RESEARCH REPORT SERIES no. 19-2013

APETHORPE HALL, APETHORPE, NORTHAMPTONSHIRE DOVECOTE ROOF

HISTORIC BUILDING REPORT

Nick Hill

ASSESSMENT

ENGLISH HERITAGE

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Dovecote Roof
Historic Building Report

Nick Hill

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SUMMARY

The circular Dovecote was built as an eye-catcher in the grounds of Apethorpe Hall in c.1740, probably to the design of Roger Morris. The roof structure was largely dismantled to carry out repairs in summer 2011, in association with a programme of recording and analysis. Its original domed roof structure survived in very complete form, though in dilapidated condition. Built of oak, the roof structure is ingenious, combining traditional carpentry with widespread use of 'forelock' bolts, a type which was a precursor to bolts with screw threads and nuts. However, the design form, with a dome rising above a low-pitched 'skirt' roof, was over-ambitious and suffered early structural failure. After falling out of use in the 19th century, the Dovecote was converted to serve as a water tower.

CONTRIBUTORS

The drawings were prepared by Rodney Melville & Partners.
Photographs by Nick Hill (except where otherwise noted).

ACKNOWLEDGEMENTS

The report was edited by Kathryn Morrison and the layout was prepared by Martin Jeffs.

ARCHIVE LOCATION

This report will be deposited in the English Heritage Archive, Swindon.

DATE OF INVESTIGATION

Opening up and survey work were carried out in 2011-12.

CONTACT DETAILS

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CONTENTS

1. INTRODUCTION

The Dovecote at Apethorpe Hall, a large circular building crowned by a distinctive domed roof (figs 1-2), is one of the most impressive dovecotes in the country. Standing on rising ground around 200m to the north-west of the Hall, it was built in c.1740 as an eye-catcher by the 7th Earl of Westmorland. An agreement survives from January 1740 with Edward Frame, mason of nearby Woodnewton, to 'build a Pigeon House', though this relates only to the plain walling, not the cornice or roof (see Appendix A). The 7th Earl carried out major improvements to the Hall and estate at this time. Recent research has suggested that the Earl's designer for the new façades to the Hall, and probably also for the Dovecote, was the leading Palladian architect, Roger Morris. In the early 20th century, the Dovecote was converted to serve as a water tower (fig 3-4). Internally, the nesting boxes were bricked up and a large cast iron water tank was built, filling the whole upper part of the stone drum.

Fig 1 The west side of the Dovecote in January 2011.

Fig 2 Works in progress, with roof covering stripped, June 2011.

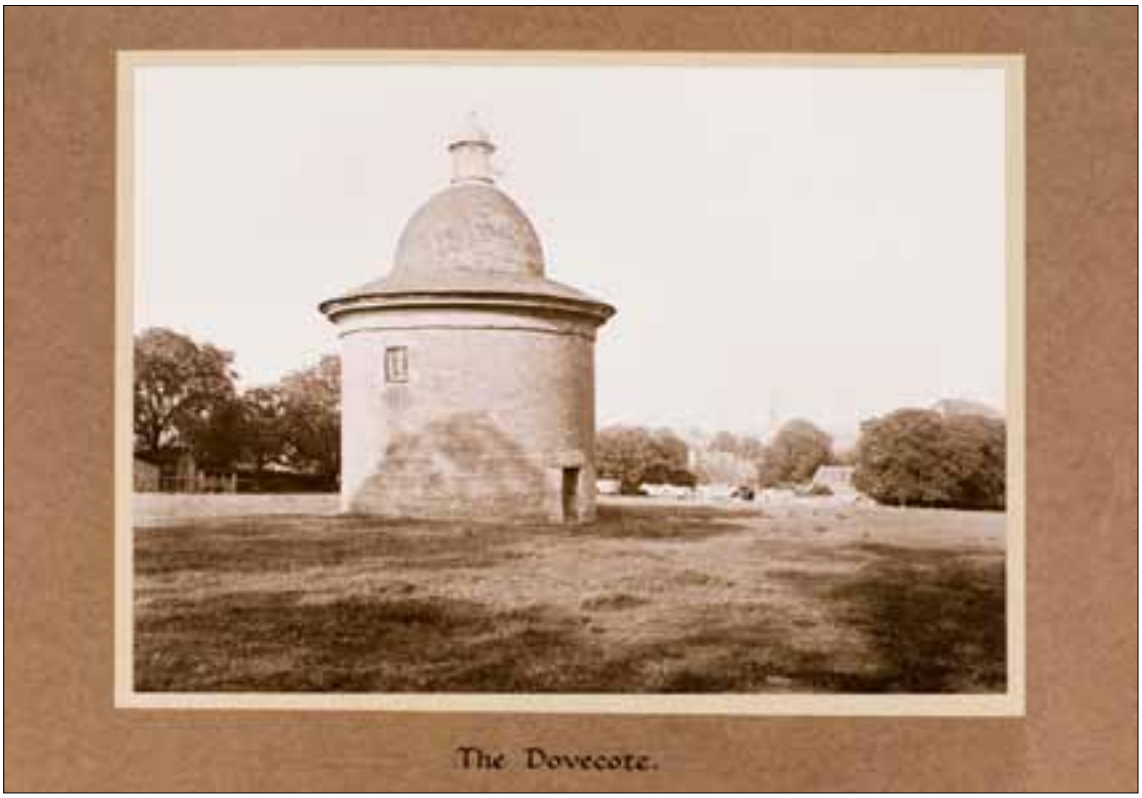


Fig 3 The west side of the Dovecote in 1922. The Dovecote had recently been fitted with a water tank inside and a new glazed lantern. Courtesy of Lord Brassey.

2. DESCRIPTION

The circular stone structure is built of well-dressed coursed limestone rubble. At the top of the stone drum is a moulded entablature of finely dressed limestone with a deeply projecting cornice. The walls are blank except for two small openings. On the south side, there is a low doorway (as normally found in dovecotes) with an old oak lintel and plain, boarded door. On the west side, set quite high up, is a small window opening, also with an old oak lintel. This would probably have been fitted originally with a timber lattice, to prevent access by birds of prey. It now has a timber window frame, iron casement and leaded lights, part of the early 20th-century alterations. The roof, covered in Collyweston slates, is formed of two sections. Below is a low-pitched cone or 'skirt', and above this rises a tall, elliptically curved dome. At the top of the dome, the original 'glover', which gave access for pigeons, was converted into a glazed lantern in the early 20th century. The lantern is surmounted by a leaded cupola.

Fig 4 The interior of the Dovecote, with bricked-up nesting boxes.

Inside, the bottom row of nesting boxes is set 600mm above floor level, with coursed stone rubble below. Above this, the main interior is built of brick, with nesting boxes for the pigeons (fig 4). The bricks used are c.60mm x 235mm x 105mm in size. Up to the base of the inserted water tank, there is evidence for 17 rows of nesting boxes, each with a projecting ledge below, for birds to alight. Each row contains around 55 nesting boxes, giving a total of around 900. Above the base of the water tank, the wall face steps inwards, and the upper part is built of coursed rubble, without nesting boxes. When the water tank was inserted, all of the nesting boxes were bricked up, and five brick buttresses were added to the north and south sides, supporting steel beams for the tank. The water tank is built up of heavy, cast iron sections, bolted together.

3. ROOF STRUCTURE

3.1 Lantern and cupola

The top lantern is of octagonal form with a leaded cupola roof. During dismantling, it became evident that the leaded cupola roof was original, but the glazed lantern was of early 20th-century date (figs 5-6).

Fig 5 The early 20th-century glazed lantern and original leaded cupola.

Fig 6 Lantern and cupola after roof stripping. The cupola retains its original boards, but the finial is of 20th-century date.

The cupola roof has a neatly framed roof structure, of oak. At the base is an octagonal plate, formed in four sections (fig 7). The sections are jointed with open-tenoned joints, pegged twice. On the lower outside edge of the base plate is a ring of iron straps, formed in four sections, rebated into the base plate and fixed with large, hand-made nails. This appears to be an original detail of 1740. A tie-beam spans across the base plate, with lap dovetail joints at each end, fixed with an iron forelock bolt. Forelock bolts pre-date bolts with screw threads and nuts, having a slot in the bolt end to receive a thin, tapered iron wedge. This bolt type is used widely throughout the 1740 structure. An octagonal kingpost is supported on the centre of the tie-beam, with a tenon passing right through the tie-beam and fixed with a wedge (a tusk tenon joint).

Eight curved oak ribs form the cupola, neatly shaped, with feet tenoned to the base plate and skew-nailed to the kingpost at the top (fig 8). The ribs have carpenter's marks, both knife-cut and chiselled, but these were only partly visible. The cupola is covered with pine boards, largely original, and fixed with hand-made nails. The original kingpost was cut off at the top of the dome, level with the boarding, and a later finial with ball top had

Fig 7 The base of the cupola, with octagonal base plate.

Fig 8 The top of the cupola, with kingpost and curved ribs.

been mounted on top. It was not possible to determine whether the 1740 structure included a finial, though this seems likely. The lead covering of the cupola had open roll joints, with various flashing repairs, one bearing the scratched graffito 'R Bellamy 16/7/79'. Roger Bellamy still works as a lead plumber in the area. During the repairs, the whole of the cupola structure was lifted off bodily and retained intact, without dismantling. The same procedure must have been followed during the early 20th-century alteration works, as the cupola had clearly never been dismantled.

The glazed lantern has eight vertical oak posts. These are seated on a thin softwood cill plate (see Appendix B 5439/7106A), which is fixed down with slotted-head screws. The posts are rebated to receive the leaded light glazing. At the head the posts are tenoned into the cupola base plate. The top rails of the window lights are of softwood, skew-nailed rather than properly tenoned to the posts. There is an applied softwood cornice, of cyma profile. The glazing has fixed leaded lights, and also two iron centre-hung pivot-opening casements. The iron casements are of the same type as those in the main house, fitted in the early 20th century. It was evident that the whole of the glazed lantern, including the posts, was a replacement of early 20th-century date. The original structure would have been octagonal, but with boarding and gaps to allow access by pigeons.

Eight heavy iron straps, of cranked form, with dome-head, threaded bolts and square nuts are used to fix the eight posts to the stepped series of timber plates below. These seemed rather crude for the early 20th-century alterations phase, and might have been applied at an earlier date, to secure the glover.

3.2 Main dome

The main dome has curved ribs which rise from a dome base beam to a set of two small circular ring-beams, located directly under the lantern. The whole structure is of oak, with all timbers surviving from the original 1740 construction. The upper ring-beam is made up of four sections of 225mm by 140mm timber, each section forming quarter of a circle, with a diameter of 1330mm (figs 9-10). The sections are jointed with open-tenoned joints, pegged twice. The top face of the beam has eight mortices (much enlarged by decay), which would have received the original eight posts of the octagonal glover. The post tenons were also originally fixed with an oak peg. It should be noted that these mortices relate only to the earlier structure, as the feet of the early 20th-century lantern posts are seated on top of the extra softwood cill plate, not tenoned into the upper ring-beam (fig 11-12). Chiselled carpenter's marks, partly missing, were observed eg 'IIII' to one section – the original numbers to the other sections were presumably I, II and III.

Fig 9 The two ring-beams after removal of the lantern. Note the iron straps which supported the eight posts of the lantern. These are applied over the internal lead flashing, which provided protection to the timber before the lantern was glazed.

Fig 10 Detail of the upper ring-beam, with pegged, open-tenoned joints and decayed mortices for the original glover posts.

Fig 11 Detail of the upper ring-beam, with early 20th-century applied softwood cill, carpenter's mark 'IIII' and oak peg which fixed the tenon of the original glover post.

Fig 12 The upper ring-beam, formed in four sections. Note the eight decayed mortices for the glover posts, and the four holes for forelock bolts, with square countersinking.

The upper ring-beam sits directly over a lower ring-beam, again formed of four sections, but of slightly smaller diameter. The upper ring-beam is fixed down to the lower ring-beam with four large forelock bolts (fig 13). The lower ring-beam was badly decayed, and further details were not retrieved.

Fig 13 One of the large forelock bolts which were used to fix the upper ring-beam to the lower ring-beam. Driving the thin tapered wedge into the slot tightens up the bolt fixing. The forelock bolts are of various sizes, this being the largest.

The inner face of both ring-beams is clad in lead flashing. This must relate to the period when there was still an open glover, and the leadwork needed protection from wind-blown rain. After the fitting of the glazed lantern in the early 20th century, the leadwork would have been redundant. The eight iron straps holding down the lantern were fixed over this leadwork.

The dome ribs are of carefully shaped oak (c.140mm by 70mm), tenoned and nailed to the dome base beam at the foot, with a nailed birds-mouth joint to the lower ring beam at the top (figs 14-15). Five of the ribs were formed of two sections, an open tenon joint. It was clearly a challenge to obtain enough timber to produce the long, curved ribs in a single piece. There are 32 ribs, with a set of chisel-cut carpenter's marks to the foot, all in sequential order – eg 'XXVII' (fig 17).

The dome base beam is circular, with an outside diameter of 4.7m (fig 19). It is formed of six curved sections (180mm by 150mm), with half-lap joints, fixed with a forelock bolt. Some chisel-cut carpenter's marks were seen to the beam sections eg 'IIII'.

Fig 14 The tops of the main dome ribs, after removal of the ring-beams. The tops of the four straight principal rafters can also be seen.

Fig 15 Detail of the birds-mouth joint to the ribs and principal rafters, which fitted against the underside of the lower ring-beam.

Fig 16 The main dome with Collyweston slate covering.

Fig 17 The interior of the main dome before roof stripping. As well as the curved ribs, one of the straight principal rafters is visible.

Fig 18 The ribs of the main dome are supported on the dome base plate, which is in turn supported by the lower 'skirt' structure. Some of the straight principal rafters to the dome can also be seen, as well as joist ends of the inserted floor.

Fig 19 Detail of the dome base plate, with the first and last dome ribs – marked 'I' and 'XXXII'.

The structure of the dome is braced by four principal rafters, straight not curved, and of c.140mm x 135mm in section. Two of these rafters are secured to a horizontal tie-beam, with a lap-dovetail joint, fixed with a forelock bolt and a large nail (figs 20-21). The tie-beam is seated on top of the dome base beam, and is fixed to this with a lap dovetail joint and forelock bolt (fig 22). The other two principal rafters have no tie-beam, and are simply birds-mouth jointed to the dome base beam and fixed with large nails. At the top, all four principal rafters have a birds-mouth joint to the lower ring-beam, through-fixed with a forelock bolt. When the iron water tank was fitted, softwood joists and boarding were added above the tie-beam, to form a partial floor.

Fig 20 Lower part of a dome principal rafter and the tie-beam – partly covered by the water tank floor.

Fig 21 Detail of the joint to dome principal rafter and tie-beam, with lap dovetail, forelock bolt and large-head nail.

Fig 22 Detail of the dome tie-beam end, with dovetail-lap seating onto the dome base plate.

3.3 Dome 'skirt'

The base beam of the main dome does not bear onto the masonry walls, but is instead supported by the 'skirt' roof structure (figs 23-24). The low-pitched 'skirt' has 16 principal rafters of c.100mm by 200mm section, which are simply birds-mouthed and nailed at top and bottom to the dome base beam and wallplate. A few chisel-cut carpenter's marks survive to the principal rafters, enough to show that there was a complete, ordered sequence from 'I' to 'XVI' (fig 25) Three common rafters (c.60mm by 85mm) are located between the principal rafters, which extend across the thickness of the wall to the outer edge of the roof. Many of these common rafters had previously been replaced in modern softwood.

Fig 23 The lower 'skirt' structure.

Fig 24 One of the principal rafters to the 'skirt', notched over the rim of the early 20th-century water tank.

Fig 25 Joint to the wallplate, with dovetailed bridle, and failed forelock bolt fixing. The outer iron strap has been to provide restraint, after the original joint pulled apart.

The circular wallplate, resting on the inner face of the stone walls, is formed of eight, curving sections, c.200mm wide by 250mm high. The sections were jointed originally with open, bridle joints with slightly dovetail-shaped tenons, and fixed with a forelock bolt (fig 26). Although designed to resist the outwards force from the 'skirt' rafters, the joints had failed to perform and in most cases had pulled apart, by up to 50mm. A flat iron strap had been bolted to the outer face of the wallplate across the joints to prevent further outwards spreading. This strap was fixed with threaded bolts and square nuts, not forelock bolts, and may date from the early 20th-century repairs, or a previous repair programme. The outer feet of the common rafters rest simply on the masonry wall top, with no evidence for an original outer wallplate.

Fig 26 The foot of one of the 'skirt' principal rafters, with carpenter's mark 'XIII'.

4. RECENT REPAIRS

During the recent repairs, the cupola roof structure to the lantern was retained largely intact, including most of the original roof boarding (figs 27-28). The timber of the early 20th-century lantern structure was fully replaced, with the two iron pivot windows and leaded-light glazing reinstated. Both the upper and lower ring-beams had to be fully replaced, though the intact upper ring-beam has been left inside the building, together with a number of forelock bolts. The main dome ribs and base plate required only minor repair and re-fixing. Quite extensive repairs were needed to the lower 'skirt', but the majority of the wallplate and principal rafters remain in situ. The Collyweston slates and leadwork were fully stripped and reinstated. The water tank structure has been retained, and provides vital support to the dome base beam via added props.

Fig 27 Reinstatement of the lantern and cupola

Fig 28 The Dovecote after repair, in 2012 (Pat Payne, DP0152841)

5. DISCUSSION

The intricate structure and carpentry details of the roof are of considerable interest. The detailing is ingenious in many ways, and makes extensive use of forelock bolts, which are able to provide restraint fixings at joints much more effectively than traditional carpentry techniques. Such iron bolt and strap fixings came into wider use from the mid-18th century onwards, replacing or supplementing traditional carpentry, often to enable wider roof spans. The whole structure has clearly been carefully designed, and fully pre-assembled in the carpenter's yard, as indicated by the very complete sequence of carpenter's marks.

However, while the structure of the main dome and lantern/cupola was well-designed and soundly constructed, the support structure of the lower 'skirt' roof was ill-conceived and proved inadequate. The whole weight of the dome had to be supported on the floating dome base plate. The forces imposed on the base plate generated considerable outwards thrust, which was intended to be restrained by the principal rafters of the 'skirt' and the dovetail-jointed ring of wallplate timbers. It was unrealistic to expect the 'skirt' structure, especially given its low pitch, to contain these forces. In spite of their forelock bolts, the wallplate joints failed under the tensile stress, and the dome suffered considerable subsidence. When the water tank structure was added in the early 20th century, with major steel beams, it provided vital support (whether by accident or design) to the dome roof, which by this stage must have been close to collapse.

It seems likely that the carpenter responsible for the roof design had little previous experience of such structures, which are indeed rare in England. If the building's architect was Roger Morris, it is also evident that he provided little assistance on structural design. Perhaps Morris contributed only a concept sketch, for a dome rising above a 'skirt', with no consideration of the practical difficulties which such a design would entail. Successful delivery of the architect's design proved, despite their ingenious efforts, beyond the abilities of the local craftsmen.

The design concept, of a tall dome rising from a sizeable lower 'skirt', is interesting. The normal design for a dome is that it rises directly from circular or faceted walls, albeit with an entablature, balustrade or similar feature. Wren's dome at St Paul's (designed in the late 17th century), Thomas Archer's pavilion at Wrest Park, Bedfordshire (1709-10) and James Gibbs' Radcliffe Camera at Oxford (1741-3) are all of this form. The Italian Renaissance church designs which generated these English examples are of the same type. An alternative way of using a dome was adopted by Palladio at his famous Villa Rotonda, near Vicenza. Here the dome is located above a circular hall, set within a villa of square plan form. The result is that a dome rises in the centre of a surrounding 'skirt', albeit of pyramidal rather than cone shape. The design of the Villa Rotonda was copied by Palladian enthusiasts in England, most notably at Chiswick House, London, built in the 1720s by Lord Burlington, and at Mereworth Castle in Kent of 1722-5, by Colin Campbell. At Chiswick, the dome takes a rather different form, rising from an extension of the octagonal saloon, with a shallow, stepped profile. But at Mereworth, there is a tall, elliptical, lead-covered dome, rising directly from the shallow-pitched roof slopes, and crowned by a lantern (fig 29). The effect of the roof and dome at Mereworth, albeit on

a very much grander scale, is rather similar to that of the Dovecote at Apethorpe. Is it possible that this was the model which inspired Roger Morris, Campbell's protégé, or John Fane, who built Mereworth Castle before he became 7th Earl of Westmorland in 1736?

Fig 29 Mereworth Castle, Kent (English Heritage Archive, AA50/10363)

ENDNOTES

[1] Pete Smith, 'The Palladian Palace at Apethorpe', English Heritage Historical Review, Volume 2, 2007, p.98.

APPENDIX A: AGREEMENT TO 'BUILD A PIGEON HOUSE'

Extract from papers relating to Apethorpe Hall 1762-63 in W(A) Box 7, Parcel XV at Northamptonshire Record Office

Endorsed Agreement with Edward Frame mason of Woodnewton to build a pigeon house at Apthorpe Jan 4th 1739/40

Edward Frame of Woodnewton proposes to build a Pigeon House in King's Close at Apthorpe on the conditions following viz

The mason's work in the foundations at per rood £1 10s 0d

The mason's work from the beginning of the pigeon holes to the top of the wall at per rood £2 10s 0d

For the wall going to Apthorpe Bridge at per rood £1 2s 6d

One course of heading bricks, and one course of stretchers alternately on the south side, the northside of stone

If built on arches, the void of the arches to be measured, as solid.

A rood 36 yards

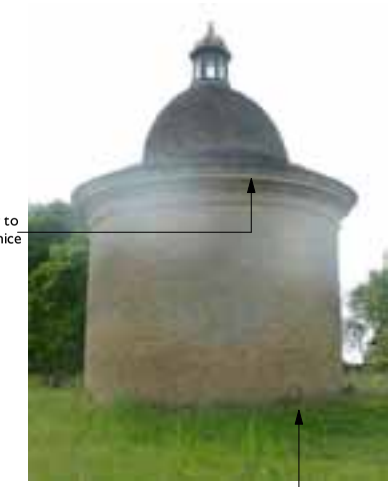
The dimension of the pigeon house to be 21 feet in diameter in the clear within, and about 25 foot from out to out - The height of the wall above ground 21 feet, the foundation 2 feet six inches below the surface.

Comment

This note describes only the masonry work for the walls of the Dovecote, and also makes no mention of the high quality moulded cornice. The Dovecote was built approximately in accordance with these dimensions. Assuming that the costs given are for a rood (ie 36 square yards) of finished face work, the total cost of the walling would have been around £13, which seems remarkably cheap. The stone cornice would have been a significant additional cost, and may have been provided by a different, more specialist mason. The costs for the roof structure, cupola and Collyweston slating are not mentioned, so this work was presumably undertaken by others.

APPENDIX B: DRAWINGS (RODNEY MELVILLE & PARTNERS):

5439/7101	Elevations
5438/40	Section and Plan
5439/7103D	Lantern and Cupola
5439/7106A	Eaves and Sill Details
5439/7105A	Rafter Layout and Cupola Roof

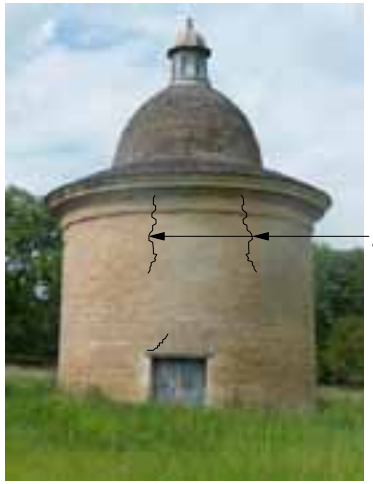


East Elevation

North Elevation

West Elevation

Window :
Repoint around oak lintel and crack below sill. Reflaunch sill. Relead both leaded lights reusing existing glass. Prepare, de-rust and redecorate all ironwork but seal left hand pivoting casement shut.



South Elevation

Door :
Prepare and redecorate. Repoint crack above lintel.

REVISIONS

NOTE

1. This drawing is copyright.
2. All dimensions must be checked on site before proceeding.
3. Dimensions of new work are to be adjusted to suit the existing building where necessary. Do not assume that the existing structure or details are plumb, square or level.
4. The contractor must report any discrepancies to the architect before proceeding.

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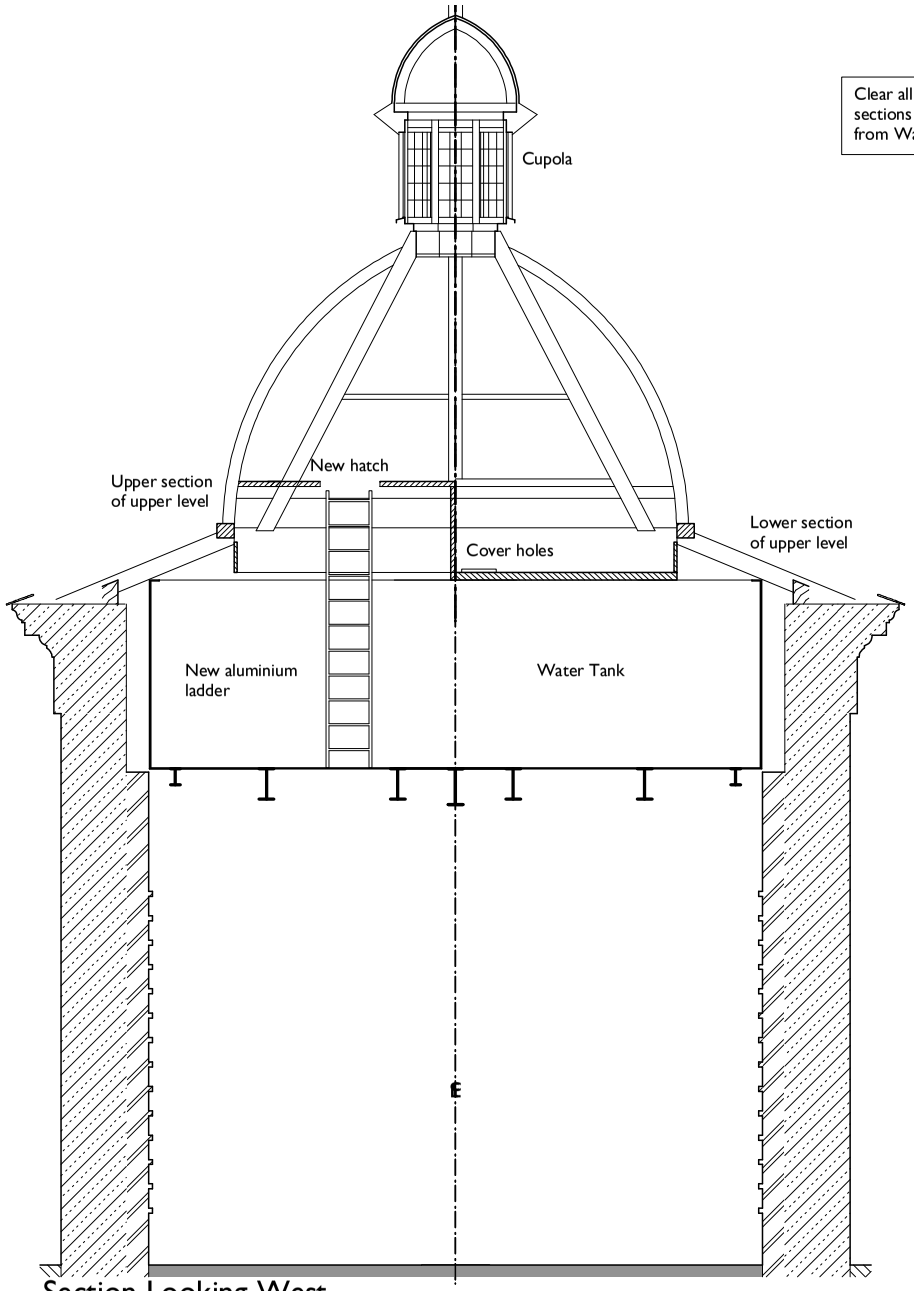
Project: Apethorpe Hall, Northamptonshire
Phase 2

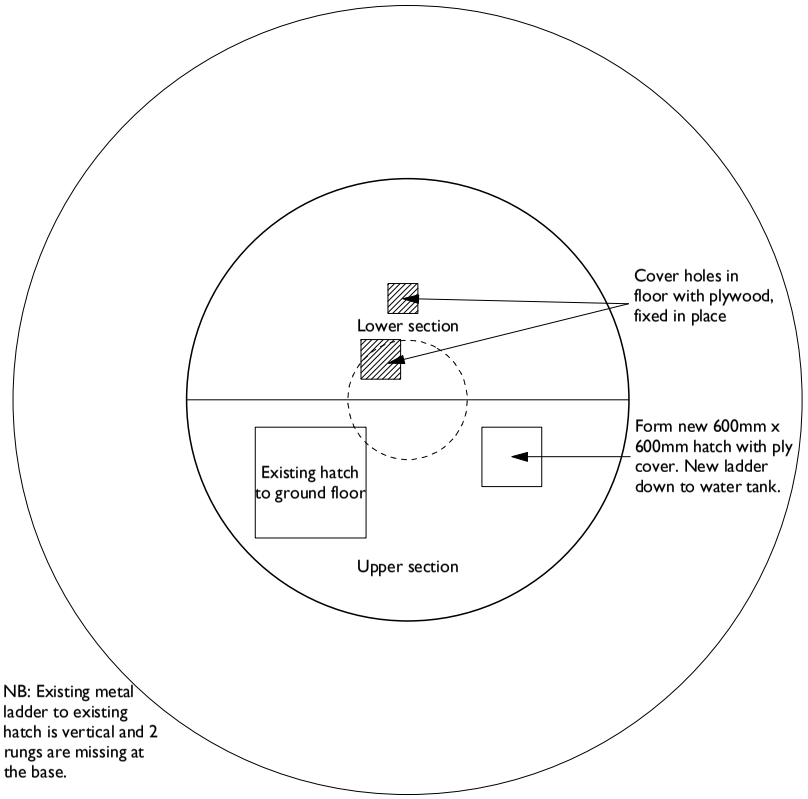
Drawing: Dovecote
Elevations as Proposed

Scale	NTS	Job No	5439
Date	Oct 2010	Drwg No	7101
Drawn	JPC / RG	Rev	–



Section Looking West

Clear all debris from both sections of upper level and from Water Tank



NB: Existing metal ladder to existing hatch is vertical and 2 rungs are missing at the base.

Plan at Upper Level

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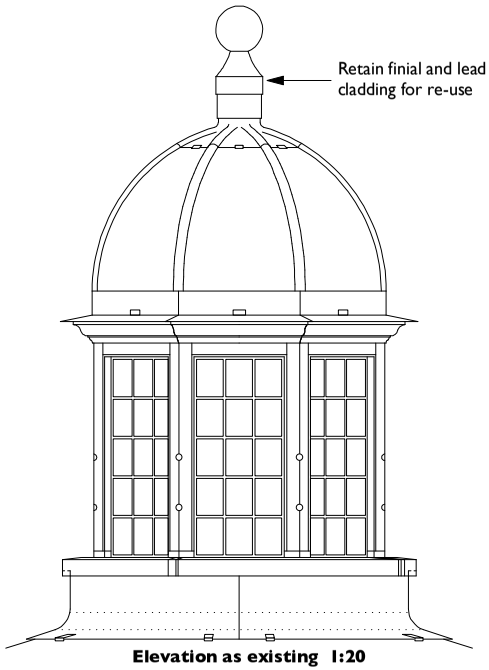
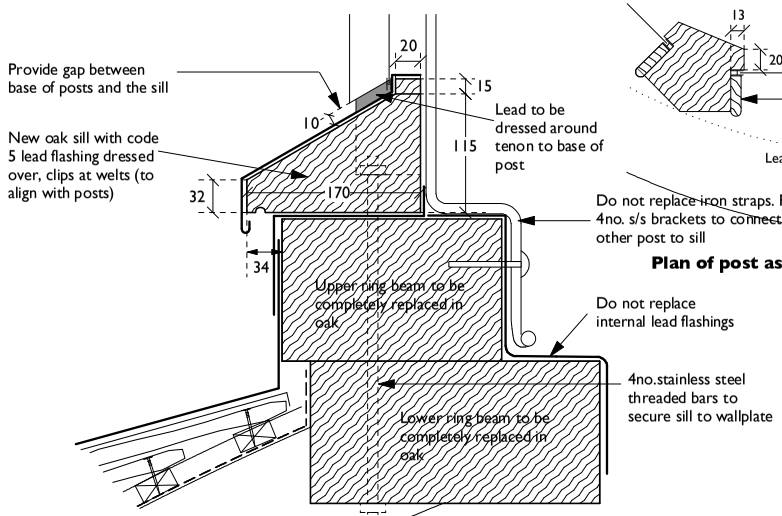
Project	Apethorpe Hall : Phase 1b/1c Works
Drawing	The Dovecote Improved Access

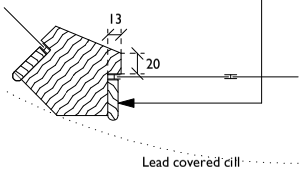
Scale	1:50@A3	Job No	5438
Date	July 10	Drwg No	40
Drawn	sjo	Rev	-



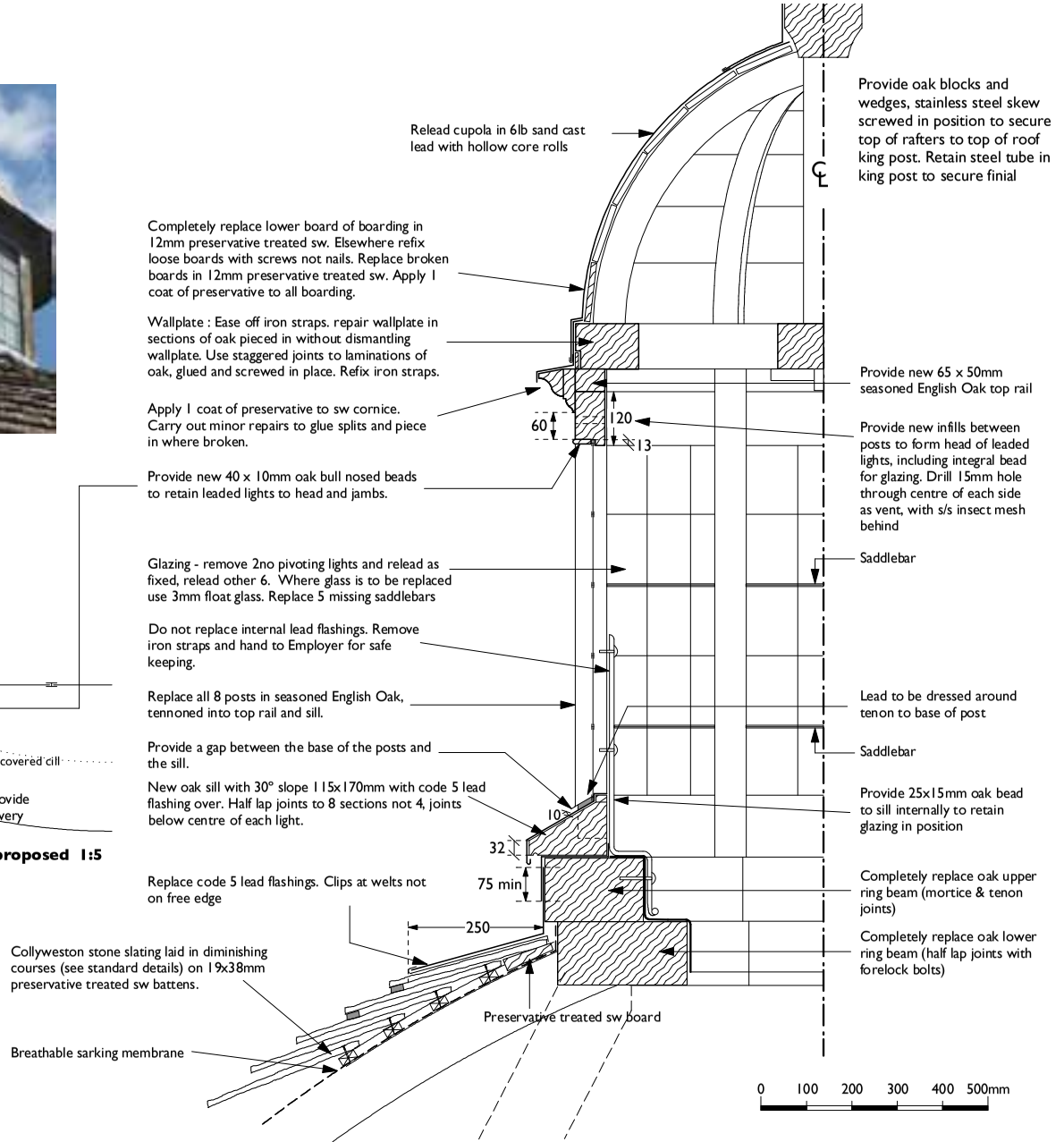
Elevation as existing 1:20



Sill detail as proposed 1:5



Plan of post as proposed 1:5



Detail C - Lantern head and sill detail as proposed

Revisions

A 21.06.2011 Elevation added and details updated
B 20.07.2011 Scope of repairs confirmed, detail C amended
C 08.09.2011 SS bars added to secure sills
D 15.09.2011 Detail c & Sill detail amended

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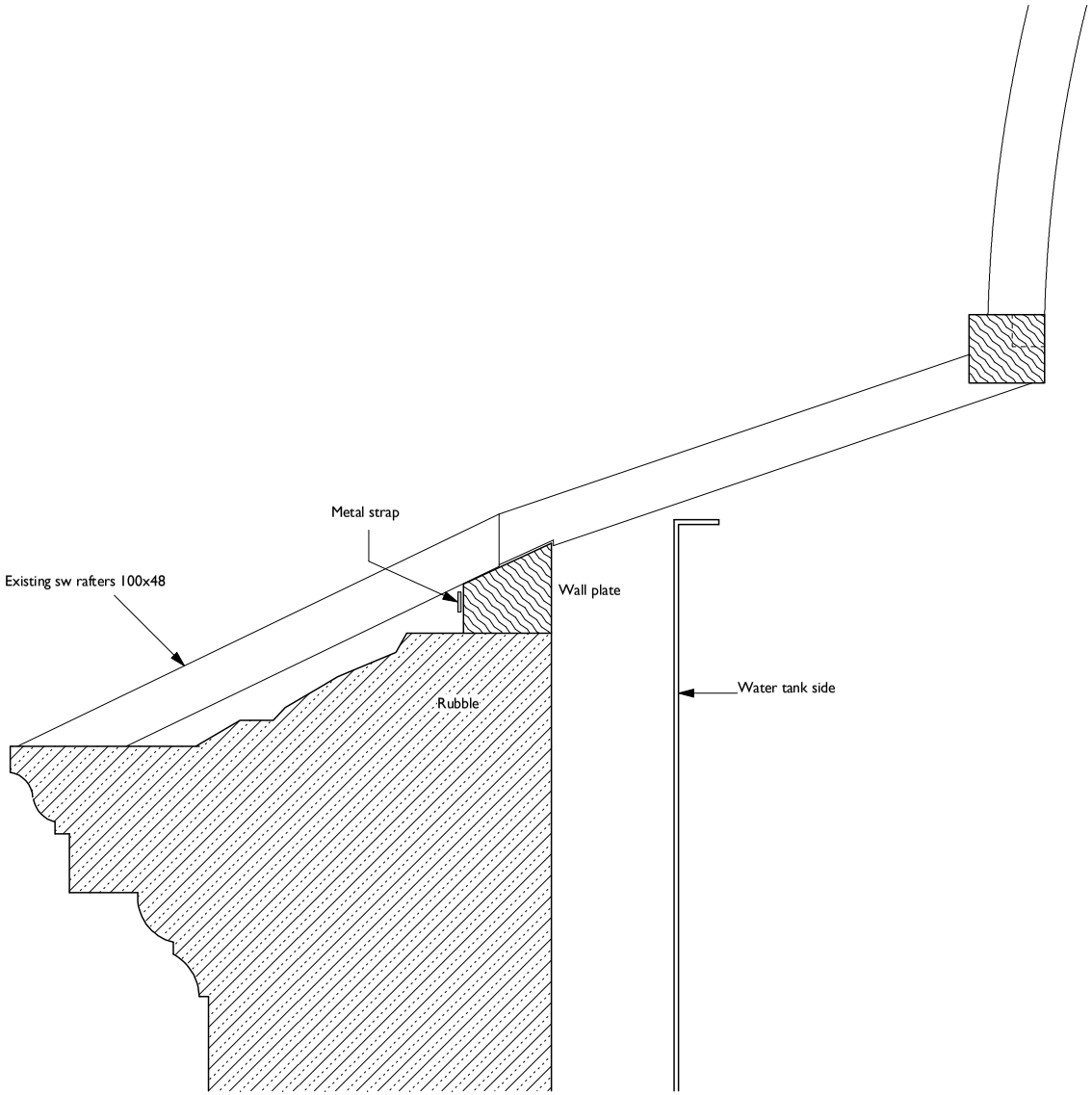
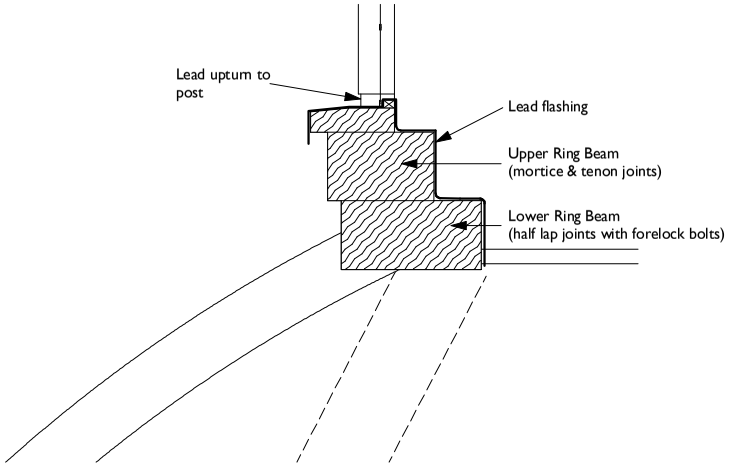
Project: Apethorpe Hall, Northamptonshire Phase 2

Drawing: The Dovecote Roof section C as proposed

Scale	1:10@A3	Job No	5439
Date	Oct 2010	Drwg No	7103
Drawn	SJO / RG	Rev	D



Eaves detail as existing



Sill detail as existing

0 100 200 300 400 500mm

Revisions

A 21.07.2011 Sill detail amended

NOTE

1. This drawing is copyright.
2. All dimensions must be checked on site before proceeding.
3. Dimensions of new work are to be adjusted to suit the existing building where necessary. Do not assume that the existing structure or details are plumb, square or level.
4. The contractor must report any discrepancies to the architect before proceeding.

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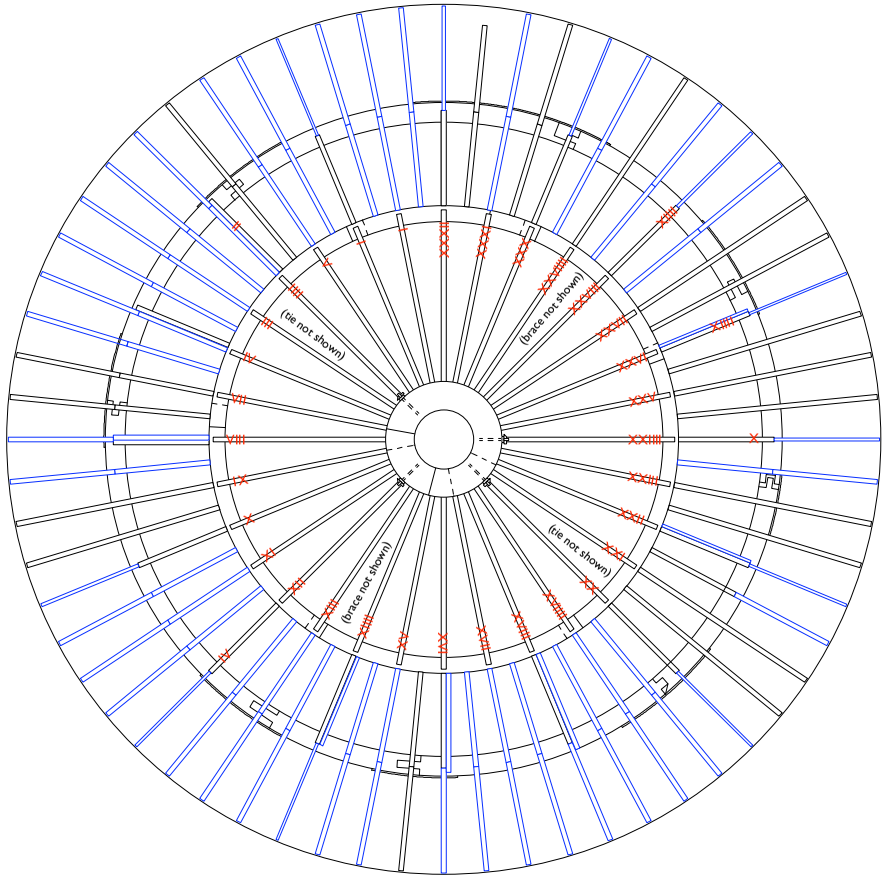
Project: Apethorpe Hall, Northamptonshire Phase 2

Drawing: The Dovecote
Sections through roof as existing

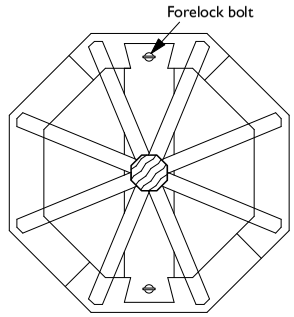
Scale	1:10@A3	Job No	5439
Date	July 2011	Drwg No	7106
Drawn	RG	Rev	A

Roof timbers generally in oak. Softwood rafters are shown in blue.
Red roman numerals relate to carpenters marks

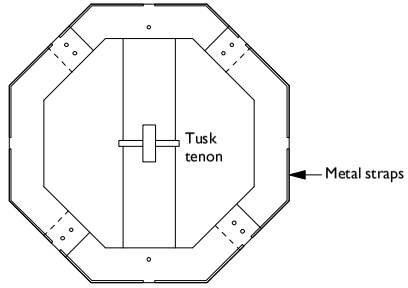


Existing rafter layout plan 1:50 (Joints to Cupola lower ringbeam shown)

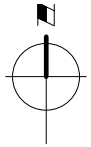
0 1 2 3m



Cupola Roof Plan from above 1:20



Cupola ceiling - Reflected Plan 1:20



(Notional)
[Loading bay on scaffold faces notional South]

19 - 2013

Revisions
19.7.2011 Dovetail joint to cupola beam shown

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Project: Apethorpe Hall, Northamptonshire Phase 2

Drawing: The Dovecote
Roof plan as existing

Scale	Various@A3	Job No	5439
Date	July 2011	Drwg No	7105
Drawn	RG	Rev	A

ENGLISH HERITAGE RESEARCH AND THE HISTORIC ENVIRONMENT

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The Heritage Protection Department provides English Heritage with this capacity in the fields of building history, archaeology, archaeological science, imaging and visualisation, landscape history, and remote sensing. It brings together four teams with complementary investigative, analytical and technical skills to provide integrated applied research expertise across the range of the historic environment. These are:

* Intervention and Analysis (including Archaeology Projects, Archives, Environmental Studies, Archaeological Conservation and Technology, and Scientific Dating)
* Assessment (including Archaeological and Architectural Investigation, the Blue Plaques Team and the Survey of London)
* Imaging and Visualisation (including Technical Survey, Graphics and Photography)
* Remote Sensing (including Mapping, Photogrammetry and Geophysics)

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