The JESSOP Consultancy

MOGGERHANGER HOUSE

Bedfordshire

Emergency Recording of Trussed Floor Beams and Historic Fabric

March 2013

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Cover: General view of entrance to Moggerhanger House, 2012.

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The JESSOP Consultancy
Heritage, Historic Buildings and their Settings

SUMMARY OF PROJECT DETAILS

OASIS ID:	Thejesso1-131684
TJC Project Code:	TJC120403
Project Type(s):	Emergency Recording of Structural Fabric
National Grid Reference:	TL 13541 48665 (centered)
Site Area:	n/a
Parish:	Moggerhanger
Local Authority:	Central Bedfordshire
Client:	Moggerhanger House/English Heritage
Planning Reference:	Not Applicable
Designation Status:	Grade I Listed Building
EH Listing No.:	1137422
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Reviewed by:	Karen E Walker MIfA, FSA
Date:	March 2013

1 NON-TECHNICAL SUMMARY

The JESSOP Consultancy (TJC) has undertaken a detailed archaeological record of selective areas of the historic fabric comprising the Grade I Listed Moggerhanger House. The features examined were exposed during a programme of emergency structural repairs resulting from the failure of key timber components at both first and second floor level above the Eating Room in the south-east part of the house.

The House is located to the south of the village of Moggerhanger, accessed from the A603 between Bedford and Sandy; NGR TL 13541 48665 (centered). The report has been prepared on behalf of the Moggerhanger House Trust, with funding provided by English Heritage.

The earliest fabric of the building dates from the 18th century, although the building that stands today is predominately early 19th century in date. It is an outstanding example of architectural design by John Soane from between 1790 and 1812; Soane refined the building into a great work of art in which every element is carefully considered.

The archaeological recording and subsequent architectural analysis has documented aspects of the floor structure, which made use of integral trussed beams. Two different designs of composite structure were observed, which have similar characteristics to floor systems used by Soane in his designs for the Bank of England. Additional observations of exposed sections of structural fabric were made, associated with internal fireplaces, the construction of stud wall partitions and the floor structure.

2 INTRODUCTION

BACKGROUND

The JESSOP Consultancy (TJC) has undertaken a targeted programme of detailed archaeological building recording of areas of exposed structural fabric at Moggerhanger House following the structural failure of floor beams above the Eating Room on the ground floor. In addition, eighteen discrete areas of exposed wall and floor fabric were also recorded within rooms F5-F8, F12-13 and S5, S6, S11.

AIMS OF THE REPORT

The intention of this report is to provide a description of the recording that was undertaken and a discussion of the principal features that were uncovered.

ARCHIVE

The project archive comprised notes, sketches, measured drawings and b/w and digital photography, and it will be deposited with the Bedfordshire Museums Service. In addition, a site specific record has been registered with the OASIS database (Online AccesS to the Index of archaeological investigations); project ID: **Thejesso1-131684**.

DISSEMINATION

Printed and bound copies of this report will be distributed to the Client, English Heritage, Inskip & Jenkins Architects and the Central Bedfordshire HER. It will also be uploaded to the OASIS online database in a digital format.

ACKNOWLEDGEMENTS

This report has been researched and prepared by Oliver Jessop MA MIfA with editing undertaken by Karen E Walker MIfA, FSA.

Stephen Gee and Peter Inskip of Inskip & Jenkins Architects commissioned the survey and have provided site plans and detailed information regarding the restoration of the house. Site access was arranged by David Small of Four Oaks (construction), who is acknowledged for his help.

Susan Palmer and Stephen Astley of the Soane Museum are thanked for permission to reproduce two of the drawings prepared for the construction of the Bank of England.

3 SITE LOCATION AND LAYOUT

MOGGERHANGER HOUSE - THE SITE

The House is located in the south of the village of Moggerhanger, accessed from the A603 between Bedford and Sandy; NGR TL 13541 48665 (centered). The house lies within a parkland of 33 acres (**Figure 1**).

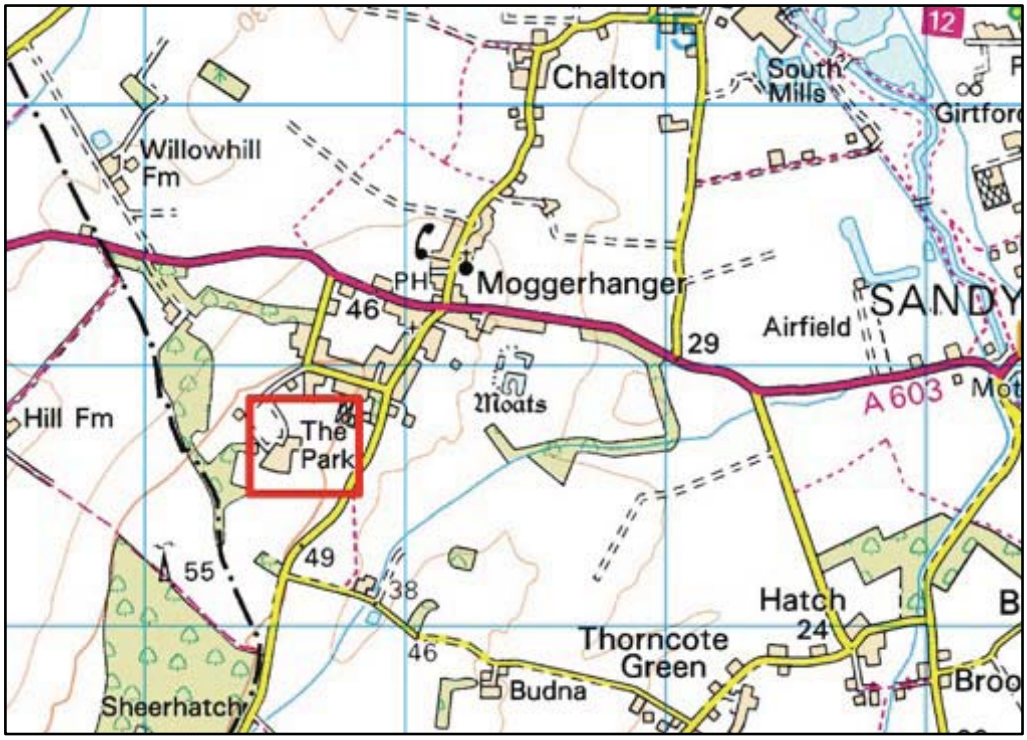

Figure 1: Site location to the south of A603 and Moggerhanger village.

LAYOUT OF HOUSE

The house has a U-shaped floorplan, with levels extending over three storeys, including a basement. The principal entrance façade faces north-west, with garden elevations to the north-east and south-east. There are service ranges and courtyards, including stables and a walled garden, to the south and east of the house.

To facilitate the archaeological survey, a site north has been adopted that re-orientates the first and second floor rooms to the cardinal points of the compass. Thus, the south-east wall is referred to as the south, the north-east wall as the east, the north-west wall as the north, and the south-west wall as the west.

4 ARCHITECTURAL HISTORY

SUMMARY DEVELOPMENT OF MOGGERHANGER

The architectural development of Moggerhanger House has been subject to detailed analysis and reporting by Inskip & Jenkins Architects (2000) and Peter Inskip (2004). The following summary is derived from their analysis and the previous work by Albion Archaeology (2004).

'Muggerhanger Lodge' was bought in 1784 by Godfrey Thornton, (1737- 1805) from his elder brother Robert (1734-1803), who had himself come into the property through marriage into the Astell family. At this date the house consisted of a small lodge building with a stable building adjacent to its east wall. It was a simple mid-18th-century rectory-like structure of two storeys and an attic with a southern entrance.

Godfrey Thornton was a director of the Bank of England, who engaged the services of John Soane, appointed Surveyor of the Bank of England in 1788, to make renovations and alter the lodge. In 1791, Soane was commissioned to extend the original building. The result was an 'L' shaped house with a three bay entrance to the east, a drawing room and best bedroom. The following year, in 1792, Humphrey Repton was commissioned to produce a red book containing proposals for a new driveway to the north with a carriage circle, a ha ha towards the south of the house, a kitchen garden to the west and a woodland walk to and from the house. This work was undertaken, and in the same year Soane undertook further construction of the symmetrical stable block to the south west of the house, which contained a laundry to the north and a brewhouse to the south.

In 1797, Thornton commissioned Soane to develop a further proposal on extension of the house. The proposal consisted of movement of the entrance from the east to the north and extension of the house to its present size. The plans were not adopted, but in 1798 Thornton instructed Soane to build the western range of the stable court.

Godfrey Thornton's death in 1805 led to his eldest son, Stephen (1767-1850), inheriting the house and lands. In the same year alterations were undertaken to the drawing room and dining room and in 1807 the plans commissioned by his father in 1797 were revived.

Multiple derivative schemes were considered and, between 1808-1812, work began on a large extension that also included the addition of verandas to the east and the south. Work was finalised between January and June 1810.

At some stage between 1850 and 1857 Soane reconstructed the conservatory to the south west of the house. The death of Stephen resulted in the House being sold on the open market and falling out of the hands of the Thorntons. The House was sold three times between 1857 and 1914.

The house was subsequently the property of the Fane family, and the onset of the Great War saw the house become a College between 1915 and 1919. It was then converted, in 1920, to a Sanatorium, which it remained until 1985. It was later owned by two property developers between 1987 and 1997 before passing into the hands of the current owners, under the care of the Moggerhanger House Preservation Trust.

EXTRACT FROM BUILDING ACCOUNTS

The following lists are extracts from the 1809 building accounts that detail the construction of the trussed floor beams.

Day Account 1809-12

Paid for sawing 4 girders and trusses 0:10:10

2 men ¼ day each cross cutting fir timber at Mr Watkins wharf 0:2:0

Mantel, 3 days for timber to truss girders 0:15:0

Paid for oak timber for trusses 6:15:0

[$ Bill-G p151]

Smiths bill Thomas Russell

1809

Four king and four queen bolts and plates made to order for truss girders Wt. 4cwt 0qt 8lbs ½ 26:12:0

……

1809 November 15

Four iron trusses made to order Wt. 9cwt 1qtr 22lbs 6d 26:9:0

[$ Bill-G p242]

5 METHODOLOGY

METHODOLOGY

The methodology employed for the archaeological recording at Moggerhanger House has been tailored to the specific requirements of the project and undertaken in accordance with standards and guidance issued by the Institute for Archaeologists (IfA 2008), English Heritage (2006) and industry best practice for a structural watching brief.

This report has been prepared following consultation with the records held by English Heritage, Inskip & Jenkins Architects, and the English Heritage National Heritage List for England.

This archaeological recording has comprised:

- *Consultation with the Architect and Site Manager in regards to the details of the programme of emergency repairs;*
- *A review of relevant archive and documentary material;*
- *Site visits that entailed making internal archaeological observations on both the first and second floors of the building;*
- *A consideration of the construction techniques used at the Site at the start of the 19th century;*
- *The preparation of this report.*

SITE INSPECTION

Two site inspections were made on the 8th June and 6th July 2012, which coincided with the programme of work being undertaken by Four Oaks (construction). The first visit recorded features on the second floor, and the second visit examined features on the first floor. Written notes and sketches were produced, accompanied by measured drawings of the floor beams and record photography, comprising both digital and 35mm b/w.

The site visits were undertaken in accordance with current Health and Safety Legislation (HSE 1992) and following a site induction from the site contractor. The JESSOP Consultancy holds appropriate professional and public liability cover for undertaking archaeological fieldwork.

6 ARCHAEOLOGICAL MONITORING - RESULTS

INTRODUCTION

This section of the report details the archaeological recording and observations. Each individual observation is described, making reference to relevant room plans, drawings and photographs as appropriate (see **Appendices 1-2**).

ROOM LAYOUT AND NOMENCLATURE

The following description of the first and second floor rooms is in accordance with the adoption of a site north, as stated in section 3.

The locations of individual archaeological observations are noted on floor plans prepared by Inskip & Jenkins Architects (**Appendices 1.1** and **1.2**).

To aid with the recording, the four trussed-beams have each been given a reference code as detailed below. Due to the limited amount of exposure of each timber and the time available on site, it was not possible to produce a comprehensive record of each individual beam. The adopted methodology, therefore, produced a set of detailed drawings of each of the two types of trussed-beam, gathering individual details from all the timbers to produce composite drawings.

The individual beam references are as follows:

- **Beam F1:**
  *spans between rooms F7 and F12 on the first floor, with a west-east orientation (**Appendix 1.1**). The beam is formed from two timbers - the north timber is* **F1.1**, *and the south timber is* **F1.2**.
- **Beam F2:**
  *spans between rooms F5 and F6 on the first floor, with a west-east orientation (**Appendix 1.1**). The beam is formed from two timbers - the north timber is* **F2.1**, *and the south timber is* **F2.2**.
- **Beam S1:**
  *spans between rooms S5 and S11 on the second floor, with a northeast-southwest orientation (**Appendix 1.2**). The beam is formed from two timbers - the east timber is* **S1.1**, *and the west timber is* **S1.2**.
- **Beam S2:**
  *spans the width of room S6 on the second floor, with a north-south orientation (**Appendix 1.2**). The beam is formed from two timbers - the east timber is labeled* **S2.1**, *and the west is* **S2.2**.

ARCHAEOLOGICAL OBSERVATIONS – STRUCTURAL FABRIC

OB1: Room F5

A section of plaster measuring 0.82m was removed from the south wall of F5. The coursed brickwork forming the core fabric of the external wall of the building was exposed. The walling contained horizontal timbers for vertical batons for a lath and plaster finish (**Appendix 2.1**). The bricks measured 6cm (2⅜") x 11cm (4⅜") x 22cm (8⅝").

OB2: Room F5

Sections of plaster had been removed from the west wall of F5 that formed a dividing wall to F6 (**Appendix 2.2**). The internal framing was exposed, which comprised of horizontal timbers tenoned into end posts at heights of 0.65m (2ft 1½") and 2.1m (6ft 10¾") above the floor and measuring 6cm (2⅜") x 11cm (4⅜"). Vertical batons were nailed onto these timbers and the soleplate. Filling the spaces between each of the horizontal timbers were bricks laid on their side; the bricks measured 6cm (2⅜") x 11cm (4⅜") x 22cm (8⅝"). Riven laths and lime plaster formed the final surface finish.

OB3: Room F5

There are two doorways in the north wall of F5, between which is a short section of walling (**Appendix 2.3**). The plaster from the lower half of this wall was removed, exposing the timber framing beneath. The wall was formed from vertical timbers with a diagonal strut and each panel was infilled with bricks laid on their side. The bricks measured 6cm (2⅜") x 11cm (4⅜") x 22cm (8⅝"). The lime plaster was attached to riven laths nailed to the vertical timbers.

OB4: Room F5

The east doorway in the north wall of F5 opens into a small walk-in cupboard. The lower section of plaster was removed exposing the timber framing, which was an identical form of construction to OB3. A few of the timbers had redundant joints and mortices indicating reuse (**Appendix 2.3**).

OB5: Room F5

A square section of removed plaster in the north-east corner of F5 exposed the brick walling fabric (**Appendix 2.4**). The plaster was applied directly to the brickwork, without the use of laths. Part of a brick arch comprising three courses of header bricks was also exposed, with bricks measuring 6cm (2⅜") x 11cm (4⅜") x 22cm (8⅝"). The spring of the arch was c.1.37m (4½ft) above the floor, with the apex at 1.88m (6ft 2"). This feature coincides with a fireplace and hearth and is interpreted as a relieving structure associated with the construction of the flue. It confirms that this location of a fireplace is contemporary with the construction of the east wall of the room that is a principal spine wall continuing on all floors throughout the building. Beneath the fireplace a partial brick vault was observed spanning between the principal floor joists, c.2.72m (8ft 11¼") apart, and which would have supported the hearth stone.

OB6: Room F5

The floor structure of F5 comprised a double joist design, with thicker joists spanning between longitudinal trussed beams (Beams **F1, F2**). The joists supported the floorboards, and timbers with a thinner scantling, attached to the underside, supported the lath and plaster ceiling of the room below (**Appendix 2.5**). The depth of the floor void was c.0.32m (12½"), which incorporated the trussed-beams described in the following section. Thin batons were nailed on to each of the side faces of the upper joists, which supported thin sectioned strips of wood. This wood was covered with a crushed lime mixture, containing chunks of clay and straw, forming a pugin layer, 4cm (1½") thick.

OB7: Room F12

The joinery forming the doorway between the corridor F12 and F13 had been removed, which exposed the walling fabric (**Appendix 2.6**). This wall was 0.45m (17¾") thick and constructed from red brick with an off-white lime mortar; the bricks measured 6cm (2⅜") x 11cm (4⅜") x 22cm (8⅝"). The width of the opening was 0.93m (3ft ⅜") and was an original feature within the structure of the wall. It had a Gothic arch head, supported upon the original timber framework. The height of the opening from the floorboards to the spring of the arch was 2.29m (7ft 6"), and the apex of the vault was c.2.67m (8ft 9⅛"). Built into the

door reveals were horizontal timbers at c.0.6m (23⅝" to 2ft) spacing, into which laths would have been nailed for the finished plaster surface.

OB8: Room F8

A preserved strip of wallpaper on the east wall of corridor F8 was recorded; although it should be noted that it had initially been exposed in an earlier phase of restoration works at Moggerhanger House (**Appendix 2.7**). Three layers of paper were recorded. The upper-most layer was a design with yellow and pink roses; the middle layer comprised pink flowers in a geometric pattern; and the lowest (earliest) layer was a blue block print with squares and parallel stripes.

OB9: Room F6

The plaster had been removed from the east wall of F6 exposing the wall fabric (**Appendix 2.8**). The partition was a timber construction with brick infill, and identical to OB3, which represents the opposing wall face.

OB10: Room F6

Three sections of plaster midway up the west wall of F6 had been removed to expose the brick wall fabric (**Appendix 2.9**). The bricks measured 6cm (2⅜") x 11cm (4⅜") x 22cm (8⅝") and were laid in alternating stretcher and header courses. The plaster was applied directly to the brickwork, without the use of laths.

OB11: Room F6

The lower half of the plaster had been removed from the north wall of F5 (**Appendix 2.10**). The internal framing was exposed, this comprised of wooden posts that contained doorway openings into F7 and F12, and were strengthened with a long diagonal brace. Vertical timbers were secured at 30cm (1ft) intervals to the diagonal timber. Secondary vertical batons were nailed onto these timbers, which had horizontal riven laths attached for the plaster finish. Infilling the gaps between the timber framework were bricks laid on their side; the bricks measured 6cm (2⅜") x 11cm (4⅜") x 22cm (8⅝").

OB12: Room F6

A section of the wooden skirting along the west wall of F6 was found to have multiple layers of painted decoration (**Appendix 2.11**). This paint had previously been examined in a earlier stage of restoration at Moggerhanger House. The paint sequence comprised, in part, the following colours: pale grey (modern top coat); translucent toffee brown; cream; ochre; duck egg blue; dark chocolate brown.

OB13: Room F6

The floor structure of F6 comprised a double joist design with thicker joists spanning between longitudinal trussed beams (Beams F1, F2). It was a continuation of the floor identified in OB6 (**Appendix 2.12**).

OB14: Room F7

The lower half of the plaster had been removed from the south wall of F7 (**Appendix 2.13**). The internal framing was exposed comprising of a wooden frame that was an identical construction to OB11, which formed the opposing face to this partition.

OB15: Room F7

The plaster surface had been removed from the dividing wall in F7 to expose the wall fabric below (**Appendix 2.13**). This timber studwork was of a similar construction to the south wall of F7, with a diagonal brace set within a timber frame. Short horizontal timbers were nailed against the brace and the spacing infilled with bricks laid on their side. The bricks measured 6cm (2⅜") x 10cm (4") x 22cm (8⅝").

OB16: Room F7

The plaster had been partially removed from the revels of the window in the west wall of F7 (**Appendix 2.14**). The brick work that formed the external west wall of the building was exposed, and found to be identical to that along the south wall noted in OB1. The bricks measured 6cm (2⅜") x 10.5cm (4⅛") x 22cm (8⅝"). Horizontal timbers had been set into the brick work, for attaching batons and laths for the plaster finish.

OB17: Room F7

Following the removal of the floorboards, the floor structure of F7 was found to be identical to F5 and F6, forming a single large floor, upon which various timber partitions had been inserted. Against the north wall of F7 a section of a brick arch was exposed (**Appendix 2.15**), which formed a support to a fireplace. The brick arch was damaged, however it appeared to be identical in form to another beneath the fireplace in F5, and recorded as OB5.

OB18: Room S11

(**Appendix 2.16**)

A section of the wooden skirting along the south wall of S11 was found to have multiple layers of painted decoration (**Appendix 2.11**). This paint had initially been examined in a previous stage of restoration at Moggerhanger House by Inskip & Jenkins Architects, however the sequence observed appeared to comprise the following colours: grey (modern top coat); translucent toffee brown; cream; ochre; dark chocolate brown.

ARCHAEOLOGICAL OBSERVATIONS – TRUSSED BEAMS

OB19: Beam F1/F2

In the south-west corner of the house the principal structural components of the first floor was a pair of trussed-beams, **F1** and **F2** (**Appendices 2.17** to **2.24**). Each beam formed a raised truss that spanned a distance of 7.95m (26ft), and they were all concealed within the thickness of the floor. Together, the two beams formed a continuous structure upon which timber and brick partitions were constructed to form the rooms - F5, F6, F11 and F12. Each beam was recessed 20cm (8") into the wall fabric, and their centers were c.4.05m (13ft) apart. They were arranged parallel to one another, and equally spaced 1.5m (3ft 9") from the north and south walls.

The beams **F1** and **F2** were constructed from four pieces of timber. The lowest timber measured 20cm (8") x 20cm (8") and was 8.4m (27ft 6¼") in length spanning the full width of the floor. The underside of the timber formed a projecting rib in the ceiling of the Eating Room on the ground floor below. The remaining three timbers combined to form an expanded U-shaped truss that was 48cm (19") in height at its widest point (**Appendix**

2.21). The truss was supported by two cast iron queen bolts, spaced 54cm (21¼") apart in the center of the beam (**Appendices 2.19** to **2.21**). These castings were substantial items, measuring 15cm (6") x 20cm (8") at the head, and diminishing to 13cm (5⅛") x 15cm (6") at the interface with the lower timber of the beam. It is suggested that they were secured in position with a square nut, although the lower face of the beam was observed by plasterwork at the time of survey. Beneath the head, the queen post had curved recesses on either side which housed the upper sections of the truss, each of which had metal bands screwed onto the ends to form a secure fit with the queen bolts, that would also have allowed a certain degree of movement (**Appendix 2.19**).

The central timber measured 65cm (25½") in length and 15cm (6") x 15cm (6") in scantling. It acted as the upper chord of the truss and sat 3cm (1⅛") below the upper face of each queen post. Positioned within the outer sides of each of the queen posts were sloping timbers set at an angle of between c.6 degrees. The outer end of each timber was set within a recessed channel in the upper face of the lowest beam. It was not possible to establish whether this joint was secured with a horizontal bolt, although at 1.98m (6½ft) from the end of each beam angled bolts were attached with a large square plate screwed to the upper face of the angled beam (**Appendix 2.19**). A second bolt was set closer to the end of each beam, and presumably acted as an end stop, which was strengthened with an inverted U-shaped strap (**Appendix 2.24**).

No secondary alterations were recorded on either of beams **F1** and **F2**, apart from the recent repairs in the form of the steel plates to provide both additional strength and lateral stiffness (**Appendix 2.23**).

OB20: Beam S1/S2

On the second floor, in the south-west corner of the house, the principal component of the floor structure was also a pair of trussed-beams, **S1** and **S2** (**Appendices 2.25** to **2.38**), similar to the floor below, although of a different design. The beams spanned a distance of 7.3m (24ft) and formed a continuous floor structure upon which timber and brick partitions were constructed to form the individual rooms - S5, S6 and S11. Each beam was recessed 20cm (8") into the wall fabric, and along the south wall, the centers were 2m (6ft 6¾") apart and equally positioned c.3.1m (10ft 2½") from the west and east walls. Beam **S2** was parallel to the orientation of the building, maintaining a distance of c.3.1m (10ft 2½") along

its length from the west wall. Beam **S1** was angled to accommodate a doorway on the floor below, resulting in the centers of each beam being c.2.65m apart along the north wall.

The beams **S1** and **S2** were constructed from two pieces of timber (**Appendices 2.25, 2.26**), originally a single squared off piece of wood that had been sawn into two equal pieces measuring 30cm (1ft) deep x 14cm (5½") wide, and 7.7-8m (25ft 3¾" to 26ft 3") in length. The beams were bolted together to form a composite construction that sandwiched between them a series of metal components, measuring 30cm (1ft) deep and 32cm (1ft ½") in width. To enable the metal components to be retained in their desired positions, the inner faces of each timber that formed the beam, were cut back (**Appendices 2.33, 2.34**). The full extent of this chasing work was not visible, but it was possible to observe significant details from above. At a distance of 2.2m (7ft 2½") from the end of each timber, the width of the beams was reduced by 3cm (1¼") to 12cm (4¾") to form a level recess 2m (6ft 6¾") in length. At each end of the recess a chased groove had been cut (**Appendix 2.33**), angled downwards at 8-10 degrees. It was within this expanded U-shaped groove, that a series of metal components were located.

The metal components that are sandwiched between the paired timbers, comprise queen bolts, end stops and trusses (**Appendices 2.27** to **2.30**). Together they form a trussed-beam that combines the strength of the metal, with the reduced cost and lightness of the timber. The principal elements were two cast iron queen bolts that formed vertical posts c.3.4m (11ft 2") from the end of the beam (**Appendices 2.27** to **2.30**). Produced as a single casting, each has a rectangular head measuring 17cm (6¾") x 7cm (2¾") (**Appendix 2.29**), with a height of c.40cm (15¾"). The head projects 4.5cm (1¾") above the top edge of the beam, and is secured on the underside with a square bolt and rectangular plate with an expanded center that clamps against the underside of each timber (**Appendix 2.30**). Within the upper section of each queen bolt, the sides have a curved profile, c.11.5cm (4½") in diameter. This curve forms a recess into which the metal bars are housed.

Two different types of metal bar, or trusses, were observed. In the center of each beam between the two queen bolts, a thick bar with rounded ends formed the middle element of the truss. This bar measured 63cm (2ft ¾") in length, 10cm (4") in height and had a thickness of 6.5cm (2½"). The additional elements of the truss comprised two angled metal bars that were located within the chased grooves on the inner face of each timber forming the beam. They were angled downwards from the top of each queen bolt (**Appendix 2.33**) and secured by the horizontal bolts and end stops (see below). These bars were comprised

of two separate pieces of metal (**Appendix 2.34**), although it was not possible to determine where they had been fire-welded to one another.

At either end of the beam, the angled metal trusses are secured with the use of a secondary bolt forming an end stop (**Appendices 2.31, 2.32**). This feature comprises a vertical bolt secured on the upper face of the beam, with a rectangular plate with an expanded center and a square nut (**Appendix 2.31**), similar to those used on the underside of the queen bolts. The secondary bolt has a rectangular head, which is locked in place by a large rectangular plate with straps (**Appendix 2.38**) that project 50cm (19¾") towards the center of the each. These straps are secured by being located within chased grooves on the underside of the beam and secured from above with square nuts and vertical bolts (**Appendix 2.37**). A small U-shaped strap on either side of the beams at the outer edge of the secondary bolts provided additional rigidity (**Appendix 2.32**).

The timbers forming each beam were secured together with horizontal metal bolts (**Appendix 2.35**). Each was a standard size and form, measuring 40cm (15¾") in length and with a square pyramidal end (**Appendix 2.36**). Following the drilling of parallel holes in the desired location of each bolt, shallow square recesses were cut into the opposing external faces of each timber. These recesses prevented slippage when each bolt was tightened. The thread of each bolt projected 6cm (2¾") from the face of each beam, and the square nut was tightened against a square washer or spacer, that was housed in each of the cut recesses. A total of eight bolts were arranged in alternating pairs, with spacing at the following distances from one another starting at 56cm (22") from the end: 83cm (2ft 8¾"), 98cm (3ft 2½"), 83cm (2ft 8¾"), 1.4m (4ft 7") (central section), 83cm (2ft 8¾"), 98cm (3ft 2½"), 83cm (2ft 8¾"). The bolts were positioned at varying heights along each beam, although they mirrored the alignment of the internal chased U-shaped groove.

Cut into the external faces of each beam were rectangular recesses measuring 14cm (6") x 20cm (8") for the principal floor joists. The recesses acted as tenons, and vertical pegs were driven down from the upper face of each beam to secure the joists in position.

Secondary alterations comprised the localized cutting back of the upper faces of the beams to accommodate wiring, heating and sanitary pipes. In addition, modern wooden wedges and holes were drilled into the upper face of each beam during the repair programme to assess the structural integrity of each beam. The repairs comprised the addition of steel

plates that were secured to the north and south brick walls, and then bolted onto the beams (**Appendix 2.25**).

7 DISCUSSION AND CONCLUSIONS

DISCUSSION

The structural watching brief of the exposed sections of building fabric within Moggerhanger House has confirmed that the external, and principal dividing walls, were built with brick and date to the Soane period of expansion c.1808-1810. The bricks were hand-made in a red/orange fabric measuring 6cm (2⅜") x 10cm (4") x 22cm (8⅝"), and bedded in white/buff coloured lime mortar with 12-15mm (⅝" to ¾") thick beds. The main structural dividing walls in this part of the building, such as the east wall to F5 and S11, were also brick with the plaster being applied directly to the face of the brickwork. The layout of the first floor rooms (F5-F7) closely correlates to the plan proposed by Soane in February 1809 (Inskip 2004, Fig. 25; Sir John Soane's Museum, 3/4/31), with a mixture of brick walls and timber studwork partitions. The only noticeable variation is the location of windows, which appears to have been refined since the plans were prepared.

The internal dividing walls that formed the various interconnected rooms on the first and second floors were made from timber studwork with raking struts and brick infill. Riven laths were then nailed onto the studs and a lime plaster applied. The skirting boards were moulded with a triple beaded design. Various applied paint schemes were noted on the skirtings in F7 and S11, along with a strip of wallpaper in F8 with at least three different designs.

A number of the rooms had cast-iron fireplaces, with stone hearths. A feature observed below the fireplaces in F5 and F7 was a partial brick vault within the thickness of the floor. This feature extended beneath the hearthstone and would have added both structural support to the hearth and provided localised fire protection. These arches were double the length required to support the hearth, however by spanning between the principal joists the vault would have contributed to the rigidity of the floor structure.

Unlike many of Soane's other schemes, where constructional drawings survive, no detailed illustrations of the floor structure have yet been identified for Moggerhanger, and thus the nature of construction of the floor beams was previously only partially understood. This repair programme has provided a unique opportunity to re-examine the floor beams, and comment on their individual characteristics. Two separate designs of trussed-beam were recorded, one used on the first floor running west-east and the other on a different

orientation of north-south on the second floor above. The skillful execution of each design strongly suggests that the trussed-beams were constructed in accordance with a set of detailed construction drawings, similar to those prepared by Soane's architectural office for sites such as the Bank of England a few years later in November 1816 (**Appendices 1.3, 1.4**).

Whilst both form of beam is concealed within the thickness of each floor, the beams demonstrate two different structural techniques. Those on the second floor are trussed beams that have integral trusses concealed within the scantling of each beam, whilst at first floor level where the spans were longer, the beams are considerably deeper and form a raised truss.

The origin of the trussed girder is unclear, although early examples used hard pieces of timber set in internal grooves and bolted between split beams (Yeomans 1989, 39-40). The earliest published description of this technique was in 1733, by James Smith in his book the Carpenters Companion (16) where he states:

> *The manner of trussing these girders, is first, to saw the girder down the middle, the deepest way; then take two pieces of dry oak, about four and a half or five inches wide, and four inches thick; let half the piece be let into one side of the girder and half into the other,….when these are thus prepared, bolt them together with iron bolts.* (After Dawes and Yeomans 1985, 147).

The internal timbers were called trussing pieces. Where two were used, a central king bolt secured them in position, and where there were three, paired queen bolts were used. The design of beams **S1** and **S2**, therefore, corresponds with aspects of the trussed components dating to the later part of the 18th century (see Price 1753, plate B), although the details have been refined by Soane.

Sutherland (1989, 49) discusses the development of the use of iron in buildings, explaining that to meet the need for floors that spanned wide rooms, such as in fashionable London houses, or public buildings, various forms of truss were adopted. Timber girders with a depth of 37.5-40cm (2ft 2¾" to 2ft 3¾") were standard within such floors, although they tended to sag and provide undesirable movement. The introduction of internal trusses within the thickness of the timbers (such as **S1** and **S2**), did add strength, although appears

to have had limited impact on the integrity of the floor, perhaps only minimizing the amount of sag.

It is curious that Soane did not adopt the use of cast-iron trusses that were being introduced by John Nash at the Royal Pavilion at Brighton in the 1820s (Dawes and Yeomans 1985, 149), at Buckingham Palace between 1826 and 1828, or in the King's Library at the British Museum by Smirke (Sutherland 1989, 50). Perhaps his work at Moggerhanger was a decade too early for the qualities of cast iron to be fully appreciated, understood, or even trusted, as an alternative to timber.

The lack of structural drawings for the floors at Moggerhanger is unfortunate, however an examination of plans prepared for the floor above the new Cheque Office at the Bank of England, dated November 1816 are very informative (**Appendices 1.3, 1.4**). Soane makes excellent use of trussed girders concealed within the floor structure, and the design is strikingly similar to that used on the first floor at Moggerhanger. The span is longer at the Bank of England, although the use of queen posts and angled timbers with iron hoops can be seen as a direct parallel. There are, however, subtle differences, such as the fact that unlike at Moggerhanger, the queen post depicted for the Bank of England is lighter in weight and stands proud of the lower beam. This may have provided the opportunity to fine tune the tightening of the truss and remove sag once the floor had been constructed.

CONCLUSION

This rapid archaeological recording of exposed sections of structural fabric at Moggerhanger House, has enabled the detailed survey of two unique examples of trussed floor beam dating from 1809 to be recorded. In addition, the surviving building accounts have confirmed that they were manufactured off site and formed part of the scheme of works overseen by Soane. It is interesting, that whilst they are similar to examples from contemporary carpentry manuals, they have noticeable differences, which can perhaps be attributed to Soane. The use of large cast-iron elements and internal metal bars for providing additional strength is perhaps the most unusual aspect and may be considered as an experimental attempt by Soane to adapt the technique of secondary strengthening of floor beams. The ultimate success of this technique is perhaps questionable, as the beams have suffered from a degree of structural failure, although it does confirm that his approach to new architectural techniques was not restricted to the external appearance of buildings and their internal spaces, but the whole composition of the structural fabric.

FURTHER WORK

It is recommended that the results of this structural watching brief should be considered for publication as a note in a relevant publication, such as the journals of either the Georgian Group, or the Structural Engineer.

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INTERNET RESOURCES

- *ADS: www.archaeologydataservice.ac.uk*
- *British Library: www.catalogue.bl.uk*
- *Government Legislation and Guidance: www.legislation.gov.uk*
- *Heritage Gateway: www.heritagegateway.org.uk*
- *Images of England: www.imagesofengland.org.uk*
- *National Archives: www.nationalarchives.gov.uk/a2a*
- *The National Heritage List for England: www.english-heritage.org.uk/professional/protection/process/national-heritage-list-for-england/*
- *The Soane Museum: www.soane.org*

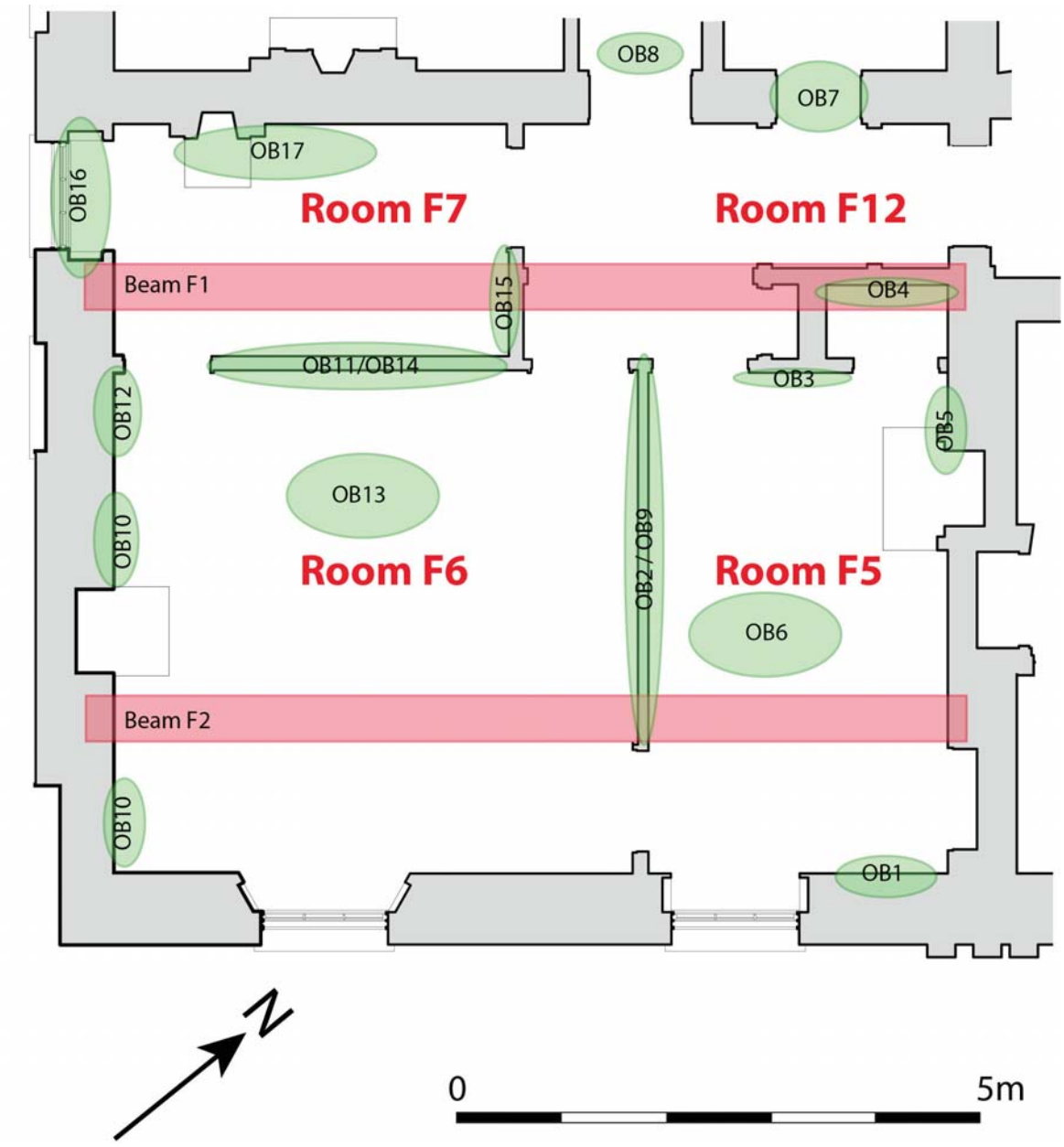
9 APPENDICES

APPENDIX 1 – FLOOR PLANS AND HISTORIC DRAWINGS

APPENDIX 2 – SITE INSPECTION PHOTOGRAPHS

Appendix 1.1

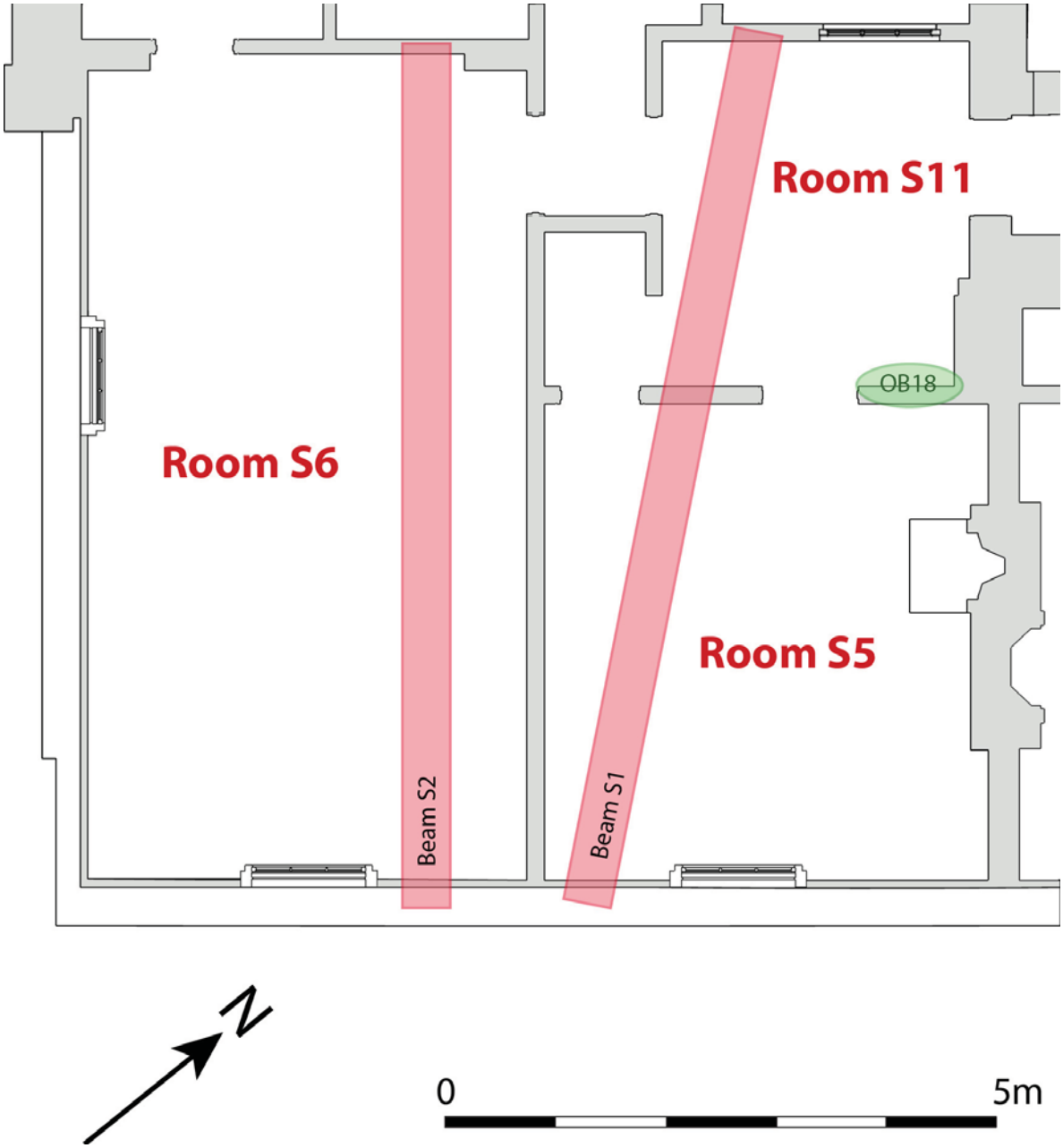
LOCATION OF ARCHAEOLOGICAL OBSERVATIONS – FIRST FLOOR



Based upon drawing prepared by Inskip & Jenkins Architects. Do not scale.

Appendix 1.2

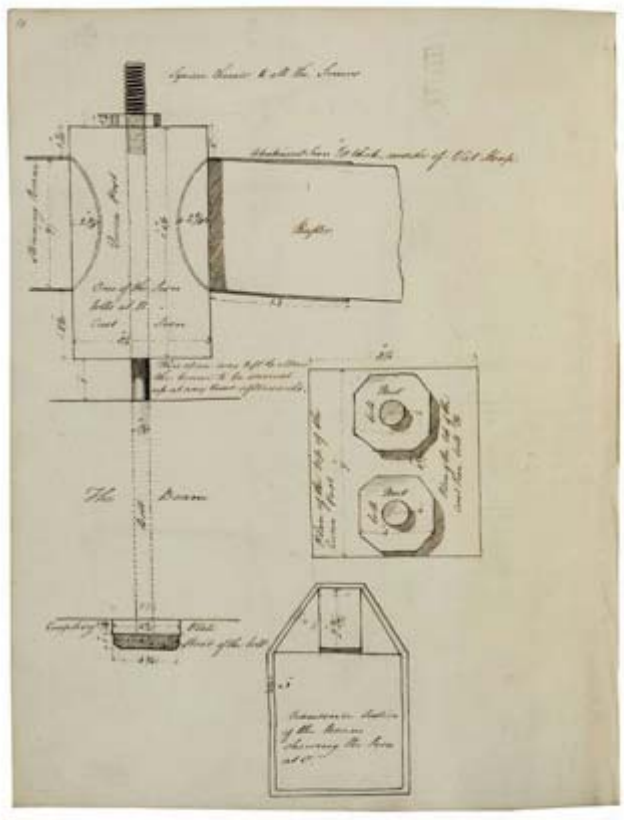
LOCATION OF ARCHAEOLOGICAL OBSERVATIONS – SECOND FLOOR



Based upon drawing prepared by Inskip & Jenkins Architects. Do not scale.

Appendix 1.3

DRAWING FROM SOANE COLLECTION – SM VOLUME 47/10



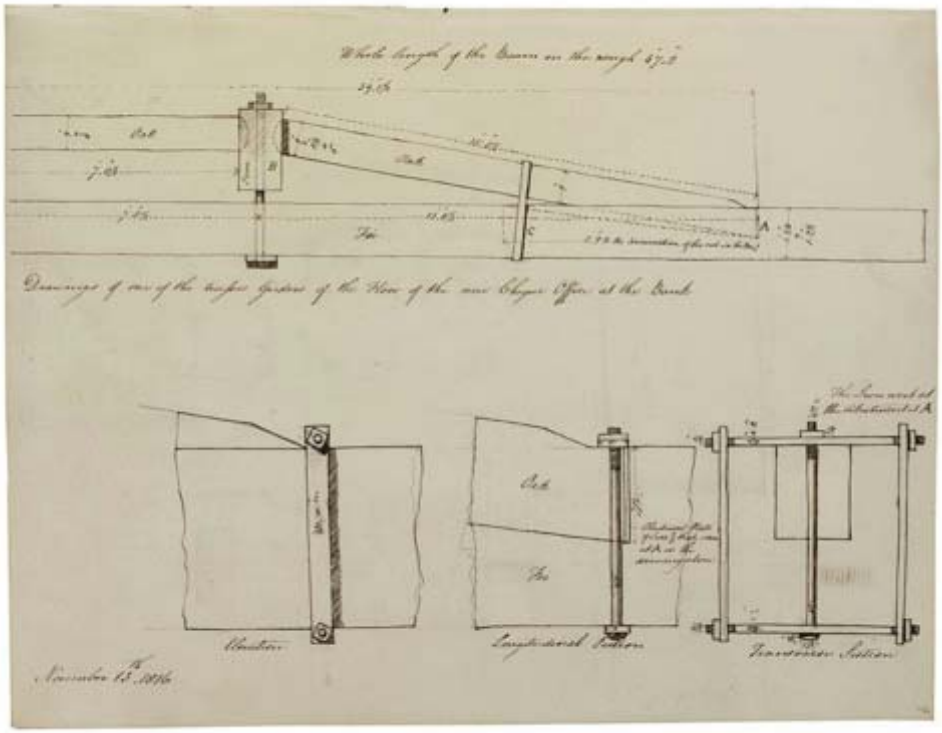
© Soane Museum – reproduced by courtesy of the Trustees of Sir John Soane's Museum

Notes (after Soane Museum online catalogue):

- *Plan of the top of the / Queen Post, transverse Section / of the Beam / shewing the Iron / at C. and a Section showing the Queen Post with iron tie rod, Straining Beam and Rafter.*
- *Plan of the top of the / cast Iron bolt B, Plate, Head of the bolt, Coupling, The Beam, Bolt (three times), This space was left to allow / the beam to be screwed / up at any time afterwards., One of the Iron / bolts at B / cast Iron, Square threads to all the Screws, abutment Iron 1/8" thick, made of Vat Hoop, nut (twice) and some dimensions given.*
- *The rafter shown on both drawings is joined to the queen post by an iron abutment, labeled on drawing 32 as 'made of Vat Hoop', which was probably a trade name for iron straps (iron-hoop straps were used to secure wooden barrels or vats). The inscription on the drawing also indicates that a space was left between the beam and the queen post so that it could be screwed up at a later date. This was presumably to allow for any shift in the foundations or similar that might render the wooden structure loose.*

Appendix 1.4

DRAWING FROM SOANE COLLECTION – SM VOLUME 47/9



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Notes (after Soane Museum online catalogue):

- *Drawings of one of the trussed Girders of the floor of the new Cheque Office at the Bank, Oak (three times), Fir (twice), abutment Plate / of Lead 3/8 thick seen / at A in the / drawing above, The Iron work at / the abutment at A, 8.9" to the termination of the cut in the Beam, Iron, Whole length of the Beam in the rough 47.2" and some dimensions given.*
- *A longitudinal section of half of the truss girder, detail Elevation, Longitudinal Section and Transverse Section of one of the truss girders.*
- *The drawing shows the straining beam and rafters are made out of oak, whereas the beam underneath is made of fir.*

Appendix 2.1

OB1: View looking south of exposed structural brickwork in south wall, F5.

Appendix 2.2

OB2: View looking north-west of exposed studwork and brick infill of west wall, F5.

Appendix 2.3

OB3, OB4: View looking north of exposed studwork and brick infill of north wall, F5.

Appendix 2.4

OB5: Detail of exposed relieving arch above fireplace in north-east corner of F5, looking east.

Appendix 2.5

OB6: Detail of exposed double floor structure within F5; note pugin still *in-situ*.

Appendix 2.6

OB7: View of arched door-head between F12 and F13; note timber framework and lath and plaster.

Appendix 2.7

OB8: Detail of preserved strip of wallpaper on east wall of corridor F8.

Appendix 2.8

OB9: General view of east wall of F6; note timber studwork and brick infill.

Appendix 2.9

OB10: General view of west wall of F6 with areas of exposed brickwork.

Appendix 2.10

OB11: General view of north wall of F6; note stud construction.

Appendix 2.11

OB12: Detail of painted skirting board in north-west corner of F6.

Appendix 2.12

OB13: Detail of floor structure in F6, looking north-east.

Appendix 2.13

OB14, OB15: View of floor structure in F7, and exposed stud walls to the south and east.

Appendix 2.14

OB16: Detail of exposed brick reveal in west wall of F7, looking north-west.

Appendix 2.15

OB17: Detail of hearth stone for fireplace in north-west corner of F7; note damaged brick arch within the floor structure to the east.

Appendix 2.16

OB18: Detail of exposed section of painted skirting board, in south-east corner of S11.

Appendix 2.17

OB19: General view looking south-east across F12; note raking timber strut and cast iron post forming east part of beam **F1.**

Appendix 2.18

OB19: General view looking west across F7; note raking timber strut and cast iron post forming east part of beam **F1.**

Appendix 2.19

OB19: Detail of east cast iron post forming beam **F1**; note wooden timbers with metal collars forming joints with cast iron post.

Appendix 2.20

OB19: Detail of base of cast iron post at interface with lower timber forming beam **F1**; note traces of bluish paint on metalwork.

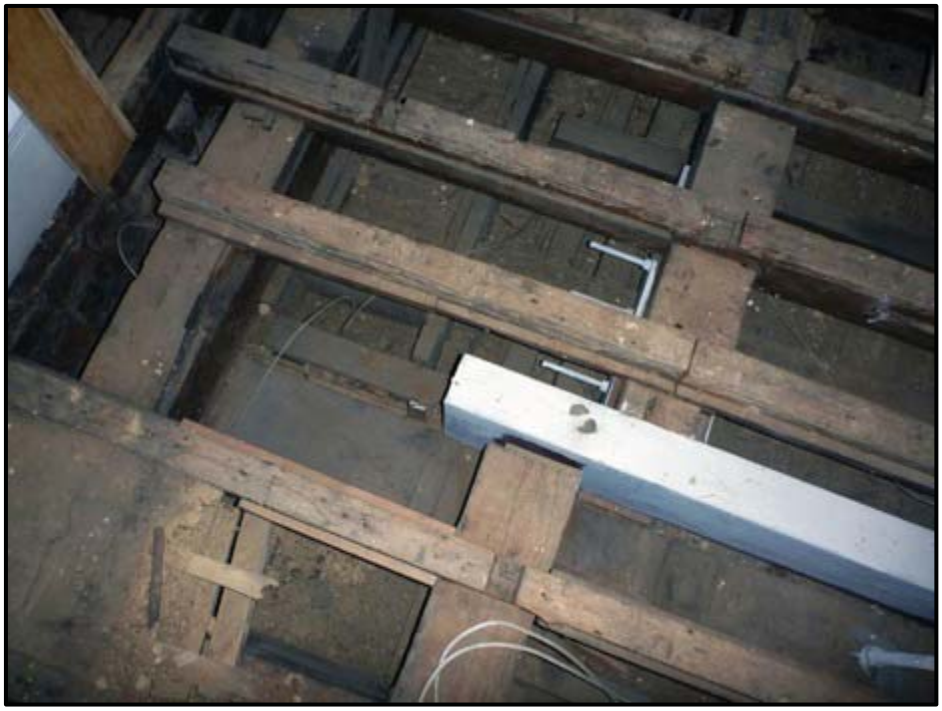
Appendix 2.21

OB19: Detail of east cast iron post forming beam **F1**; note slot headed screws used to secure metal hoops onto the end of the timber joints.

Appendix 2.22

OB19: Detail of square head of bolt and rectangular plate (spacer) securing together components of beam **F1.**

Appendix 2.23



OB19: General view of east end of beam **F2**; note iron strap and square bolt head and spacer.

Appendix 2.24

OB19: Detail of forged strap at east end of beam **F2**; note use of slot headed screw to secure strap.

Appendix 2.25

OB20: General view of south end of beam **S1**; note proximity of structure to underside of floorboards.

Appendix 2.26

OB20: General view of north end of beam **S1**; note central slot.

Appendix 2.27

OB20: Detail of central section of beam **S1**; note head of cast iron post sandwiched between timber beams **S1.1** and **S1.2**.

Appendix 2.28

OB20: Detail of central section of beam **S2**; note head of cast iron post and metal bars projecting on either side sandwiched between timber beams.

Appendix 2.29

OB20: Detail of cast iron post in central section of beam **S2**; note rounded end of central cast iron bar.

Appendix 2.30

OB20: Detail of lower end of cast iron post of beam **S1**; note expanded rectangular plate and square nut.

Appendix 2.31

OB20: Detail of upper surface of end bolt of beam **S1**; note expanded rectangular plate and square nut.

Appendix 2.32

OB20: Detail of rectangular head of end bolt of beam **S1** from below; note U-shaped strap and extended straps with square headed bolts.

Appendix 2.33

OB20: Detail of central groove at north end of beam **S1**; note angled alignment and paired bars at base forming internal truss.

Appendix 2.34

OB20: Detail of central groove at of beam **S1**; note paired bars forming internal truss secured in place by horizontal bolt with threaded end and square nut.

Appendix 2.35

OB20: Detail of horizontal bolt with threaded end and square nut.

Appendix 2.36

OB20: Detail of cut recess in side face of beam **S1** to house head of horizontal bolt; note crushed surface of wood due to excessive tightening and missing washer.

Appendix 2.37

OB20: Detail of nuts securing vertical bolts at south end of beam **S1**; note use of wooden pieces below metal washers and redundant hole in center of groove.

Appendix 2.38

OB20: Detail of longitudinal straps set in chased grooves in underside of south end of beam **S1**; note square headed ends of vertical bolts securing straps in place.