapwood in European oaks tends to be of a relatively constant width and/or number of rings. By 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 (Miles 1997). The narrower this range of sapwood rings, the more precise the estimated felling date range will be.

Methodology: The Dating Process

All timbers sampled were of oak (*Quercus* spp.) from what appeared to be primary first-use timbers, or any timbers which might have been re-used from an early phase. Those timbers which looked most suitable for dendrochronological purposes with complete sapwood or reasonably long ring sequences were selected. In situ timbers were sampled through coring, using a 16mm hollow auger. Details and locations of the samples are detailed in the summary table.

The dry 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. Thus each ring or year is represented by its measurement which is 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 principle behind tree-ring dating is a simple one: the seasonal variations in climate-induced growth as reflected in the varying width of a series of measured annual rings is compared with 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, computer comparisons can be accurately quantified. 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 dendrochronologists. The cross-correlation algorithms most commonly used and published are derived from Baillie and Pilcher's CROS programme (Baillie and Pilcher 1973), although a faster version (Munro 1984) giving slightly different t-values is sometimes used for indicative purposes.

Generally, *t*-values over 3.5 should be considered to be 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, or higher, and for these to be well replicated from different, independent chronologies with local and regional chronologies well represented. Users of dates also need to assess their validity critically. They should not have great faith in a date supported by a handful of *t*-values of 3's with one or two 4's, nor should they be entirely satisfied with a single high match of 5 or 6. Examples of spurious *t*-values in excess of 7 have been noted, so it is essential that matches with reference chronologies be well replicated, and that this is confirmed with visual matches between the two graphs. Matches with *t*-values of 10 or more between individual sequences usually signify having originated from the same parent tree.

In reality, the probability of a particular date being valid is itself a statistical measure depending on the *t*-values. Consideration must also be given to the length of the sequence being dated as well as those of the reference chronologies. A sample with 30 or 40 years growth is likely to match with high *t*-values at

varying positions, whereas a sample with 100 consecutive rings is much more likely to match significantly at only one unique position. Samples with ring counts as low as 50 may occasionally be dated, but only if the matches are very strong, clear and well replicated, with no other significant matching positions. This is essential for intra-site matching when dealing with such short sequences. Consideration should also be given to evaluating the reference chronology against which the samples have been matched: those with well-replicated components which are geographically near to the sampling site are given more weight than an individual site or sample from the opposite end of the country.

It is general practice to cross-match samples from within the same phase to each other first, combining them into a site master, before comparing with the reference chronologies. This has the advantage of averaging out the 'noise' of individual trees and is much more likely to obtain higher *t*-values and stronger visual matches. After measurement, the ring-width series for each sample is 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 are then compared visually at the positions indicated by the computer matching and, if found satisfactory and consistent, are averaged to form a mean curve for the site or phase. This mean curve and any unmatched individual sequences are compared against dated reference chronologies to obtain an absolute calendar date for each sequence. Sometimes, especially in urban situations, timbers may have come from different sources and fail to match each other, thus making the compilation of a site master difficult. In this situation samples must then be compared individually with the reference chronologies.

Therefore, when cross-matching samples with each other or against reference chronologies, a combination of both visual matching and a process of qualified statistical comparison by computer is used. 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). A version of this and other programmes were written in BASIC by D Haddon-Reece, and re-written in Microsoft Visual Basic by M R Allwright and P A Parker.

Ascribing and Interpreting Felling Dates

Once a tree-ring sequence has been firmly dated in time, a felling date, or date range, is ascribed where possible. For samples which have sapwood complete to the underside of, or including bark, this process is relatively straight forward. Depending on the completeness of the final ring, i.e. if it has only the early wood formed, or the 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 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.

An alternative method of estimating felling date ranges has recently been developed (Miles 2005) which runs as a function under OxCal (Bronk Ramsey 1995; Miles and Bronk Ramsey *in prep*). Instead of using a simple empirical estimate for a particular geographical location, one model was found to be suitable for the whole of England and Wales. With the methodology set out by Millard (2002), Bayesian statistical models are used to produce individual sapwood estimates for samples using the variables of number of heartwood rings present, the mean ring width of those heartwood rings, the heartwood/sapwood boundary date, and the number of any surviving sapwood rings or a count of those lost in sampling. Using the suite of calculation and graphical plotting functions in OxCalInput and OxCalPlot (Bronk Ramsey *in prep*), the area of highest probability density for each sample can be graphically displayed to any of three confidence levels. The addition of surviving sapwood to the equation narrows the felling date range for each sample, although the outer end of the range shifts slightly later, more noticeably on those samples with higher sapwood counts. An empirically-derived stock-piling factor added to the ranges produced also helps to make the estimated felling date ranges

more representative for the actual latest common felling date, from which a construction date can then be extrapolated.

This new method of predicting sapwood ranges has resulted in over 94% of the samples tested producing felling date ranges narrower than the 36-year empirical estimate currently used. About a quarter of the samples tested showed an improvement with a range of 24 years or less. Conversely, some 4.5% of the samples tested produced a range larger than the empirical range, but again these ranges are more representative of the actual sapwood found.

However, it has been found that some unusual samples do not fit the model well. These include samples which have exceptional or sudden variation in mean ring width, such as might be found in pollarded or managed timber. Sometimes a tree will exhibit a sudden drop in mean ring width toward the end of its life, resulting in more sapwood rings being present then might be suggested in the faster-grown heartwood. Additionally, samples which have come from small timbers converted from larger, slow-grown trees would have a much larger number of heartwood rings then were actually present in the sample. Some examples of heartwood ring counts of 25 years or less with a narrow mean ring width are good indicators of this situation, as were observations made during sampling. Samples with these characteristics should be excluded from such analysis.

A particularly useful feature of OxCalPlot is the ability of producing combined felling date ranges for a group of samples comprising a single phase of building. Here, two samples combined can reduce the individual felling date ranges from about 30 to about 20 years. By including more samples within the combined phase, this 20-year range can be reduced to half or even less, depending on the number of samples in the phase. Thus felling date ranges for combined building phases have the potential to being reduced by as much as a two-thirds or even three-quarters of the individual empirically-derived felling date ranges (Miles 2005).

Some caution must be used in interpreting solitary precise felling dates. Many instances have been noted where timbers used in the same structural phase have been felled one, two, or more years apart. Whenever possible, a *group* of precise felling dates should be used as a more reliable indication of the *construction period*. 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 under study. However, it is common practice to build timber-framed structures with green or unseasoned timber and that construction usually took place within twelve months of felling (Miles 2006).

Details of Dendrochronological Analysis

The results of the dendrochronological analysis for the building under study are presented in a number of detailed tables. The most useful of these is the summary **Table 1**. This gives most of the salient results of the dendrochronological process, and includes details for each sample, its location, and its felling date or date range, if successfully tree-ring dated. This last column is of particular interest to the end user, as it gives the actual year and season when the tree was felled, if bark is present, or an estimated felling date range if the sapwood is incomplete. Occasionally it will be noted that the felling date ranges may not coincide with the precise felling dates. This is nothing to be overly concerned about so long as these are not too far apart. It must be remembered that the estimated felling date ranges are calculated at a 95% confidence level, which means that statistically one sample in 20 will have felling dates which actually fall *outside* the predicted range.

It will also be noticed that often the precise felling dates will vary within several years of each other. Unless there is supporting archaeological evidence suggesting different phases, all this would indicate is either stockpiling of timber, or of trees which have been felled or died at varying times but not cut up until the commencement of the particular building operations in question. When presented with varying precise felling dates, one should always take the *latest* date for the structure under study, and it is likely that construction will have been completed for ordinary vernacular buildings within twelve or eighteen months from this latest felling date (Miles 1997).

Table 2 gives an indication of the statistical reliability of the match between one sequence and another. This shows the *t*-value over the number of years overlap for each combination of samples in a matrix table. It should be born in mind that *t*-values with less than 80 rings overlap may not truly reflect the same degree of match and that spurious matches may produce similar values.

First, multiple radii have been cross-matched with each other and combined to form same-timber means. These are then compared with other samples from the site and any which are found to have originated from the same parent tree are again similarly combined. Finally, all samples, including all same timber and same tree means are combined to form one or more site masters. Again, the cross-matching is shown as a matrix table of *t*-values over the number of years overlaps. Reference should always be made to **Table 1** to clearly identify which components have been combined.

Table 3 shows the degree of cross-matching between the site master(s) with a selection of reference chronologies. This shows the county or region from which the reference chronology originated, the common chronology name together with who compiled the chronology with publication reference and the years covered by the reference chronology. The years overlap of the reference chronology and the site master being compared are also shown together with the resulting *t*-value. It should be appreciated that well replicated regional reference chronologies, which are shown in **bold**, will often produce better matches than with individual site masters or indeed individual sample sequences.

Figures include a bar diagram which shows the chronological relationship between two or more dated samples from a phase of building. The site sample record sheets are also appended, together with any plans showing sample locations, if available.

Publication of all dated sites are published in *Vernacular Architecture* annually, and the entry, if available, is shown on the summary page of the report. This does not give as much technical data for the samples dated, but does give the *t*-value matches against the relevant chronologies, provide a short descriptive paragraph for each building or phase dated, and gives a useful short summary of samples dated. These summaries are also listed on the web-site maintained by the Laboratory, which can be accessed at `www.dendrochronology.com`. The Oxford Dendrochronology Laboratory retains copyright of this report, but the commissioner of the report has the right to use the report for his/her own use so long as the authorship is quoted. Primary data and the resulting site master(s) used in the analysis are available from the Laboratory on request by the commissioner and bona fide researchers. The samples form part of the Laboratory archives.

Summary of Dating

The Chapel Royal at Hampton Court is thought to have been constructed in two principal phases, the first by Cardinal Wolsey between 1514-28 which produced a T-shaped plan similar to collegiate chapels such as Magdalen and New College, Oxford. Major works were carried out by Henry VIII around 1535-6 which included the elaborate timber fan-vaulted ceiling was constructed over the main body of the chapel. What is not known is just when the Royal Pew was constructed over the ante-chapel, together with the partition screen. Later remodelling of the Royal Pew occurred in the late 17th century when it was divided into three compartments. This involved strengthening the main supporting beam at first floor level, which appeared to have been lowered, and other structural alterations. It was the failure of a number of these structural elements that necessitated the opening up of the timber frame in 2006, and hence the desire to understand the chronological development of the surviving fabric.

This involved sampling seven timbers from the gallery structure, nine timbers from Henry VIII ceiling over the man body of the chapel, five timbers comprising a later truss over the Henry VIII ceiling, and 11 timbers from the ante-chapel ceiling and roof structure. One of the timbers sampled from the gallery, **hcp6**, related to a later repair.

The first stage of the analysis compared multiple samples from the same timber taken to obtain complete sapwood or where internal fractures caused breaks in the core samples. Thus, three radii from the north upright in the Royal Pew were combined to form the mean **hcp2**, five radii from the lower gallery beam

were combined to form the mean **hcp3**, and two samples from the horizontal beam over the gallery were combined to form the mean **hcp5**. From the Henry VIII ceiling, two samples from the middle secondary beam were combined to form the mean **hcp23**, and this was found to match with a ceiling joist (**hcp25**) to form the same-tree mean **hcp235**. This matched with nine other timbers from the ceiling and the gallery to form the 150-ring site master **HMPTNCT1**. This was compared with the reference chronologies and was found to date, spanning the years 1376-1525. One other sample, **hcp22a1**, failed to match with the other samples or the site master, but did date individually with a last measured ring date of 1493.

As the truss over the Henry VIII chapel seemed to be structurally integral to the roof over the ante-chapel, these 16 timbers were analysed as one group. Two samples from the king post to truss ∅ were combined to form the mean **hcp32**, whilst two samples from the kingpost to the same truss were combined to form the mean **hcp33**. From the ante-chapel, three samples from a tiebeam were combined to form the mean **hcp23**, two of three segments from an intermediate principal were combined to form the mean **hcp41**, and two samples from a raking strut were combined to form the mean **hcp44**. This last mean was found to match exceptionally well with a principal rafter from over the Henry VIII ceiling (**hcp34**) to form the same-tree mean **hcp3444**. Similarly, the two intermediate principals from Bay 1 were found to have originated from the same tree and were combined to form the same-tree mean **hcp412**. These two same-tree means were compared with the other samples and a total of 10 sequences were found to match. These were combined to form the 136-ring site master **HMPTNCT2**. This was compared with the reference chronologies and dated, spanning the years 1498-1633.

Three principal phases of construction were identified through the analysis. The first is from the six dated timbers making up the gallery supporting the Royal Pew, Lady Chapel, and Winter Pew. Only one of these appeared to be clearly *in situ*, the lower gallery beam. This produced a precise felling date of spring 1525. Another precise felling date was produced by one of the main upright posts **hcp2**, which was felled in the winter of 1525/6. Three other upright posts **hcp2**, **hcp4**, and **hcp7**. Although these did not retain complete sapwood, they produced felling date ranges of 1505-35, 1504-36, and after 1479 respectively. The horizontal beam **hcp5** at gallery ceiling level also produced a felling date range of 1498-1530. All of these dates are consistent with the 1525-6 felling dates of the lower main gallery beam and upright.

However, some difficulty in the interpretation of these dates are presented by the question as to whether they are also *in situ*, or are a later re-arrangement of primary phase timbers. Clearly the lower gallery beam **hcp3** is *in situ* and is built into the brickwork. It is over 40 feet long and has a clear span exceeding 35 feet and measured about 16" square. Laid over this are three beams, edge-jointed, which are jointed at the extremities into the lower beam by means of a projecting tenon with long sloping shoulder, resulting in the removal of a considerable amount of material from the bottom of the upper beams. The upper member of this composite beam receives the upright timbers dated above. However, whilst these uprights have assembly marks at their lower ends which appear to run sequentially (four out of seven upright have been subsequently removed), there are no corresponding assembly marks on the gallery on which they are jointed. More seriously is the evidence for the upper gallery beam having seasoned before the mortice was cut for one of the upright posts, and this seasoning would have taken at least several years to account for the amount of distortion in the gallery beam. However, the beam was completely seasoned as there was still a small amount of distortion in the outer side of the mortice.

Photograph of mortice in upper gallery beam for missing upright post VI **in Lady Chapel** (D Miles)

Given that both elements dated to within a year of each other, they certainly were not constructed at the same time. Thus, a number of interpretations might be offered. The first is that most of the timbers for the gallery were felled at the same time but were not framed together for several years or more after conversion. This however would have placed the completion of the gallery to after 1530, and as Cardinal Wolsey was forced to give up the Palace in September 1528, this would have placed the erection of the gallery to the period of Henry VIII's occupancy. As the gallery beam was built into the brick walls at the time the chapel was constructed, this would have placed the construction of the chapel during the reign of Henry VIII, which is too late for the historical and and historical documentation.

A second, more likely interpretation, is that the gallery beam had already been built into the walls of the chapel by Wolsey, but the structure above separating the gallery from the main body of the church was not completed by Henry VIII. There are documented accounts from 1536 for the forming of a bay window in each of the two compartments, and the sub-division of the gallery into two compartments, or Holyday Closets, one for the King on the north side and one for the Queen on the south, together with the forming of a bay window in each. Evidence has recently been discovered for these bay windows cut in the gallery beams, and it is quite likely that the structure above the gallery beam was inserted at this time, using timbers previously cut by Wolsey but not used. The upper gallery beam could take as long as 10 years or more to fully season (Miles 2005), and if it was cut in 1525 or 1526, it is quite possible that Henry VIII might have used the timbers previously cut, but not used, by Wolsey in forming the two compartments for the King and Queen. Alternatively, the uprights might have been erected elsewhere in the gallery and were reused by Henry VIII in 1536. In any event, the seasoning distortion in the upper gallery beam prior to the cutting of the mortice would fit well with an interval of between 5 and 10 years.

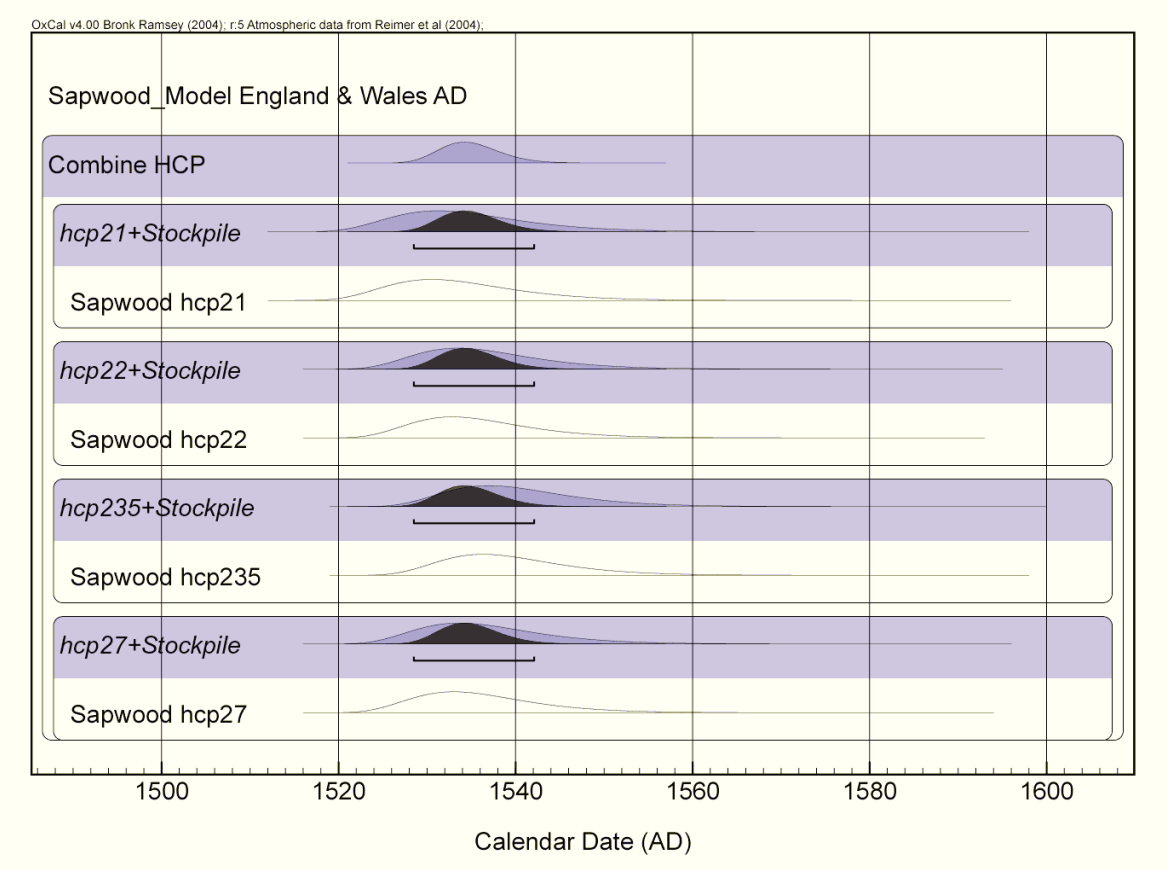
An archaeological reconstruction of the gallery and partitions carried out by Oxford Archaeology suggest that the uprights are *in situ*, although some of disused mortices still require explanation.

On the appropriation of Hampton Court by Henry VIII, he replaced Wolsey's ceiling over the main body of the Chapel Royal with the magnificent fan-vaulted ceiling in timber. This is of four bays and is spans 35 feet with timber-framed pendants, moulded ribs, and highly decorated. The moulded ribs are connected to the upper supporting timbers by numerous tusk tenons. It was prefabricated at Sonning in Berkshire and then transported down the river to Hampton. It was probably designed by William Clement who went on to create Nonsuch Palace.

Of the nine timbers sampled from this ceiling, seven of these dated. None retained complete sapwood, but most retained at least the heartwood/sapwood boundary. Two fragments of original V-edged ceiling boards were found loose in the roof space but these did not retain any evidence for sapwood.

The empirical felling date ranges based on a range of 9-41 years varied from 1518-1550 to 1523-1555. Two samples, **hcp21** and **hcp22**, fractured during coring, resulting in a loss of 3 and 2 rings respectively at the interface. Thus the heartwood/sapwood boundary date for **hcp21** has been calculated by taking the last measured ring date of 1473 for inner dated segment **hcp21a1** and adding the 33 rings of the undated outer segment **hcp21a1** plus 3 rings lost in coring to arrive at the 1509 heartwood/sapwood boundary date. Similarly, the heartwood/sapwood boundary date for **hcp22** has been calculated by taking the last measured ring date of 1493 for inner dated segment **hcp22a1** and adding the 18 rings of the undated outer segment **hcp22a2** plus 2 rings lost in coring to arrive at the 1513 heartwood/sapwood boundary date. By taking the average heartwood sapwood boundaries of these two samples plus **hcp27** and the same-tree mean **hcp235**, a mean heartwood/sapwood boundary date of 1512 is produced. This produced an empirical felling date range of 1521-1553 to be given to the phase. By running the samples through the OxCal sapwood estimating program (Miles 2006), slightly reduced felling date ranges of 1521-1552 to 1527-1556 are produced. By combining these ranges, a combined felling date range of 1529-1542 is given. This coincides well with the documented 1535-1536 date for the ceiling.

OxCal plot showing individual and combined felling date ranges



The provenance of the timbers was presumably Berkshire, Oxfordshire, or North Hampshire, as demonstrated by the matches with the reference chronologies shown in Table 3a. This accords well with the documentary references to the ceiling being prefabricated up the Thames at Sonning on the Berkshire/Oxfordshire border. One other dated sample from a secondary beam, **hcp22a1**, did not match the other dated samples in this phase, but did match very well on its own. Although it matched chronologies from further afield including some from East Anglia, it is not likely to have been transported from very far away. Instead, it probably came from an entirely different woodland situation. The geography of Berkshire and Oxfordshire near to Sonning is noted for its variable landscape.

The ante-chapel roof design is simple in concept but sophisticated in the jointing details. It has a clear span of about 35 foot and is comprised of a king-post and one set of raking struts to the principal rafters. There are five trusses, the middle three are supported over the main body of the Chapel by a truss formed over the wallplate (truss ∅). The tiebeams are thickened at their ends where meeting the principal rafters and run over the wallplates, and the king-posts have thickened tops and bottoms where the joints with the principals and raking struts are often joggled. The joint with the raking strut with the principal is especially sophisticated in that there are two hidden sloping shoulders either side of the central tenon for maximum compressive restraint. Ceiling joists are tenoned into the tiebeams with pine boarding beneath on which lath and plaster was applied over which moulded timber ribs and pendants were fixed. It has not yet been determined if these applied ribs were part of the original decorative scheme, as can still be seen over the main staircase and Lady Chapel, or whether they were a later introduction. Certainly they were in place before 1689 when the central dividing wall was removed and a coved ceiling inserted below, later painted by James Thornhill in 1710-11. Sometime later the roof had been partially reconstructed with the rafters reset, and some additional bracing inserted after a fire at the south end of the roof, probably caused by an incendiary bomb during the 1939-45 war.

A structural analysis of the roof structure determined that as truss ∅ over the eastern wall plate was the same phase as the roof and ceiling of the ante-chapel roof allowed the number of samples required to be substantially reduced. Five timbers were sampled from truss ∅ accessed from within the main chapel roof space, and a further 11 timbers were sampled from within the ante-chapel roof. Of the 12 timbers which were found to date, 7 were found to have complete sapwood, or were part of a same-tree match with a timber with bark edge. Five of these clustered in the early 1630s, ranging from winter 1633/4 to summer 1634. Three other timbers had virtually complete sapwood which corresponded well with these precise felling dates. Sample **hcp41b** had lost no more than two rings beneath the bark giving a felling date range if 1633-4, and as **hcp42a1** was from the same parent tree, the same could be ascribed to this timber. Also sample **hcp46** had finished growing in the spring before being cut down, but as some of the rings in the last decade were exceptionally narrow, there was a possibility that a ring or two could be missed, thus the extended date felling range of spring 1632-4 being given. Two samples without complete sapwood gave felling date ranges consistent with the 1634 precise felling dates: after 1598 for sample **hcp39** and 1624-1656 for sample **hcp40**. All of these dates strongly suggest a construction period during 1634 or 1635 for this work.

Two final samples produced precise felling dates which were significantly earlier than this period. The west principal rafter of truss 2 (**hcp45**) was found to have been felled in the spring of 1619, and one of the ceiling joists in bay 1 (**hcp38b**) was felled in the winter of 1584/5. The best interpretation for these timbers is that they were material that had been reused or left over from other building projects.

The 1634-5 construction period is of exceptional significance in that it would appear that the entire ceiling and roof structure to the ante-chapel were by Inigo Jones. These dates place it firmly during the time when Jones was Surveyor of the King's Works between 1615 and 1643. This is one of the very few surviving examples of his structural carpentry, the only other surviving examples being the Queen's Chapel at St James's Palace and possibly Stoke Bruerne, Northants (Yeomans 1986). It is likely that Master Carpenter Ralph Brice would have been responsible for executing the work at Hampton Court.

This important phase of work has not as yet been identified in any of the building accounts. There are references to the refitting of the Queen's Holyday Closet which might relate to the Lady Chapel in 1631-2, and the construction of a new organ in 1636-8 in the Chapel Royal, but neither of these can relate to the complete reconstruction of the roofs to the ante-chapel. However, there are accounts for significant structural repairs being carried out between 1619-23 to the ante-chapel roofs (Rawlinson 2005), and it is most likely that the principal rafter **hcp45** dating to spring 1619 originated from these repairs, reused in the 1634-5 reconstruction. Given the evidence above, the most likely interpretation is that the roof over the ante-chapel, then not even 100 years old, was suffering from structural problems by 1619. Inigo Jones, Surveyor of the King's Works at this time, probably effected the best repairs possible at this time. However, less then 20 years later, further structural problems probably continued to manifest themselves and it was decided to completely rebuild the entire roof in 1634-5. It is this roof that that largely remains to this day, as shown by this dendrochronological survey.

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References

Arnold, A J, and Howard, R, 2006 Tree-ring analysis of timbers from St Mary's Church, Winkfield, Bracknell Forest, Berkshire, Res Dept Rep, 66/2006

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

Bridge, M C, 2001 Tree-ring analysis of timbers from Hengrave Hall, Hengrave, Suffolk, Centre for Archaeol Rep, 111/2001

Bridge, M C, 2003 Compilation of master chronologies from East Anglia, unpublished computer file ANGLIA03, University College London Dendrochronology Laboratory

Bridge, M C, and Miles D H W 2004 Tree-Ring Analysis of Timbers from the Hall Roof, West Gateway, and Gates at Fulham Palace, London Borough of Hammersmith and Fulham, Centre for Archaeol Rep, 79/2004

Bronk Ramsey, C, 1995 Radiocarbon calibration and stratigraphy: the OxCal program, *Radiocarbon*, **37**, 425-30

Haddon-Reece, D, Miles, D H, and Munby, J T, 1989 List 32 - Tree-ring dates, Vernacular Architect, 20, 46-49

Haddon-Reece, D, Miles, D H, Munby, J T, and the late Fletcher, J M , 1993 Oxfordshire Mean Curve - a compilation of master chronologies from Oxfordshire, unpubl computer file OXON93, Oxford Dendrochronology Laboratory

Hillam, J, and Groves, C, 1996 Tree-Ring Research at Windsor Castle: Aims and Initial Results, in Tree Rings, Environment and Humanity, (eds J S Dean, D M Meko, and J W Swetnam), 515-23, Arizona Univ

Howard, R E, Laxton R R, and Litton, C D, 1998 Tree-ring analysis of timbers from Chicksands Priory, Chicksands, Bedfordshire, Anc Mon Lab Rep, 30/98

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

Miles, D H, 2003 Dating Buildings and Dendrochronology in Hampshire, in Hampshire Houses 1250 - 1700: Their Dating and Development (ed E Roberts), 220-6, Southampton (Hampshire County Council)

Miles, D H, 2004 Working compilation of reference chronologies centred around Somerset by various researchers, unpubl computer file SOMRST04, Oxford Dendrochronology Laboratory

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

Miles, D H, 2006 Refinements in the Interpretation of Tree-Ring Dates for Oak Building Timbers in England and Wales, *Vernacular Architecture*, **37**, 84-96

Miles, D H, and Worthington, M J, 1997 Tree-ring dates, Vernacular Architect, 28, 159-181

Miles, D H, and Worthington, M J, 1998 Tree-ring dates, Vernacular Architect, 29, 111-129

Miles, D H, and Worthington, M J, 2002 Tree-ring dates, Vernacular Architect, 33, 81-102

Miles, D H, Worthington, M J, and Bridge, M C, 2004 Tree-ring dates, Vernacular Architect, 35, 95-113

Miles, D H, Worthington, M J, and Bridge, M C, 2007 Tree-ring dates, Vernacular Architect, 38, 120-139.

Millard, A, 2002 A Bayesian approach to sapwood estimates and felling dates in dendrochronology, *Archaeometry*, **44** (1), 137-143

Munro, M A R, 1984 An Improved Algorithm for Crossdating Tree-Ring Series, *Tree Ring Bulletin*, **44**, 17-27

Rawlinson, K, 2005 'Chapel Royal, Hampton Court Palace (Royal Pew): Summary Statement of Significance' unpublished report July 2005

Tyers, I, 1998 Tree-ring analysis of Cann Hall, Clacton, Essex, Anc Mon Lab Rep, 25/98

Yeomans, D, 1986 'Inigo Jones's roof structures' *Architectural History* **29**, 85-101

Table 1: Summary of Tree-Ring Dating

Sample number & type		Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges (AD)
Partition between Chapel Royal and Royal & Winter Pews										
* **hcp1**	c	N upright in Winter Pew	1397-1494	1494	H/S	98	2.39	1.18	0.210	1503-1535
hcp2a	c	N upright in Royal Pew	1391-1496			106	1.20	0.35	0.202	
hcp2b	c	ditto	1460-1523	1505	18	64	1.21	0.31	0.193	
hcp2c	c	ditto	1489-1525	1505	20C	37	1.05	0.24	0.226	
* **hcp2**		Mean of **hcp2a1** + **hcp2b** + **hcp2c**	1391-1525	1505	20C	135	1.15	0.33	0.198	Winter 1525/6
hcp3a	c	Lower main beam	1406-1447			42	1.58	0.53	0.202	
hcp3b	c	ditto	-			40	2.13	0.98	0.229	
hcp3c	c	ditto	1437-1485			49	1.32	0.39	0.221	
hcp3d	c	ditto	1408-1524	1484	40	117	1.04	0.39	0.188	
hcp3e	c	ditto	1388-1487			100	1.71	0.53	0.221	
hcp3f	c	ditto	1442-1524	1490	34¼C	83	1.14	0.42	0.181	
* **hcp3**		Mean of **hcp3a** + **3c** + **3d** + **3e** + **3f**	1388-1524	1487	37¼C	137	1.35	0.56	0.183	Spring 1525
* **hcp4**	c	S upright Royal Pew	1395-1502	1495	7	108	1.74	0.60	0.197	1504-1536
hcp5a	c	Horizontal beam over gallery	1376-1489	1489	H/S	114	1.52	0.87	0.216	
hcp5b	c	ditto	1438-1489	1489	H/S	52	1.19	0.41	0.233	
* **hcp5**		Mean of **hcp5a** + **hcp5b**	1376-1489	1489	H/S	114	1.51	0.87	0.215	1498-1530
hcp6	c	N side panel to S upright in Winter Pew	-			59	2.85	0.88	0.189	
* **hcp7**		Upright post between Lady Chapel & R Pew	1413-1470			58	2.82	0.87	0.229	After 1479
CHAPEL ROYAL CEILING – HENRY VIII										
* **hcp21a1**	c	Tiebeam T ∅	1343-1473			131	1.70	0.70	0.269	
hcp21a2	c	ditto	-	(1509)	H/S	33	0.95	0.15	0.153	1518-1550 (OxCal 1521-52)
hcp22a1	c	S secondary beam	1379-1493			115	1.89	0.43	0.142	
hcp22a2	c	ditto	-	(1513)	H/S	18	1.86	0.27	0.141	1522-1554 (OxCal 1524-53)
hcp23a	c	Middle secondary beam	1399-1515	1515	H/S	117	1.58	0.45	0.206	
hcp23b	c	ditto	1487-1516	1516	H/S	30	1.42	0.30	0.192	
hcp23		Mean of **hcp23a** + **hcp23b**	1399-1516	1516	H/S	118	1.59	0.44	0.203	(1523-1555)
hcp24	c	N secondary beam	-		1	47	1.96	0.68	0.263	
hcp25	c	Ceiling joist	1456-1514	1514	H/S	59	1.79	0.46	0.250	(1523-1555)
hcp26	c	Ceiling joist	-		H/S?	71	1.61	0.53	0.181	
* **hcp27**	c	Ceiling joist	1438-1513	1513	H/S	76	1.59	0.71	0.226	1522-1554 (OxCal 1524-53)
* **hcp28**	s	Fragment of ceiling boarding	1386-1477			92	1.42	0.62	0.222	After 1486
* **hcp29**	s	Fragment of ceiling boarding	1424-1492			69	1.78	0.41	0.172	After 1501
* **hcp235**		Mean of **hcp23** + **hcp25**	1399-1516	1514	2	118	1.70	0.41	0.213	1523-1555 (OxCal 1527-56)
*** = HMPTNCT1 Site Master**			**1376-1525**	**1512**		**150**	**1.73**	**0.71**	**0.147**	**1521-1553 (OxCal 1529-42)**

Key: *, † = sample included in site-master; c = core; s = slice/section; ¼C, ½C, C = bark edge present, partial or complete ring: ¼C = spring (last partial ring not measured), ½C = summer/autumn (last partial ring not measured), or C = winter felling (ring measured); H/S bdry = heartwood/sapwood boundary - last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity

Sample	Timber and position	Dates AD	H/S	Sapwood	No of	Mean	Std	Mean	Felling seasons and

number & type			spanning	bdry	complement	rings	width mm	devn mm	sens mm	dates/date ranges (AD)
Ante-Chapel Ceiling and Roof										
hcp31	c	S raking strut T ∅	-		H/S	32	4.89	1.44	0.192	
hcp32a	c	S principal rafter T ∅	1508-1616			109	1.57	0.51	0.218	
hcp32b	c	ditto	1585-1633	1619	14¼C	49	2.28	0.47	0.189	
† **hcp32**		Mean of **hcp32a** + **hcp32b**	1508-1633	1619	14¼C	126	1.70	0.56	0.224	Spring 1634
hcp33a	c	Kingpost T ∅	-		6	46	5.20	1.41	0.132	
hcp33b	c	ditto	-		8¼C	22	4.16	0.82	0.145	
hcp33		Mean of **hcp33a** + **hcp33b**	-		8¼C	48	5.17	1.39	0.131	
hcp34	c	N principal rafter T ∅	1498-1632	1615	17	135	1.69	1.13	0.210	(Winter 1633/4)
hcp35	c	N raking strut T ∅	-		H/S	38	4.36	1.29	0.175	
Ante-Chapel Ceiling and Roof										
hcp36a	c	Tiebeam T 4	1527-1633	1611	22C	107	1.73	0.60	0.172	
hcp36b1	c	ditto	1531-1618	1609	9	88	1.80	0.51	0.131	
hcp36b2	c	ditto	1620-1633		+14C	14	1.19	0.29	0.218	
† **hcp36**		Mean of **hcp36a** + **hcp36b1** + **hcp36b2**	1527-1633	1610	23C	107	1.70	0.55	0.163	Winter 1633/4
† **hcp37**	c	Tiebeam T 3	1516-1633	1619	14½C	118	1.57	0.48	0.214	Summer 1634
hcp38a		21st ceiling joist Bay 1	-			53	1.43	0.62	0.243	
† **hcp38b**		ditto	1510-1584	1567	17C	75	1.18	0.36	0.209	Winter 1584/5
† **hcp39**	c	11th ceiling joist Bay 2	1501-1589			89	1.31	0.72	0.323	After 1598
† **hcp40**	c	8th ceiling joist Bay 2	1547-1615	1615	H/S	69	2.81	0.69	0.214	1624-1656
hcp41a1	c	E intermediate principal (reset) Bay 1	1539-1625	1620	5	87	1.77	0.66	0.252	
hcp41a2	c	ditto	-		+7C	7	1.75	0.30	0.209	
hcp41b	c	ditto	1603-1632	1620	12	30	2.36	0.52	0.230	
hcp41		Mean of **hcp41a1** + **hcp41b**	1539-1632	1618	14	94	1.82	0.67	0.244	1633-4
hcp42a1	c	W intermediate principal (reset) Bay 1	1547-1625	1620	5	79	1.80	0.91	0.224	(1633-4)
hcp42a2	c	ditto	-		+8C	8	1.78	0.19	0.137	
hcp43	c	E rafter T 2	-		H/S	64	2.03	1.03	0.184	
hcp44a	c	E raking strut T 2	1522-1613	1613	H/S	92	0.88	0.62	0.214	
hcp44b	c	ditto	1509-1633	1612	21C	125	1.28	0.76	0.197	
hcp44		Mean of **hcp44a** + **hcp44b**	1509-1633	1612	21C	125	1.17	0.81	0.193	Winter 1633/4
† **hcp45**	c	W principal rafter T 2	1525-1618	1598	22¼C	94	1.56	1.23	0.202	Spring 1619
† **hcp46**	c	W raking strut T 3	1535-1631	1609	22¼C	97	1.44	0.70	0.196	Spring 1632-4
† **hcp3444**		Mean of **hcp34** + **hcp44**	1498-1633	1614	19C	136	1.54	1.11	0.198	Winter 1633/4
† **hcp412**		Mean of **hcp41** + **hcp42a1**	1539-1632	1619	13	94	1.81	0.72	0.224	1633-4
† = **HMPTNCT2**		Site Master	1498-1633			136	1.77	0.64	0.149	

Key: *, † = sample included in site-master; c = core; s = slice/section; ¼C, ½C, C = bark edge present, partial or complete ring: ¼C = spring (last partial ring not measured), ½C = summer/autumn (last partial ring not measured), or C = winter felling (ring measured); H/S bdry = heartwood/sapwood boundary - last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity

Explanation of terms used in Table 1

The summary table gives most of the salient results of the dendrochronological process. For ease in quickly referring to various types of information, these have all been presented in Table 1. The information includes the following categories:

Sample number: Generally, each site is given a two or three letter identifying prefix code, after which each timber is given an individual number. If a timber is sampled twice, or if two timbers were noted at time of sampling as having clearly originated from the same tree, then they are given suffixes '**a**', '**b**', etc. Where a core sample has broken, with no clear overlap between segments, these are differentiated by a further suffix '**1**', '**2**', etc.

Type shows whether the sample was from a core 'c', or a section or slice from a timber's'. Sometimes photographs are used 'p', or timbers measured *in situ* with a graticule 'g'.

Timber and position column details each timber sampled along with a location reference. This will usually refer to a bay or truss number, or relate to compass points or to a reference drawing.

Dates AD spanning gives the first and last measured ring dates of the sequence (if dated),

H/S bdry is the date of the heartwood/sapwood transition or boundary (if present). This date is critical in determining an estimated felling date range if the sapwood is not complete to the bark edge.

Sapwood complement gives the number of sapwood rings. The tree starts growing in the spring during which time the earlywood is produced, also known also as spring growth. This consists of between one and three decreasing spring vessels and is noted as *Spring* felling and is indicated by a ¼ C after the number of sapwood ring count. Sometimes this can be more accurately pin-pointed to very early spring when just a few spring vessels are visible. After the spring growing season, the latewood or summer growth commences, and is differentiated from the proceeding spring growth by the dense band of tissue. This summer growth continues until just before the leaves drop, in about October. Trees felled during this period are noted as *summer* felled (½ C), but it is difficult to be too precise, as the width of the latewood can be variable, and it can be difficult to distinguish whether a tree stopped growing in autumn or *winter*. When the summer growth band is clearly complete, then the tree would have been felled during the dormant winter period, as shown by a single C. Sometimes a sample will clearly have complete sapwood, but due either to slight abrasion at the point of coring, or extremely narrow growth rings, it is impossible to determine the season of felling.

Number of rings: The total number of measured rings present on the samples analysed.

Mean ring width: This, simply put, is the sum total of all the individual ring widths, divided by the number of rings, giving an average ring width for the series.

Mean sensitivity: A statistic measuring the mean percentage, or relative, change from each measured yearly ring value to the next; that is, the average relative difference from one ring width to the next, calculated by dividing the absolute value of the differences between each pair of measurements by the average of the paired measurements, then averaging the quotients for all pairs in the tree-ring series (Fritts 1976). Sensitivity is a dendrochronological term referring to the presence of ring-width variability in the radial direction within a tree which indicates the growth response of a particular tree is "sensitive" to variations in climate, as opposed to complacency.

Standard deviation: The mean scatter of a population of numbers from the population mean. The square root of the variance, which is itself the square of the mean scatter of a statistical population of numbers from the population mean. (Fritts 1976).

Felling seasons and dates/date ranges is probably the most important column of the summary table. Here the actual felling dates and seasons are given for each dated sample (if complete sapwood is present). Sometimes it will be noticed that often the precise felling dates will vary within several years of each other. Unless there is supporting archaeological evidence suggesting different phases, all this would indicate is either stockpiling of timber, or of trees which have been felled or died at varying times but not cut up until the commencement of the particular building operations in question. When presented with varying precise felling dates, one should always take the *latest* date for the structure under study, and it is likely that construction will have been completed for ordinary vernacular buildings within twelve or eighteen months from this latest felling date (Miles 2006).

Felling date ranges are produced using an empirical estimates using the appropriate estimate (Miles 1997). However, these can sometimes be reduced using a new sapwood estimation methodology which uses the mean ring width, number of heartwood rings, known H/S boundary date, and the number of surviving sapwood rings, if present (Miles 2006). These are used after the empirical range and are shown in brackets (OxCal followed by date range). Combined felling date ranges for a phase of building is shown at the end of the phase to which it relates.

Table 2: Matrix of *t*-values and overlaps for same-timber means and site masters

Components of timber **hcp2**

Sample:	**hcp2b**	**hcp2c**
Last ring date AD:	1523	1525
hcp2a	9.76 / 37	2.78 / 8
hcp2b		8.82 / 35

Components of timber **hcp3**

Sample:	**hcp3c**	**hcp3d**	**hcp3e**	**hcp3f**
Last ring date AD:	1485	1524	1487	1524
hcp3a	5.58 / 11	5.83 / 40	3.31 / 42	0.00 / 6
hcp3c		6.43 / 49	7.69 / 49	5.81 / 44
hcp3d			7.92 / 80	5.12 / 83
hcp3e				10.33 / 46

Components of timber **hcp5**

Sample:	**hcp5b**
Last ring date AD:	1489
hcp5a	11.86 / 52

Timber **hcp23**

Sample:	**hcp23b**
Last ring date AD:	1516
hcp23a	5.41 / 29

Same-tree mean **hcp235**

Sample:	**hcp25**
Last ring date AD:	1514
hcp23	10.46 / 59

Components of site master **HMPTNCT1**

Sample:	**hcp2**	**hcp3**	**hcp4**	**hcp5**	**hcp7**	**hcp235**	**hcp28**	**hcp29**	**hcp27**
Last ring date AD:	1525	1524	1502	1489	1470	1516	1477	1492	1513
hcp1	5.93 / 98	3.42 / 98	5.75 / 98	4.37 / 93	3.50 / 58	5.17 / 96	2.68 / 81	3.52 / 69	2.72 / 57
hcp2		3.00 / 134	3.45 / 108	4.70 / 99	1.97 / 58	5.30 / 118	2.56 / 87	3.29 / 69	4.35 / 76
hcp3			2.42 / 108	4.81 / 102	3.18 / 58	3.15 / 118	2.08 / 90	3.65 / 69	0.26 / 76
hcp4				3.75 / 95	2.32 / 58	3.01 / 104	3.99 / 83	4.56 / 69	3.34 / 65
hcp5					3.85 / 58	3.37 / 91	5.30 / 92	6.39 / 66	1.51 / 52
hcp7						2.81 / 58	3.43 / 58	3.81 / 47	0.38 / 33
hcp235							3.70 / 79	2.55 / 69	9.54 / 76
hcp28								4.93 / 54	1.09 / 40
hcp29									1.14 / 55

Components of timber **hcp32**

Sample:	**hcp32b**
Last ring date AD:	1633
hcp32a	5.75 / 32

Timber **hcp33**

Sample:	**hcp33b**
Last ring date AD:	1633
hcp33a	9.79 / 20

Timber **hcp36**

Sample:	**hcp36b1**	**hcp36b2**
Last ring date AD:	1618	1633
hcp36a	9.14 / 88	5.79 / 14
	hcp36b1	0.00 / 0

Components of timbers **hcp41** **hcp44**

Sample:	**hcp41b**	*Sample:*	**hcp44b**
Last ring date AD:	1632	*Last ring date AD:*	1633
hcp41a1	9.30 / 23	**hcp44a**	7.33 / 92

Same-tree means **hcp3444** **hcp412**

Sample:	**hcp44**	*Sample:*	**hcp42a1**
Last ring date AD:	1633	*Last ring date AD:*	1625
hcp34	11.11 / 124	**hcp41**	13.89 / 79

Components of site master **HMPTNCT2**

Sample:	**hcp36**	**hcp37**	**hcp38b**	**hcp39**	**hcp40**	**hcp46**	**hcp45**	**hcp412**	**hcp3444**
Last ring date AD:	1633	1633	1584	1589	1615	1631	1618	1632	1633
hcp32	2.76 / 107	5.68 / 118	3.40 / 75	2.38 / 82	2.65 / 69	4.37 / 97	3.75 / 94	4.23 / 94	3.52 / 126
hcp36		2.55 / 107	1.06 / 58	1.56 / 63	1.60 / 69	3.41 / 97	3.43 / 92	4.20 / 94	2.46 / 107
hcp37			4.02 / 69	3.22 / 74	4.40 / 69	4.33 / 97	4.21 / 94	9.32 / 94	2.65 / 118
hcp38b				2.72 / 75	1.28 / 38	4.29 / 50	4.07 / 60	4.05 / 46	2.43 / 75
hcp39					1.93 / 43	4.03 / 55	2.56 / 65	3.98 / 51	6.40 / 89
hcp40						1.23 / 69	2.05 / 69	4.77 / 69	2.65 / 69
hcp46							3.49 / 84	2.58 / 93	2.68 / 97
hcp45								3.36 / 80	2.60 / 94
hcp412									3.02 / 94

Table 3a: Dating evidence for the site sequence **HMPTNCT1**: 1376–1525 Regional multi-site chronologies are in **BOLD**

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Hampshire Ω	Abbots Barton	(Miles and Worthington 1998)	ABTSBRTN	1387–1559	139	8.7
Berkshire	Shalford	(Miles and Worthington 2001)	SHALFRD2	1403–1574	123	8.7
Hampshire	Hampshire Master Chronology	(Miles 2003)	**HANTS02**	443–1972	150	8.4
Oxfordshire	Christ Church Cathedral	(Fletcher pers comm)	KITCHEN	1389–1484	96	8.3
Berkshire	Windsor Castle kitchen	(Hillam and Groves 1996)	WC KITCH	1331–1573	150	8.3
England	Ref3 Master Chronology	(Fletcher 1977)	**REF3**	1399–1687	127	8.1
Berkshire	Round Tower, Windsor Castle	(Miles and Haddon-Reece 2003)	WINDSOR2	1385–1468	84	7.9
Hampshire Ω	St Olaf's Pond Cottage, Wonston	(Miles and Worthington 1997)	STOLAFS	1376–1535	150	7.9
Hampshire Ω	Mottisfont Abbey	(Miles 1996)	MOTISFNT	1388–1538	138	7.7

Table 3b: Dating evidence for the site sequence **hcp22a1**: 1379–1493 Regional multi-site chronologies are in **BOLD**

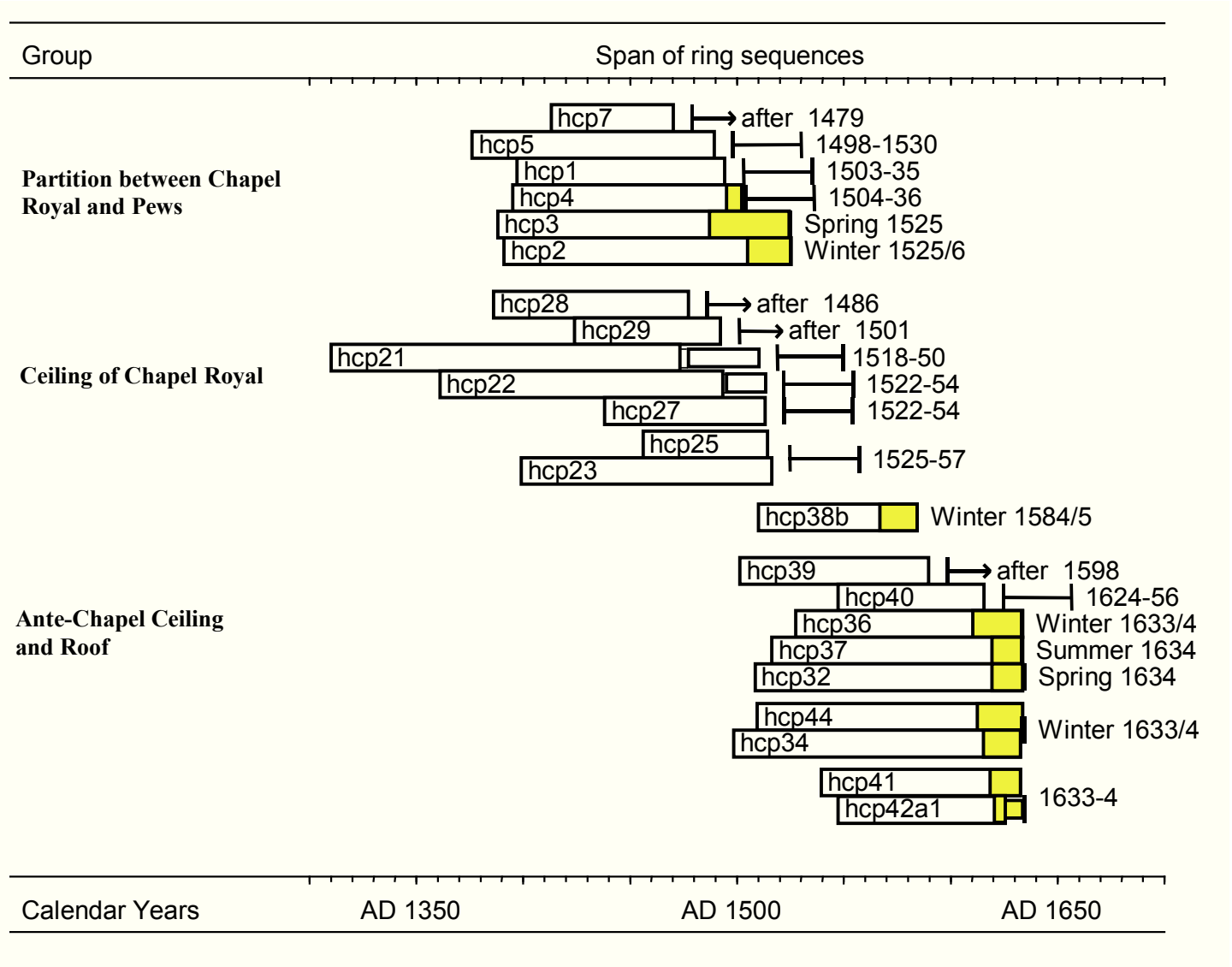
County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Berkshire	Windsor Castle kitchen	(Hillam and Groves 1996)	WC_KITCH	1331–1573	115	6.5
Suffolk	Crow's Hall	(Miles *et al* 2007)	CROWSHL1	1406–1559	88	6.1
Hampshire	Summers Farm, Long Sutton	(Miles and Worthington 2002)	SMMRSFRM	1270–1440	62	6.0
Essex	Cann Hall	(Tyers 1998)	CANNHALL	1301–1511	115	5.8
Suffolk	Hengrave Hall, Hengrave	(Bridge 2001)	HENGRAVE	1367–1512	115	5.7
London	Fulham Palace	(Bridge and Miles 2004)	FULHAM1	1356–1494	115	5.7
East Anglia	East Anglia Master Chronology	(Bridge 2003)	**ANGLIA03**	944–1789	115	5.5
Bedfordshire	Chicksands Priory	(Howard *et al* 1998)	CHKSPQ01	1200–1541	115	5.5
London	White Tower, Tower of London	(Miles and Worthington 1997)	WHTOWER3	1301–1489	111	5.4

Table 3c: Dating evidence for the site sequence **HMPTNCT2**: 1498–1633 Regional multi-site chronologies are in **BOLD**

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Hampshire	Hampshire Master Chronology	(Miles 2003)	**HANTS02**	443–1972	136	11.3
Oxfordshire	Oxfordshire Master Chronology	(Haddon-Reece *et al* 1993)	**OXON93**	632–1987	136	10.1
London	White Tower, Tower of London	(Miles and Worthington 1997)	WHTOWER6	1517–1616	100	9.8
Oxfordshire	Upper House Farm, Nuffield	(Haddon-Reece *et al* 1989)	NUFF	1404–1627	130	9.6
East Anglia	East Anglia Master Chronology	(Bridge 2003)	**ANGLIA03**	944–1789	136	9.3
Oxfordshire	Chazey Court	(Miles *et al* 2004)	CHAZEY1	1507–1614	108	8.9
Berkshire	St Mary's Church, Winkfield	(Arnold and Howard 2006)	WKFASQ01	1534–1628	95	8.8
Somerset	Somerset Master Chronology	(Miles 2004)	**SOMRST04**	770-1979	136	8.8
Hampshire Ω	The Vyne, Sherbourne St John	(Miles and Worthington 1998)	THEVYNE3	1543-1653	91	8.5

Ω = constituent of **HANTS02**

Bar diagram showing dated timbers in chronological position



APPENDIX IV HISTORIC PAINT ANALYSIS REPORT

The Royal Pew, Hampton Court Palace Chapel: An examination of paint traces found on original surfaces

by C. Hassall
January 2008

THE ROYAL PEW

HAMPTON COURT PALACE CHAPEL

An examination of paint traces found on original surfaces.

Contents of report

1	Background information & examination procedure
2	Timbers within Hidden Room
4	Original ceiling and ceiling mouldings
5	Timbers on front of Pew
8	East wall of Lady Chapel
9	Cross-section evidence
13	Sample locations

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Report no.A149
January 2008

Background information

The original sixteenth century chapel was refurbished under the direction of Wren in the late seventeenth century.

Wren's work involved installing a false ceiling to the Pew, and the area above this ceiling became a hidden void. In creating the lower ceiling and the new facade of the Pew, a number of original timbers were re-used.

In the autumn of 2007 the Pew was partly dismantled to carry out structural repairs, and to strengthen the existing supports. The removal of the late seventeenth-century panelling revealed small patches of paint on the sixteenth-century timbers.

Four areas where original paint was examined

1 Timbers at the front of the 'hidden room', some re-used, some original.

2 The original plaster ceiling, within the 'hidden room', and examples of the painted ceiling mouldings, now in store.

3 Timbers at the front of the pew, in their original location but later covered by Wren panelling.

4 Early wall paints on the east wall of the Lady Chapel, at the south end of the pew.

The list of samples and the sample locations are given at the end of this report.

Examination

The samples were examined under low magnification, then mounted as cross-sections to show the layers.
Paint from the different layers was dispersed on glass slides and the pigments identified using a Zeiss polarising light microscope, at magnification x1000.
A chemical test for lead was carried out on red and white layers.
The fibre found in Sample 4 was examined in plane and cross-polarised light

1 - HIDDEN ROOM

1(i) Patches of white paint were observed on the underside of a diagonal brace , made of re-used timbers, at the south end of the east wall

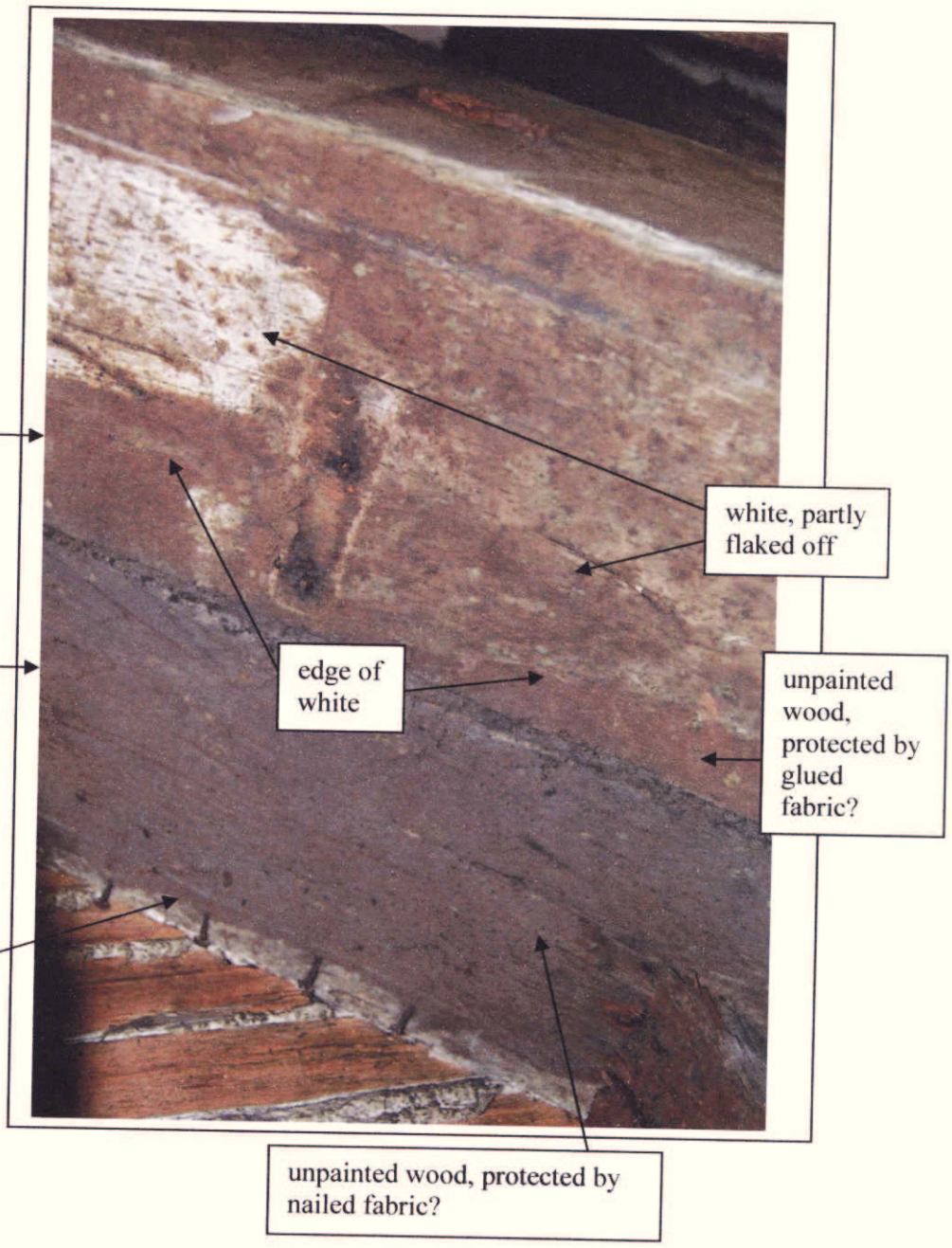
1(ii) A line of red paint was found on the underside of an original horizontal beam at the north end.

1(i) South end – under diagonal brace, consisting of two timbers

The white paint that was found is calcium carbonate and the paint is likely to be a soft distemper or a gesso used as a ground for painted decoration. It could be either as both gesso and distemper are mixed from chalk and animal glue, so they are indistinguishable, however the evidence of the ceiling mouldings suggests gesso is more likely.

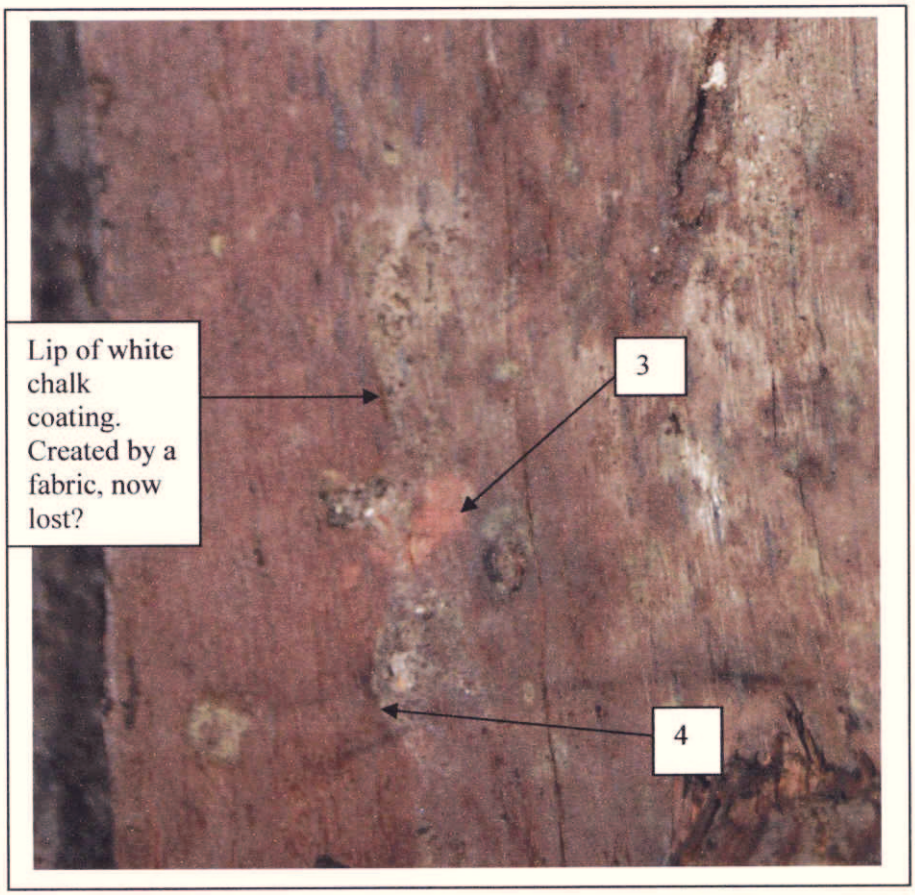
Underside of S. brace

The face of the inner beam has white on it. There are no nail holes, but the shaped edge of the white suggests that part of the wood was protected by fabric - perhaps glued rather than nailed.



The outer edge of the outer beam has a strip of white gesso [or distemper] bordered by a series of nails. The scalloped edge of the white suggests that the unpainted part of the wood was originally covered with some kind of stretched and nailed fabric.

Diagonal brace shown on previous page – the beam nearest the interior of the hidden room.



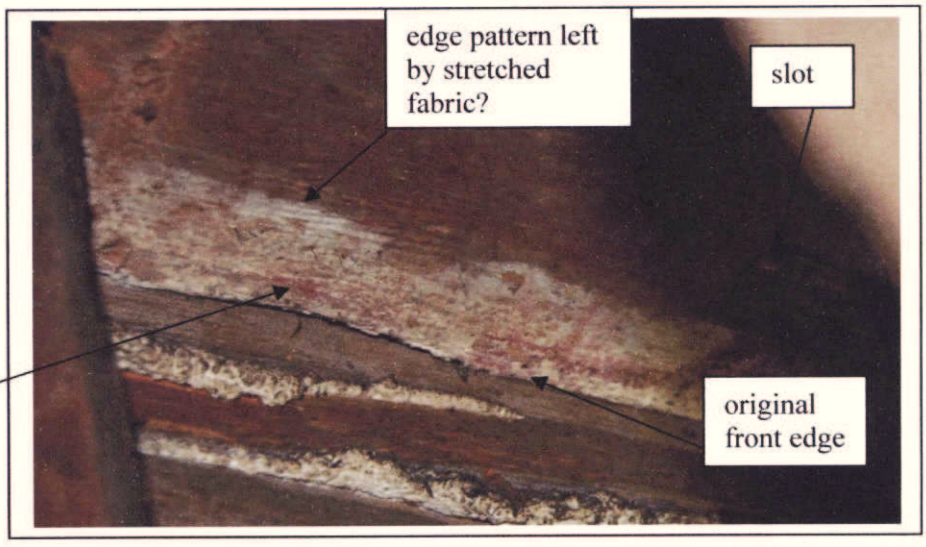
Sample 3, taken from a patch of pinkish red paint, was found to be red lead, similar to the red lead found in splashes on the original timbers of the Pew front.

Sample 4, taken from the edge of the white, was found to contain a single short fibre, identified as a vegetable fibre, probably linen. It is impossible to say if this is from later contamination, or from fabric originally fastened to the wood.

1(ii) Original horizontal beam at north end of hidden room

The underside of the horizontal beam has rectangular slots cut in it at regular intervals, close to the front edge.

Between the slots and the front edge is a band of white gesso [or distemper], and on top of that a strip of pure red iron oxide [Sample no.8]



2 - ORIGINAL CEILING

Within the void created by the seventeenth-century false ceiling, is the original sixteenth-century ceiling. The wooden mouldings have been removed, leaving a pattern on the plaster.

The plaster itself consists of a coarse coat containing hair and fine sand, followed by a fine skim coat of pure lime plaster.

Either side of the shapes left by the mouldings is a single thin layer of white soft distemper. This distemper is the original decoration, as it is clear that the ceiling was never decorated again.

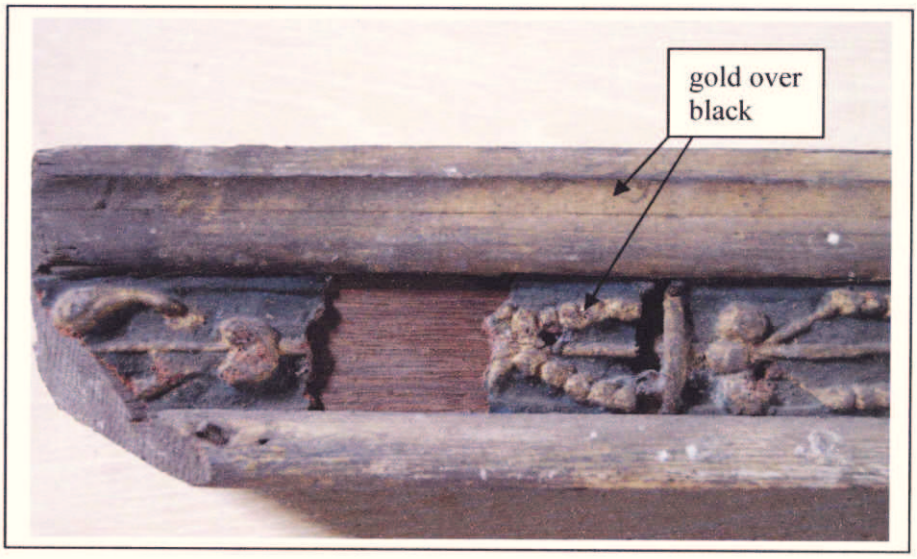
Removed ceiling mouldings

Several pieces of original ceiling moulding are kept in store. A sample of blue and of gold were taken from them to compare with splashes of blue paint found on the front of the Pew.

The cross-sections show that the wood was first prepared with a thin ground of white chalk gesso.

The next layer was a grey/black undercoat of carbon black and a small amount of lead white. This is different from the pure carbon black found on the front of the Pew [e.g. Sample 19]

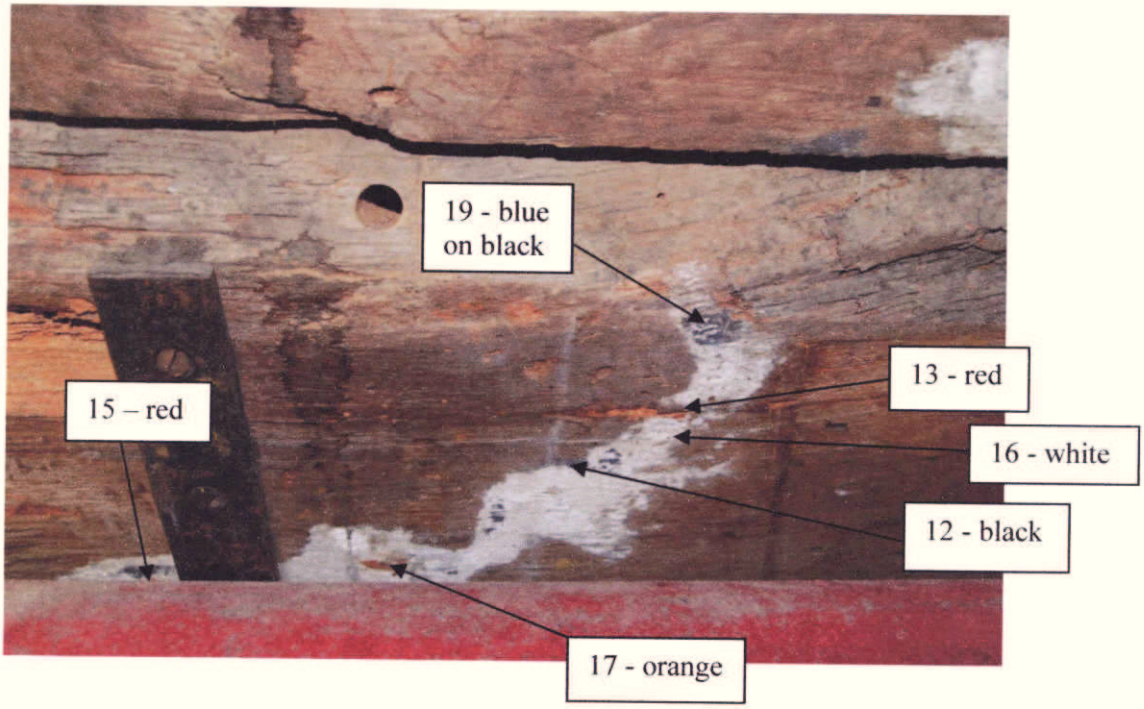
The gold leaf [Sample 25] was laid on next using an orange oil size of lead white, ochre and red lead. The final layer was pure blue azurite [Sample 26].



Significantly, the oil size is the same mix as the orange found on the Pew front [Samples 14 & 17].

3 - PEW FRONT

3(i) Horizontal beam. Most of the paint splashes were found on the front of the horizontal timbers, below the Royal Pew, in the centre. The pattern they make suggests that they were accidentally created by painters decorating the original ornamental front of the Pew which was removed in the late seventeenth century.



Blue on black

Sample 19 was taken from a blue area, but it did not make a satisfactory cross-section as the blue particles crumbled off, and only the black survived. However, we can see in this detail that the black was intended as a ground for the blue.

The azurite has only survived where it is in a hollow of the wood grain.

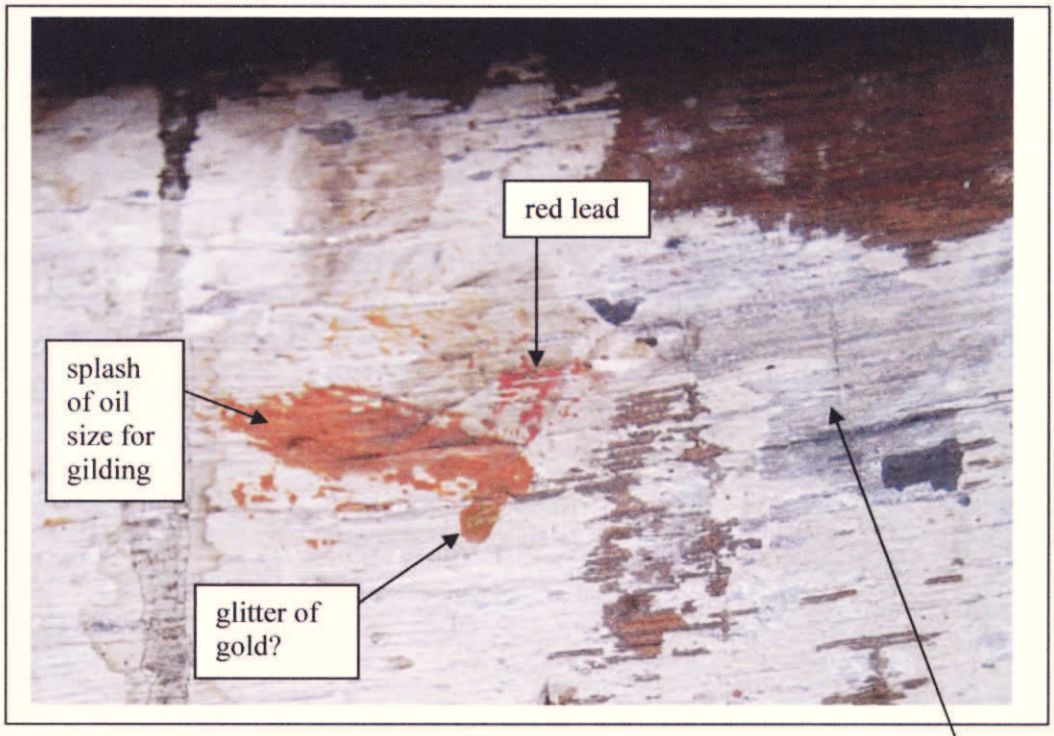
Orange and red

There were three patches of bright red, and one patch of orange.

The reds were all red lead. Some patches were brighter than others, but this seems to relate to the condition of the pigment. The paint had a slightly powdery consistency, similar to the black and the blue.

The patch of orange had a glossy surface, and appeared more richly bound than the other paints. It was found to be a mixture of yellow ochre, lead white and red lead and, and as these are the same pigments used for the oil size under gilding on the ceiling mouldings, it is reasonable to deduce that this patch was splashed on by gilders. An oil size would have to be rich in drying oil, hence the glossy texture of the paint splash.

When the patch of orange was lit from certain directions there seemed to be a slight glitter of gold, however no gilding was picked up in Samples 14 and 17.



In this photograph we can see that there was once much more of the black, and that it has flaked off, leaving a greyish shadow on the white gesso [or distemper].

It is safe to conclude that the front of the Royal Pew was decorated in azurite blue and gold, like the ceiling mouldings, but with added details executed in red lead.

The fact that there is so much black over white, suggests that the same technique was applied as on the ceiling mouldings, i.e. first a white gesso ground, then a black undercoat applied to all surfaces, then gilding and finally the blue [and the red].

3(ii) Post to left of Royal Pew

Partly hidden behind Wren panelling, one can see a white distemper ground then thin black undercoat and pure azurite top coat.

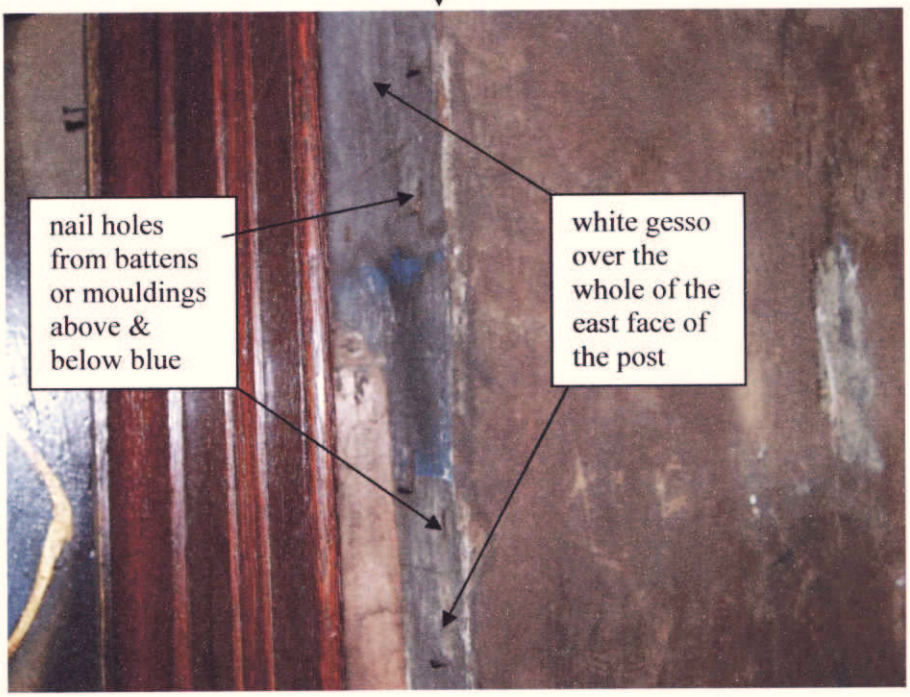
The band of blue was clearly meant to be seen, but the patch of black seen here below the blue, is irregular in shape and is likely to be an accidental splash.

Here the black undercoat is thin, and the blue has survived fairly well.

3(iii) Post at south end of Pew gallery

The same band of blue as above, is seen at this end of the gallery, but with the marks of battens and nail holes above and below it.

A small patch of azurite blue over white can also be seen on the north face of the post, at the same level.



3(iv) Post at north end of Pew gallery – Winter Pew

A thin, straight line of gesso [or white distemper], followed by a splash of pure azurite.

There are no nails, or other fixings, but something vertical, and painted blue, must have butted up against this post

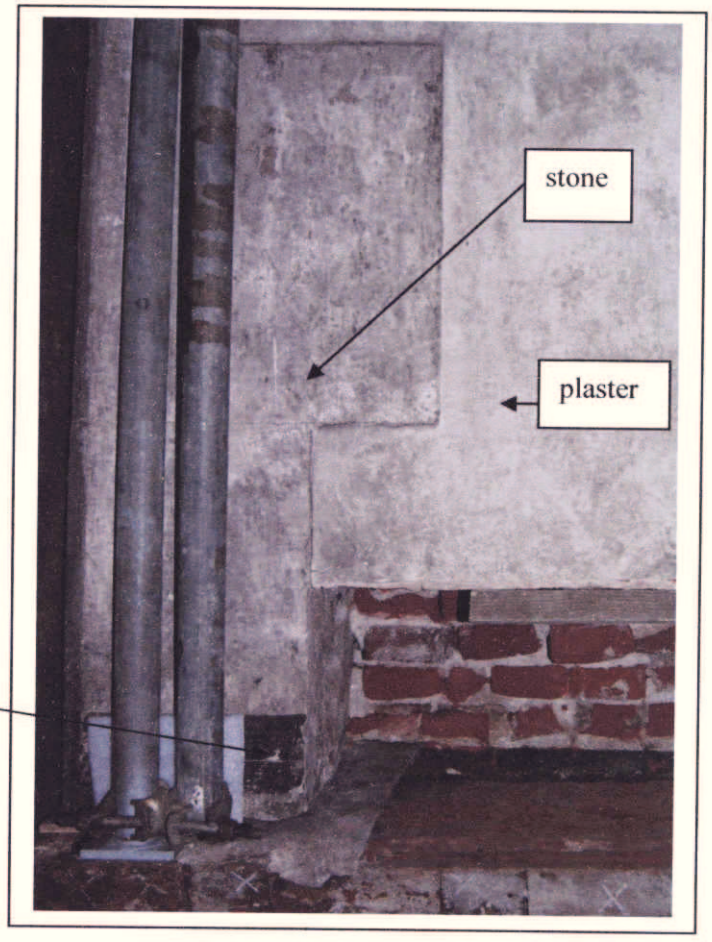
4 - East wall of south end of Pew [Lady Chapel]

The wall is constructed partly of stone, and partly of plaster. Samples were taken from both plaster and stone to compare with Sample 9, taken from the original ceiling.

Unlike the ceiling, which was painted just once, this wall was painted three times with white distemper [or limewash] before the end of the seventeenth century.

The stone was treated the same as the plaster, i.e. it was never left bare, but always painted.

The black paint used for the fictive skirting is associated with the final decoration. The first two times the room was painted, this part of the wall was plain white [see Sample 4b].



CEILING IN HIDDEN ROOM

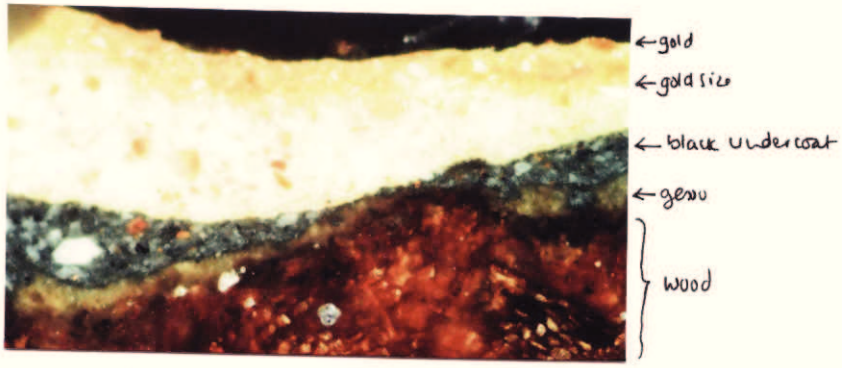
SAMPLE 9
Plaster next to shape of lost moulding

A single layer of soft distemper on fine plaster.

[x200]

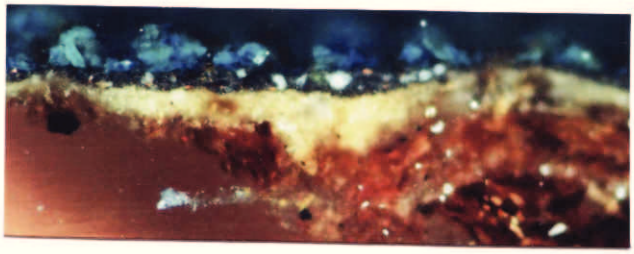
SAMPLE 25
Gilding on ceiling moulding

The yellow oil size under the gold is the same as a splash of orange on the front of the pew [see no.17]



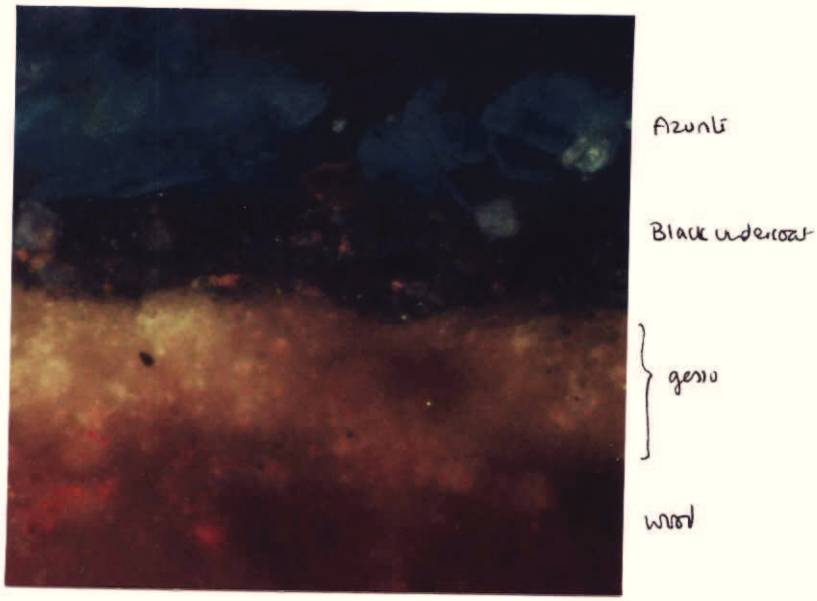
SAMPLE 26
Blue from ceiling moulding

Azurite on black undercoat, on gesso. [x200]



Detail, showing the large blue particles of fine quality azurite.

[x500]

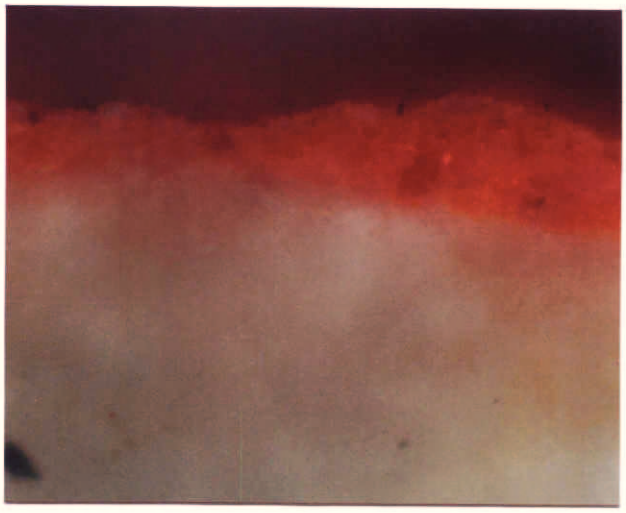


FRONT OF PEW

SAMPLE 13
bright red

Red lead somewhat discoloured.

[x500]



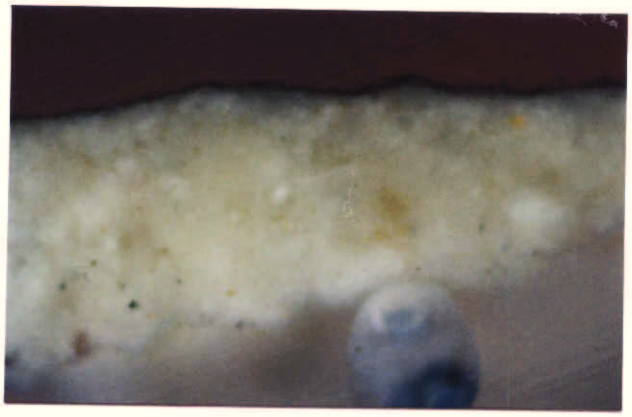
SAMPLE 15
bright red

Red lead in good condition

[x500]

SAMPLE 16
White

Chalk distemper [or gesso]

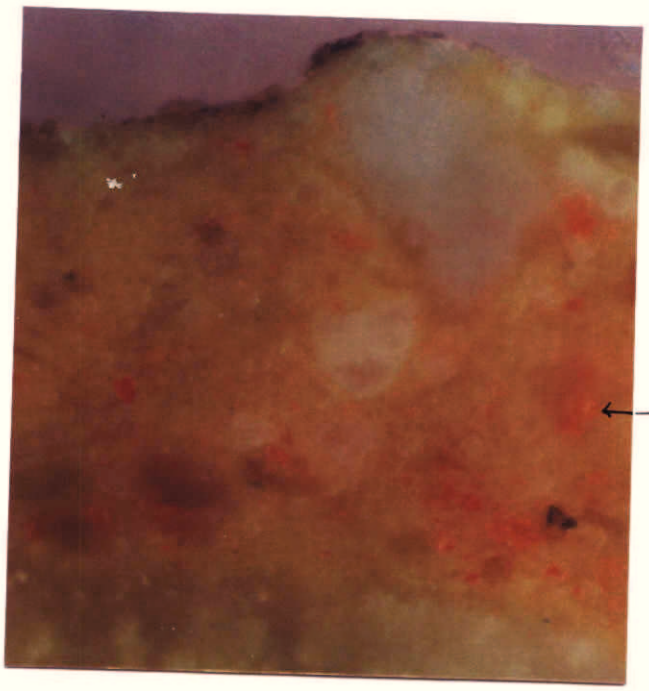


Wood [x200]

SAMPLE 17
Orange

This is a splash of the oil size mixture used for gilding the ceiling mouldings.

[x500]



SAMPLE 19
Black

Where the black was brushed on most thickly the blue has flaked off.

[x500]

SAMPLE 20
Blue on post

Blue over moderately thick black undercoat.

[x200]

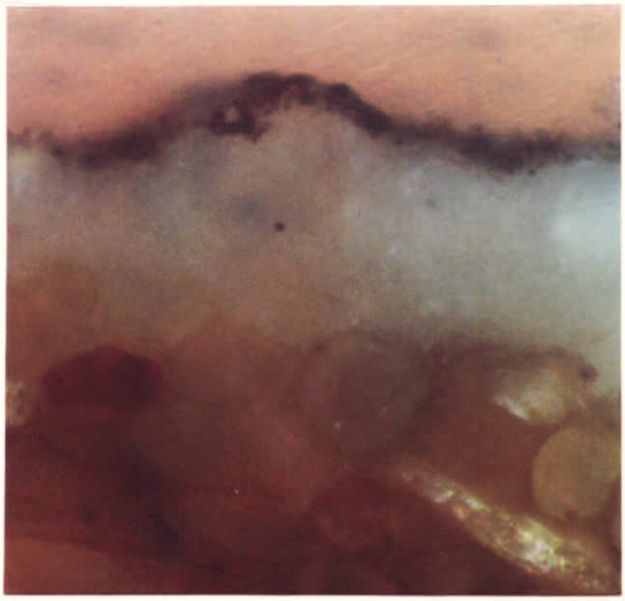
SAMPLE 22
Azurite over a mere skim of the black undercoat. The blue has survived better. [x200]

HIDDEN ROOM, & SOUTH END OF PEW

SAMPLE 1
White from underside of timber used as brace at south end

White distemper [or gesso] based on chalk.

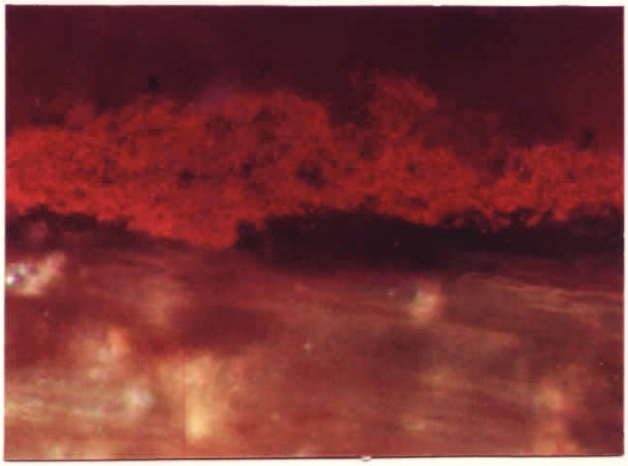
[x500]



SAMPLE 10
Red from underside of horizontal beam at north end

Pure red iron oxide.

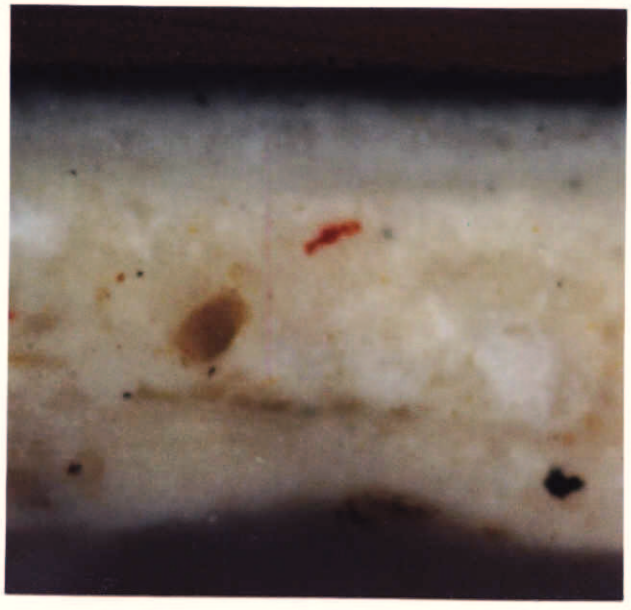
[x500]



SAMPLE 4b
East wall of south end of pew limewashes on stone

Three limewashes with carbon black 'skirting' paint.

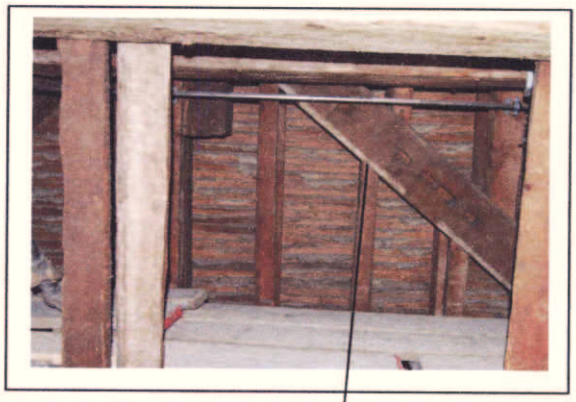
[x500]

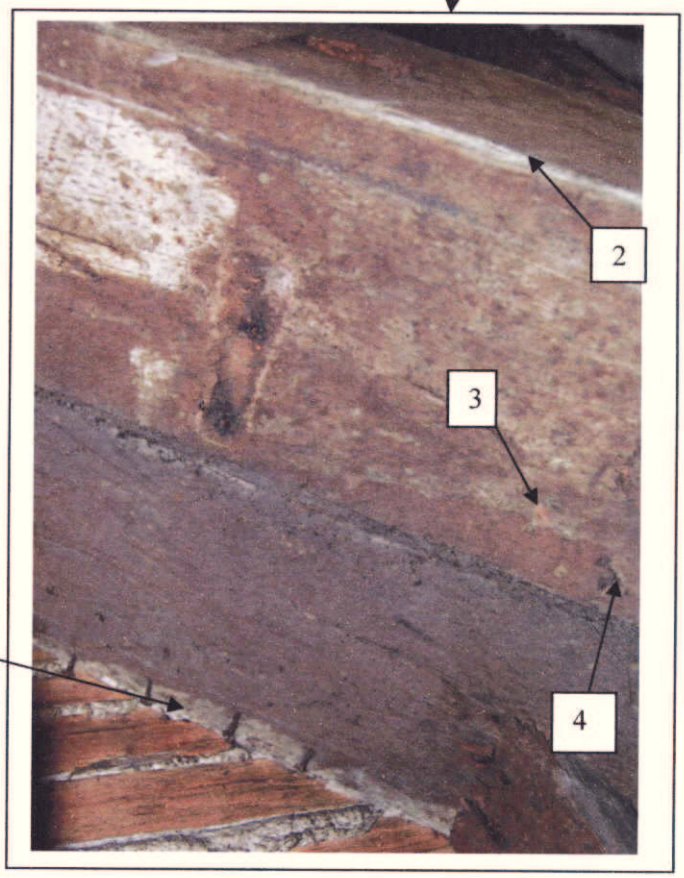


SAMPLES

Hidden room

East elevation - Underside of diagonal brace at south end





1 white on outer edge
2 strip of white down inner edge
3 spot of pinkish red near edge of 'fabric line'
4 fibre caught up in white paint

Underside of beam at north end

8 red on outer edge

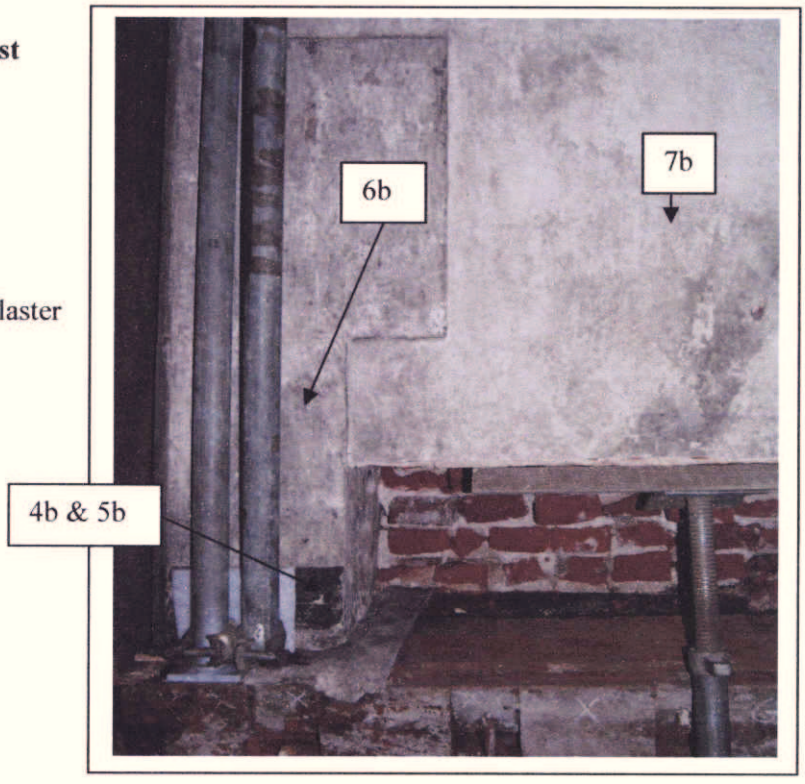
9 plaster ceiling, between marks of lost wooden mouldings.

south end of pew – east wall

4b + 5b black painted skirting

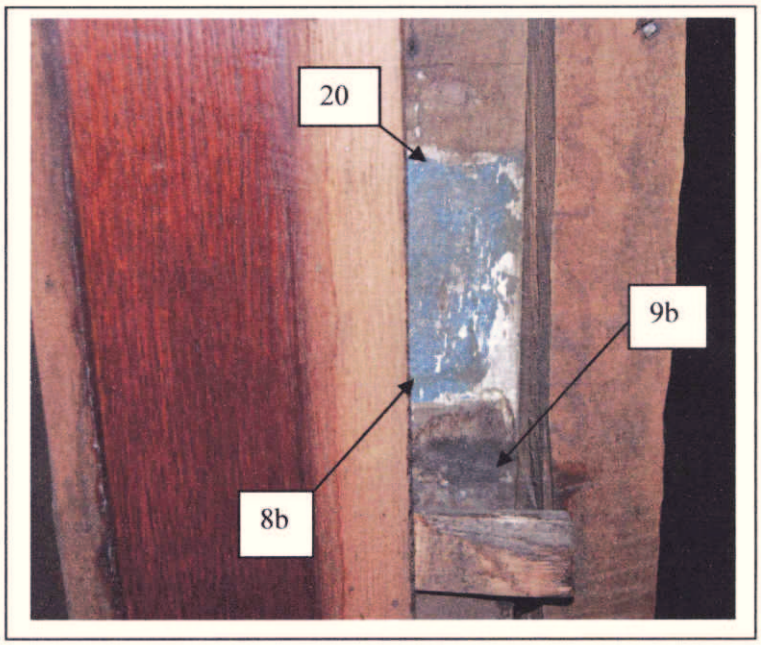
6b white above painted skirting, on stone

7b white limewashes on plaster



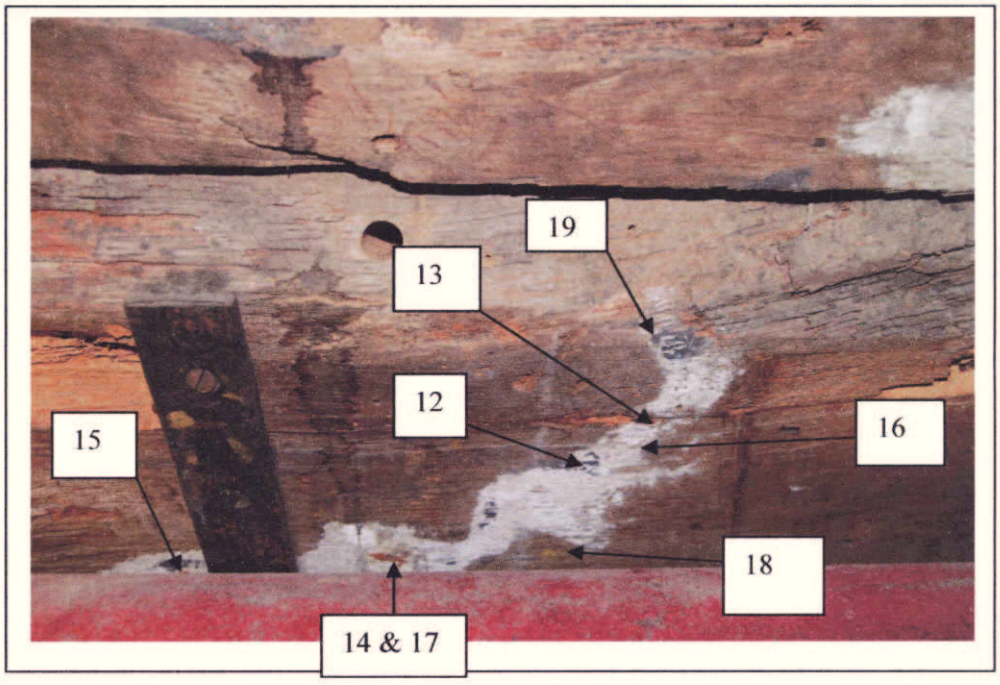
Front of royal pew – post

8b	rectangular patch of blue
9b	splash of black below blue
20	more blue to check for black undercoat



Paint on original horizontal beam supporting the pew front – centre of beam, east face

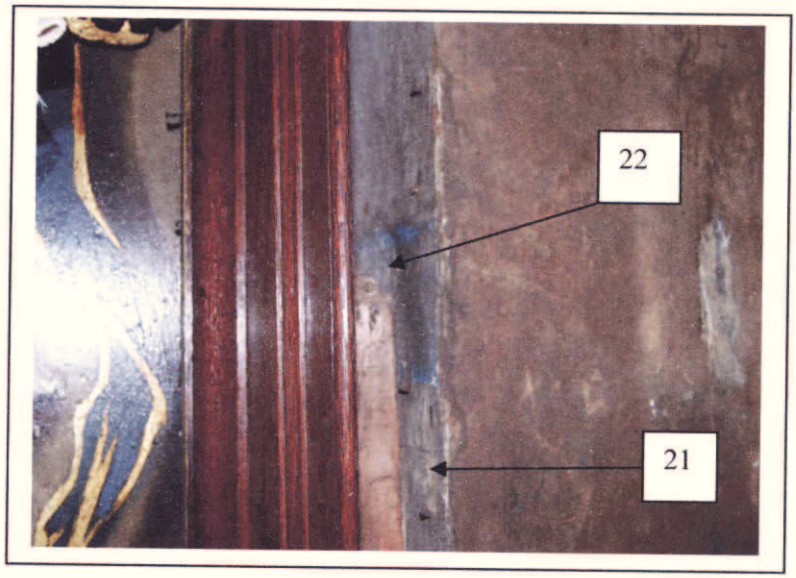
12	black
13	bt red
14	orange
15	bt red
16	thick white
17	orange + gold?
18	yellow smear
19	blue on black



Post at extreme south end of pew

21 Thin white used over the whole of this side of the post

22 Blue horizontal band



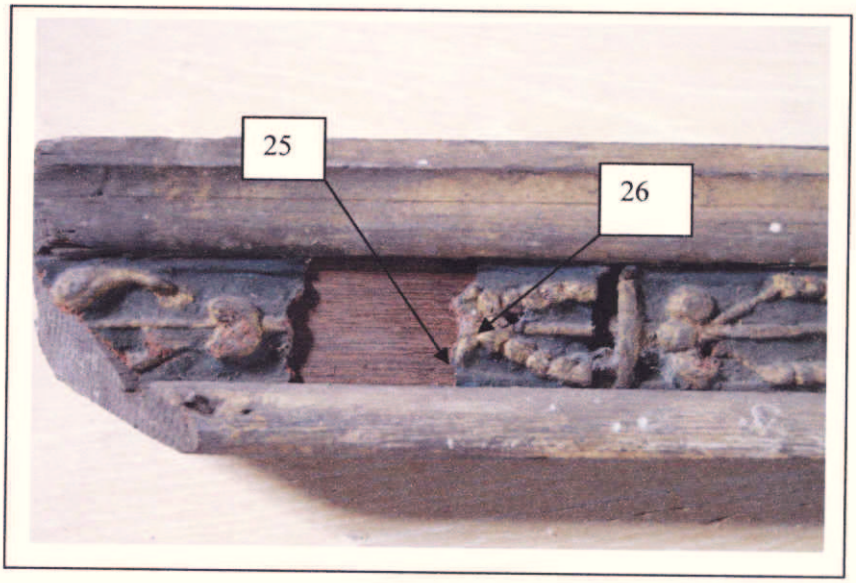
Post at extreme north end of pew

23 Blue on white

Ceiling mouldings

25 gilding

26 blue



APPENDIX V **PAINT CONDITION REPORT**

Condition assessment of paint fragments discovered on balcony beam and elsewhere: Chapel Royal, Hampton Court Palace

By Jon Burbidge
Granville & Burbidge
October 2007

GRANVILLE & BURBIDGE
CONSERVATION AND RESTORATION

Condition assessment of paint fragments discovered on the balcony beam and elsewhere: Chapel Royal, Hampton Court Palace

1. Introduction

During a major campaign to stabilise the structure, scattered paint fragments were discovered on the balcony beam and on the structural timberwork in the vicinity. This report documents the condition of the surviving fragments. Separately, the detailed mapping of the fragments was undertaken by Alison Kelly (Oxford Archaeology) and the technical analysis of the paint was by Catherine Hassall (report forthcoming).

The beam and surrounding area were initially examined on 1st August 2007 in the company of Alison Kelly and Catherine Hassall. The fragments were examined using a methyl-halide spot light and ultra-violet light. A subsequent examination of fragments discovered later, was undertaken on 25th September in the company of Andrew Harris and Alison Kelly.

2. Description

The majority of paint fragments were found on the east face of the balcony beam; a large area of blue was found on the east face of the north post (5) and on the south post (***Plate 1***); traces of red were found on the north bracing beam above the Thornhill ceiling. Significantly, a series of nails with the negative of where a cloth was affixed, were found on the south bracing beam (***Plate 2***).

The surviving fragments can be classified into three categories:

a) Intact decoration: where the entire paint structure is extant
b) Incidental layers: where possibly only the preparatory layer survives, but indicates an edge or outline of some previous structure – now missing, such as the oriel windows
c) Accidental layers: drips and daubs of colour that have fallen or been applied accidentally.

Often the surviving paint will be a combination of these categories and in totality provides important information about this early 16th century decoration.

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Jenny Granville Dip. Restoration (City & Guilds of London Art School)
John Burbidge Dip. Restoration (Opificio delle Pietre Dure, Florence), ACR

2.1 Balcony beam

The paint fragments consist mainly of a thick white preparation (gesso – calcium carbonate + animal glue?) which has never been painted. Occasional random odd daubs and drips of other colour: black, blue, red, dark yellow ochre and gold can be seen on this coating (***Plates 3-5***). There was a difference in fluorescence between the white preparation and the black when viewed in ultra-violet light, indicating a different binding medium. Significantly, some of the residue white preparation appears to roughly correspond with the outline of two former oriels for which there is structural and archival evidence (***Plate 1***). There are also similar vertical tracks - suggesting previous fixings, in other areas of white which correspond to the base of (former) posts 6 and 2 (***Plates 1 & 6***). The symmetry of these remains has implications for isolated areas of surviving paint – see below.

2.2 North post (5)

The east face bears perhaps the most significant remains of a decoration (c. 9.5cm high): a thick white preparation – similar to that found on the balcony beam - covered with a bright blue colour. The upper horizontal edge appears to be intentionally delineated, suggesting a previous fixture. Below this is a daub of black directly onto the cut surface of the timber (***Plate 7***). It is quite likely that an area of comparable blue decoration survives on the east face of the corresponding south post (3?).

2.3 North bracing beam (above the Thornhill ceiling)

Tucked away in the roof space is a long strip of white preparation – similar to that found on the balcony beam, covered with a red colour. The preparation and colour also have an intentional edge (***Plate 8***).

2.4 South bracing beam (above the Thornhill ceiling)

A series of hand forged nails with the outline of where a cloth was attached, was discovered (***Plate 9***). The use of cloth – frequently linen, tacked to the timber structure to cover an awkward space and provide a continuous surface for painting, was a common practice in the 16th century.

3. Condition assessment

In most areas where paint survives there are widespread - relatively fresh looking - small paint losses (***Plates 4, 5 & 7***). Most areas of loss appear to be caused by a failure of cohesive strength within the thick white preparation. This is most likely caused by variations in temperature and relative humidity which has no doubt increased since the removal of the protective panelling and cladding. Similar losses have occurred in cases where there are black drips over the white preparation. Despite this the surviving polychromy appears relatively sound whilst remaining vulnerable.

4. Conclusions

- The uv examination did not reveal any areas of paint not readily visible to the naked eye. It did differentiate between the white background layer and the superimposed black layer suggesting these are of different mediums.

- There are some interesting paint fragments suggesting the remnants of an early 16th century decorative scheme. Characterisation of the paint samples by Catherine Hassall could provide some very useful information and possibly confirm this. It would also be interesting to see if this decoration was part of a more general decoration of the Chapel from this period. Although totally overpainted, an obvious starting point would be the ceiling.[1]
- There are obvious and fairly substantial "fresh-looking" losses to the surviving paint – evident on the blue band (north post) and the white with superimposed black (beam) – two of the most significant areas of surviving paint. The surviving paint is vulnerable to loss from direct contact and vibration through the structure. It is debatable whether the surviving paint warrants treatment at this point, but certainly caution when working in the vicinity. Comparison with images taken immediately after the panelling was removed may indicate when losses occurred.
- The pipe running along the face of the beam currently partially conceals the fragments of paint – but also helps protect it. There is concern that the removal of this pipe will put areas of paint at risk.

John Burbidge – 17th October 2007

[1] A sample of blue paint was collected from a ceiling rib in August 2002 and deposited with the Conservation and Collection Care Department. Ref. report *"Condition Audit of the Painted Walls and Ceiling – 12/13.08.02: The Chapel Royal, Hampton Court Palace"*, Granville & Burbidge.

5. Plates (1-9)

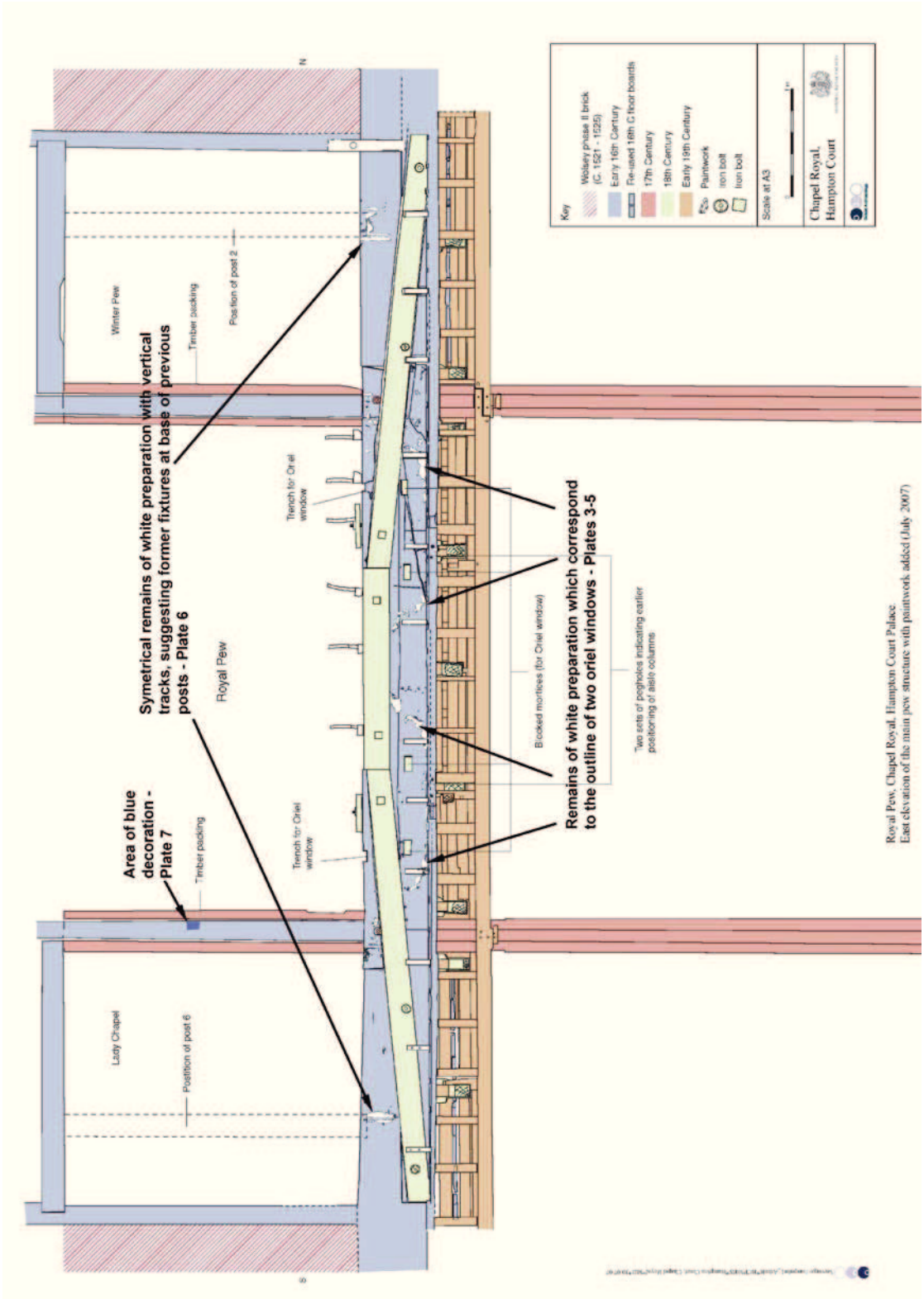


Plate 1: East elevation of the main pew structure showing location of polychromy. Original image courtesy of Oxford Archaeology

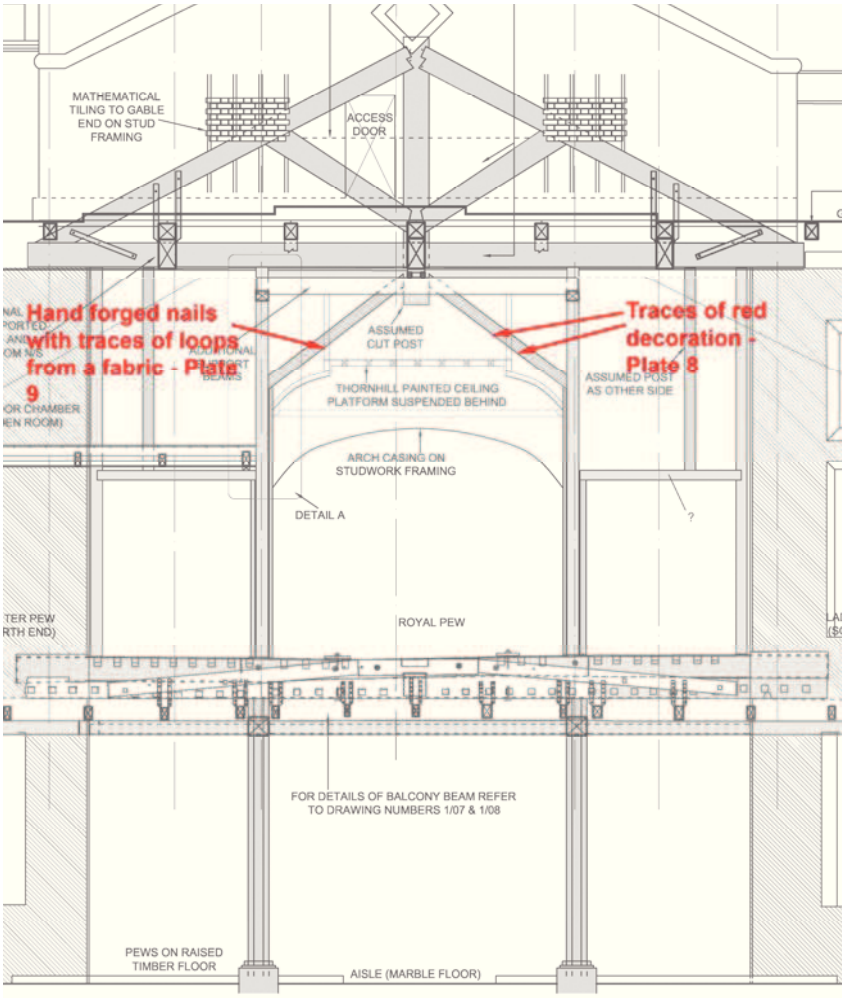


Plate 2: west elevation of pew framework showing location of polychromy. Original image courtesy of Oxford Archaeology

Plate 3: detail of white preparatory layer surviving on the east face of the balcony beam. The remains indicate the outline of a former oriel window - see Plate 1

Plates 4 & 5: details of the white preparation surviving on the east face of the balcony beam. The random dribs and daubs of other colours (black, red, dark yellow ochre and gold) are visible. Note widespread losses in the white layer and losses to the black drips.

Plate 6: detail of the vertical tracks within the white preparation on the east face of the balcony beam at the base of former post 2. Similar traces are visible on the north side of the beam, at the base of former post 6.

Plate 7: detail of an area of bright blue decoration on the east face of post 5 – see Plate 1. The upper edge appears intentional, suggesting a previous fixture. Note small, fresh-looking paint losses.

Plate 8: detail of red decoration on the north bracing beam (above the Thornhill ceiling) showing an intentional edge – the limit of the decoration. See Plate 2

Plate 9: detail of the surviving nails with the outline where a cloth was formerly attached, south bracing beam (above the Thornhill ceiling). See Plate 2

APPENDIX VI HISTORIC GRAFFITI

A Summary of historic graffiti recorded during investigative works

by Andy Miller and Alison Kelly
Oxford Archaeology
March 2008

Contents:

Summary of graffiti found

1. Graffiti recorded – ground floor north side of ante chapel wall, lower panel, west facing elevation
2. Graffiti recorded – ground floor, north end of ante chapel wall, second panel, west facing elevation
3. Graffiti recorded – ground floor, north end of ante chapel wall, lower quoin, west facing elevation
4. Graffiti recorded – first floor, north end of ante chapel wall (Winter Pew), second quoin up, west facing elevation
5. Graffiti recorded – first floor, north end of ante chapel wall (Winter Pew), second and third quoins up, west facing elevation
6. Graffiti recorded – first floor, north end of ante chapel wall (Winter Pew), fourth and fifth quoins up, west facing elevation

Summary of Graffiti Recorded

1.1 The removal of panelling both at ground and first floor level has revealed large areas of graffiti inscribed in a number of hands. This graffiti was presumably inscribed during periods of renovation and repair either before the addition of panelling or when the panelling was removed. The style of lettering and the carved dates suggest that the graffiti belong to the 17th, 18th and 19th centuries.

1.2 Although this is not the first time that graffiti has been seen in these areas, a fish design was revealed during minor exploratory works in 2004 (Rawlinson, Pers. Com.), this phase has proved an excellent opportunity to record further examples. Most of the graffiti was concentrated at ground and first floor level on the northern side of the chapel, with only two examples seen on the south side at ground floor level and none at first floor level. It must be borne in mind that not all the panelling at ground floor level was removed during the course of investigations and repair works, particularly on the south side. The graffiti had been carved (or in some cases written) on the stone quoins and plaster work found at the north and south ends of the main horizontal beams of the pew structure, originating from ground floor level and also extending upwards into the hidden room located above the Winter Pew.

1.3 Much of the surviving graffiti has the appearance of casual doodling, or practise tool strokes, but there are several notable examples of dates and names that have been painstakingly carved. It is difficult to date the graffiti by the writing styles but there are certainly a number of early (17th century?) letters with A's, W's and R's with thick strokes at the terminal ends and across the top. Some of this earlier work appears to be not initials but variants of the rebus (where a number of letters are combined into one shape as a monogram). There is also script in a more florid handwriting style. The date 'April 21. 89' probably relates to 1689 and the 'John Colcut 92' is probably 1692. It is likely that many of the rebus type marks and some of the signatures date to the late 17th century refurbishment of this area. The presence of any obvious graffiti elsewhere in the chapel before this date is possible, and any future works should include the recording of any exposed graffiti.

1.4 An individual called 'Johnny/John' has attempted at least twice to carve his name on one of the stone quoins, but appears to ultimately have given up and written his name (in charcoal) in a very elegant script, (possibly dated to March 18th 1858). Other names and dates carved into the quoins include 'Edward II (but with a date of 1760); one individual has somewhat improbably carved 'Walter Raleigh'. As expected there is also a degree of religious symbolism in the graffiti observed including what may be the representation of the Holy Trinity in the form of a criss-crossed triangle and at least one discernible example of the carved initials I.C (Jesus Christ?) that has subsequently been quite vehemently carved over.

1.5 Various chalk marks and numbers have also been observed on the stone quoins, the adjacent plaster work (at ground and first floor levels) and on both sides of the main pew structure. Most of these appear to be marks for setting out during phases of construction and matching elements (panelling?) together with no significant doodles or names identified. Indeed at first floor level on the plasterwork in the Winter Pew there appears to be what can only be the chalk setting out marks for the fixing of a late 19th or early 20th century electrical fitting.

1.6 Unlike the plethora of examples from the floor below, there was little discernible evidence for graffiti, carved or otherwise, on the quoins within the hidden room above the Winter Pew. The only example present was located on the thin white layer of plaster at the southern end of the elevation with the inscription 'J.A. '97' although it is not certain to which century this refers.

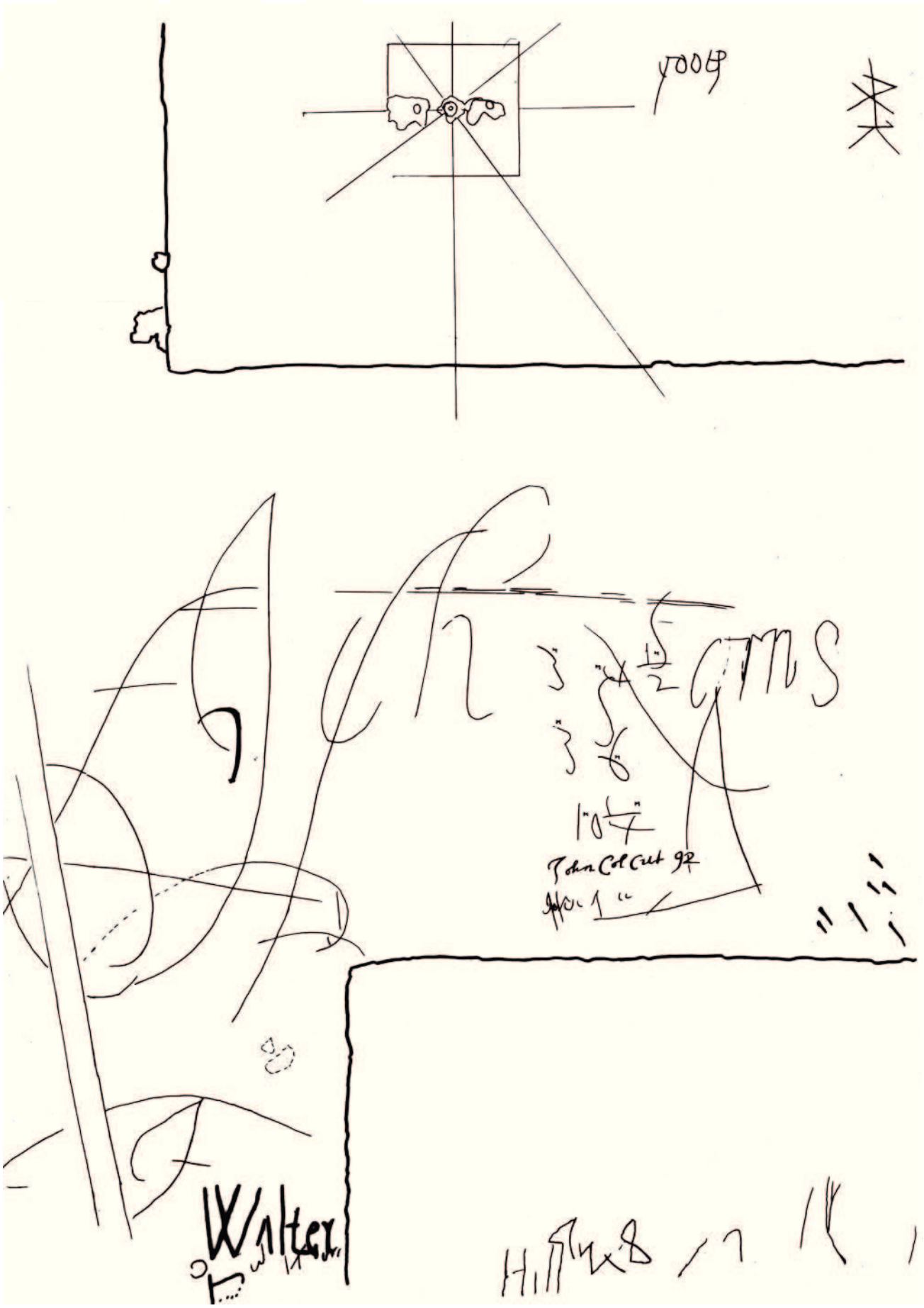
1.7 Three instances of graffiti were found connected to the ground floor north eastern antechapel window. Pencilled graffiti was found upon the stonework on the south eastern reveal. This comprises a list of three indecipherable names and a date of September 1891 – presumably in someway connected with refenestration works that took place around that time. The wooden panel covering the sill of this window has three sets of graffitied initials dated 1795, 1839 and 1835.

1.8 Other examples of graffiti were partially visible but hidden behind panelling not removed on this occasion and perhaps any future work may allow these others to be recorded too. Further analysis will be able to make more sense of the plethora of overlapping names, dates and doodles present on tracings and whether these can be matched to any of the craftsman's names that appear in the building accounts from the Chapel's history and to the fluctuating changes in religious doctrine that took place over the course of the Chapel's history.

Andrew Miller/Alison Kelly
Oxford Archaeology

Appendix V1 (1)

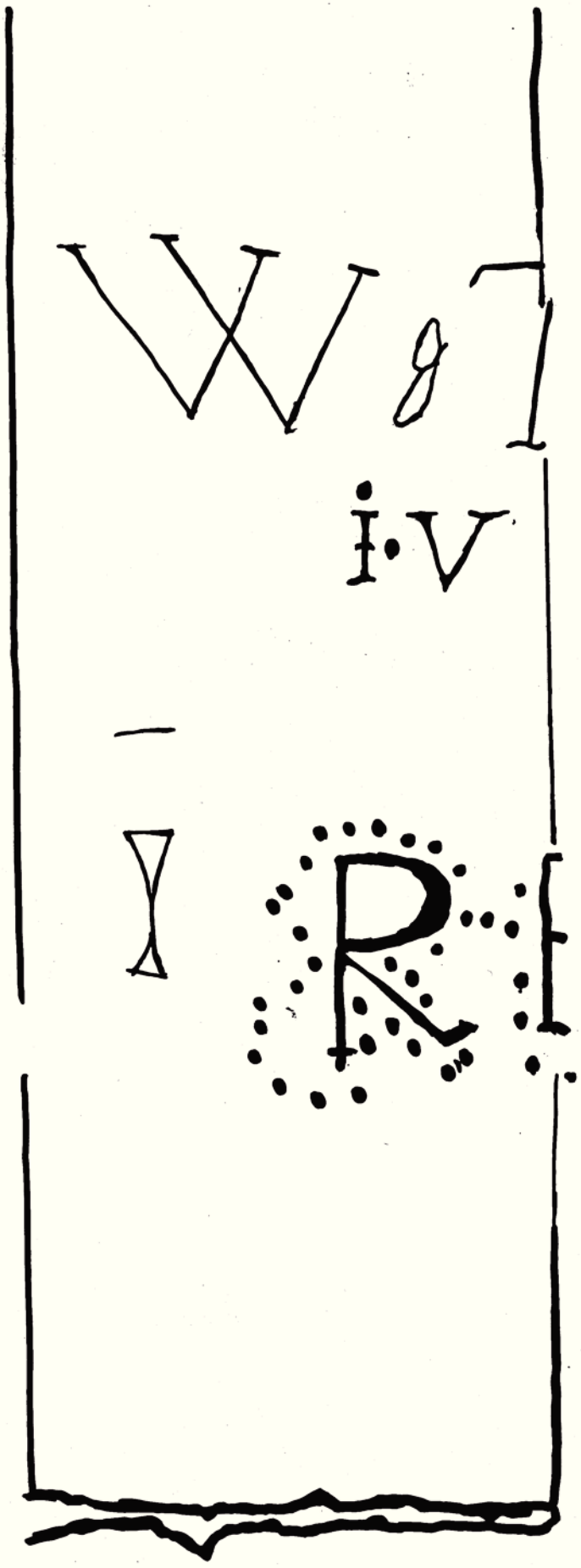
Graffiti: Royal Pew, Chapel Royal, Hampton Court Palace.
Location: Ground floor, north side of ante chapel wall, lower panel, west facing elevation.



0 10 cm

Appendix V1 (2)

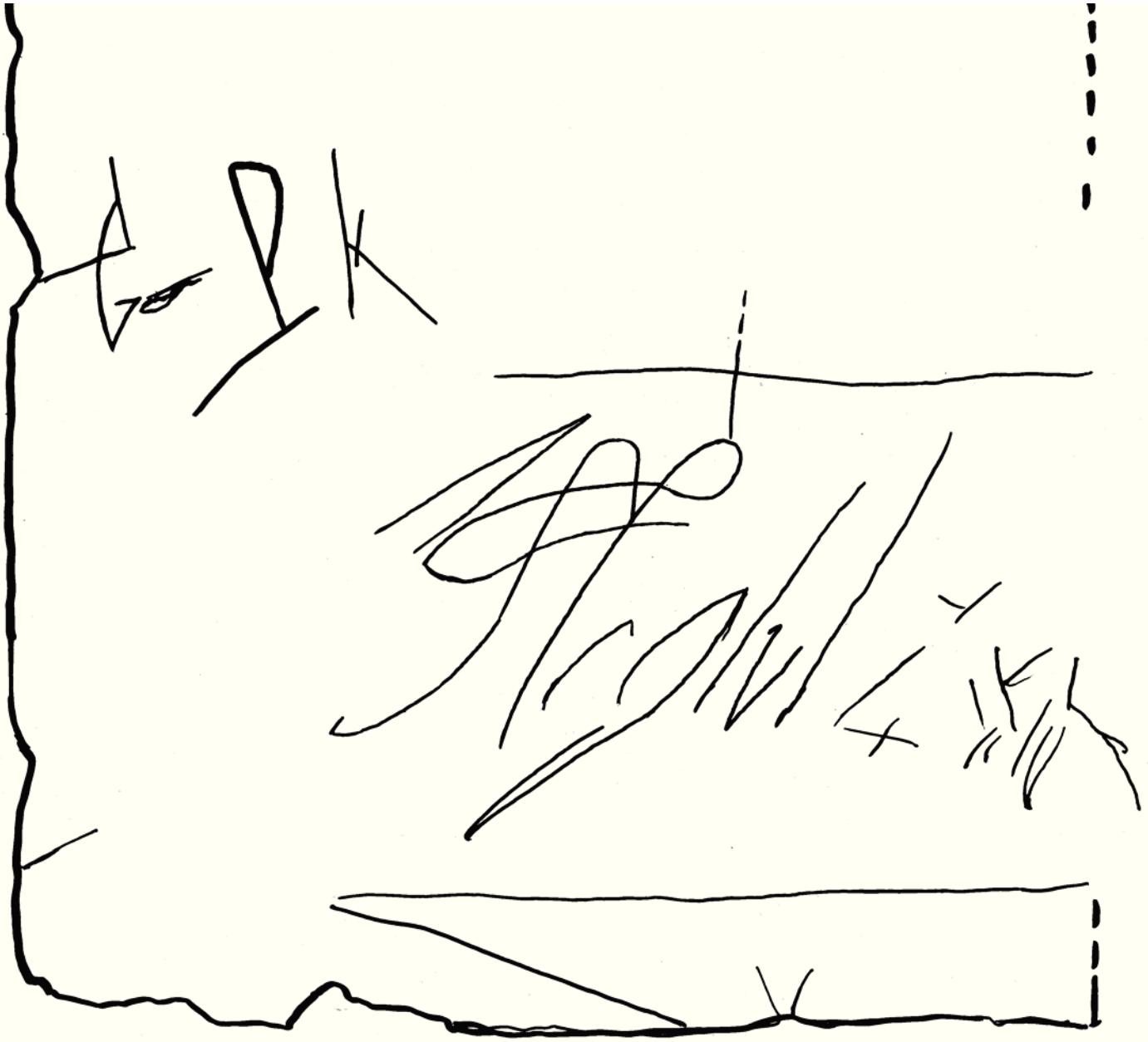
Graffiti: Royal Pew, Chapel Royal, Hampton Court Palace.
Location: Ground floor, north side of ante chapel wall, second panel, west facing elevation.



0 5 cm

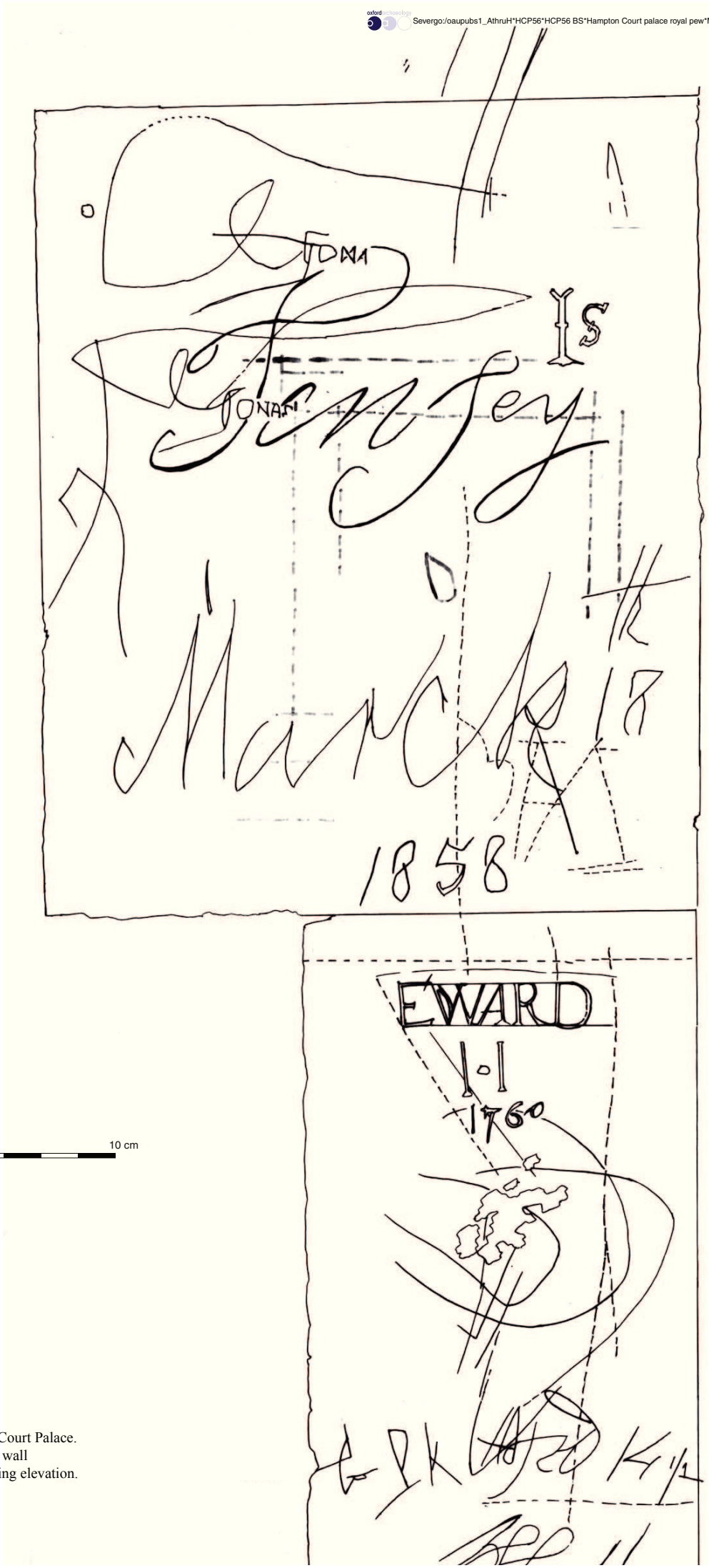
Appendix VI (3)

Graffiti: Royal Pew, Chapel Royal, Hampton Court Palace.
Location: Ground floor, south side of ante chapel wall, lower quoin, west facing elevation.



Appendix V1 (4)

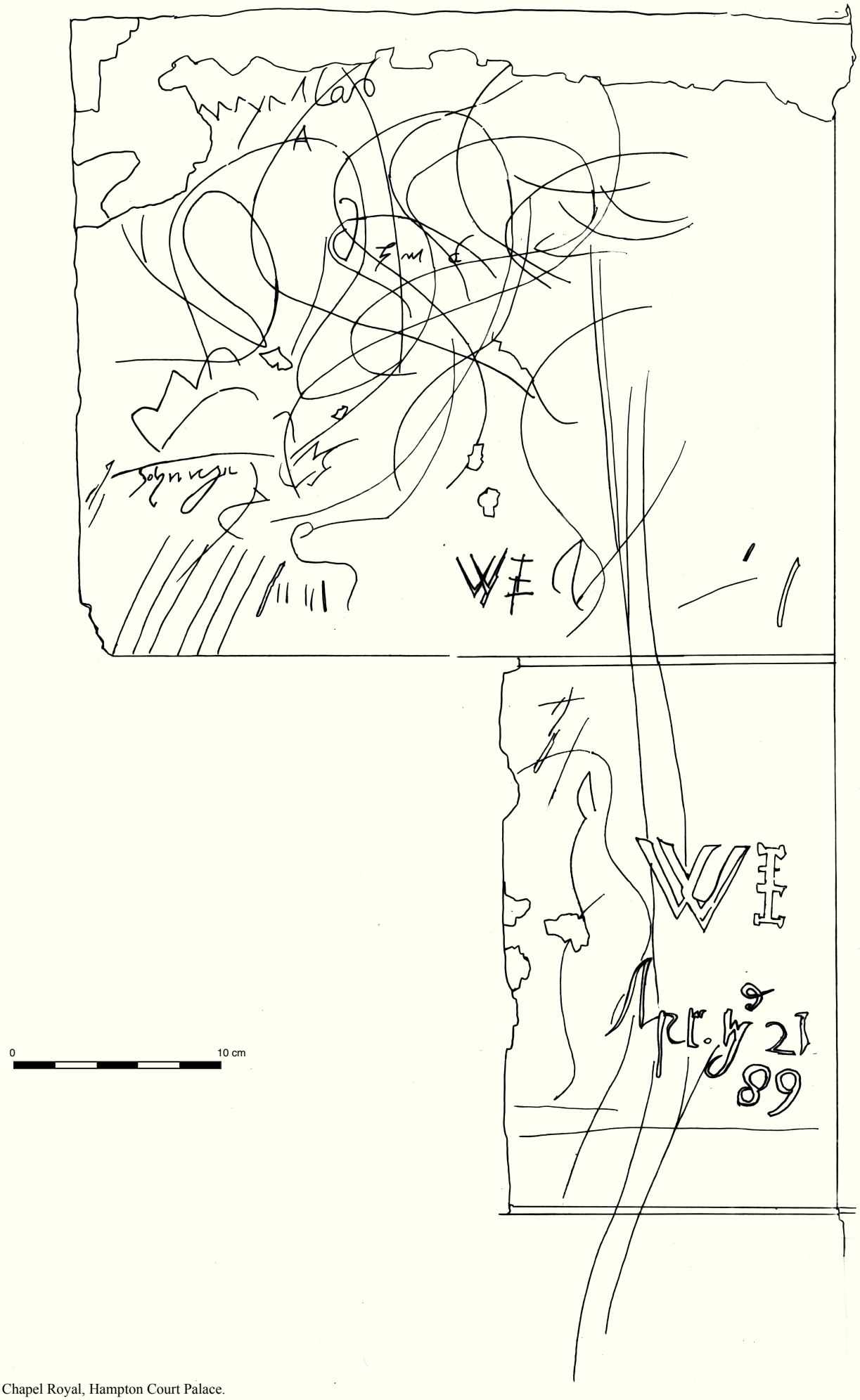
Graffiti: Royal Pew, Chapel Royal, Hampton Court Palace.
Location: First floor, north side of ante chapel wall (Winter Pew), 2nd quoin up, west facing elevation.



0 10 cm

Appendix V1 (5)

Graffiti: Royal Pew, Chapel Royal, Hampton Court Palace.
Location: First floor, north side of ante chapel wall (Winter Pew), 2nd and 3rd quoins up, west facing elevation.



Appendix VI (6)

Graffiti: Royal Pew, Chapel Royal, Hampton Court Palace.
Location: First floor, north side of ante chapel wall (Winter Pew), 4th and 5th quoins up, west facing elevation.

APPENDIX VII CARPENTERS AND OTHER MARKS

A summary of carpenters and other marks recorded on historic timbers during investigative works

By Alison Kelly
Oxford Archaeology
March 2008

Contents:

1. Summary of marks found on historic timbers
2. Table of Baltic/shipping marks recorded
3. Table of assembly and other marks recorded

2 SUMMARY OF MARKS FOUND ON HISTORIC TIMBERS

1.1 Both elevations of the two main horizontal timbers and the top surface exhibit many incised marks from the craftsmen that worked on the construction of various phases of the Royal Pew. The marks on the timbers can be classed as either true assembly/construction marks or unintentional/graffiti marks. The unintentional and graffiti markings on the timbers include many sample cut marks that can be seen on almost all the surfaces observed but primarily on the upper edges of the upper main beam, representing, multiple blade cuts varying in length from 1 to 12cm. These are most likely to have been formed during the construction process when large timbers would be used as workbenches either in the worksyard or when in situ. It is difficult to date the marks on the top face of the upper beam as they could have been made at anytime the upper beam was exposed. There are also numerous other cuts, which are likely to represent specific construction marks made during the assembly and various phases of repair of the Royal Pew throughout its history. Specifically these can be seen on the east elevation of the upper and lower beams and the inserted truss. These are predominantly vertical marks for setting out slots and marking the position of peg holes and bolt holes in relation to other elements of the structure. There are also a set of vertical marks that appear to confirm the marking out of the slots on the east face and the top face of the timbers relating to the position of the oriel windows.

1.2 Other interesting carpenter's marks were noted on the west elevation of the Tudor posts dividing the Royal Pew. The roman numerals I, III, V and VII scribed with a race knife and with a circular tag 0.03m in diameter added. It is assumed that the missing posts would have been numbered II, IIII and VI, where II and VI are the dividing posts for the Winter Pew and Lady Chapel and post IIII is the central post. A main point of interest is the absence of any corresponding numbering on the main beams in order for the carpenters to position the posts in the correct mortice hole. This is a further indicator that the posts were inserted after the main construction of the pew.

1.3 There are numerous diagonal cuts and a semi-circle bisected by two other marks on the north section of the inserted truss. A further full circular mark with two diagonal cross cuts is visible on the east face of the upper main beam at its south end. A symbol cut on the east elevation of the upper beam (visible just below the horizontal inserted truss) is likely to be the central construction mark for the structure (although this does appear now to be slightly off centre). A similar type of scribed mark was discovered at the top of the octagonal column beneath post 5 and also on the inserted truss suggesting that these marks were added during repair works of the 17th/18th century. There is a daisywheel design scribed into the lower beam on the south end of the east elevation which is difficult to date. Generally daisy wheels are seen as a ritual marking, used to protect the building from evil spirits and are often found around doorways, windows and hearths. The daisy

wheel is also a geometric symbol historically used in construction to calculate angles and proportions (Smith 1997, 3). The meaning/purpose of this incised marking on the east elevation is unclear and may simply be a 'doodle'.

1.4 On the west elevation at the south end of the upper primary beam, clear carpenters fitting marks for the three-part upper beam can be observed: a single race scribed line and scribed circle on each timber at the point where the south and central timbers join together. At the other end of the beam where the central timber joins with the northern end two race scribed lines are seen on each, however it is unclear if there is also a circular symbol because at this point the mark is somewhat obscured by the 18th century additional truss.

1.5 '*Baltic' or shipping style marks* - Many overseas trade and shipping marks are present on timbers connected with the later development of the pew. These marks were made upon the timber with a race knife to show the quality, dimensions, origin and destination of the timber and are common in timbers of this date, particularly those of softwood. The south octagonal column had a variety of deeply scribed marks which are probably shipping marks and several cornice beams from the ground floor antechapel beneath the winter pew

1.6 Several standard numeric carpenters marks were observed on many of the timbers within the ante chapel roof space. These were incised marks made with a 2" chisel rather than a race knife and the markings denote the individual trusses. The curved trusses of the vaulted ceiling above the main chapel space have symbolic carpenters marks, however these were not recorded in detail.

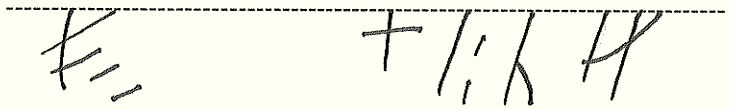
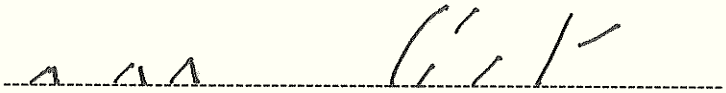
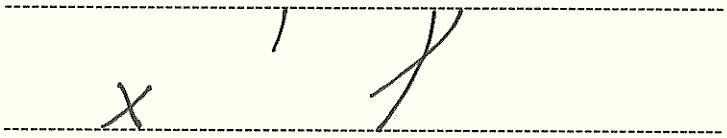
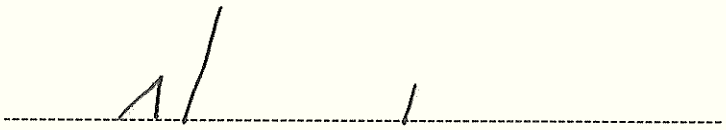
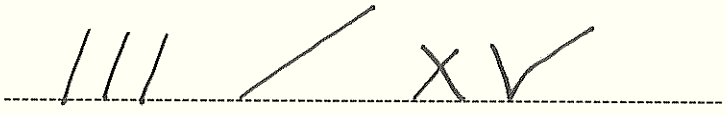
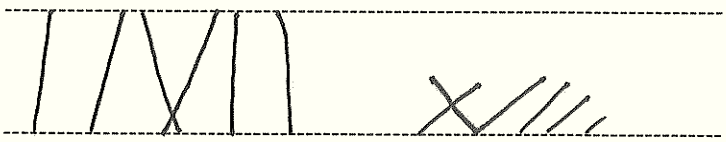
Alison Kelly

March 2008

Royal Pew, Chapel Royal, Hampton Court Palace

APPENDIX VII

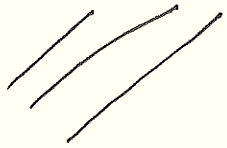
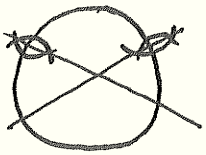
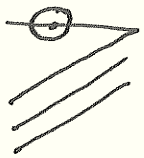
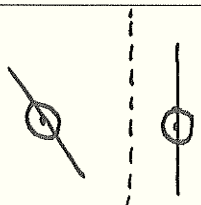
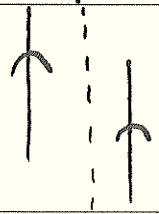
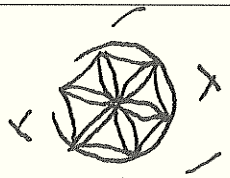
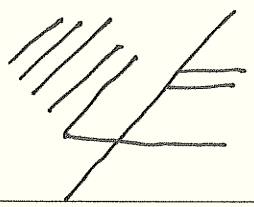
Baltic/Shipping marks recorded during survey (dotted line denotes cut edge of timber)

Mark	Location
	Ante Chapel cornice beam (north) - Face
	Ante Chapel cornice beam (north) - Reverse
	Ante Chapel corner post (north) - Face
	Ante Chapel corner post (north) - Reverse
	Ante Chapel cornice beam (north east) - Face
	Ante Chapel cornice beam (north east) - Reverse
	Thornhill Void - stud within west elevation
	Octagonal column - ground floor antechapel (north face)

Royal Pew, Chapel Royal, Hampton Court Palace

APPENDIX VII

Carpenters assembly and other marks recorded during survey
(NB - Not to scale; dotted line denotes cut edge of timber)

Mark	Location	Mark	Location
	Partition wall between Lady Chapel and Royal Pew		18th century inserted truss (East elevation)
	Post 1 (East elevation)		Upper beam (East elevation)
	Post 3 (East elevation)		Upper beam (East elevation)
	Post 5 (East elevation)		Upper beam (East elevation)
	Post 7 (East elevation)		18th century inserted truss (East elevation)
	Upper Beam (West elevation)		Head of octagonal column (South)
	South truss (Roof space over Chapel)		Lower beam (East elevation)
	Partition wall between Winter Pew and Royal Pew		Infill piece- lower beam (West elevation)

APPENDIX VIII MINOR SUB-SURFACE EXPLORATIONS

Andy Miller and Alison Kelly
Oxford Archaeology
March 2008

1 MINOR SUB-SURFACE EXPLORATIONS IN THE CHAPEL ROYAL AND ANTE CHAPEL

1.1 As a requirement for the erection of the scaffolding on the east elevation of the Royal Pew at the start of the project, and also recently to allow the further propping up of the Royal Pew, eight areas of floorboard were removed. On the northern and southern side of the chapel three small areas were opened up in addition to a slightly larger area under the box pews on both sides.

1.2 On the north side three small areas were opened up (2.83 x 0.34m, 1.78 x 0.32m and 1.08 x 0.19m). They revealed only (20th century?) floor joists of softwood construction (0.04 x 0.10m in section). The depth from the current floor level to the surface below was only 0.12m. The surface revealed was the grey marble floor tiles visible elsewhere in the Chapel.

1.3 In the box pew and area approximately 0.46 x 1.30m was revealed then re-covered and at a later date two smaller areas were opened up. All that was revealed was a number of predominantly softwood joists and related shorter supporting timbers aligned north - south within the box pew. The joists (0.08 x 0.12m in section) were all softwood and part of the four course (?) supporting red brick plinth for the joists could be partially observed on the west side under the pew seat. On the subsequent later reopening of this area to a depth of 0.39m all that was observed was a crude and loose make up hardcore material of broken red brick (late 19th / early 20th century), mortar and other unidentifiable material. A small brick structure was observed on the east side of the pew at a depth of 0.34m but again appeared to be the remnants of the supporting structure for the floor joists. No significant floor layers or timber structures of any form were encountered.

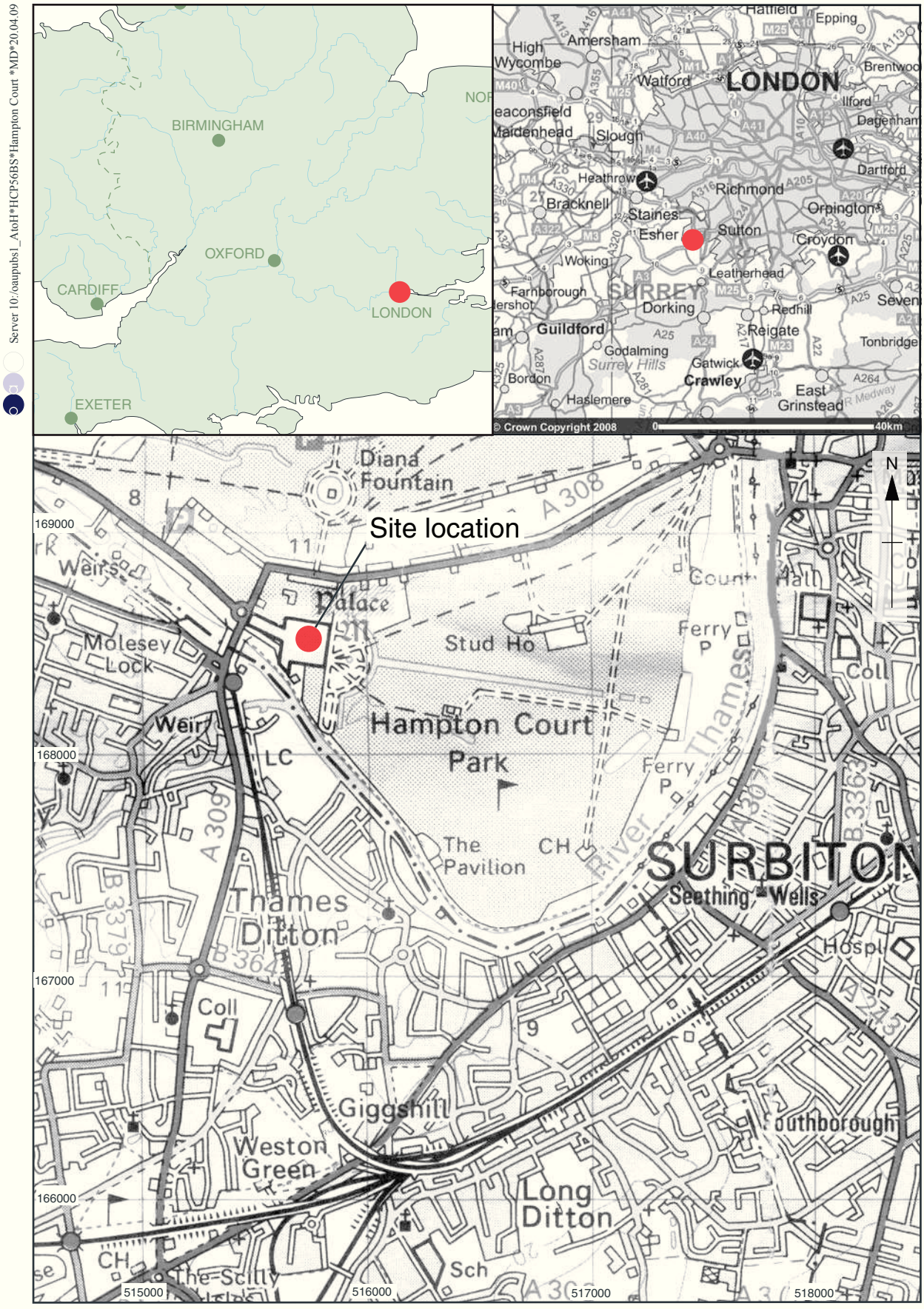
1.4 On the south side of the aisle three small areas were also opened up (0.66 x 1.19m max, 1.56 x .35m and 1.23 x .35m) down to a depth of 0.12m. This revealed a selection of softwood floor joists (0.03 - 0.07 x 0.09m in section) resting on the grey marble tiles as observed on the north side with nothing of significance found except for a number of modern electrical cables.

1.5 The box pew on the south side of an area 1.30 x 1.00m was initially uncovered to a depth of 0.20m (approx.) and then two smaller areas at the south end of the pew (0.76 x 0.17m) and at the north end (1.02 x 0.15m) to a depth of 0.40m. A number of softwood floor joists (0.9 x 0.12m) were seen aligned north - south with a further truncated set, aligned east west underneath on east side. On the south side under the pew seat a short section of supporting red brick wall could be partially observed. The space was again filled with rubble consisting of broken brick, mortar and timber off-cuts. No floor layers or timber structures of any note were encountered and it is probable that excavations would need to go considerably deeper to encounter any historically significant floor surfaces related to the earlier phases of the Chapel Royal.

1.6 Also of note on the south side of the aisle was the stone base (0.64 x 0.66m max) adjacent to the quoins on the ante chapel wall. A semi-circular hole approximately 0.25 x 0.20m and 0.35m deep had been roughly carved from the base and into the floor below. The base appears to have been constructed at a later date than the wall (it has quite clearly built around the quoins) although it is not known whether this hole was designed to take a timber post or some other vertical structure. Its shape does however look reminiscent of a half section through one of the existing pine octagonal columns. The hole was already empty on observation and no material or finds were recovered from it to elucidate its purpose or date further.

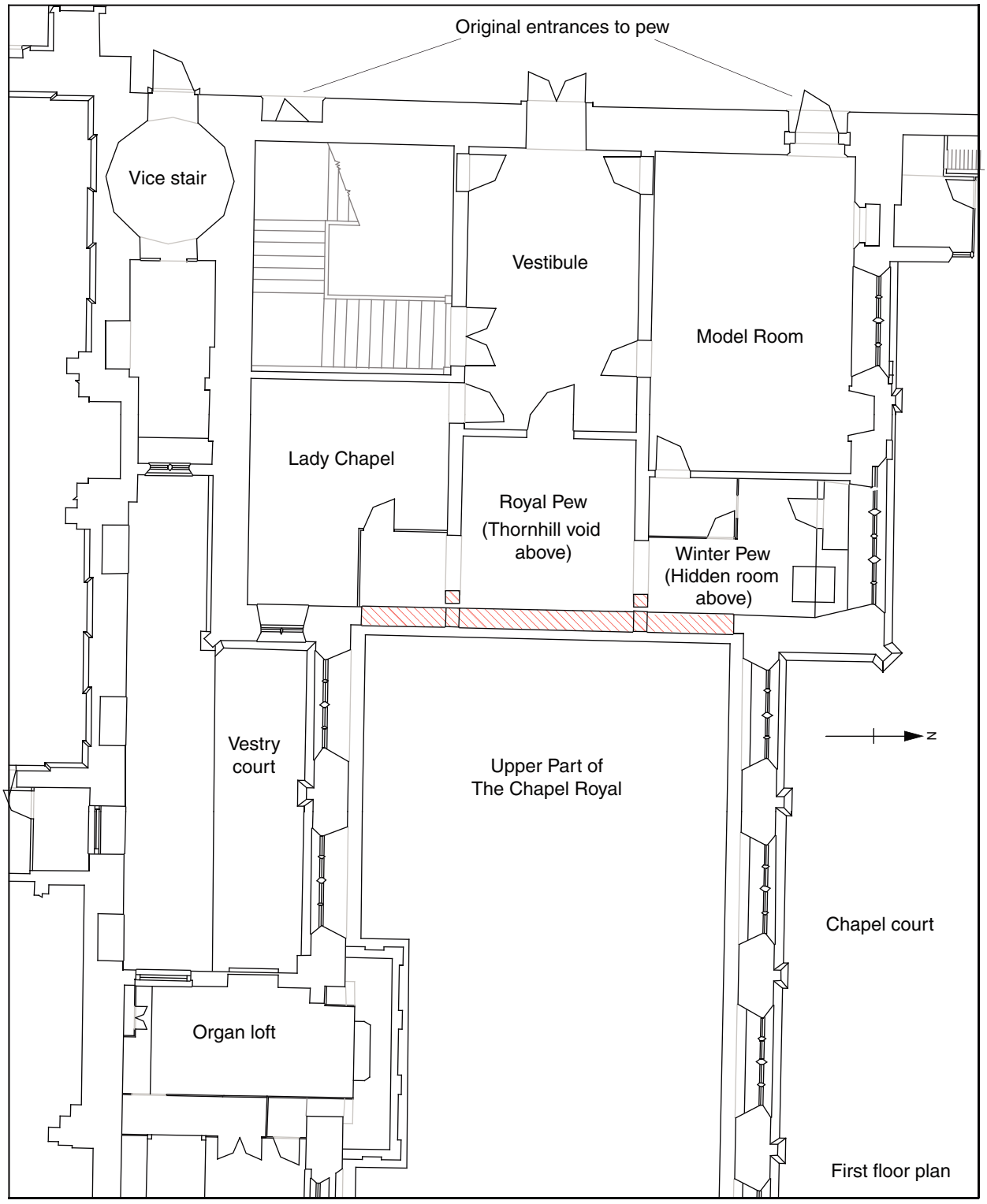
1.7 The south column stone base was removed for repair work during the 2007 works. The stone base was base is 0.66m square in plan, with a height of 0.22m and is in two sections, sitting atop a void 0.37m deep. The removal of the column base revealed a marble floor underneath, with the tiles forming a pattern. These marble tiles are possibly the ante chapel floor laid in 1727 (Hanoverian period) which consisted of marble hexagons with lozenges in black and white. The stones were mortared on and traces of a creamy, friable, fine grained mortar with no major inclusions remained. Several bricks were to be seen underneath the marble tiles and, approximately 29cm below the current floor level (16.8cm below the top of the marble tiles) two terracotta tiles approximately 20cm square were discovered. These tiles are on a bed of creamy, friable mortar with small-medium lime inclusions on top of a bed of sand, and there is a possible indentation for a missing third terracotta tile. Brick one was removed as part of the cleaning work and was pinky/orange in colour, loosely square with no frog, and creased in parts - it also shows stacking lines. The depth of the brick is 10cm, and the height 6cm. Brick two was blackened but not vitrified, with a thick, black paint/substance on the corner and is possibly later in date than brick one as it is more clearly defined, yet also has no frog. Below the hole is a brick lined channel which lies approx. 28cm below the marble floor, and appears to be around 36cm deep and it may form part of the Victorian heating system which was installed. Around the hole is a fill of rubble and mortar in which a rusted square-headed nail was found.

Alison Kelly
September 2008



Scale 1:25,000

Figure 1: Site location



Not to Scale

Location of main pew structure

Figure 2: Royal Pew, Chapel Royal, Hampton Court Palace. Plan showing location of the main area of the pew structure examined at first floor level (Based on original drawing provided by Martin Ashley Architects)

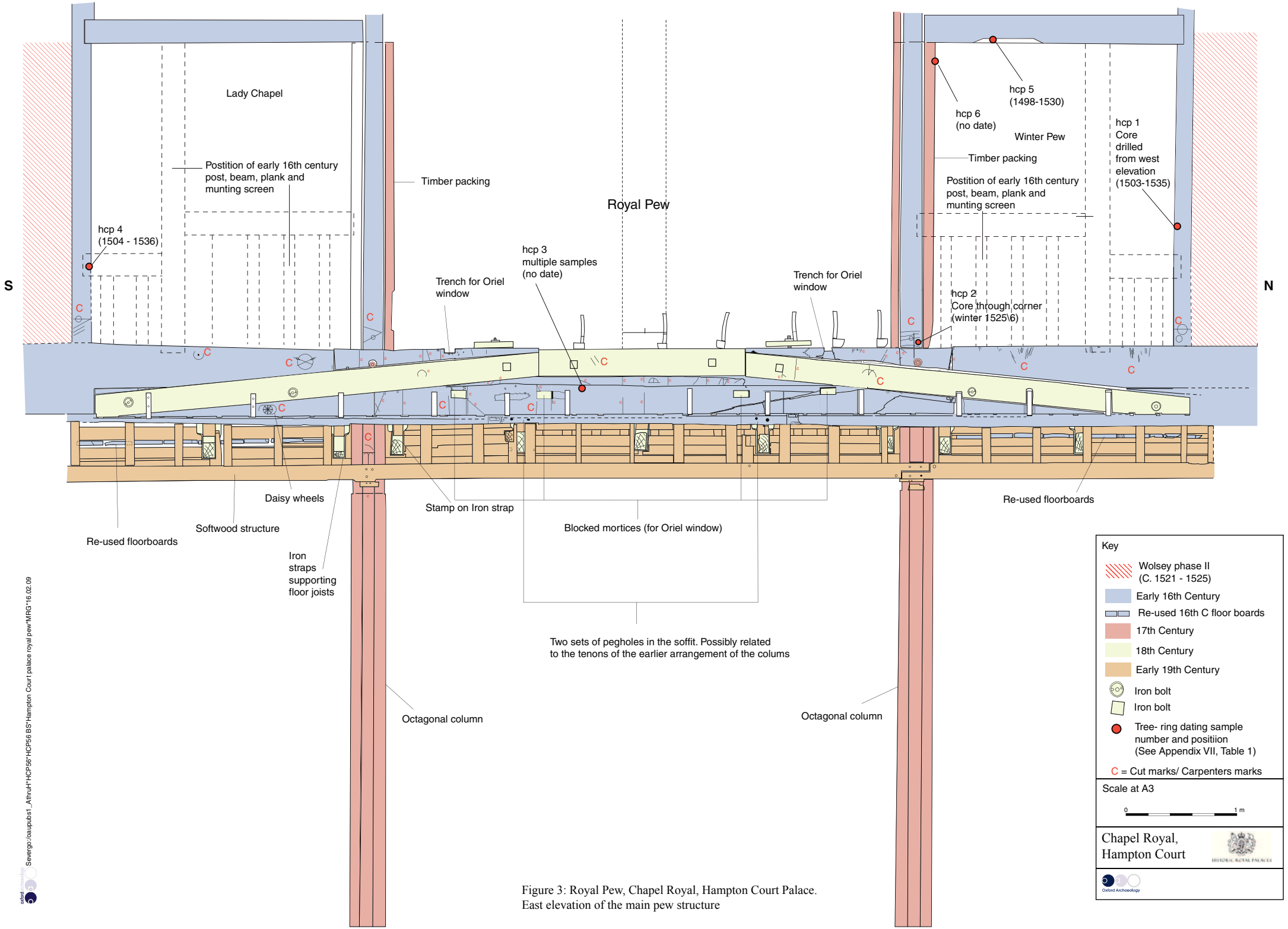


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Figure 3: Royal Pew, Chapel Royal, Hampton Court Palace.
East elevation of the main pew structure

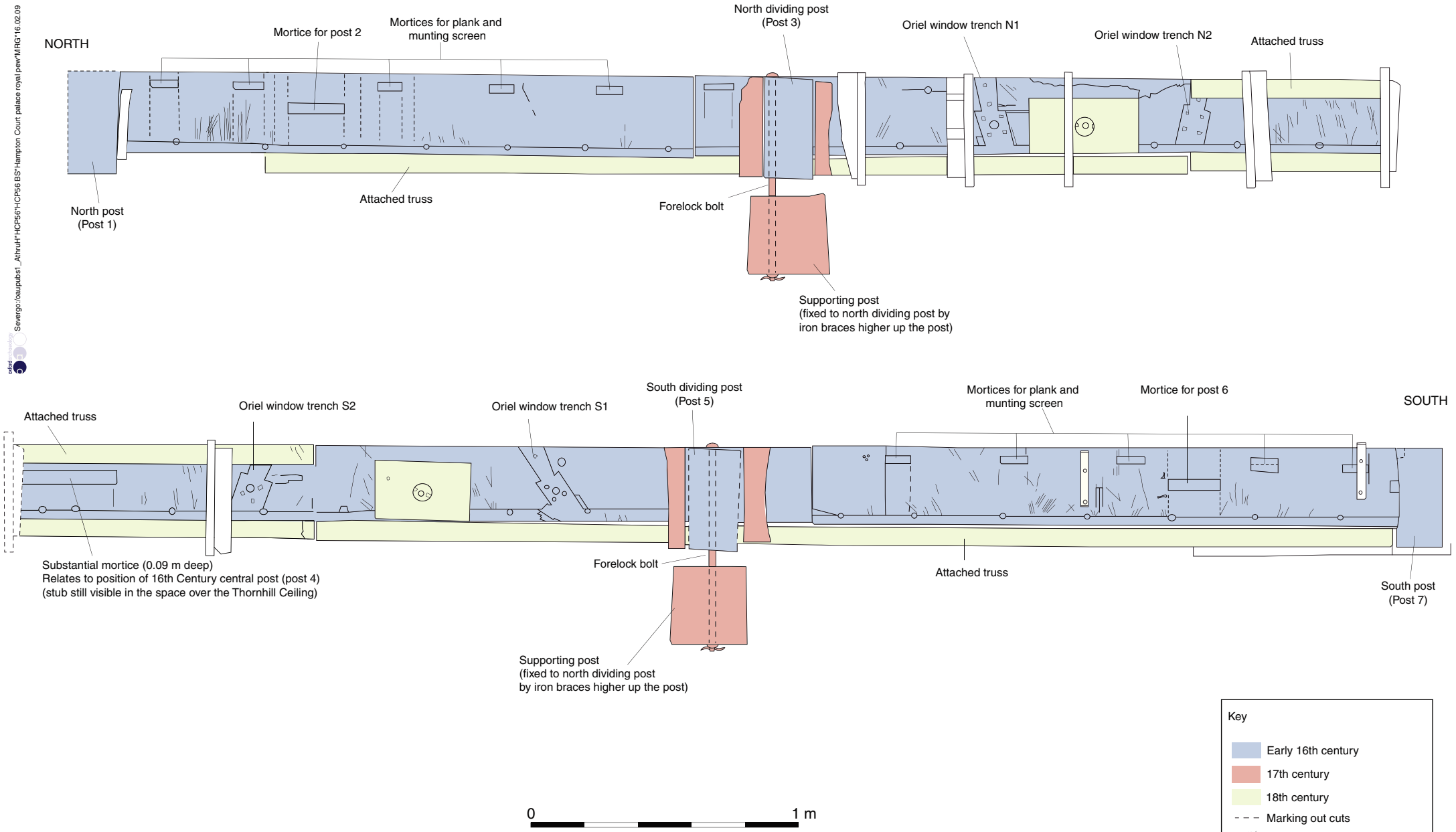

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Figure 4: Royal Pew, Chapel, Royal, Hampton Court Palace. Plan of upper beam

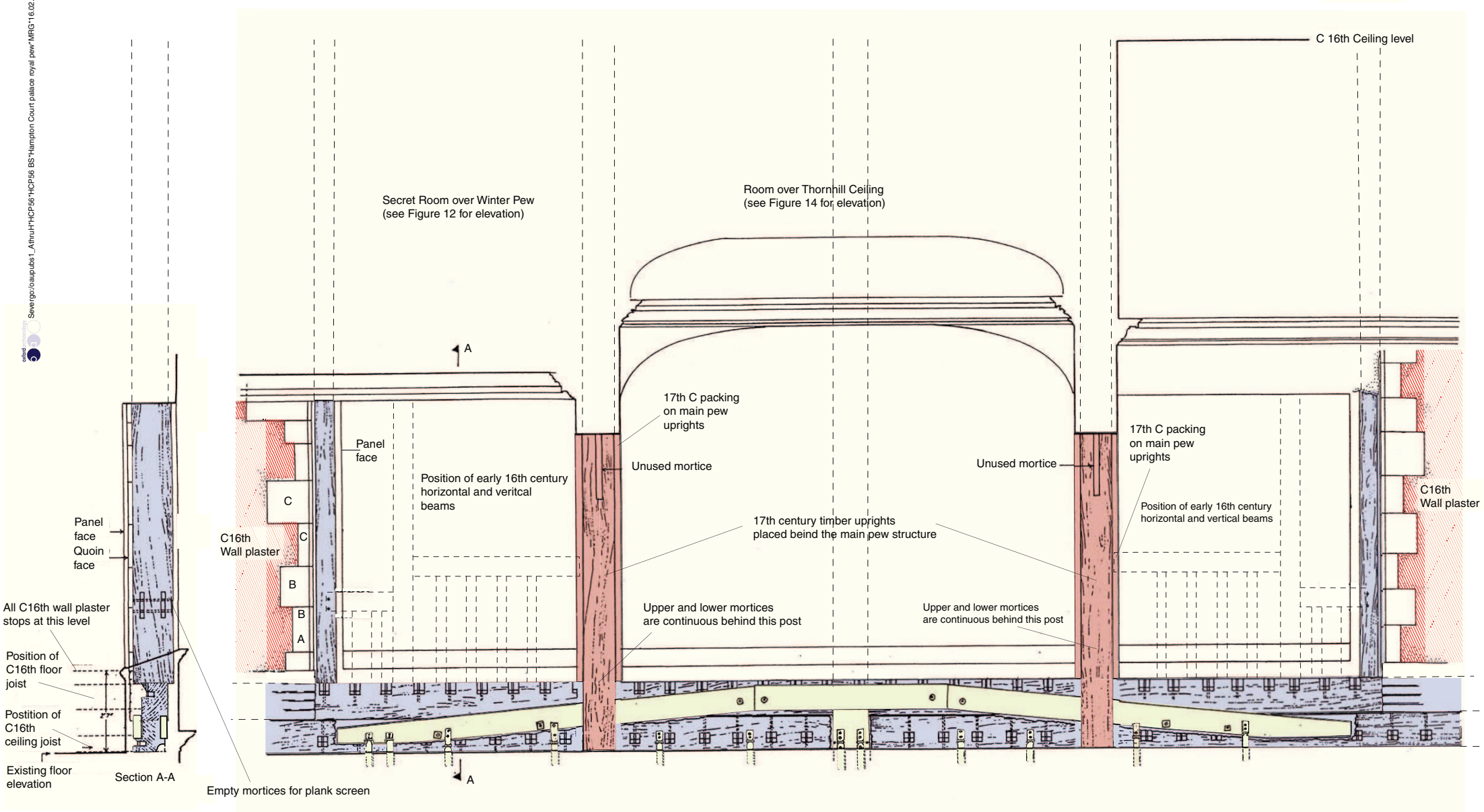
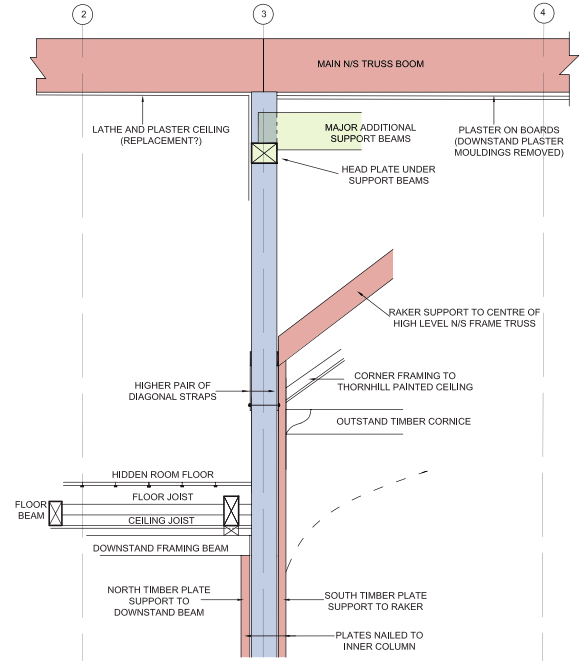
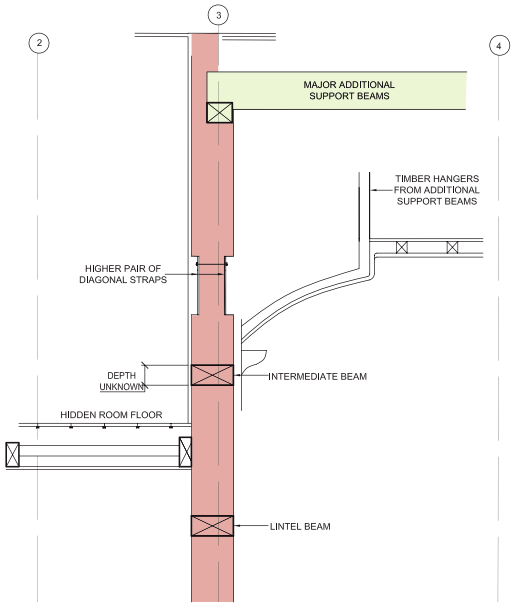


Figure 5: Royal Pew, Chapel Royal, Hampton Court Palace. Lower Pew Structure West elevation, October 1990 (Based on survey and drawing by D. Hart, English Heritage)



'DETAIL A' AT TRIPLE OUTER COLUMN



'DETAIL A' AT INNER COLUMN

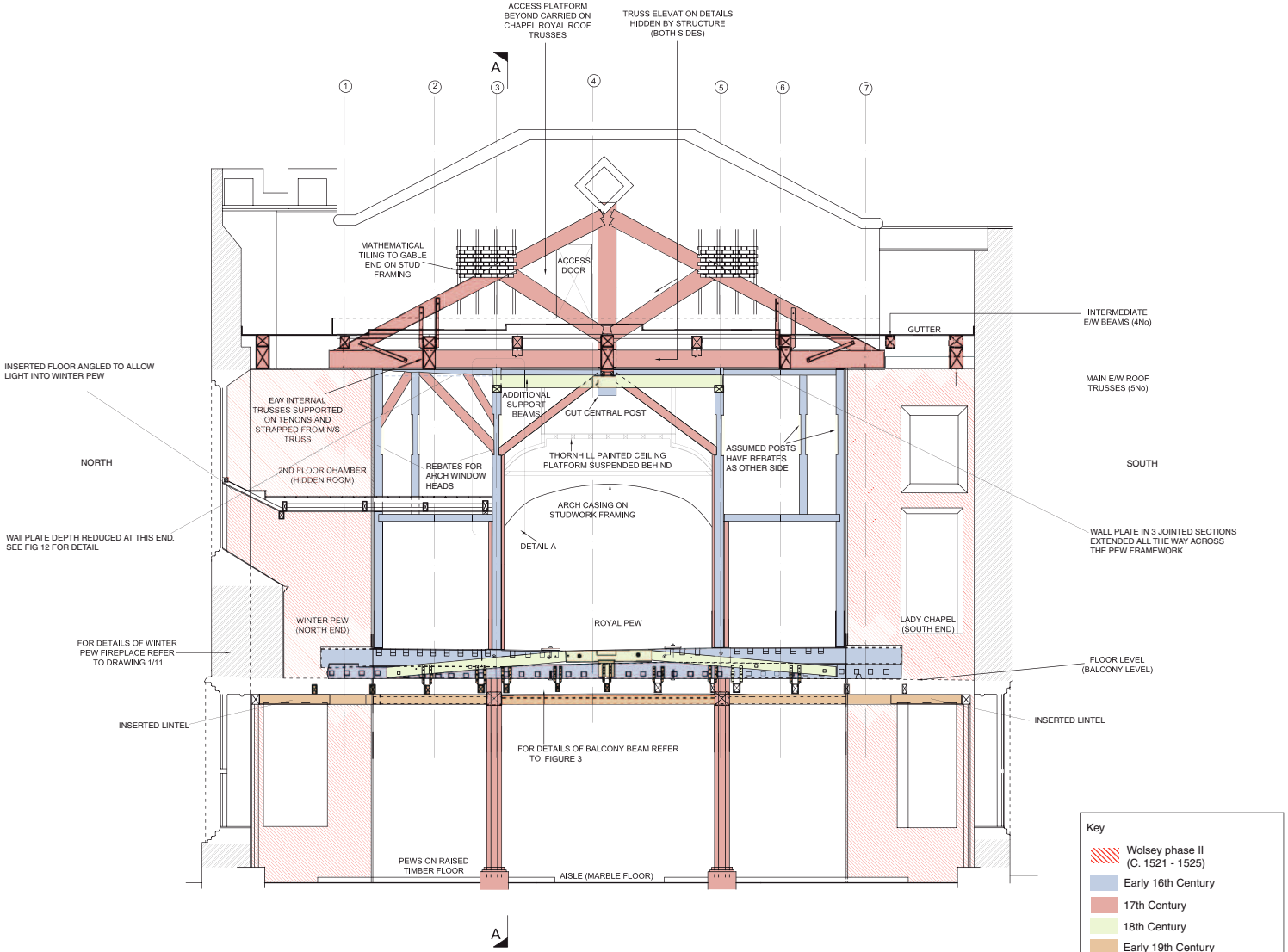
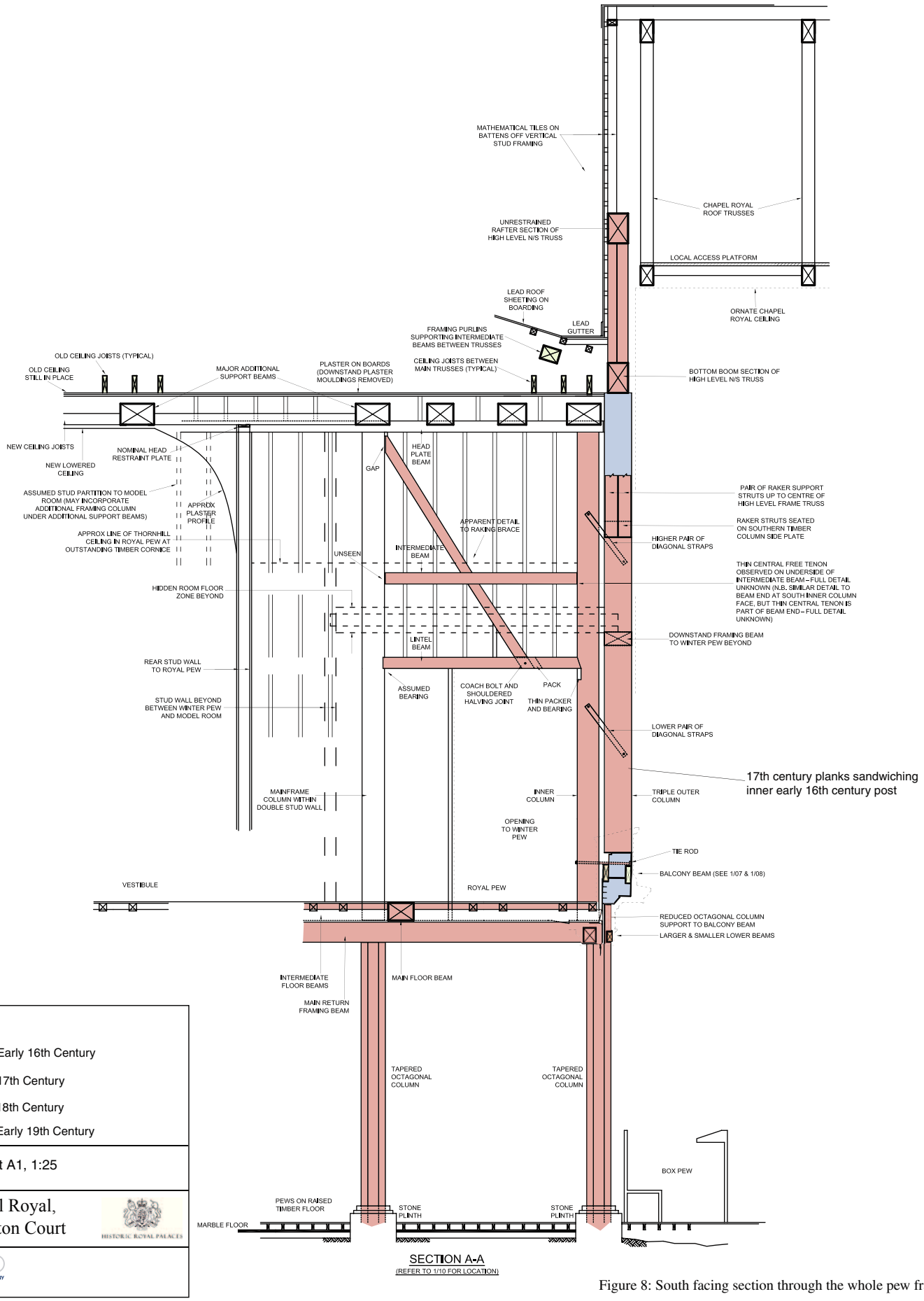


Figure 6: Royal Pew, Chapel Royal, Hampton Court Palace. Phased west facing elevation of the overall pew framework.

Figure 7: Sections through the upper and lower beams of the front pew structure, south facing. (From a drawing by Hockley and Dawson)

DO NOT SCALE THIS DRAWING



Key

- Early 16th Century
- 17th Century
- 18th Century
- Early 19th Century

Scale at A1, 1:25

Chapel Royal, Hampton Court

HISTORIC ROYAL PALACES

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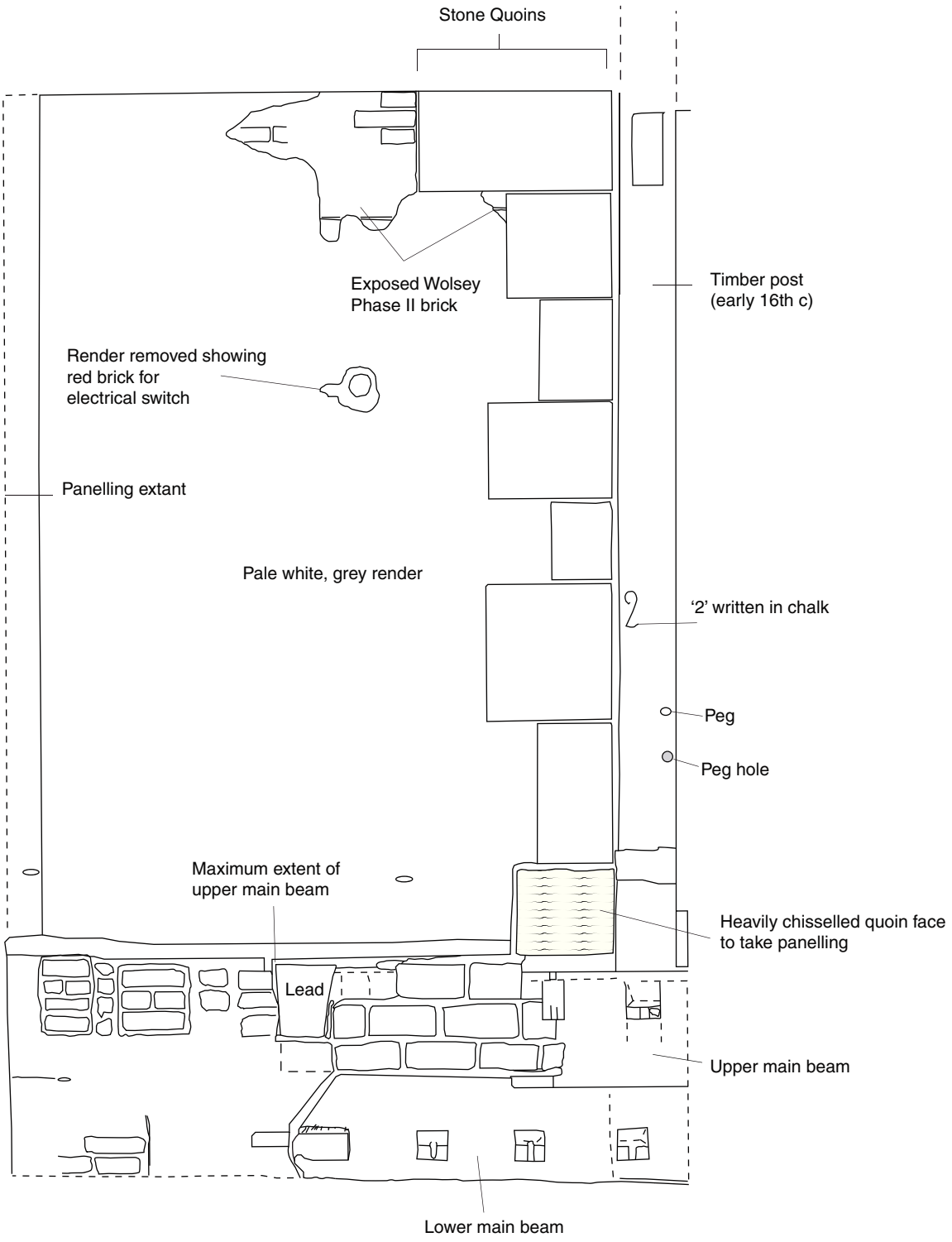
Figure 8: South facing section through the whole pew framework



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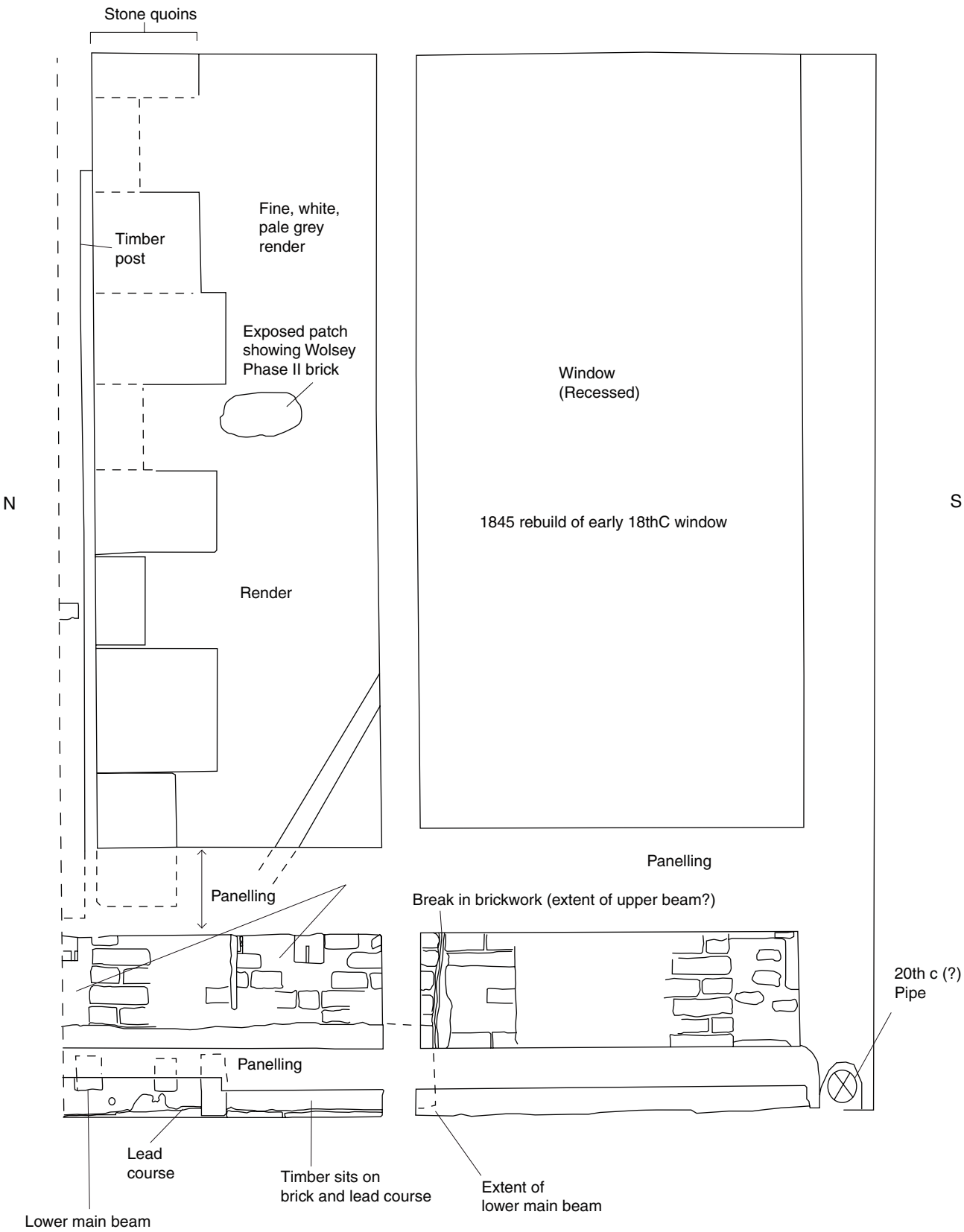
Winter Pew, Chapel Royal Hampton Court

Figure 9a: Winter Pew, first floor west facing elevation prior to removal of lower beam end

Figure 9b: Detail of main beam ends within winter pew following removal of bricks and section of lower beam



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Lady Chapel, Chapel Royal, Hampton Court

HISTORIC ROYAL PALACES

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Figure 10: Lady Chapel, first floor, west facing elevation during 2006 investigations

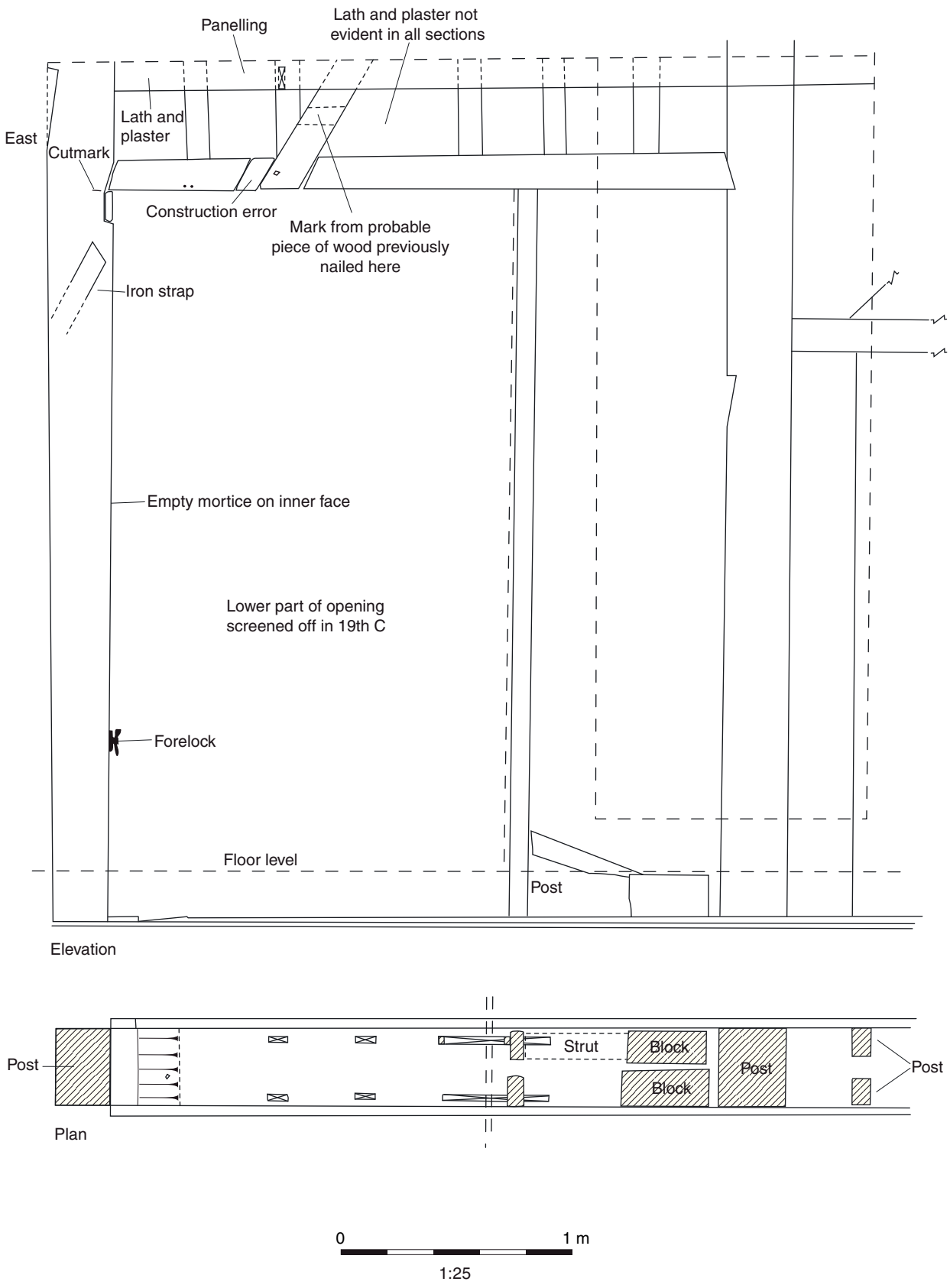


Figure 11: Elevation and plan of late 17thC timber structure dividing Royal and winter pews (North facing elevation)

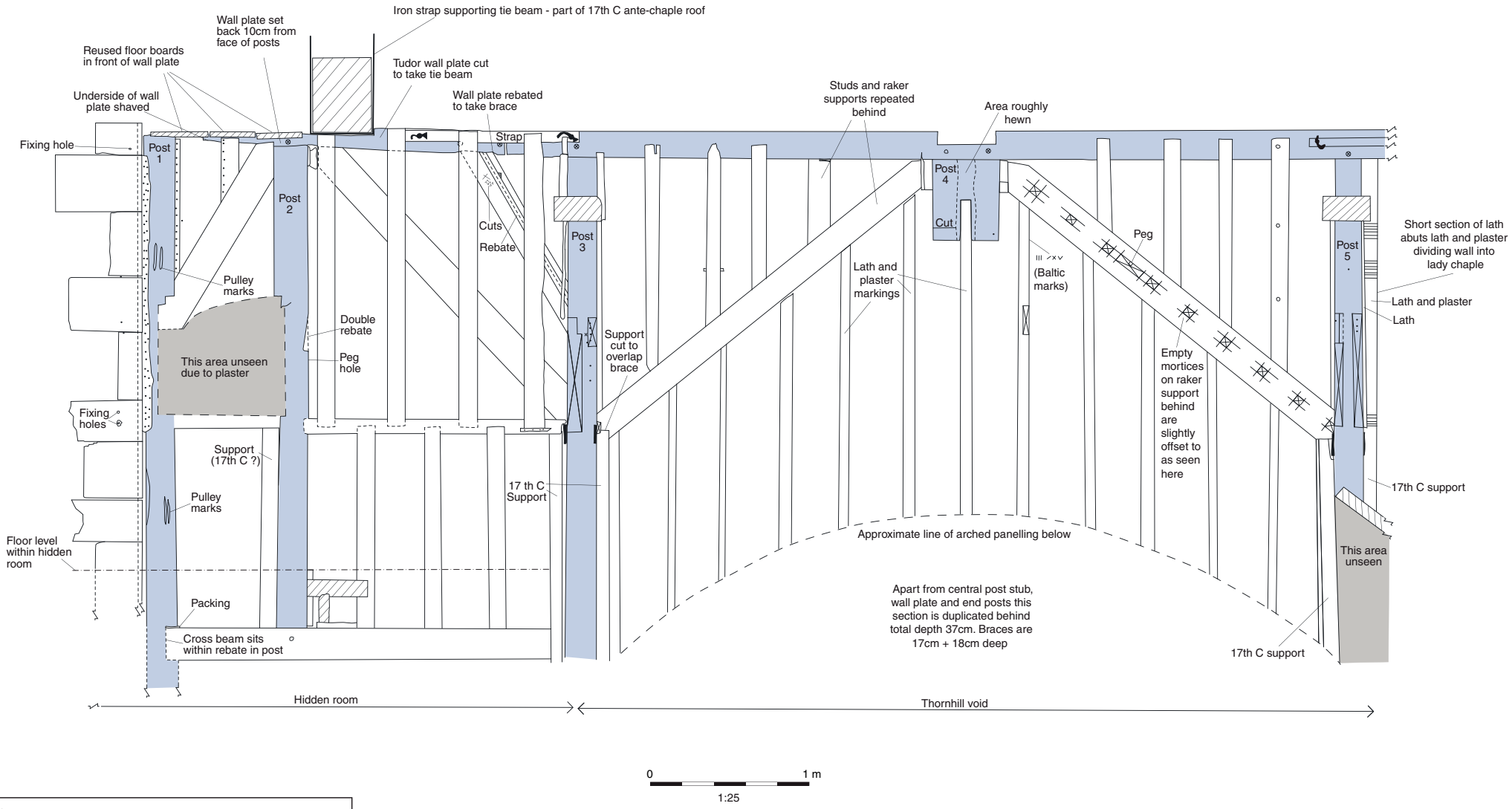
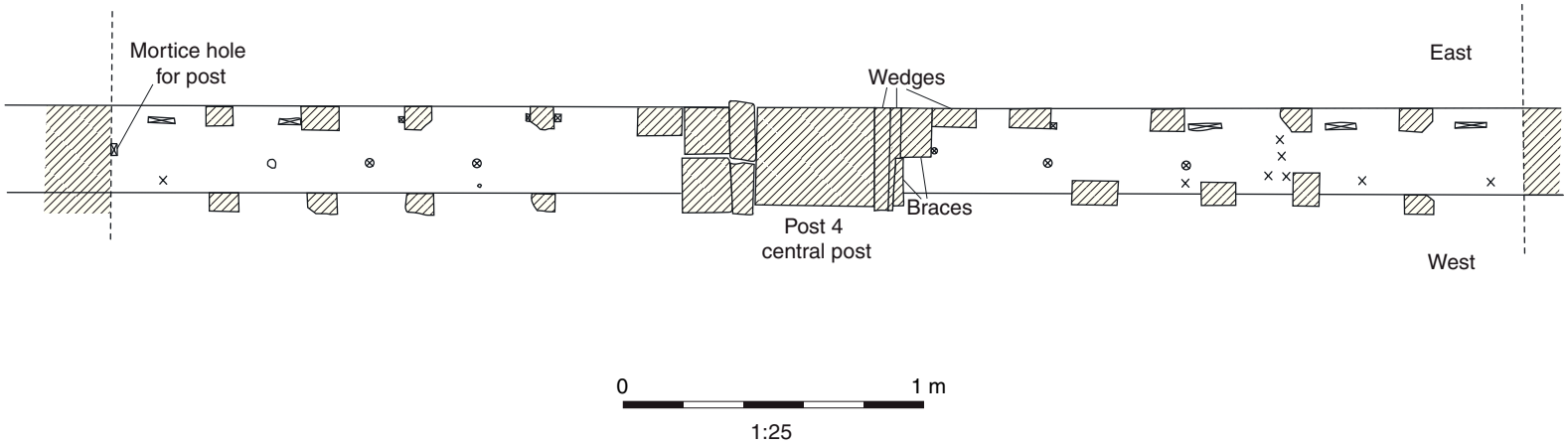
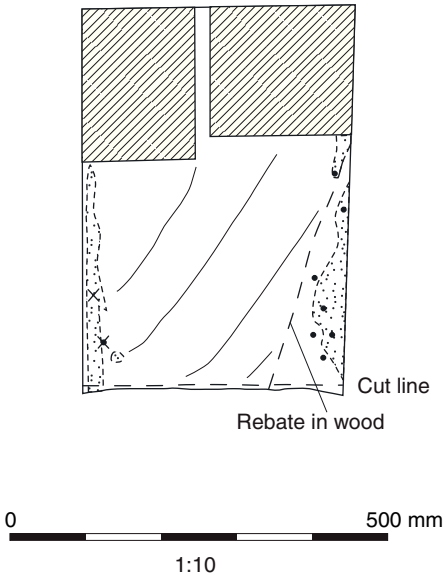


Figure 12: Chapel Royal, Hampton Court Palace. Royal Pew East elevation within Thornhill void and hidden room





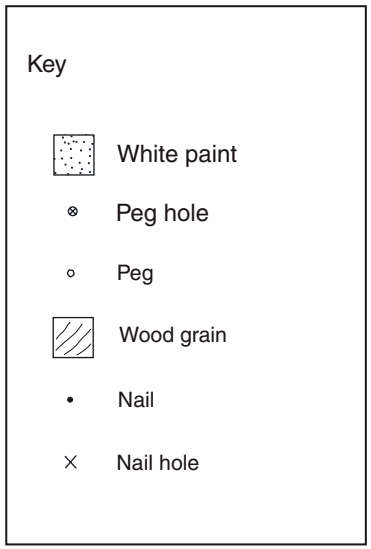


Figure 13: Soffit of Tudor wall plate within Thornhill Void and detail of south face of central post (post 4) stub

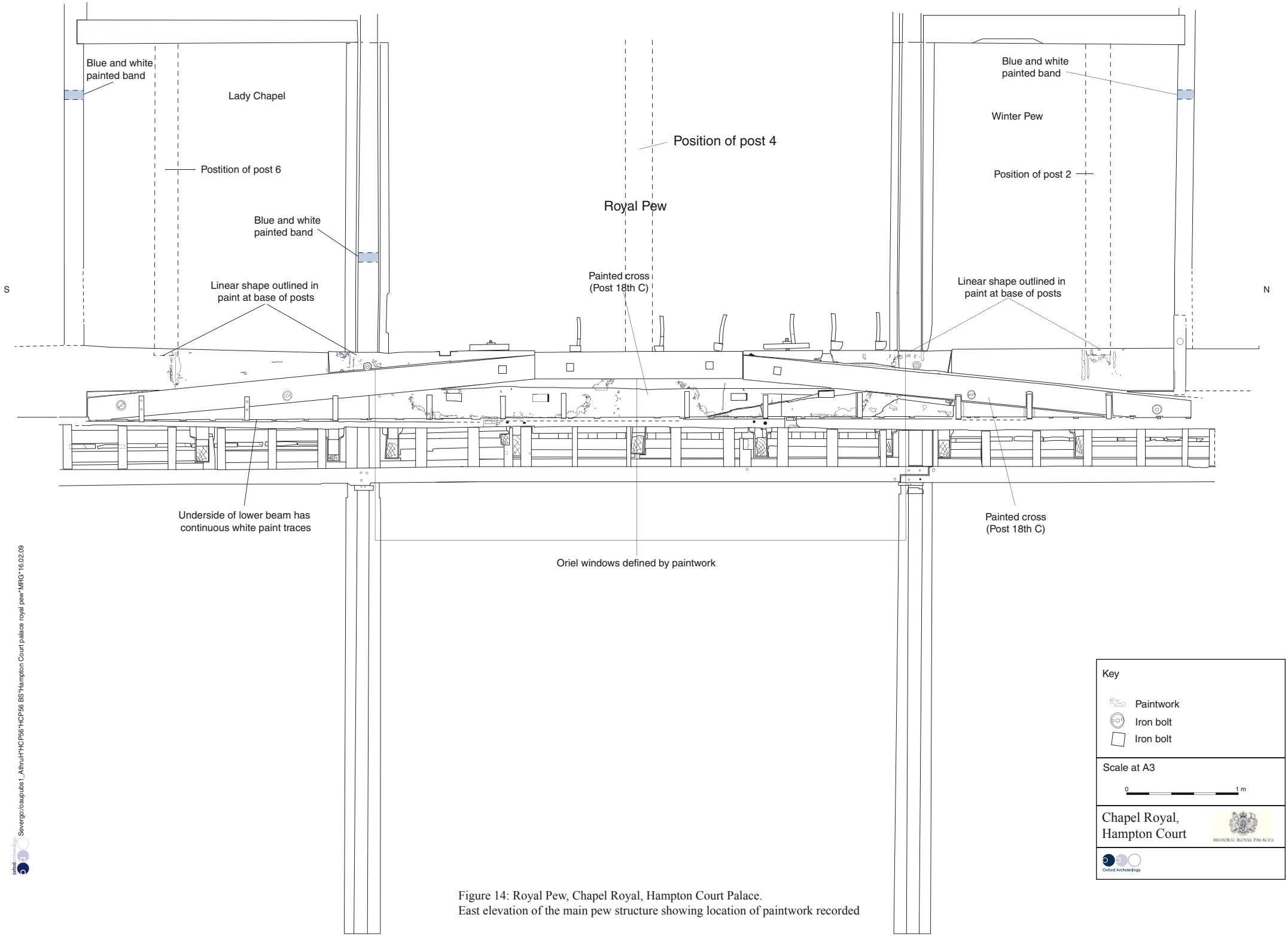


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Figure 14: Royal Pew, Chapel Royal, Hampton Court Palace.
East elevation of the main pew structure showing location of paintwork recorded

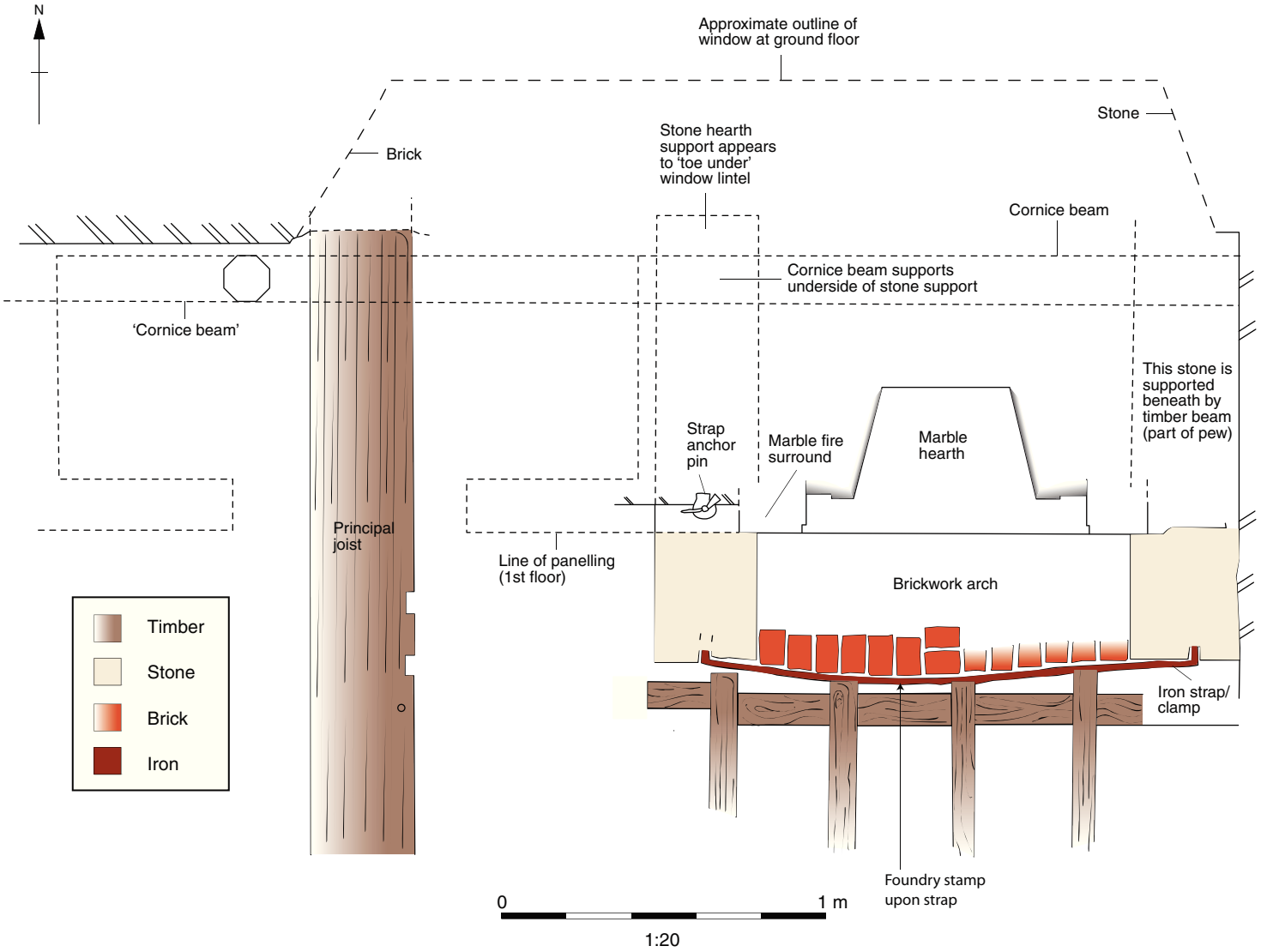

Figure 15: Royal Pew, Chapel, Royal Hampton Court Palace: Plan of fireplace and hearth area within winter pew

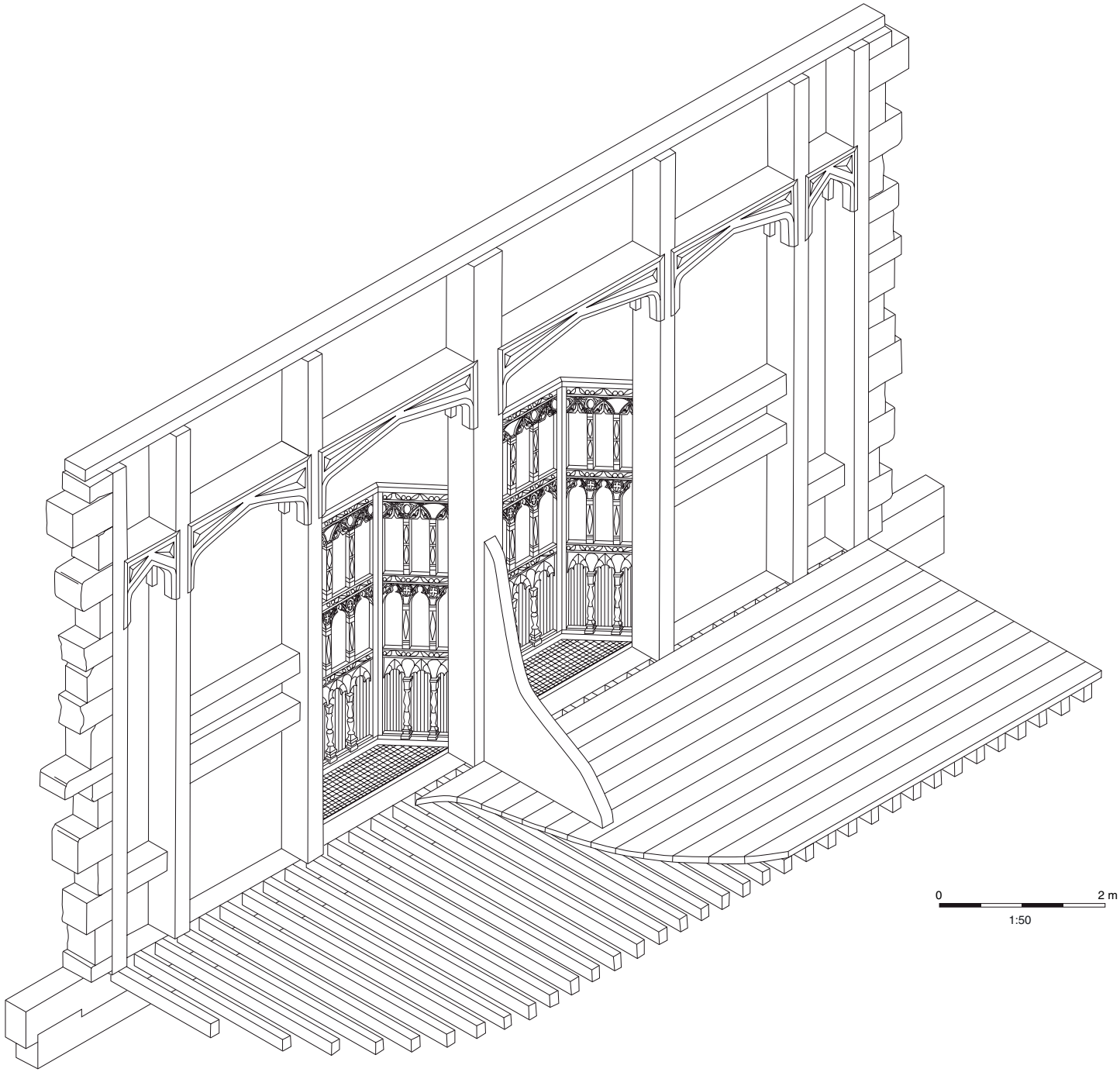

Figure 16: Chapel Royal, Hampton Court Palace. Royal Pew isometric

Plate 1: Royal Pew, Chapel Royal, Hampton Court Palace: View of the east elevation of the Royal Pew prior to commencement of works in November 2005.

Plate 2: Royal Pew, Chapel Royal, Hampton Court Palace: View of the east elevation of the Royal Pew following panelling removal in 2006. (Image © Historic Royal Palaces)

Plate 3: Royal Pew, Chapel Royal, Hampton Court Palace: View of the chapel in 1819 by C Wild (in folder). Note the whitewashed ceiling and casement windows.

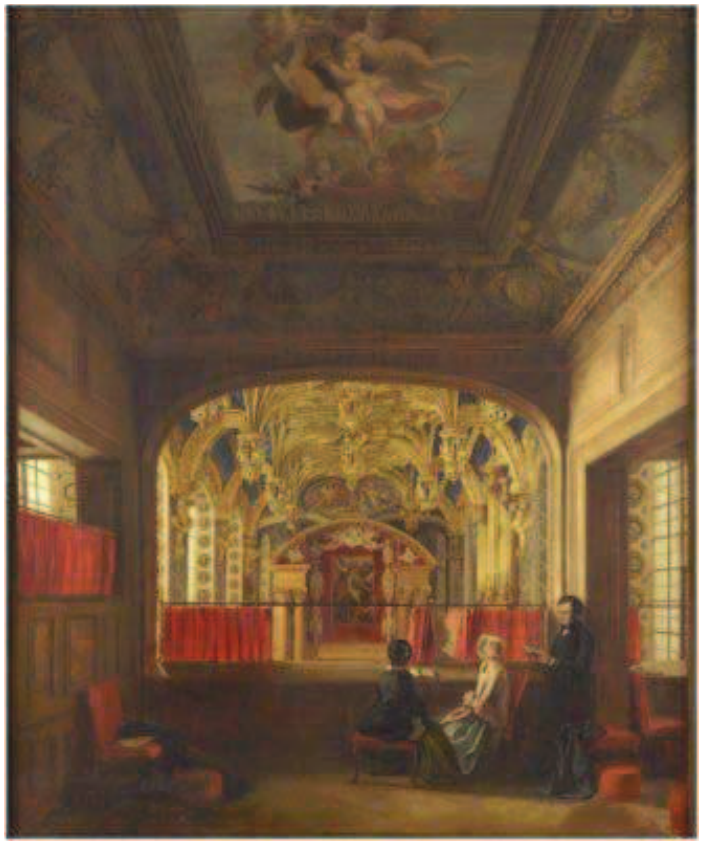

Plate 4: Royal Pew, Chapel Royal, Hampton Court Palace: View of the Royal Pew by James D Wingfield (1849). Note the partition between the Royal and Winter Pews.

Plate 5: Royal Pew, Chapel Royal, Hampton Court Palace: St Georges Chapel, Windsor. External view of Oriel window in chapel built for Catherine of Aragon in 1525.

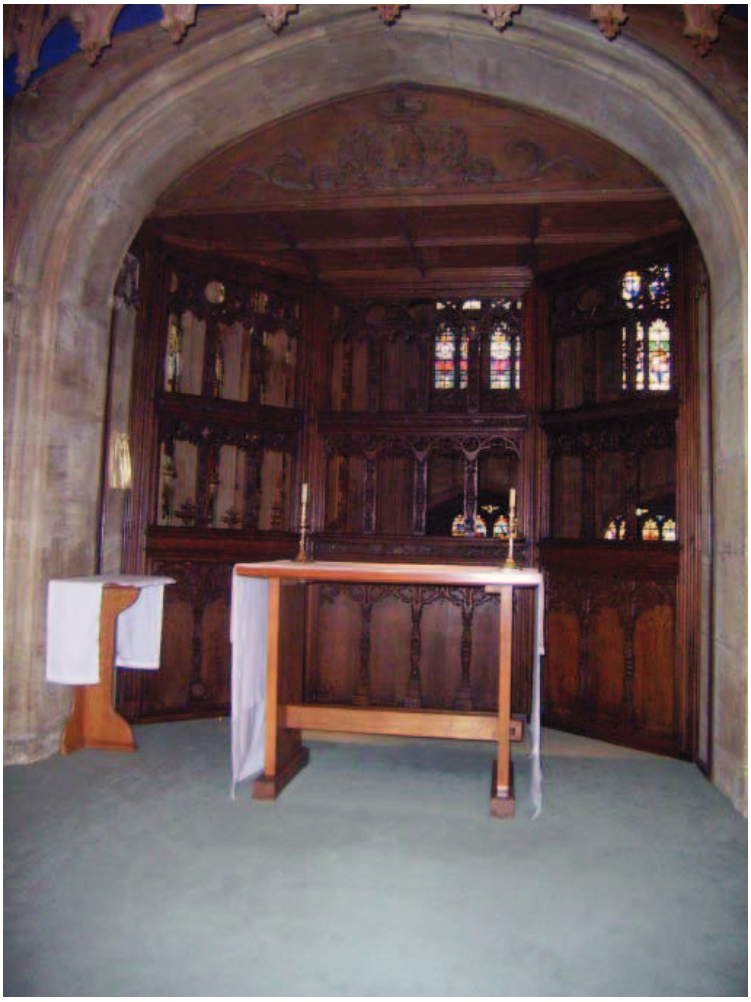

Plate 6: Royal Pew, Chapel Royal, Hampton Court Palace: St Georges Chapel, Windsor. Internal view of Oriel window in chapel built for Catherine of Aragon in 1525.

Plate 7: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, west elevation, detail of central section.

Plates 6 and 7

Plate 8: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, west elevation, primary beams extending north into ante chapel wall prior to removal of brickwork.

Plate 9: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, west elevation, primary beams extending north into ante chapel wall following removal of lower quoin and brickwork.

Plate 10: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, west elevation, detail of tenon following removal of lower beam

Plate 11: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, model room, primary phase doorways to Royal Pew. The left doorway was the entrance to the pew and the doorway on the right was for the vice stair leading down to the chapel. Note the difference in floor height.

Plate 12: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, supporting octagonal column (south).

Plate 13: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, surviving mortice for central main post (view east).

Plate 14: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, further mortices and floorboard rebate surviving on the top surface of the upper primary beam.

Plate 15: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, detail of a mortice relating to the possible Oriel window (south end).

Plate 16: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, detail of carved trench (4) relating to the possible Oriel window (north end).

Plate 17: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, detail of 17th century upright and iron brace attached to main pew structure.

Plate 18: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, detail of forelock used to attached 17th century upright to main pew structure.

Plate 19: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, lath and plaster and timber framework, south elevation of south partition.

Plate 20: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, exposed timber framework, north elevation of north partition.

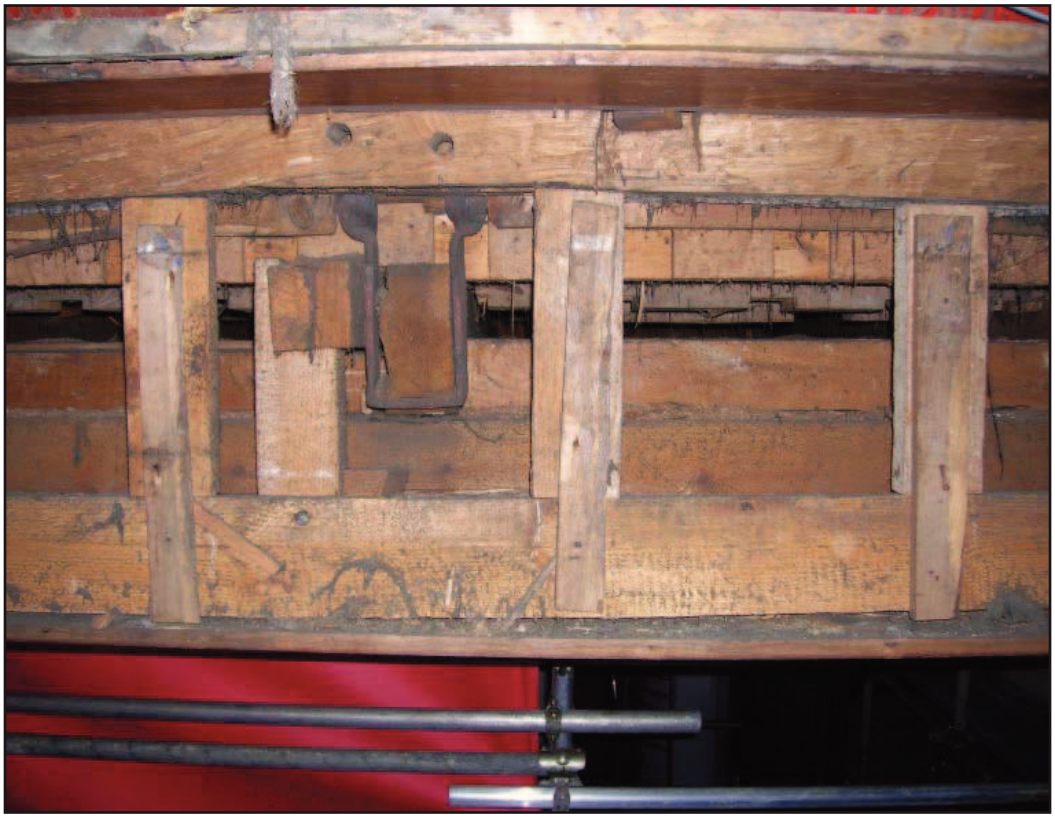

Plate 21: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, east elevation, detail of 'U' shaped straps to support floor joists.

Plate 22: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, east elevation, detail of foundry stamp on iron strap.

Plate 23: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, Lady Chapel, Detail of iron pipe set within lower beam.

Plate 24: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, east elevation, detail of re-used floorboards at the south end of the main structure.

Plate 25: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, Lady Chapel, detail of hidden mortice and rebate within quoin below.

Plate 26: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, east elevation viewed south, overall detail of the lower softwood structure.

Plate 27: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, octagonal supporting column (south), detail of mortice for screen.

Plate 28: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, octagonal supporting column (north), detail of markings on north face.

Plate 29: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, soffitt of lower primary beam showing peg holes and mortice for earlier

Plate 30: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, Lady Chapel west elevation, detail of brickwork of ante chapel wall. wall

Plate 31: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, west elevation (north), detail of brickwork in ante chapel wall.

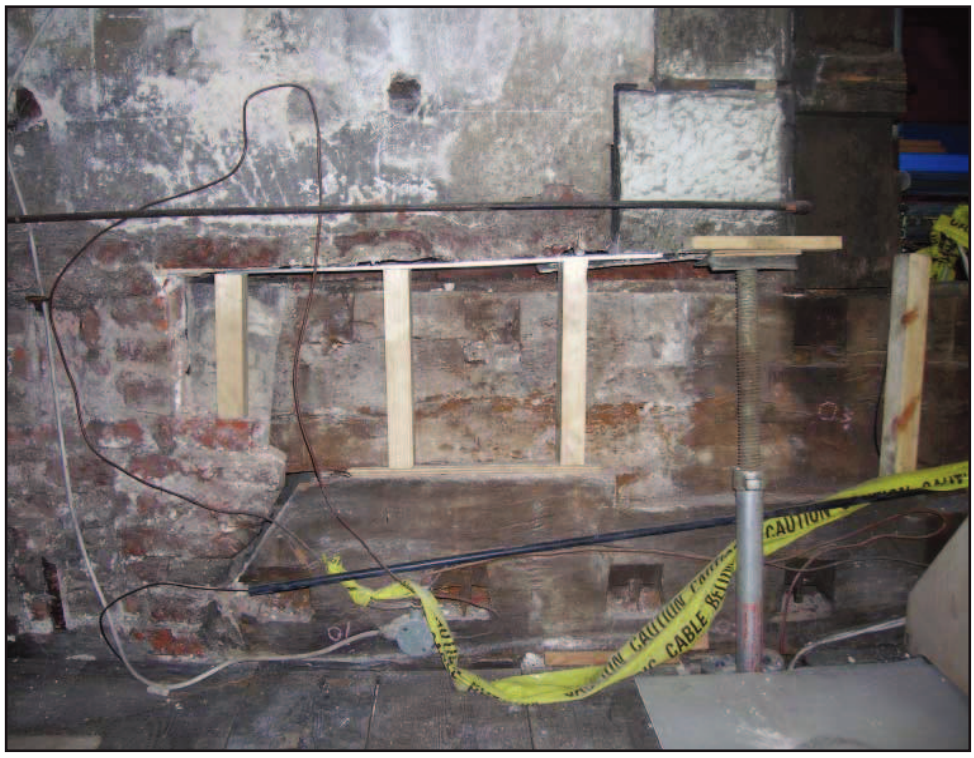

Plate 32: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, west elevation (south), detail of beam in ante chapel wall on removal of brickwork.

Plate 33: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, ground floor, west elevation of ante chapel wall. Graffiti tracing.

Plate 34: Royal Pew, Chapel Royal, Hampton Court Palace:Royal Pew, ground floor, west elevation of ante chapel wall. Detail of graffiti. See Appendix I - VI for detailed tracings.

Plate 35: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, east elevation, detail of oriel corbel paintwork

Plate 36: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, east elevation, detail of paintwork on upper beam at location of post 2.

Plate 37: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, east elevation, detail of paintwork on post 5.

Plate 38: Royal Pew, Chapel Royal, Hampton Court Palace: Roof space over the Royal Pew, south elevation showing brick detail and King post truss.

Plate 39: Royal Pew, Chapel Royal, Hampton Court Palace: Roof space over the Royal Pew, north elevation showing brick detail and King post truss.

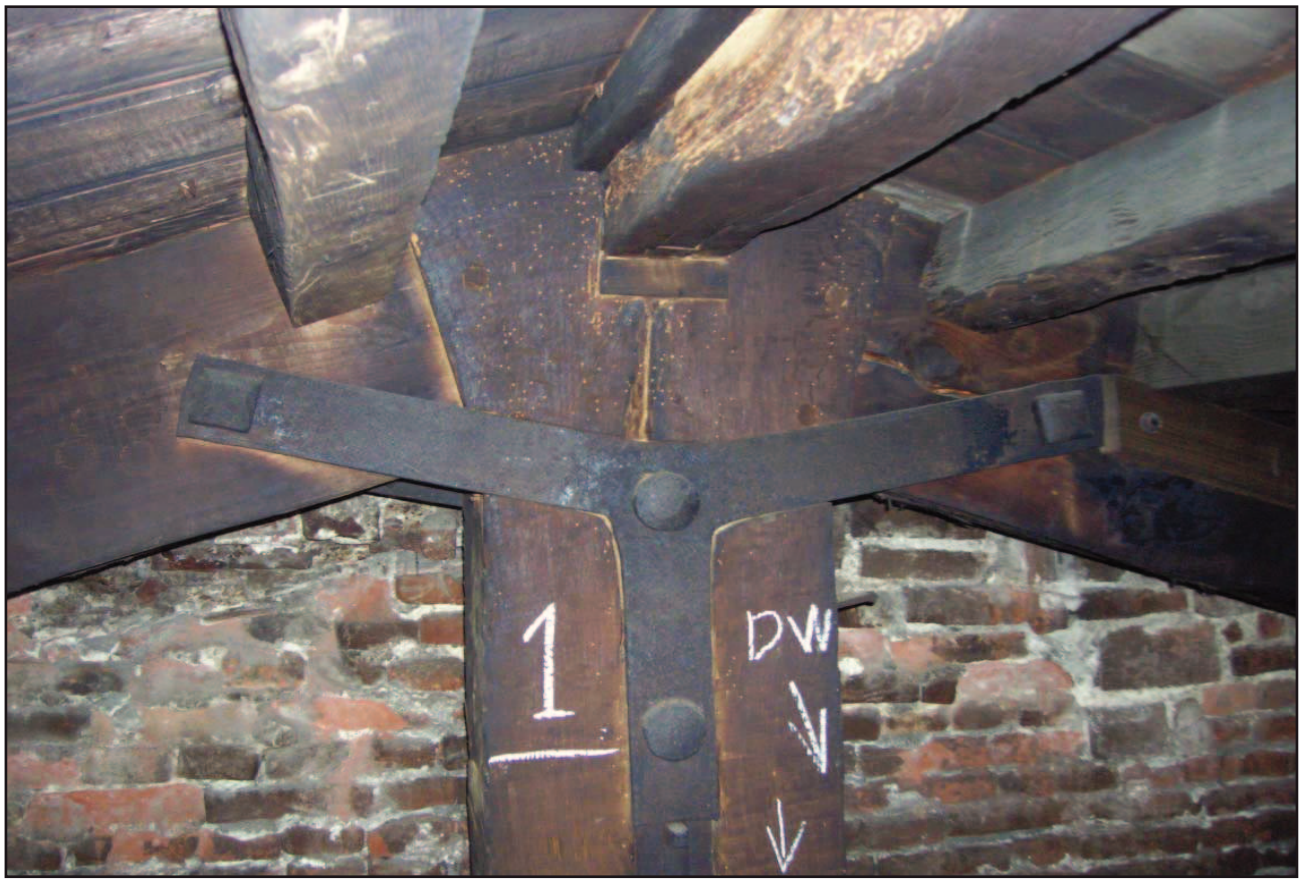

Plate 40: Royal Pew, Chapel Royal, Hampton Court Palace: Roof space over the Royal Pew, south elevation, detail of top of King post and iron strapping.

Plate 41: Royal Pew, Chapel Royal, Hampton Court Palace: Roof space over the Royal Pew, east side, detail of re-used timbers as primary purlin.

Plate 42: Royal Pew, Chapel Royal, Hampton Court Palace: Roof space over the Royal Pew, detail of forelocks used on one of the King posts.

Plate 43: Royal Pew, Chapel Royal, Hampton Court Palace: Roof space over the Chapel Royal, Hampton Court Palace. Detail of the 17th century (?) king post at the west end of the Chapel Royal forming part of the overall framework of the Royal Pew structure.

Plate 44: Royal Pew, Chapel Royal, Hampton Court Palace: Roof space over the Chapel Royal, Hampton Court Palace. Detail of the 17th century (?) truss in the north west corner of the Chapel Royal roof space, forming part of the overall framework of the Royal Pew structure.

Plate 45 : Royal Pew, Chapel Royal, Hampton Court Palace: Roof space over Chapel Royal. View to the south showing details of truss and 'u' support.

Plate 46: Roof space over Chapel Royal, detail of moulding on underside of truss at the south end.

Plate 47: Royal Pew, Chapel Royal, Hampton Court Palace: 'Secret Room' above Winter Pew, east elevation, quoins and plastered wall.

Plate 48: Royal Pew, Chapel Royal, Hampton Court Palace: 'Secret Room' above Winter Pew, rise of floor in north east corner.

Plate 49: Royal Pew, Chapel Royal, Hampton Court Palace: 'Secret Room' above Winter Pew, detail of truncated stone moulding north east corner.

Plate 50: Royal Pew, Chapel Royal, Hampton Court Palace: Hidden room above Winter Pew, east elevation,

Plate 51: Royal Pew, Chapel Royal, Hampton Court Palace: Hidden room above Winter Pew, east elevation following removal of plaster, reduced Tudor wall plate.

Plate 52: Royal Pew, Chapel Royal, Hampton Court Palace: Hidden room above Winter Pew, east elevation following removal of plaster, rebates on post 3 for possible arch.

Plate 53: Royal Pew, Chapel Royal, Hampton Court Palace: Hidden room above Winter Pew, east elevation following removal of plaster, top of post 2

Plate 54: Royal Pew, Chapel Royal, Hampton Court Palace: Small room over Thornhill Ceiling, east elevation, supporting braces and remains of central post (post 4)

Plate 55: Royal Pew, Chapel Royal, Hampton Court Palace: Void over Thornhill Ceiling, east elevation, substantial re-used timber running in front of east elevation.

Plate 56: Royal Pew, Chapel Royal, Hampton Court Palace: Void over Thornhill ceiling, view to the north revealing surviving elements of the former plaster ceiling.

Plate 57: Royal Pew, Chapel Royal, Hampton Court Palace: Void over Thornhill ceiling, detail of ceiling moulding fixing point on former plaster ceiling. The lines are scored and the central boss location is marked with red paint

Plate 58: Royal Pew, Chapel Royal, Hampton Court Palace: Void over Thornhill ceiling, west elevation reset brace (south) with empty mortices and paint traces.

Plate 59: Royal Pew, Chapel Royal, Hampton Court Palace: Void over Thornhill ceiling, detail of paint on inside of northern brace with nails and looping evidence for material fixing.

Plate 60: Royal Pew, Chapel Royal, Hampton Court Palace: Void over Thornhill ceiling, red and white paint traces on soffit of beam

Plate 61: Royal Pew, Chapel Royal, Hampton Court Palace: Void over Thornhill ceiling, rebates for possible arch detail on post 3

Plate 62: Royal Pew, Chapel Royal, Hampton Court Palace: Void over Thornhill ceiling. Surviving Tudor post and 17th century supporting post strapped in front of it (north side). The Tudor post is chamfered on the closest edge and is recessed in two places halfway up the photograph.

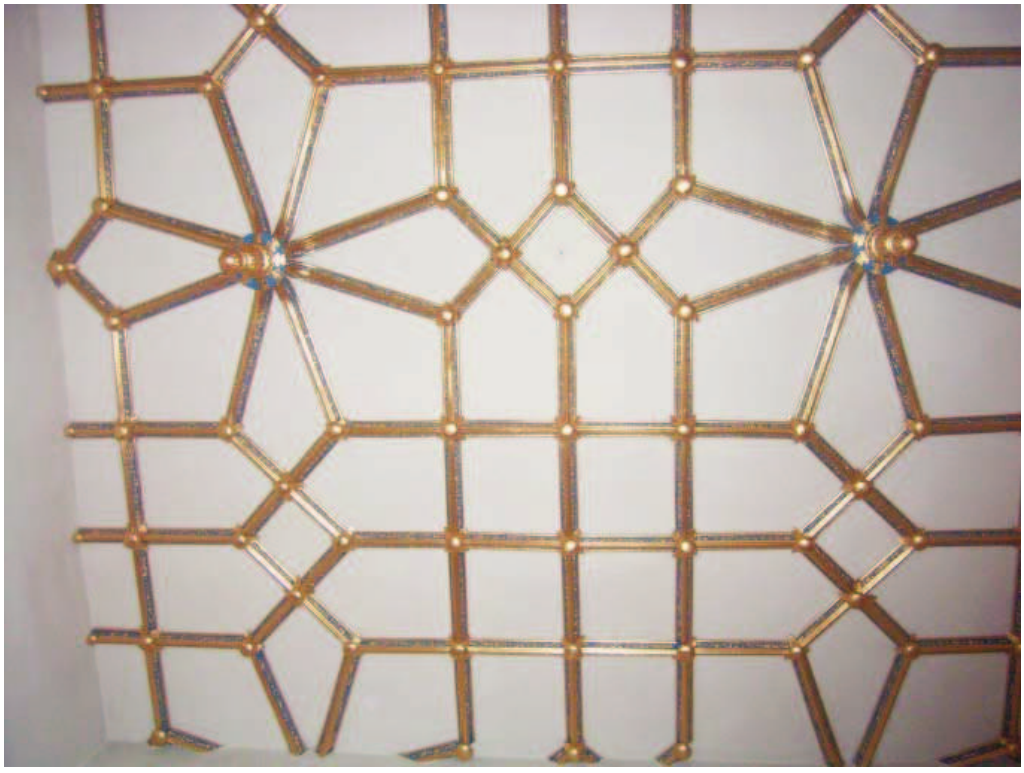

Plate 63: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, Lady Chapel, in situ Tudor ceiling

Plate 64: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, Lady Chapel, cut floor joist mortice at end of upper beam

Plate 65: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, Winter Pew, detail of hearth showing forelock

Plate 66: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, ground floor ante chapel, underside of hearth within Winter Pew

Plate 67: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, Winter Pew, window cut by inserted ceiling

Plate 68: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, lifting of the floorboards on the south side of the ante chapel. Detail of floor joist and marble floor tiles.

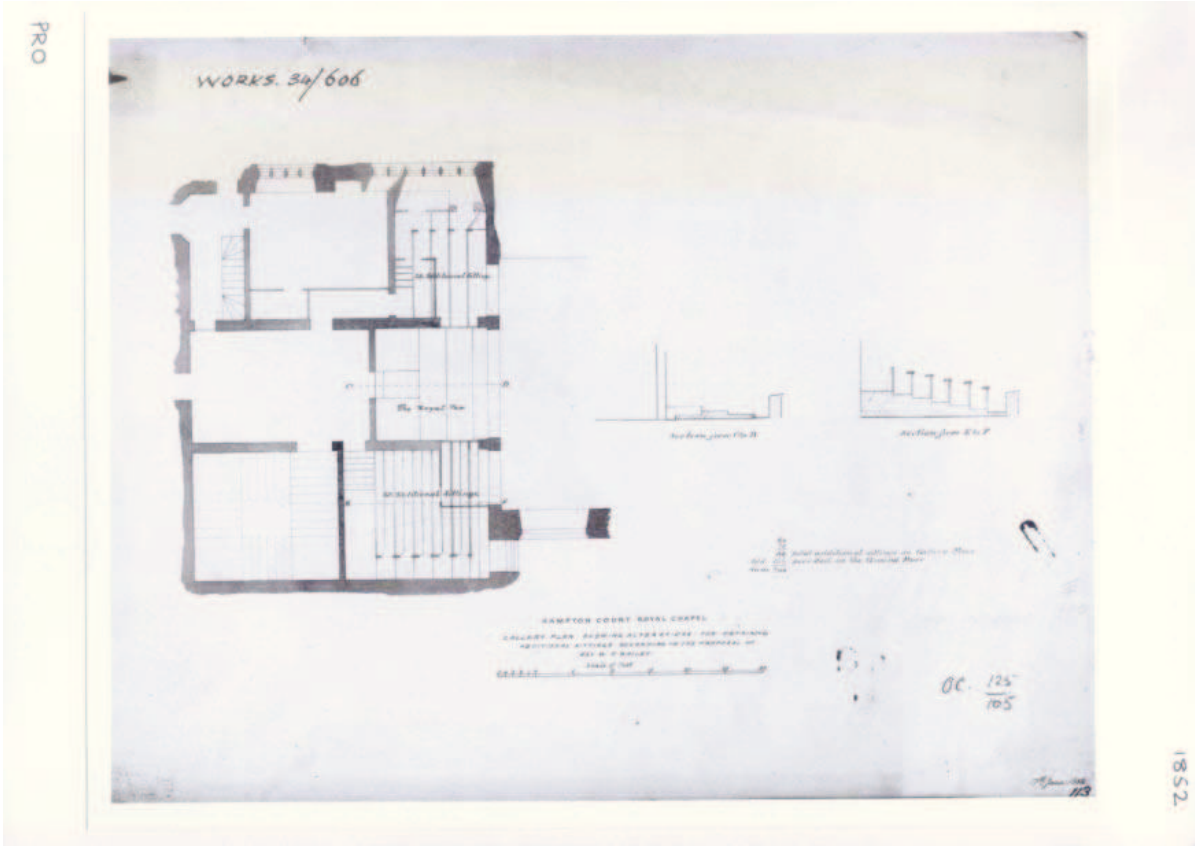

Plate 69: Royal Pew, Chapel Royal, Hampton Court Palace: Royal Pew, 19th century plan of raised seating within the Winter Pew, Royal Pew and Lady Chapel.