

**ASSESSMENT REPORT ON THE  
ARCHAEOLOGICAL BUILDING  
RECORDING (INCLUDING  
PETROGRAPHIC SURVEY) AND  
WATCHING BRIEF AT THE  
BELL TOWER AND ADJACENT  
INNER CURTAIN WALL,  
HM TOWER OF LONDON,  
LONDON BOROUGH OF TOWER  
HAMLETS**

**SITE CODE: TOL149**

**FEBRUARY 2016**

**REPORT NO. R12359**



**PRE-CONSTRUCT ARCHAEOLOGY**

**Assessment Report on the Archaeological Building Recording (including petrographic survey) and Watching Brief at the Bell Tower and adjacent Inner Curtain Wall, HM Tower of London, London Borough of Tower Hamlets**

**Site Code:** TOL 149

**Central NGR:** TQ 33517 80513

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**February 2016**

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## DOCUMENT VERIFICATION

# BELL TOWER AND ADJACENT INNER CURTAIN WALL, HM TOWER OF LONDON, LONDON BOROUGH OF TOWER HAMLETS

## ARCHAEOLOGICAL BUILDING RECORDING (INCLUDING PETROGRAPHIC SURVEY) AND WATCHING BRIEF

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	Report Number	R12359

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## 1 NON-TECHNICAL SUMMARY

- 1.1 Pre-Construct Archaeology Limited was commissioned by Historic Royal Palaces to undertake archaeological building recording (including petrographic survey) and watching brief at the Bell Tower and adjacent Inner Curtain Wall, HM Tower of London, London Borough of Tower Hamlets centred on OS NGR TQ 33517 80513. The recording was carried out as a condition of Scheduled Monument Consent for the conservation work from January to September 2015 during the work.
- 1.2 The Tower of London is a Scheduled Monument, a UNESCO World Heritage Site and lies in a Conservation Area. The Bell Tower and adjacent Inner Curtain Wall are Grade I listed and the former is described as: ‘c.1190-1200. Octagonal plan to ground floor, and thereafter cylindrical. 2 storeys above solid base with ashlar plinth’. The Bell Tower is important because it was here that Sir Thomas More was probably imprisoned in 1535. The adjacent Queen’s House was built in the 16<sup>th</sup> century.
- 1.3 The archaeological building recording work has established that the Bell Tower and adjacent Inner Curtain Wall were originally mainly constructed of Kentish Ragstone *sensu stricto* and Reigate Stone with the occasional use of Taynton Stone, Sussex Marble and Caen Stone. Both structures had an ashlar base with rubble walling above. Relict Tudor/Stuart brickwork shows that both were altered in the 16<sup>th</sup>/17<sup>th</sup> centuries.
- 1.4 By the late 19<sup>th</sup> century, alterations included the construction of brick parapets to both structures, the replacement of paired medieval windows in the upper part of the Bell Tower with rectangular windows, the replacement of one arrow loop with a rectangular window, the rebuilding and/or insertion of quoins, the replacement of stone ashlar in both the dressings of the arrow loops and at the base of the walls, the addition of roughcast/pebbledash render to the rubble walling of both structures, the construction of a partition wall to create a lobby for the upper chamber, the raising of the ceiling of the upper chamber, the raising of the head of the fireplace to take a range and the introduction of new stone types. By c.1900 two small windows had been inserted. A porch was added c.1904. By 1924, the roughcast/pebbledash render had been removed from the walls of the Bell Tower and its brick parapet had been rebuilt externally in Kentish Ragstone. After 1924 the roughcast/pebbledash render and Virginia Creeper were removed from the adjacent Inner Curtain Wall.
- 1.5 These works suggest that the Bell Tower underwent considerable alteration in the 19<sup>th</sup> century perhaps to convert it to a kitchen. The walls of both the Bell Tower and Inner Curtain Wall also underwent a large amount of refurbishment at this time. These works demonstrate that 19<sup>th</sup> and early 20<sup>th</sup> century restoration principles were radically different to early 21<sup>st</sup> century conservation principles.
- 1.6 The results of this archaeological building recording work has considerably increased our understanding of the development of Bell Tower and Inner Curtain Wall and it is recommended that they are published in an article.

## 2 INTRODUCTION

### 2.1 Background

2.1.1 Pre-Construct Archaeology Limited (PCA) was commissioned by Historic Royal Palaces to undertake archaeological building recording (including petrographic survey) and watching brief at the Bell Tower and adjoining Inner Curtain Wall, HM Tower of London, London Borough of Tower Hamlets centred on OS NGR TQ 33517 80513 (**Figures 1 and 2**). The recording was carried out from January to September 2015 during conservation works on these structures.

2.1.2 The Tower of London is a Scheduled Monument (Greater London SM No 10) and a UNESCO World Heritage Site (No 488). The Bell Tower lies within the boundaries of these designations. Designations of this level recognise that the Tower of London and its buildings are of international significance. The *Tower of London Conservation Plan* (2010) lists the Bell Tower as of exceptional significance. The Tower of London also lies in the Tower of London Conservation Area. The Bell Tower and adjacent Inner Curtain Wall form part of the Grade I listed *Inner Curtain Wall, with Mural towers, The Queen's House, Nos 1, 2, 4, 5 and 7 Tower Green and the New Armouries* which are described in their listing citation as follows:

‘The Tower of London: Inner curtain wall and towers. Bell Tower and curtain wall (of which lower courses remain) to Bloody Tower built c.1170; Wakefield Tower, Lanthorn (demolished and rebuilt in C19) and curtain wall and postern between them built c.1220-40 for Henry III; Watergate, later incorporated into Bloody Tower, also built c.1220-40; curtain wall and towers from Devereaux Tower in north-west corner to Salt Tower in south-east corner built 1238-75; west side of curtain wall, including Beauchamp Tower, built 1275-85 for Edward I; southern side of curtain wall heightened and crenellated 1339; Bloody Tower remodelled 1360-1362. Restored in C19, principally by A Salvin in 1840s to 1860s. Squared and coursed Ragstone with ashlar dressings; lead and copper roofs to towers. Curtain Walls: gunports, loops and crenellation reworked in C19; west side of curtain wall has fine continuous line of embrasures, built in late C13 brick, to loops. Towers described in clockwise order from Bell Tower: c.1190-1200. Octagonal plan to ground floor, and thereafter cylindrical. 2 storeys above solid base with ashlar plinth. Restored loops; early C18 keyed square-headed architraves to upper windows; late C17 wooden bell turret. Interior, with access from The Queen's House (qv): ground floor has irregular-shaped lobby, with C18 brick round-arched entry to inner chamber with garderobe in recess, original splayed embrasure to south and pointed barrel vault; skewed 2-centred arch to vaulted pentagonal-shaped chamber with pointed embrasures and acutely pointed vault with foliate-carved boss and square ribs springing from corbels with flattened stiff-leaf carving; pointed-arched doorway to upper room, with vice to roof, blocked pointed-arched doorway to east (to constable's house, on site of Queen's House

(qv)), and skewed stone-flagged passage to barrel-vaulted garderobe chamber in thickness of main wall; circular main room has moulded rere-arches to windows, blocked wall passage to south-west, C14 square-headed cupboard in north wall, C14 fireplace (hood removed) in east wall, and heightened C17 domed roof (ring beam of original roof visible beneath)...'

2.1.3 Historic Royal Palaces, as custodian of the Tower, seek the agreement of Historic England regarding any repairs, improvements or alterations that may impact upon historic fabric. Scheduled Monument Consent has been granted by Historic England for the conservation work. The recording before and during conservation was carried out as a condition of this consent.

2.1.4 The building recording was carried out intermittently from 13<sup>th</sup> January to 11<sup>th</sup> September 2015 in accordance with a Brief (Gregory, 2014a).

## **2.2 Site Location**

2.2.1 The Bell Tower lies at the south-west corner of the Inner Curtain Wall. The recorded stretch of the Inner Curtain Wall lies to the east between the Bell Tower and Bloody Tower along Water Lane.

2.2.2 The Bell Tower is located at Ordnance Survey National Grid Reference TQ 33517 80513 (**Figures 1 and 2**).

### **3 METHODOLOGY**

#### **3.1 Aims and Objectives**

3.1.1 The objectives of the project as set out in the Brief for archaeological building recording and watching brief (Gregory, 2014a) were as follows:

- To update and correct Historic Royal Palace's photogrammetric recording of the Bell Tower and adjoining curtain wall elevations, by close observation from the ground and from the scaffolding.
- To mark up and record on the photogrammetry any significant features and building phase changes.
- To carry out a full stone-by-stone petrographic survey of all elevations and mark up the results on the photogrammetry.
- To digitise the results of the recording and petrographic phases, and provide a context based interpretation of the results, which will help inform the conservation works.
- To carry out the above tasks to the standard of a Level 4 survey (English Heritage, 2006), the full requirements of which are listed below.
- To provide as necessary a well-informed watching brief service during the conservation works.
- To identify the need for, and the location of, suitable areas for mortar analysis to assist with understanding the sequence of building construction. This mortar analysis should be the responsibility of the archaeologist and geologists. This is distinct from mortar analysis for matching fresh repairs which will be co-ordinated by the architect.
- To record and analyse the interior of the upper Bell Tower to a standard commensurate with the above requirements. This should include laser scanning of the interior to act as a record to inform future monitoring.
- To undertake post-conservation work laser scanning of the lower external elevations of the Bell Tower to record the Reigate Stone and form a record to inform future monitoring.

3.1.2 The research aims of the archaeological building recording and the watching brief as set out in the Brief for archaeological building recording and watching brief (Gregory, 2014a) were as follows:

- To what extent can the archaeology of the building identify distinct datable building phases?
- Is there evidence for the buildings that formerly adjoined to the outside of the Bell Tower and to the Curtain Wall along Mint Street?
- What do the areas of brick infilling to the Water Lane side represent and when were

the identifiable changes made?

- Is there any evidence for the position and size of the balcony on the south elevation that is recorded in late 17<sup>th</sup> century accounts of works?

### **3.2 Documentary Research**

- 3.2.1 The historical background detailed in Gregory, 2014b '*The Queen's House and Bell Tower: Statement of Significance*' has been repeated in this report. No new documentary research was undertaken for this report.

### **3.3 On-Site Recording**

#### ***Photographic Survey***

- 3.3.1 An initial photographic survey of the external elevations of the Bell Tower and adjoining Inner Curtain Wall was not carried out because they were covered with scaffolding for the conservation works before PCA's started the project. A number of photographs of the external walls were provided by Historic Royal Palaces and have been used in this report (**Plates 1 to 9**). High quality digital images of the interior of the Upper Bell Tower were taken using an SLR camera by PCA's photographer on 12<sup>th</sup> May 2015 (**Plates 37 to 94**). Digital photographs were also taken during the conservation work by the PCA Petrologist (**Plates 10 to 36 and 95 to 101**).

#### ***Petrographic Survey***

- 3.3.2 A detailed stone by stone petrographic survey of the elevations in accordance with Level 4 as set out in English Heritage 2006 *Understanding Historic Buildings; A Guide to Good Recording Practice* and the Brief (Gregory, 2014) was undertaken from the scaffold platforms from January to September 2015. Identification of the stone types, ceramic building materials and mortar present in the external elevations of the Bell Tower and Inner Curtain Wall was undertaken. Identification of the *in-situ* fabric was conducted using a Gowland x10 magnification hand lens by Dr Kevin Hayward, PCA's petrologist. Small (10-20mm) samples of some stone types (referred to in the text as samples S1 to S7) were obtained from the extant fabric using a small (1kg) masons hammer and sharp chisel from a loose or unobtrusive part of the block for comparative analysis. The location of the samples is shown on **Figures 15, 16, 30 and 31**. A comparative stone reference collection was used to assist identification.

#### ***Ceramic Building Material Analysis***

- 3.3.3 Bricks were analysed using the system of ceramic building material classification used in archaeological work in Greater London. Each fabric number (e.g. fabric 3031) specifies the composition, form, approximate method of manufacture and date range of the material. Examples of the brick fabrics can be found in the archives of the Museum of London and PCA.



### *Stone Identification*

- 3.3.4 In accordance with the Brief (Gregory 2014a, 6.2 iv), emphasis was placed upon the identification of the stone types from the medieval and early post-medieval elements of the Bell Tower and Inner Curtain Wall (**Figures 14 to 24 and 29 to 33**). Although the Brief stated that areas identified as 19<sup>th</sup> or 20<sup>th</sup> century were not to be given the same level of petrographic analysis, detailed stone-by-stone geological identification of the post-medieval stone was undertaken. This included an identification of the fabric and form of any ceramic building material (tile and brick).

### *Bedding Mortar Analysis*

- 3.3.5 As set out in the Brief (Gregory, 2014a, 6.2 v), an important aspect of the analytical recording of the Bell Tower and Inner Curtain Wall was the sampling of the bedding mortar. 'Original' mortars from the surviving medieval and early post-medieval fabric as well as a number of later mortars were sampled. The mortar samples are described in **Appendix 2** and were distinguished in hand specimen using a Long Arm Stereoscopic Microscope (x15). Petrological analysis of two of these samples (M1 and M2) identified their component parts.
- 3.3.6 Locations suitable for mortar sampling were identified from the scaffolding during the stone by stone geological survey. Criteria such as changes in rock-type, insertion of replacement stone, evidence for later patch repairs and rebuilding as well as discrete changes in colour and texture of the mortar itself determined suitable "spots" for sampling. The selection of these locations became clearer once the stone identifications had been colour-coded and mapped on each elevation.
- 3.3.7 Mortar samples were obtained using a small masons hammer and chisel. Thin sections were made of two of these mortars (M1 and M2) and are listed in **Appendix 2**, whilst petrographic photomicrographs (**Plates 111 and 112** summarise the visual characteristics of the different mortars).

### *Historic Building Recording*

- 3.3.8 Historic building recording in accordance with Level 3 as set out in English Heritage 2006 *Understanding Historic Buildings; A Guide to Good Recording Practice* was undertaken in the interior of the Upper Bell Tower prior to and during essential maintenance and repair works to the building. Stone by stone photogrammetric drawings were not provided for the interior of the Upper Bell Tower and photographs were annotated with stone types and mortars.

## **3.4 Thin Section Preparation and Analysis**

- 3.4.1 The two mortar samples (M1 and M2) were ground and embedded in coloured epoxy resin under vacuum and mounted as standard 30 micron thin sections. All were (in addition to the seven stone samples (S1 to S7) half stained with the addition of Alizarin

Red C and Potassium Hexocynoferrate powder, allowing both the treated and untreated parts of the slide to be examined and compared. All samples were examined under plane-polarised light using a polarising microscope (Leica DMLP) and a series of photomicrographs produced (Leica DFC 320 Digital Camera). These are reproduced here as **Plates 102, 103, 105 to 108, 110 to 112**).

### **3.5 Project Archive**

3.5.1 The project archive is currently held at the offices of Pre-Construct Archaeology Limited in Brockley, London, under the site code TOL 149. It is anticipated that the archive (copies of the report, drawings and photographs) will be lodged in the Historic Royal Palaces permanent archaeological stores at Hampton Court Palace in due course.

### **3.6 Guidance**

3.6.1 All works were undertaken in accordance with standards set out in:

- English Heritage (2006) *Understanding Historic Buildings: A Guide to Good Recording Practice*
- ClfA (2014) *Standard and guidance for the archaeological investigation and recording of standing buildings or structures*
- Historic England (2015) *Greater London Archaeology Advisory Service: Guidelines for Archaeological Projects in Greater London*.

## **4 HISTORICAL AND ARCHAEOLOGICAL BACKGROUND**

### **4.1 Introduction**

- 4.1.1 The following historical and archaeological background is mainly taken from Gregory, 2014b.

### **4.2 The Tower of London**

- 4.2.1 The building of the Tower of London was begun shortly after the Conquest by William the Conqueror, whose great keep, the 'White Tower', sits at its heart. The fortress was first constructed within the south-eastern corner of the ancient Roman city walls, along the riverbank of the Thames. Extended beyond the boundaries of the Roman city walls by Henry III, and developed as a concentric castle by Edward I in the 13th century, the Tower – the monarch's stronghold amidst an often hostile city – became the home of major State Institutions, as well as the setting for nationally significant historical events. The Tower is the home of the Coronation Regalia and Crown Jewels, and the birthplace of the Royal Armouries Museum, which still displays part of its collection within the White Tower. The fortress is most strongly associated in the popular imagination with the Tudors, and the turbulent events of the 16th century, particularly with the many prisoners kept within its walls. The 19th century Romantic perception of the Tower, and the castle's emerging identity as a tourist attraction, led to the demolition of many institutional buildings and the addition of new 'medieval' style neo-gothic edifices.

### **4.3 The Bell Tower**

- 4.3.1 The Bell Tower forms the south-west corner of the inner ward of the Tower of London. It is a late 12<sup>th</sup>-century corner tower that originally formed part of the outer defences of the medieval castle.
- 4.3.2 The history of the Bell Tower's development and use is sparsely recorded in the archival sources. This should not detract from its significance, however, and indeed the relatively few mentions of it in the historic accounts may simply reflect the fact that it has been little altered since its initial construction in the late 12<sup>th</sup> century. It has been attributed a build date on stylistic grounds of c.1190-1200, and thus, almost certainly, formed part of the strengthened outer defences of the castle built by Justiciar William Longchamp, Bishop of Ely, for Richard I, the Lionheart (Impey, 2008, pp142-3). Much of the surviving masonry, both external and internal, is thought to be from the primary build-phase and the fine vaulting and carved corbels and bosses of the rooms it contains demonstrate the high status of the building. As such it represents not only a remarkably complete example of the early mural defences and one of the oldest surviving components of the Tower but also a point of development in English castle architecture that combined defensive structures with elaborately decorated living space (*ibid.*).
- 4.3.3 The Queen's House lies immediately to the north-east of the Bell Tower and its adjacent

Inner Curtain Walls. The first house on this site was probably built in 1360. This was built for the Constable of the Tower at great expense. A summary report on archaeological excavations carried out in the early 1960s (on file at Historic England, Waterhouse Square) concluded that:

‘The forerunner of the Queen’s House probably consisted of a main E.W. range slightly narrower but the same length as the present Queen’s House. Its ground floor which was lower than the floor level now obtaining was divided in two or more probably three rooms by stone cross walls abutting the curtain. Two, and probably the third rooms were interconnecting, and the third (western) room was probably connected with the Bell Tower, by an additional doorway – now blocked in the E. wall of the Tower’s lower chamber. A further ground floor chamber may have existed abutting the W. curtain and N. side of the Bell Tower’.

The presence of the large buttress on the north-east angle of the main south range and an intermediate buttress to the internal cross wall suggests that there was a substantial upper storey (or storeys) which then as now probably contained the living apartments. Indications in the East gable wall suggest that this superstructure may have been at least partially timber framed’.

4.3.4 The earlier building appears to have stood until the early 16<sup>th</sup> century, when it became the residence of the Lieutenant of the Tower. In 1539 Cromwell’s Remembrances record several reminders of the poor state of the building and the need to address it (L&P XIV.ii, 287, 427 and 495; TNA SP 1/153 f.171; BL Cotton Titus MS B/I f.446v). The work to rebuild the Lieutenant’s House was underway by June 1540, the letters guaranteeing funds to the Lieutenant, Sir Edmund Walsingham, seemingly having been signed by Cromwell only weeks, if not days, before his own arrest and imprisonment at the Tower (BL Arundel MS 97 f.140). The extent of the rebuilding is unclear. It would seem, on the basis of the extant building, that the works of 1540 involved a wholesale demolition of the earlier house and that an entirely new building was constructed in its place.

4.3.5 What is clear, however, is that the extant building was constructed in at least two broad phases. The earliest, presumably that dating to 1540, is the range to the south containing the kitchen and Council Chamber as well as space for domestic chambers. The Council Chamber formed the hub of the house and in its original configuration was a double-height first floor great hall, the division of which was effected by the insertion of a floor at second-storey level in 1607 (BL Add. MS 14044 f.9r). Above it retains its original open roof structure, though in a much altered form. Similarly the kitchen also appears to have been a double-height room, and like the Council Chamber retains its original roof structure. Both roofs have been identified as of broadly early 16<sup>th</sup> century date on the basis of their appearance and construction.

4.3.6 The second build phase saw the addition of the west range which abuts awkwardly with the earlier south range and appears to have been built against it rather than as part of a

single planned build. It is difficult to give an exact date to the construction of this addition since there is no record amongst the surviving accounts but it must have been added shortly after the completion of the south range and was certainly standing by 1566 when the servants of the Duchess of Lennox inscribed their names and the date on the stone lintel of a fireplace in a second floor room of the west range. The fireplace itself is of a type typical of the early- to mid-16th century.

4.3.7 Agas 1561 map of London produced c.1633 (**Figure 3**) is a bird's-eye view of the city from the south. It shows the Bell Tower and adjacent Inner Curtain Wall with the south elevation of the Queens House. Three gable roofs are shown over the Queen's House with two pairs of small windows above a large window with rounded head and three small windows below in the south elevation/Inner Curtain Wall. The Bell Tower and eastern part of the adjacent Inner Curtain Wall are shown as crenellated.

4.3.8 The accounts for 1590-91 refer to mending stone window jambs, and though equally lacking in detail, presumably refer to windows on the south elevation that predated the extant sashes and casements (TNA E351/3225). That there were stone windows on this elevation is confirmed by the account of 1602-03 that records repairs to the cill, mullions and jambs of the 'greate stonne windowe in mr Lewetenautes hall' (TNA E351/3238). Since this cannot have been the window in the timber-framed north end of the hall it must have been that to the south and was probably the large window shown on Agas 1561 map (**Figure 3**). The same window is shown as a double-height window on the Haiward and Gascoyne plan of 1597 (**Figure 4**). The gable roofs of the Queen's House (Lieutenant's Lodgings) are also shown although the configuration of the smaller windows is different to that shown on Agas 1561 map (**Figure 3**).

4.3.9 The first few years of the 17<sup>th</sup> century saw some small repairs and alterations, but nothing in the way of substantial building phases. In 1600-01 the parapet wall of the wall-walk along the Inner Curtain Wall immediately north of the Bell Tower was taken down and built up again in brick, and in 1604-05 the back wall of the kitchen chimney was broken down, 'to save the house the kitching beinge on fyer' (TNA E351/3240).

4.3.10 In 1605-06, alongside various payments for works in the Lieutenant's kitchen there is a payment for re-laying the roof on the stairs going up to the Gentleman Porters' lodgings by the Bell Tower (TNA E351/3241). Although the document is not specific about the location of the Porters' lodging and subsequent histories of the Tower have not identified where it stood, accounts made later in the century suggest that there was direct access between the Lieutenant's and the Porters' houses, and the apparent proximity to the Bell Tower indicated by the 1605-06 account allows some speculation about the nature of the connection (e.g. TNA WORK 5/10 f.9r). It is possible that the Gentleman Porter's lodging is the gabled building shown to the east of the Byward Tower on Haiward and Gascoyne's plan (**Figure 4**). Research (Keay, 2001, p.29) has established that the Gentleman Porter lived in or near-to the Byward Tower, and as such the buildings

identified to the east seem good candidates. The building in question seems to have been demolished at some point in the 18<sup>th</sup> century. The location of the Porter's House is significant to both the Bell Tower and the Queen's House for two reasons. First it probably abutted the Bell Tower and thus may have impacted the external masonry of the building. Secondly it may account for the passage-like structure that Haiward and Gascoyne shows against the western-most gable of the Queen's House. This feature has not been considered or remarked upon before and suggests that buildings to the south of the Queen's House could formerly be accessed from a door in its south wall close to the junction with the Bell Tower. It is possible that some evidence for this structure can be found in the extant fabric of either the Bell Tower or the Queen's House.

4.3.11 Work recorded in the early decades of the 17<sup>th</sup> century included masonry repairs to the curtain walls and re-tiling and re-leading over both the Queen's House and the Bell Tower, though the accounts are generally unspecific about the scope of these works. In 1633-34 masons were paid to lay new Purbeck paving on the wall walk between the Bell Tower and the Beauchamp Tower. At the same time they cut back the lower 16 inches of the brick wall of the Queen's House there along a length of 143 feet and laid in Purbeck blocks on edge to provide a waterproof barrier between the wall-walk and the building, 'to keepe the raine from porring in' (TNA E351/3267). The same phase of work saw repairs to the south Thames-facing wall where decayed Ragstone was cut out and replaced with new Ragstone and the provision of 'a base of Portland Stone wrought and sett under the Collumne at the Lewetenantes Hall dore'; a reference that is difficult to interpret in light of many subsequent changes to this part of the building (*ibid.*).

4.3.12 A view of the Tower from the south drawn by Wenceslas Hollar in 1637-41 (**Figure 5**; British Museum 1859-8-6-389; TNA WORK 5/13 f.20v) again shows the Bell Tower and adjacent Inner Curtain Wall. The three tall gable roofs are shown with a large traceried gothic type window below the central gable.

4.3.13 In 1669 work began to add a balcony to the south elevation seemingly accessed from the present dining room on the first floor. The scaffold from which to build the balcony was constructed in March 1670 and the work was completed within the year (TNA WORK 5/16 f.1r). This structure was 20ft long by 5ft wide and required the addition of substantial cantilevered beams to provide it support. Furthermore it required the remodelling of the associated windows which, until this date may still have been the large gothic traceried window shown in Hollar's 1638-41 view (**Figure 5**). In its place was a new window for the Council Chamber and a set of 'folding doors' leading out on to the lead balcony from the dining room below. In 1687 the Queen's House underwent a major refurbishment which included the insertion of sash windows. The work seems to have been overseen by Christopher Wren.

4.3.14 The large balcony in the south elevation of the Queen's House is clearly shown in Holcroft Blood's bird's-eye view of the Tower made in 1688 (**Figure 6**) and in William

Maitland's 1756 drawing in *History and Survey of London* (**Figure 7a**) showing the south elevation of the Queen's House. The latter shows two large mullioned and transomed windows above the balcony that was added in 1669-70. The Bell Turret is clearly shown on the Bell Tower in this drawing for the first time. George Dance the younger's 1790 'View of the Tower from the Thames' clearly shows the parapet of the south elevation of the Queen's House/Inner Curtain Wall and three windows in positions that roughly equate with extant locations (**Figure 7b**). The Bell Tower is more difficult to understand as it is partially obscured by buildings in the foreground, however the Bell Turret is clearly visible.

- 4.3.15 Anthony Salvin's c.1860 drawing showing the south elevation of the Bell Tower and the Queen's House (**Figure 8**) again depicts the three gable roofs over the Queen's House with a line at the height of the parapet coping. All of the window openings shown in this drawing are still extant and only two small windows have since been added. These are the toilet window in the south-east elevation of the Bell Tower and a window at low level in the south elevation of the Queen's House below the third gable to the east (**Figures 14 and 29**). A vertical downpipe has since been added below this latter window and a diagonal pipe has been added above it. A chimneystack/flue between the first and second gable from the west has since been removed. Another chimneystack on the east side of the Bell Tower to the south of the chimneystack just to the south of the stair turret has also since been removed.
- 4.3.16 A group of undated, presumably late 19<sup>th</sup> century, photographs of the Bell Tower show the south-east side of the Bell Tower before the insertion of the existing toilet window (**Plates A to E**). Some of these photographs were taken between 1870 and 1900 (**Plates B to D**). They show that the parapet of the Bell Tower at that time was constructed of brickwork (now stone) and the upper two thirds of the elevations immediately below this was covered with a roughcast/pebbledash render. The same render covered the Inner Curtain Wall up to the now brick string course at second floor level. These late 19<sup>th</sup> century photographs show that this string course was covered with a cement render at that time. The small brick chimneystack/flue shown in Salvin's 1860 drawing (**Figure 8**; now removed) is visible in these photographs and has clearly been added to the south elevation of the Queen's House. Cement render covers the head of the large window with a balcony railing in the same style as shown in Salvin's drawing (**Figure 8**). The photographs show that plants, assumed to include Virginia Creeper, are being encouraged to grow up the Inner Curtain Wall as well as the Bell Tower with protective baskets along the pavement.
- 4.3.17 Undated photographs of the interior of the Upper Chamber of the Bell Tower presumably taken in the late 19<sup>th</sup>/early 20<sup>th</sup> century show the internal walls covered with whitewash (**Plates M to O**). A large internal downpipe is visible against the east wall (**Plates N and O**) and appears to have drained rainwater from the roof down through the Upper

Chamber. A photograph of the interior of the Upper Chamber taken in the early 29th century (**Plate P**) shows that a number of changes had taken place since the earlier photographs of the interior had been taken (**Plates M to O**). These included the removal of the drainpipe down the east wall and the addition of a number of thin water pipes along the east wall.

4.3.18 Photographs taken c.1900 show that the toilet window had been inserted in the south-east elevation of the Bell Tower by this time (**Plates H, I to K**). At this time cement roughcast/pebbledash render still covered most of the Bell Tower elevations and the parapet was still constructed of brickwork (**Plates F to K**). At sometime in the early years of the 20<sup>th</sup> century, the cement pebbledash render appears to have started to fall off the quoin on the east side of the Bell Tower and is visible as a vertical white line down this angle (**Plates J and K**). An early 20<sup>th</sup> century view of the north side of the Bell Tower shows the c.1904 porch, the north elevation of the stair turret much as it is today and a large drainpipe gently sloping down from the Bell Tower parapet east towards the porch (**Plate L**). A window had replaced an arrow loop in the north elevation of the Lower Chamber (compare **Figure 11** with **Plate L**).

4.3.19 A set of photographs of the Bell Tower taken in June and July 1924 show that by this time the brick exterior of the parapet had been replaced with stone and the cement roughcast/pebbledash render had been removed (**Plates Q to V**). Other changes included the removal of the large drainpipe on the north side of the parapet (compare **Plates L and Q**), the removal of a chimneystack on the east side of the Bell Tower (compare **Figure 8; Plates E, H, I, J and R**). The earlier photographs (**Plates E, H and I**) show this chimneystack with a distinctive chimney pot, which had been removed in the early 20<sup>th</sup> century (**Plate J**). By June 1924 the brick chimney stack added to the south elevation of the Queen's House had been lowered to the level of the parapet (compare **Plates A to C, E, H to K, R, U and W**). It has since been totally removed (**Plates 8 and 9**). The June and July 1924 photographs suggest that the Inner Curtain Wall was still covered with pebbledash cement render under the prolific vegetation (Virginia Creeper) growing up the wall (**Plates R, U and W**). It has since been removed along with the cement render to the brick string course and to the head of the large window with a balcony (**Plates 8 and 9**). Ashlar quoins missing in the 1924 photographs have since been added to the angles of the Bell Tower (compare **Plates Q, S with 1; T with 3, 6 and 7**).

4.3.20 Documentary evidence shows that in 1971, the sash windows in the south wall of the Queen's House were replaced and repaired.



## **5 DESCRIPTION**

### **5.1 Introduction**

5.1.1 The Bell Tower is located at the south-western corner of the Inner Ward and originally projected south-westwards into the Thames before the Outer Ward was built (**Figure 2**).

5.1.2 The Bell Tower is thought to have been built c.1190-1200 on stylistic grounds (Impey, 2008, pp. 142-3) and is 16 metres (60 feet) high. The lower part of the structure is octagonal in plan with the upper part cylindrical (**Plates 1 to 8**). The structure has a solid base with two further storeys above this. Excavations around the base of the tower exposed its base (**Plate 29**), originally washed by the Thames and buried in the 13th-century when the Outer Ward was constructed. This base consists of a plinth of seven chamfered offsets set on a projecting rubble platform, above this the wall is ashlar faced – much of which is Reigate Stone - up to a string course of Sussex Marble.

### **5.2 External Elevations of the Bell Tower**

5.2.1 The external elevations of the Bell Tower can broadly be subdivided into four major components. The lowermost 4 to 6 metres is dominated by mainly replaced regular sized ashlar and quoin blocks of freestone (**Figure 14; Plates 1 to 5**). Above, 11 metres or so of Kentish Ragstone rubble make up the medieval core of the tower. The freestone used in the window jambs and quoins make up another component. Above the rubble core, the former external brickwork of the parapet was replaced between c.1904 and c.1924 with larger Kentish Ragstone topped with Yorkstone paving (**Plates 6 and 7**).

#### ***Basal Ashlar***

5.2.2 The base of the Bell Tower is constructed of facing blocks of ashlar. Relict medieval green Reigate Stone ashlar and rare orange Taynton Stone survive at the base of the elevations although some has been replaced over the years (**Figures 14 to 20**).

5.2.3 **Elevation A:** The ashlar base of the north elevation (A) is about 4 metres in height and comprises regular-sized 25cm square and rectangular shaped blocks of freestone (**Figure 15; Plates 1 and 10**). The ashlar base is distinct from the Kentish Ragstone rubble above. Most of the original Reigate Stone ashlar survives with one block of original Taynton Stone. Some ashlar blocks have been replaced by a small group of crisply dressed olive green Chilmark Stones from courses 1 to 7 (up from ground surface), probably 19th or 20th century repairs.

5.2.4 Two large mottled white and red medieval bricks occur 16 courses up (2.5 metres) from the ground surface conform in their size and shape with the Beauchamp type bricks used to construct much of the Beauchamp Tower (built in 1281) to the north of the Bell Tower near the junction of Elevations A and B. It is at this point the Tower juts slightly further out with the exposed stone showing evidence of wear, possibly rope marks.

- 5.2.5 During the current works, replacement of 5 ashlar blocks of Reigate Stone from the basal courses of Elevation A on 14th and 20th July 2015 identified four putlog holes. The dimensions of the putlog voids varies between 180x180mm to 170x220mm and are typically 1.5metres deep. Behind the ashlar facing stone, the original medieval bedding mortar, a fawn-yellow (2.5 YR 8/8), loose brown gravel mortar (Type A), was revealed along with fragments of Kentish Ragstone. The contents of each void is described in turn.
- 5.2.6 Putlog Hole 1 was also uncovered on 14th July 2015. It is situated on the east side of the elevation near the top of the basal ashlar (**Figure 15; Plate 11**). The covering Reigate Stone (S2) was sampled for thin-section analysis (**Figure 15; Plate 102**). The void was completely clear and clean (**Plate 12**).
- 5.2.7 Void 2 was also uncovered on 14<sup>th</sup> July 2015. It lay to the west of Putlog 1 and two courses down (**Figure 15, Plates 13 and 14**). Medieval rubble wall and mortar was visible behind the void of the removed ashlar block (**Plate 15**).
- 5.2.8 Putlog Hole 3 was also uncovered on 14<sup>th</sup> July 2015. It is situated in the same course as Putlog 1 on the west side of the elevation near the top of the basal ashlar (**Figure 15; Plate 16**). The deep void contained a small amount of black dusty fill, which was sooty rather than charcoal rich (**Plates 17 and 18**). It contained the remains of a stamped envelope dated 1965, perhaps from a previous phase of repair.
- 5.2.9 Putlog Hole 4 was uncovered on 20<sup>th</sup> July 2015. It is situated below Putlog 1, some 10 rows up from the ground surface (**Figure 15; Plates 19 and 20**). The void was blackened internally with evidence of scorch marks and burning (**Plate 21**). A sample of medieval mortar (M2) was obtained for thin section analysis.
- 5.2.10 Putlog Hole 5 was also uncovered on 20<sup>th</sup> July 2015. It is situated below Putlog 3, some 14 rows up from the ground surface close to the junction of Elevations A and B (**Figure 15; Plates 22 and 23**). It had been infilled with a hard 20<sup>th</sup> century flint gravel concrete (**Plates 24 and 25**).
- 5.2.11 These putlog holes were used to receive the ends of wooden scaffolding poles or beams. After the scaffolding was taken down, the ashlar block was inserted in the putlog void in order to prevent any water damage.
- 5.2.12 **Elevation B:** The base of the north-west elevation (B) continues up to about 5 metres in height for a distance of about 2 metres with regular-sized 25cm square and rectangular medieval Reigate Stone ashlar blocks (**Figure 16**). A number of crisply dressed olive green Chilmark Stones are also visible in courses 2 to 4 (up from the ground surface), and are probably 19<sup>th</sup> or 20<sup>th</sup> century repairs.
- 5.2.13 Further along Elevation B, some 2.5 metres from its junction with Elevation A, much larger (60cm across) post-medieval pale cream and yellow Magnesian Limestone ashlar blocks, occasional Portland Stone ashlar and Purbeck Limestone flags have replaced the original ashlar up to some 6m above ground level. Portland Stone has been used to

replace the original medieval stone surround of the arrow loop in this elevation. An undated probably 19<sup>th</sup> century drawing (**Figure 11**) shows a proposal to replace the stone dressing around this arrow loop, although nine stones are shown rather than the current four large stones (**Figure 16**). Magnesian Limestone has mainly been used to replace the quoin stones at the junction of Elevations B and C up to 6.5 metres in height.

5.2.14 Other stone types recorded in this lower ashlar section are large examples of what may have been reused shelly “featherbed” Quarr stone, a rock that was little used in London after the 12th century and is associated with some of the earliest construction phases of the White Tower (Impey, 2008). Taynton Stone and what can only be described as a muddy mollusk-rich rock, possibly from the Tertiary of the Isle of Thanet are also visible.

5.2.15 **Elevation C:** Small blocks of Reigate Stone ashlar are still extant in Elevation C (**Figure 17; Plates 3 and 4**). Unlike elevation A, the crisply dressed olive green Chilmark Stones are absent.

5.2.16 Three “Beauchamp” mottled red and white medieval bricks are visible within the Reigate Stone ashlar some 14 to 15 courses above the ground surface. Similar bricks at roughly the same level are also visible in Elevation A (**Figure 15**) and a few more lie in other areas of Elevation C (**Figure 17; Plate 26**). This brick type was used in the construction of the White Tower in 1281 (Impey 2008).

5.2.17 Replacement yellow, pale cream, oolitic and laminated Magnesian Limestone have been used in the basal 2 courses and in quoins at the sides of Elevation C.

5.2.18 **Elevation D:** The petrological character of the basal ashlar of Elevation D differs in a number of ways from Elevations A to C. Firstly, the remnant medieval Reigate Stone is limited to the lowest 8 courses and about half of it has been replaced during various post-medieval repairs by a variety of materials including small ashlar blocks of poor quality Kentish Ragstone, Ketton Stone, laminated, oolitic, pale cream and yellow Magnesian Limestone (**Figure 18**).

5.2.19 In addition, above the lower 2 metres and up to 6 metres, there has been wholesale 19<sup>th</sup> or 20<sup>th</sup> century stone replacement using hard and poor quality Kentish Ragstone ashlar blocks. These are arranged in a rather blocked ‘crazy-paving’ fashion up to and above the arrow loop. This stone replacement work appears to have removed the lower string course visible in Elevations A to C (**Figure 14**).

5.2.20 **Elevation E:** The petrological character of the basal ashlar in Elevations D and E are similar (**Figure 14**). Firstly, there are notable clusters of Reigate Stone ashlar in the lowest 8 courses (**Figures 18 and 19; Plate 2**). Much of this stone has been replaced during various post-medieval repairs with a variety of materials including small ashlar blocks of poor quality Kentish Ragstone, Ketton Stone, laminated, oolitic, pale cream and yellow Magnesian Limestone.

5.2.21 In addition, both elevations have seen wholesale 19<sup>th</sup>/20<sup>th</sup> century stone replacement with large blocks of Kentish Ragstone and poor quality Kentish Ragstone up to about 6

metres. One difference is that the stone in the western (left) half of Elevation E at between about 4 and 6 metres above ground level is almost entirely Portland and Ketton Stone (**Figure 19**). This may indicate a discrete phase of urgent 19<sup>th</sup>/20<sup>th</sup> century repair using available materials. Interestingly, large medieval mottled Beauchamp bricks are visible between courses 16 and 20 above ground level. The same brick type is visible in Elevations A and C and were used in the construction of the Beauchamp Tower in 1281. These relict bricks have survived from the medieval period.

5.2.22 **Elevation F:** The basal ashlar of Elevation F includes an additional 2 metres below ground level at the base of the Bell Tower (**Figure 20; Plate 29**). The foundations are exposed in a viewing pit, which was archaeologically excavated in 1928 (Gill, 2003, 4). The same deeply excavated pit has also exposed an additional 3 metres below ground level at the base of the adjacent Inner Curtain Wall (**Figure 32 and 33**). These below ground foundations were originally washed by the Thames and buried in the 13<sup>th</sup> century when the Outer Ward was constructed. The upper part of these below ground foundations was constructed of surviving Reigate Stone ashlar with a string course of Sussex Marble (previously thought to be Purbeck Marble; *ibid.*). This Sussex Marble plinth reappears a further 20 metres east along the Inner Curtain Wall at ground surface level (**Figure 34; Plate 30**).

5.2.23 Above ground level, the basal ashlar of Elevation F again includes some primary Reigate Stone however it also includes extensive replacement Magnesian Limestone and large blocks of Kentish Ragstone up to 6 metres and therefore has some similarities to Elevations D and E (**Figure 14**).

### ***Medieval Rubble Wall***

5.2.24 Large sections of original medieval rubble are present between 4-6 and 15-16 metres above ground surface in Elevations A to E of the Bell Tower (**Figure 14**). They comprise irregularly placed 5-15cm angular and tabular blocks of the very hard calcareous sandstone, Kentish Ragstone *sensu stricto* bonded with a fawn-brown lime-gravel mortar (Type A) (**Plate 31**).

5.2.25 **Elevation A:** String courses of better-shaped Kentish Ragstone blocks interrupt the rubble wall at 6 and 9 metres above ground level (**Figure 15**). At 13 metres above ground level, elongated blocks of Ragstone arranged in a fan-like manner delineate the heads of two former original narrow window openings immediately above a large replacement post-medieval window (**Plates Q, 1 and 32**).

5.2.26 Other rock types are few and far between and include a tiny quantity of Reigate Stone, Purbeck and Sussex Marble. All of these typical medieval lithotypes are present up to about 9 metres above ground level. Above 9 metres there is evidence for repair with occasional post-medieval Purbeck Limestone.

5.2.27 **Elevation B:** A string course of better shaped Kentish Ragstone blocks again interrupts

- the medieval rubble at 9-10 metres above ground surface (**Figure 16; Plate 1**). The lower string course is constructed of primary Reigate Stone. At 13 metres, elongated blocks of tabular Kentish Ragstone, arranged in a fan-like manner again delineate the heads of two former original narrow window openings (**Plate Q**).
- 5.2.28 Again other stone types within the rubble core are few and far between. A tiny quantity of Reigate Stone, Purbeck Marble and Sussex Marble, all of which are typical medieval lithotypes, are present up to 16 metres. A later post-medieval patchwork repair in Purbeck Limestone is visible in the rubble core next to the replacement Chilmark quoins at the junction of Elevations B and C at a height of 9 metres above ground surface.
- 5.2.29 **Elevation C:** The original medieval large-rubble core section between 4 and 16 metres is better preserved in Elevation C than in either Elevations A or B.
- 5.2.30 Two string courses of better shaped Kentish Ragstone blocks are again visible in this elevation (**Figure 17; Plates 3 and 6**). They occur at 6 and 10 metres above ground surface. Further examples of medieval fabric survive as elongated blocks of tabular Kentish Ragstone, arranged in a fan-like manner delineating the heads of two former original narrow window openings (**Plate T**).
- 5.2.31 At a height of 6 metres above ground level, the jambs of the lower arrow loop retains its original Kentish Ragstone fabric (**Plates 3 to 6**).
- 5.2.32 Differences in the medieval fabric of the rubble core include the presence of render on the Kentish Ragstone blocks and examples of the hard bivalve rich Thanet Stone. Both are features seen in the earliest batter of the White Tower constructed in 1070 (Hayward 2015) and are likely to represent recycled materials used in the construction of the Bell Tower, which is thought to have been built c.1190-1200 based on stylistic grounds (Impey, 2008). Small post-medieval patchwork repairs using Purbeck Limestone flags in the rubble core are more numerous in Elevation C than in Elevations A and B.
- 5.2.33 **Elevation D:** Some of the medieval details visible in Elevations A to C are missing in Elevation D.
- 5.2.34 Only one string course of better-shaped Kentish Ragstone blocks remains at 9 metres above ground surface in this elevation (**Figures 14 and 18; Plates 3 and 5**). The insertion of large post-medieval Kentish Ragstone ashlar at 6 metres above ground surface has removed the lower string course. The string course is however shown on the undated, probably 19<sup>th</sup> century, elevation drawing (**Figure 11**).
- 5.2.35 There are also no elongated fan-shaped tabular blocks delineating an earlier upper medieval window in this elevation. A former window at about 13 metres above ground surface appears to have been removed. Its outline can be established by the infilling of much finer broken up Kentish Ragstone blocks with a large remnant tabular block of Purbeck Limestone Broken Beds possibly its former sill (**Figure 18; Plate 7**).
- 5.2.36 At 6 metres above ground surface, the original medieval worn Caen Stone and Kentish Ragstone jambs of the lower arrow loop survive (**Figure 18; Plate 5**).

- 5.2.37 Similar to Elevation C, the presence of render on Ragstone blocks and examples of the hard bivalve rich Thanet Stone in the rubble core suggest reuse of earlier Norman material possibly from the White Tower. Purbeck and Sussex Marble blocks in the rubble core of Elevation D may have been reused from elsewhere in the Bell Tower as they are similar in size to those found in the foundations exposed in the viewing pit excavated at the corner of the Bell Tower and Inner Curtain Wall/south elevation of the Queen's House.
- 5.2.38 **Elevation E:** Some of the medieval details visible in Elevations A to C are missing in Elevation E.
- 5.2.39 Only one string course of better-shaped Kentish Ragstone blocks remains at 9 metres (**Figures 14 and 19; Plates 2 and 8**). As with Elevation D any trace of a 6 metres string course has been removed by the insertion of large post-medieval Kentish Ragstone ashlar. The string course is however shown on the undated, probably 19<sup>th</sup> century, elevation drawing (**Figure 11**). There are also no elongated fan-shaped tabular blocks outlining a remnant upper medieval window.
- 5.2.40 As with Elevations C and D the presence of render on the Kentish Ragstone blocks, and examples of the hard bivalve rich Thanet Stone in the rubble core suggest reuse of earlier Norman material possibly from the White Tower. These are nearly all located in a discrete band 6.5 metres above ground surface and would perhaps suggest recycling of a group of salvaged materials.
- 5.2.41 **Elevation F:** Some of the medieval details visible in Elevations A to E are missing in Elevation F.
- 5.2.42 As with all the other elevations there is a string course at 9 metres made from better-shaped Kentish Ragstone blocks (**Figure 20**). Any trace of a string course at a height of 6 metres as seen in Elevations A to C has disappeared with the insertion of large post-medieval Kentish Ragstone ashlar blocks. This elevation never had an arrow loop because of its narrow width.
- 5.2.43 The identification of Norman render on some the Kentish Ragstone blocks and examples of the hard bivalve rich Thanet Stone at 6.5m above ground surface at the same height as in Elevation E suggests salvage from the same group of early materials.

#### ***Window jambs and quoins***

- 5.2.44 **Elevation A:** The junction of the Bell Tower with the Inner Curtain Wall along Mint Street is defined from a height of 2m to 14m by large (up to 1 metre) quoin blocks of replacement 19<sup>th</sup> century Magnesian Limestone from South Yorkshire (**Figures 14 and 15; Plates 1, 11 and 34**). These still have large dowel holes present. Indeed, the rubblestone adjoining them including poor quality Kentish Ragstone and some flint galleting would suggest wholesale replacement of this section during the 19<sup>th</sup> century before the elevations of the Bell Tower were covered with a roughcast/pebbledash

render.

- 5.2.45 The same type of Magnesian Limestone was also used in jambs surrounding the large upper windows in Elevations A and B suggesting that window replacement or enlargement occurred at this time too (**Figures 14 to 16; Plates L, Q, S and 1**).
- 5.2.46 The undated, probably 19<sup>th</sup> century, elevation drawing of the lower part of the Bell Tower shows that the lower window in Elevation A is a later replacement of a former arrow loop (**Figure 11**). The jambs of this window are constructed in poor quality Kentish Ragstone.
- 5.2.47 The junction of Elevations A and B is delineated between 6 and 11 metres above ground level by blocks of worn post-medieval Chilmark Stone quoins. Photographs taken in June and July 1924 shows some of these stones *in situ* and others below are missing suggesting that many were added after these photographs were taken (**Plates Q and S**).
- 5.2.48 At 11 metres is a triangular batter, above which the tower becomes rounded.
- 5.2.49 **Elevation B:** Magnesian Limestone was again used in jambs, sill and lintel surrounding the smaller replacement upper window (**Figures 14 and 16; Plates L, Q, S and 1**) and a sample (S7) was retained for thin-section analysis (**Figure 16**). The jambs surrounding the original lower arrow loop had been replaced with Portland Stone, a freestone only used from the mid-17th century onwards in London and at the Tower of London.
- 5.2.50 The same worn replacement Chilmark Stone is used in the quoin at the junction of Elevations B and C from 7 to 12 metres above ground surface as is used in the junction between Elevations A and B. The same stone is used in the string course at the base of the parapet (at approximately 16m above ground surface) and was samples for thin section analysis (S1; **Figure 16**). This may suggest that these repairs and additions were contemporary.
- 5.2.51 **Elevation C:** Portland Stone and not Magnesian Limestone was used in the jambs surrounding the small upper window at a height of about 14 metres above ground surface in this elevation (**Figures 14 and 17; Plates D, T, X, 6 and 7**). Magnesian Limestone was only used sparingly, one block in this upper window and to replace one block of the arrow loop.
- 5.2.52 As with Elevations A and B, worn quoins of post-medieval Chilmark Stone were used as the uppermost replacement stone between 6.5 and 11 metres above ground level at the junction of Elevations C and D. Above this, at 11 metres, is a triangular batter, above which the tower becomes rounded. Again the same type of Chilmark Stone is used in the parapet string course at 16 metres above ground surface suggesting that these repairs and additions were a contemporary build.
- 5.2.53 A big difference is the first appearance of large later post-medieval replacement quoin blocks of yellow-orange Ketton Stone from Lincolnshire between 2 and 6.5 metres above ground surface at the junction of Elevations C and D (**Figure 17**). Their use in the c.1904 porch (**Figure 21**) may suggest that they were used as replacement material at this time however, a photograph taken in the early 20<sup>th</sup> century shows the newly constructed porch

and the Bell Tower still covered with pebbledash render (**Plate L**).

5.2.54 **Elevation D:** As with Elevations A to C, worn quoins of post-medieval Chilmark Stone were used as the uppermost replacement stone between 6 and 11 metres above ground surface at the junction between Elevations D and E (**Figures 14 and 18**). Above this, at 11 metres, is a triangular batter, above which the tower becomes rounded. Again the same type of Chilmark Stone is used in the parapet string course at 16 metres above ground surface suggesting that these repairs and additions were contemporary.

5.2.55 Large replacement quoin blocks of Ketton Stone are again used from 2 to 6.5 metres above ground surface at the junction of Elevations D and E. A replacement quoin in Bath Stone may have been carried out at the same time as the insertion of the upper window in Elevation E in Bath Stone.

5.2.56 **Elevation E:** As with Elevations A to D, worn quoins of post-medieval Chilmark Stone are used as the uppermost replacement stone between 6 and 11 metres above ground surface at the junction of Elevation E and F (**Figures 14 and 19; Plates R, 2, 7 and 8**). Above this, at 11 metres above ground surface, is a triangular batter, above which the tower becomes rounded. Again the same type of Chilmark Stone is used in the string course at 16 metres above ground surface, suggesting that these repairs and additions were contemporary.

5.2.57 At 6 metres height, the original medieval worn Caen Stone jambs of the lower arrow loop survive (**Figure 19; Plates 33**).

5.2.58 The upper rectangular window at 13m above ground surface has a surround of early/mid 19th century crisply dressed Bath Stone blocks and reused Caen Stone (**Figures 14 and 19; Plates A to E, H, I, J, K, R, U, 2, 7 and 8**). The small adjacent window has a timber frame. Photographs show that it was inserted at the end of the 19<sup>th</sup> century (compare **Plates A to E** with **Plates H, I, J, K, R, U, 2, 7 and 8**).

### ***Parapet***

5.2.59 Above a string course of worn Chilmark Stone at 15 metres above ground surface, the parapet consists of larger blocks of Kentish Ragstone sensu-stricto arranged in an early 20th century 'crazy-paving' type pattern, capped with large paving slabs of Yorkstone. Photographs show that the parapet was faced with brickwork in the 19<sup>th</sup> and early 20<sup>th</sup> century (**Plates A to E, H to L**). At sometime between c.1904 and 1924 the external parapet was reconstructed in stonework (**Plates Q to V**).

## **5.3 Lower Chamber of the Bell Tower**

5.3.1 Internally the Bell Tower contains two large chambers, one above the other but no longer connected by a staircase, if they ever were (**Figure 26 and 27**). The ground floor chamber is reached via an irregular-shaped lobby leading to an inner lobby with garderobe, an original splayed embrasure to the south and a pointed barrel vault. This



room leads to the main pentagonal chamber with an acutely pointed vault with foliate carved boss and square ribs springing from corbels with flattened stiff-leaf carving (three surviving). The room has four pointed embrasures, each slightly different and originally stepped up with high sills and plunging loops. That to the west is now blocked and that to the north fitted with a window, its sill hacked away. The rough earth floor was formerly paved with bricks – in 1663-4 a bricklayer was paid for mending the brick paving (TNA WORK 5/4) – and surviving beam holes in the upper levels of the wall demonstrate the degrees to which the space has been subdivided, though the exact arrangement and dates of this work are unclear.

- 5.3.2 The lower chamber was used as a prison and has a sturdy 16<sup>th</sup>- or 17<sup>th</sup>-century prison door and was described as a 'prison' as late as 1687 when a mason was employed to repair its stonework (TNA WORK 5/41). Sir Thomas More and Bishop John Fisher were imprisoned at the Tower of London in 1535. Both men were canonised in 1935 and thus the places of their imprisonment and martyrdom have great resonance for the Catholic faith. Fisher, it seems certain, was kept in the upper chamber of the Bell Tower, though the place of More's imprisonment has never been proven. There is good reason to believe that his cell was the lower chamber of the Bell Tower; his close association with Fisher makes confinement in the same building likely and his son-in-law described More watching prisoners being led out of the Tower to their execution on Tower Hill from a window in his cell, something arguably uniquely possible from the Bell Tower with its direct views to the Tower gates and to Tower Hill.

## 5.4 Upper Chamber of the Bell Tower

### *Porch*

- 5.4.1 On the floor above, the Bell Tower is entered through a porch built c.1904 at the southern end of the wall walk to the north (**Figures 13 and 21; Plates S, V and 1**). The quoins of the porch are constructed of blocks of Lincolnshire Limestone (mainly Ketton Stone with some Clipsham Stone; **Figure 21**). The walls are constructed of Kentish Ragstone rubble stone arranged in a 'crazy-paving' style in Roman cement.
- 5.4.2 Comparison of the 1899 and 1904 proposed plans shows that the arrow loop in the west wall was inserted c.1904 in yellow Magnesian Limestone (**Figures 12 and 13; Plates Q and 1**). It was presumably inserted to help light the porch along with the glazing in the upper part of the door to the porch (**Plate 40**). The window was presumably added early on to keep the space warmer although it is not shown on the proposed drawings (**Figure 13; Plates 38 and 39**). The door is the original c.1904 door, although the multi-glazing panels have since been replaced with a single sheet of plate glass (compare **Figure 13** with **Plate 40**). The floor of the porch is in Yorkstone (**Plates 37 and 40**). The stone drain next to the arrow loop in the west wall if made from Dundry Limestone (**Plate 38**).

### ***Entrance Passage and Stair Vice***

- 5.4.3 The c.1904 porch now provides access through an original medieval doorway into an entrance passage with a stair vice in the turret to the east. The doorway has Caen and Reigate Stone jambs and a Purbeck Marble lintel (**Plate 37**). The passage has a Purbeck Limestone-flagged floor and walls of Reigate Stone ashlar (**Plates 41 and 55**). An inscription on the wall of the entrance passage by the stair vice is dated to the late 16<sup>th</sup> century and is thought to be by Thomas Meagh, when he was imprisoned here. It is the only prisoner inscription in the Bell Tower although the tower is well known as a prison (Spooner and Gillespie, 2011).
- 5.4.4 The walls of the stair vice are also mainly lined with Reigate Stone ashlar (**Plates 41 to 54**). Two Caen Stone ashlar blocks alternate with Reigate Stone in the east jamb of the entrance doorway (**Plate 41**). Parts of the stair vice walls are covered with a hard late post-medieval lime render (**Plates 45 to 47, 50 and 51**). A window opening blocked with reused Reigate Stone ashlar, post-Great Fire brick (1700-1900) and reused red brick with a Purbeck Marble stone lintel is visible on the east side of the stair (**Plate 42**).
- 5.4.5 Apart from the first step, which is made from Kentish Ragstone, the lower stone steps from the Upper Chamber level have been covered with timber (**Plates 41 to 44**) possibly in the 19<sup>th</sup> century when the original 12<sup>th</sup> century stone steps had become worn. The soffits of the higher Reigate Stone steps are visible from underneath (**Plates 52 to 54**). Later chalk and Kentish Ragstone infill perhaps to support the steps had been placed below some of the steps (**Plates 53 and 54**). At the top of the stairs, a door (**Plate 48**) leads to the roof of the Upper Chamber, which is covered with lead (**Plate 95**). The short walls on each side of the door are built of narrow post-Great Fire brick (1780-1900) as well as 19<sup>th</sup> century Yorkstone and are partially rendered (**Plates 48 and 49**). The occasional post-Great Fire brick and Tudor/Stuart red brick are also visible towards the top of the stair vice walls (**Plates 50 and 51**). The flat roof at the top of the stair vice is supported by a number of horizontal timber joists covered with timber boards (**Plates 50, 51 and 99**).
- 5.4.6 Dan Miles of the Oxford Dendrochronology Laboratory carried out some dendro-chronological dating of some ex-situ timbers during the conservation works. He understood that the timbers came from the joists supporting the flat timber roof boards shown in **Plates 50 and 51**. He emailed (27 Nov 2015) that 'the latest measured ring (LMR) date for the Bell Tower (stair) turret was 1750. There was no bark edge, so hard to say how much later this was actually felled, but there were other joists with earlier LMR dates so I would have thought it to be in the next 50 years? Just guessing, really need bark edge. Of course the joists might have been replacement in earlier brickwork, but at least we can say the stair tower roof was replaced after 1750'.

### ***Lobby***

- 5.4.7 The passage leads past the stair vice into a lobby entered via an open doorway marked by a Purbeck Marble lintel supported by a Reigate Stone corbel on the west side (**Plates 55 to 57**). A doorway on the east side of the lobby with a shallow curved Reigate Stone arch has been blocked with a mixture of reused Tudor/Stuart (16<sup>th</sup>/17<sup>th</sup> century) brickwork and post-Great Fire brickwork (1700 to 1900) (**Plate 59**). This opening is thought to have connected with an earlier Constable's House at first-floor level. In front (west) of the shallow arch over the blocked doorway is a pointed Gothic arch in Reigate Stone (**Plate 59**) and in front (west) of that is another Reigate Stone arch on a different alignment. The back (east side) of the latter has been packed out with Kentish Ragstone and chalk rubble in a soft brown gravel medieval mortar in the wedge shape between the two arches with the wider part of the wedge-shaped triangle to the south (**Plate 58**).
- 5.4.8 A doorway with a timber lintel in the west side of the lobby leads into the main chamber (**Plate 57**). This doorway appears to have been constructed at the same time that the surrounding narrow post-Great Fire and reused red brick (1780-1900) wall was built on this side of the main chamber. A straight joint between the Reigate Stone quoins supporting the skewed arch and the later post-medieval brickwork is visible in the south wall of the lobby (**Plate 56 and 58**). Another straight joint is visible between the Reigate Stone west jamb supporting the Purbeck Marble lintel over the north doorway into the lobby and the post-Great Fire (1780-1900) brickwork (**Plate 57**).

### ***Garderobe Passage***

- 5.4.9 A doorway with an early 20<sup>th</sup> century timber two panel door in the south side of the lobby with Reigate Stone jambs and Purbeck Marble lintel leads into the garderobe passage (**Plates 56, 60 and 61**), which runs south with Kentish Ragstone rubble lined walls. By the doorway, the floor is covered with Portland Stone, whereas along the passage it is laid with large (230x230x30mm) unglazed Flemish clay tiles (1600-1800). The passage leads to a toilet with a north-south barrel-vaulted ceiling constructed of Kentish Ragstone rubble in a medieval brown gravel mortar (**Plates 62 and 63**).
- 5.4.10 The east window in the toilet has a curved arch in front of a flat lintel (**Plate 64**). Historic photographs show that it was inserted in the late 19<sup>th</sup> century (compare **Plates A to E** with **H to K**). Another window lights the garderobe passage (**Plates 61 and 65**). Its sill is constructed of narrow post-Great Fire brick (1780-1900). The ceiling of the garderobe passage is constructed of large flat stones supported by Purbeck Marble corbels (**Plates 56, 60 to 62**).

### **Main Chamber**

- 5.4.11 In 1934 amid discussions about opening the Upper Bell Tower to visitors, proposals were drawn up to alter the space. The brick partitions and infills, including the fireplace hood, were to be removed and the limewash was to be scraped off of the walls to reveal the stonework (TNA WORK 14/976). Although the removal of the brickwork never happened because the plans to open the space fell through, it is clear that limewash has been stripped from the surfaces and this may have happened at about this date (compare **Plates M to P** with **Plates 66 to 90**). The scheme of work also proposed removing the modern toilet from the garderobe in the upper chamber; a proposal that puts pay to the idea that it had been installed in preparation for Hitler's imprisonment in the event of his capture.
- 5.4.12 The main first-floor chamber is roughly circular in plan with moulded Reigate Stone rere-arches (arch that supports the inner face of a wall above a door or window opening) to windows, the mouldings of which form a continuous string course around the northern, western and southern parts of the room (**Plates 66, 70, 74 and 81**). This perhaps suggests that the eastern side of the chamber has been reworked with the addition of the chimney breast and the infilling post-Great Fire brickwork round the entrance doorway to the chamber.
- 5.4.13 The masonry of the walls of the chamber is extremely fragile and in places equally fragile fragments of historic render and medieval sandy gravel mortar survive. A mortar sample (M1) of the latter was removed for thin-section analysis. Photographs of the interior taken in the late 19<sup>th</sup> and early 20<sup>th</sup> century show that the walls were whitewashed at this time (**Plates M to P**) and some of this white covering still remains (**Plates 66 to 90**).
- 5.4.14 The windows are set in deep embrasures, the extant openings appear to be of 19<sup>th</sup>-century construction and contain 19<sup>th</sup>-century timber casement windows. The brickwork surrounding the window openings consists of narrow post-Great Fire bricks dating to 1780-1900. The same arrangement of windows is shown in photographs taken of the Bell Tower in the late 19<sup>th</sup> and early 20<sup>th</sup> century (**Plates L, Q, S, T and X**). Paired stone arches in Kentish Ragstone are visible above Windows 1 to 3 in the external elevations suggesting that the windows originally had two-lights (**Figures 14 to 17; Plates Q, T and X**).
- 5.4.15 A large timber door with long iron hinges and latch opens into the main chamber (**Plates 66 and 67**). It sits within a timber doorframe in the infill wall, which is covered with whitewash. Above the door lintel, a brick relieving segmental arch is just visible on both the east and west sides of the wall. The arch appears to be constructed of a course of alternate soldier bricks and two bricks on edge. The narrow post-Great Fire bricks in the arch date to 1780-1900. Under the whitewash, the wall appears to have been mainly constructed of a variety of materials including reused early post-medieval brick (1450-1700), post-Great Fire brick (1664-1900) with some reused Reigate Stone, Caen Stone

and Kentish Ragstone ashlar. Above, the upper nine courses of brickwork are constructed in post-Great Fire bricks (1780-1900) and are associated with the raising of the roof.

- 5.4.16 The lower part of the fireplace in the east wall is thought to be 14<sup>th</sup> century in date and is built of large ashlar blocks in Reigate Stone (**Plates 68 and 69**). Its original hood has been replaced with a taller head in brickwork with a segmental arch of a single course of brick-on-edge. The narrow post-Great Fire bricks used in the brickwork are 1780-1900 in date. The raising of the arch over the fireplace may have been to take a range in the 19<sup>th</sup> century, presumably the structure shown in the early 20th century photograph (**Plate P**). This structure, presumably a range/oven, appears to have a water tap on top in the photograph perhaps for a copper. The range/oven appears to have gone out of use in the early 20<sup>th</sup> century when first the chimney pot is removed from its chimney stack (compare **Plates E, H, I** with **Plate J**) and by June 1924 the chimney stack had been lowered to parapet height as it is today (**Plate R**).
- 5.4.17 A metal flue is shown in the early 20th century photograph in front of the fireplace leading from a metal box on a metal frame up into the wall (and chimney flue) above the fireplace. The box and lower part of the flue appear to have been heated. Behind the fireplace, the brick-lined flue is constructed in red early post-medieval bricks in fabric 3033, which date to 1450-1700. This is probably the chimney recorded as being cut into the wall by the bricklayer William Browne in 1609-10 (TNA E 351/3244).
- 5.4.18 A large Portland Stone sits within the sloping hood immediately above the arch. This stone type was used in London from the mid 17<sup>th</sup> century.
- 5.4.19 The wall above the fireplace and to the south is constructed of Kentish Ragstone with a vertical line of Reigate Stone quoins in a medieval-type calf brown gravel mortar at the change in angle just to the south of the fireplace (**Plates 68 and 69**). This line of stones is extant *in situ* medieval fabric. An amalgam of broken up post-Great Fire bricks, red Tudor/Stuart bricks, Reigate Stone, Caen Stone and Kentish Ragstone blocks have been used in two areas of repair in the wall immediately above the fireplace hood. These repairs were probably carried out in the 19<sup>th</sup> century and are visible in the early 20<sup>th</sup> century photograph under the whitewash (**Plate P**).
- 5.4.20 A marked constructional change is visible slightly above the top of the stone quoins, where the stone wall has been raised with about nine courses of brickwork in narrow post-Great Fire bricks (1780-1900) bonded in a hard light grey Portland type cement. This band of brickwork is visible all around the room and is associated with a presumably 19<sup>th</sup> century rebuild of the original domed roof (**Plate 95**). In the north-east corner of the room this band of brickwork is supported by a large timber ring beam thought to have supported the original roof (**Plates 66 and 67**). Some 1m to 1.5m beneath the timber ring beam, in this far corner, a crisply dressed Yorkstone lintel supports a brick supporting arch consisting of a further 11 courses of whitewashed later post-medieval brick (1780-

1900). The Yorkstone and brickwork may have been inserted to strengthen possible structural weakness here, or may relate to the 19<sup>th</sup> century renovations or changes to the door entrance. The late 19<sup>th</sup>/early 20<sup>th</sup> century photographs show a timber or metal beam running east-west across the room embedded in the brickwork just above the height of the stone wall above the south side of the fireplace and above the rerearch to Window opening 2 (**Plates O and P**).

5.4.21 The section of wall to the south of the vertical line of quoins is constructed of Kentish Ragstone. The mortar is lighter brown to the sides and a deeper calf brown towards the centre. The mortar is medieval and the colour change may be connected with the drainpipe shown in the early 20<sup>th</sup> century photographs (**Plates N and O**).

5.4.22 A stone pointed Gothic arch leads into a short passage that has been blocked with Kentish Ragstone (**Figure 27; Plates 70 to 72**). The Gothic arch has Reigate ashlar surrounds with segmental blocks of Kentish Ragstone higher up. A window has been inserted at an angle into the east side of the passage. The window has a post-medieval ceramic peg tile sill (1480-1900) and post-Great Fire brickwork (1700-1900) is visible below the sill and around the sides of the window. The short passage has a barrel vaulted ceiling in Kentish Ragstone, pointed in a medieval gravel mortar, a feature similar to that over the toilet (**Plates 63, 71 and 73**).

5.4.23 The stone pointed Gothic rerearch to Window 1 is slightly wider than that to the short passage with the canted window (**Figure 27; Plate 70**). This arch again has Reigate ashlar surrounds with segmental blocks of Kentish Ragstone higher up. The embrasure is marked on the south side by a vertical step/straight joint in the Kentish Ragstone rubble and Reigate stonework, which is also visible over the head of the window (**Plates 75 and 76**). On the north side this change in angle is marked by a short passage or niche (**Plates 78 to 80**). The north end of the passage has been blocked with early post-medieval red brickwork in fabric 3033 (1450-1700) with timber battens in amongst the courses perhaps to take shelves (**Plates 79 and 80**). The niche has a chalk ashlar barrel vaulted ceiling (**Plates 77 to 79**). Its floor is covered with Purbeck Limestone flagstones like the rest of the Upper Chamber (**Plates 78 and 80**).

5.4.24 A curious square Reigate Stone masonry feature is just visible in the Kentish Ragstone wall opposite the fireplace in the Upper Chamber and between the Gothic rere-arches to windows 1 and 2 and below the brickwork of the raised ceiling. The feature has been infilled with four courses of early post-medieval post-Great Fire red brick in a light-grey gravel mortar, which was just visible beneath the whitewash.

5.4.25 The nine courses of 19<sup>th</sup> century brickwork at the top of the chamber were inspected in detail above the rere-arches to windows 1 and 2. Here the stone walls were round in plan whereas the brick courses above were more polygonal in plan. The first course of bricks above the stone wall forms a slight step with the brickwork above set back.

5.4.26 The stone pointed Gothic rere-arch to Window 2 is the same width as that to Window 1

(**Figure 27; Plate 74 and 81**). This arch again has Reigate ashlar surrounds with segmental blocks of Kentish Ragstone higher up. The south side of its embrasure is covered with render and appears to be constructed mainly of Kentish Ragstone and blocks of Reigate Stone (**Plates 81 and 82**). The brick blocking of the opening through from the north side of the embrasure of Window 1 is visible although it is mostly covered with render. The bricks in the blocking are the same early post-medieval red brickwork in fabric 3033 (1450-1700).

5.4.27 Brickwork using narrow post-Great Fire bricks (1780-1900) is visible at low level along the north side of the Window 2 embrasure and below the sill of the Window 2 (**Plate 74**). The same bricks have been used to construct a low step, possibly a seat, along the north side of the embrasure (**Plate 83**). Above, the wall is covered with render and appears to be constructed in stone.

5.4.28 The stone pointed Gothic rere-arch to Window 3 is the widest arch in the main chamber (**Figure 27; Plates 84 and 85**). This arch again has Reigate ashlar surrounds with segmental blocks of Kentish Ragstone higher up. The embrasure has a large niche in its western side and another in its eastern side (**Figure 27; Plates 86 to 89**). The walls of the west niche are partially covered with render and are constructed of Ragstone rubble with some brickwork at low level to the sides and end wall. This brickwork is formed of narrow post-Great Fire bricks (1780-1900). Above, the niche has a chalk and Reigate Stone ashlar barrel vaulted ceiling (**Plate 88**). Brickwork (narrow post-Great Fire brick (1780-1900)) in the north wall of the niche continues under the sill of Window 3 (**Plates 84 to 87**). Some Reigate Stone ashlar blocks in the general area of Window 3 may have formed part of the original medieval window, which is visible as a pair of window heads in the external elevation (Elevation A; **Figure 15; Plates Q and 1**). The walls of the east niche are partially covered with render and are constructed of Kentish Ragstone and chalk rubble with some brickwork (**Plate 89**). Above, the niche has a Reigate Stone ashlar barrel vaulted ceiling. Brickwork is visible at low level in the south wall of the east niche which continues around the walls into the main chamber (**Plates 84, 85 and 90**). This brickwork is mainly constructed of post-Great Fire bricks (1780-1900), however the lowest three courses are constructed in red brick in fabric 3033 (1450-1700).

5.4.29 An inserted 14<sup>th</sup>-century square headed cupboard in the north wall has a Purbeck Marble lintel with a chase for a shelf (**Plate 90**). Above a Kentish Ragstone pointed relieving arch is visible. Reigate Stone and chalk ashlar fill the space between the cupboard and the arch. The arch and the infill are butted by the post-medieval wall constructed of reused early post-medieval red brick (1450-1700), post-Great Fire brick (1664-1900) with some reused Reigate, Caen and Kentish Ragstone ashlar on its east side. The wall below the cupboard is constructed of Kentish Ragstone in a medieval brown gravel mortar.

5.4.30 The floor is covered with heavily worn Purbeck Limestone flags and occasional

replacement pavers in Yorkstone supported by the vault below (**Plates 91 to 94**).

## **5.5 Roof of the Bell Tower**

- 5.5.1 The roof above is leaded, as it has been since at least the 16<sup>th</sup>-century, and rises to a conical over the domed ceiling below (**Plate 95**). Repairs to the roof leads are the most frequently occurring payment in the extant building accounts. The earliest surviving reference to such work is found in the accounts for the year 1585-86 (TNA E 351/3220). To the south-west there is a 17<sup>th</sup>-century timber bellcote with a concave lead roof topped by an orb containing the Tower's curfew bell (**Plate 7**). The bell bears the inscription 'W.B. 1651' and was probably cast in that year for the Tower of London. Though the construction of the bellcote is not recorded in the extant building accounts it must pre-date December 1662, when a carpenter was employed to mend the boarding on one side of the 'bell house', and may, therefore, be contemporary with 1651 casting date of the bell itself (TNA WORK 5/3). A further payment was made in 1669-70 to a carpenter for replacing the bell wheel (TNA WORK 5/13).

## **5.6 External Elevations of the Staircase Turret**

- 5.6.1 Proposed drawings dated 1899 (**Figure 12**; HRP Plans Archive, TOL-EH-766) show a new scheme for the upper part of the stair turret and a timber porch providing access into the Queens House and Bell Tower from the wall walk to the north. Both schemes were never carried out instead a new stone porch was added in accordance with plans dated 1904 (**Figure 13**; HRP Plans Archive, TOL-EH-772).
- 5.6.2 The more visible north elevation of the stair turret is constructed from a variety of reused rubble stone, fragments of brick and tile with fresh ashlar quoins with some twenty or so courses of brick at the top of the wall finishing with a coping course of brick-on-edge (**Figure 22**; **Plate 96**). The rubble stone consists mainly of Kentish Ragstone in a medieval/Tudor fine brown mortar, particularly towards the base. Replacement Sarsen, basalt cobbles, flint and Purbeck Limestone amongst the rubble shows that the wall was repaired in the 19<sup>th</sup> century. At least three groups of possibly reused early post-medieval red bricks (1450-1700) were visible in this elevation and were mainly replaced during the conservation works. When these bricks were removed during the works voids in the wall behind were observed.
- 5.6.3 The window dressing and most of the quoins in the north elevation of the stair turret are in post-medieval Portland Stone. The three lower quoin stones on the west side of the elevation are all worn Chilmark Stone. The stones are not visible in the early 20<sup>th</sup> century photograph taken after c.1904 (**Plate L**) and are present in a photograph taken on 13<sup>th</sup> June 1924 (**Plate Q**). Chilmark Stone was also used for the string course at the base of the parapet and for the upper quoin stones between the main elevations of the Bell Tower (**Figure 14**). The work in Chilmark Stone appears to have been carried out c.1924 when the roughcast/pebbledash render was removed from the elevations of the Bell



Tower and the brick parapet was replaced in stone. This work may have been carried out just before the photographs taken in June and July 1924 (**Plates Q to U**).

5.6.4 The upper twelve courses of brickwork in the north elevation of the stair turret are constructed in large well-made post-Great Fire late 19<sup>th</sup> century bricks in English Bond. These are in the same hard brown gravel cement used in large sections of the upper part of the adjacent Inner Curtain Wall/south elevation of the Queen's House and in the other elevations of the stair turret. The bricks and mortar are likely to date between 1850 and 1900 and are likely to belong to one phase of renovation.

5.6.5 The west elevation is mainly constructed of well-made post-Great Fire brick (1850-1900) with some yellow Medway brick (1780-1940) in English bond in the same brown gravel mortar used in large sections of the upper part of the adjacent Inner Curtain Wall/south elevation of the Queen's House and in the other elevations of the stair turret (**Figure 24; Plate 97**). Three post-medieval Portland Stone quoins sit above three c.1924 Chilmark Stone quoins on the north side of the elevation. Other stone used in this elevation include reused Reigate and Quarr stone ashlar.

5.6.6 The south elevation is almost entirely constructed of well-made post-Great Fire brick (1850-1900) in hard brown gravel mortar in Flemish bond. The doorway from the stair to the roof has queen closers down its west side and a brick-on-edge head (**Figure 24; Plate 98**). The coping of the wall is also constructed of brick-on-edge (**Plates 98 and 99**). The upper part of the chimneystack to the south of the stair turret is mainly constructed of 19<sup>th</sup> century post-Great Fire brick (1850-1900); however at lower level relict poorly made shallow Tudor/Stuart brickwork (1450-1700) is visible (**Figure 24; Plates 98 and 100**).

5.6.7 The east elevation of the stairwell turret is similar to its north elevation with a substantial rubble masonry section capped with late 19<sup>th</sup> century brickwork (**Figure 23; Plate 101**). Furthermore, the same stone types are used in its rubble core (Kentish Ragstone, basalt, flint, granite, Purbeck Limestone and sarsen). The quoins at the north side of the elevation are in Portland Stone. The lowest ten courses of the chimneystack's east elevation are constructed in Tudor/Stuart brickwork (1450-1700) with late post-medieval post-Great Fire bricks above like its south elevation. The terracotta chimney top is stamped *Patent Stevens Exhaust*.

5.6.8 Two or three courses down from the top of the parapet around the staircase turret on the internal side one to two courses of Tudor/Stuart red brickwork (1450-1700) are visible (**Figure 25; Plate 99**). The brickwork above is constructed in post-Great Fire brick (1850-1900).

## 5.7 Bell Tower parapet

5.7.1 Nearly all of the brickwork on the internal side of the Bell Tower parapet is of mid to late 19<sup>th</sup> century post-Great Fire brick (1850-1900) in the same brown gravel mortar as that used in the chimney stack and in the upper courses of the Inner curtain wall (**Figure 25**).

This includes the drain in the southern elevation (**Figure 25**). Late 19<sup>th</sup> and early 20<sup>th</sup> century photographs show that the parapet was entirely constructed in brick (**Plates A to E and H to L**) until c.1924 when the external brickwork was replaced with Kentish Ragstone in a 'crazy-paving' pattern (**Plates Q to X**).

## **5.8 Inner Curtain Wall**

### ***Introduction***

- 5.8.1 The Bell Tower and the adjacent Inner Curtain Wall along Water Lane are amongst the oldest surviving structures of the Tower of London, with only the White Tower constructed from the 1070s to c.1100 pre-dating them. The Bell Tower is thought to have been built c.1190-1200 on stylistic grounds. The adjacent Inner Curtain Wall along Water Lane was constructed at the same time since excavation of the viewing pit in 1928 at the Corner of the Bell Tower and the Inner Curtain Wall showed that both have the same style of foundations. They are therefore believed to have formed part of the William Longchamp scheme of building under Richard I, at a time when the River Thames was flush against the Inner Ward.
- 5.8.2 A 25 metre length of the Inner Curtain Wall was recorded from the Bell Tower to the east (**Figures 29 to 33**). Only the southern side of the Inner Curtain Wall was recorded because the lower part forms a retaining wall while the upper part forms the rear (south) wall of the Queen's House. The wall retains the higher ground of the Inner Ward to the north from the lower ground between the Inner and Outer Ward (Water Lane) to the south. Like the Bell Tower, the lower part of the Inner Curtain Wall is constructed of ashlar with rubble above and above that the wall is built of brick (**Plate 8**).
- 5.8.3 Historic building recording of the entire length of the Inner Curtain Wall between the Bell Tower and the Bloody Tower was carried out by Oxford Archaeology in 2003 as part of a wider programme of repointing and restoration works (Gill 2003). This has greatly enhanced our understanding of its construction. Analysis of the bedding mortar, breaks in construction and changes in the shape and size of the stone masonry showed how many times the wall was raised in height, refaced, repaired and rebuilt with at least two thirds of the original late 12<sup>th</sup> century masonry structure still intact. These periods of build, summarised on photogrammetric plans by lettering provided a useful guide for this current survey, which has added to the previous study with the petrological identification of the stone ashlar and rubble masonry. The current study has also dated and identified the brick fabrics of the brickwork which forms the upper part of the wall and the southern elevation of the Queens House and No.7 Tower Green.

### ***Ashlar plinth in the viewing pit***

- 5.8.4 Archaeological excavation of the viewing pit at the south-east corner of the Bell Tower

and adjacent Inner Curtain Wall carried out in 1928 showed that the bases of both walls have the same construction and were built at the same time (**Plate 29**). The bases (plinth and lower off set foundations) of both walls have been buried and this has ensured the preservation of medieval fabric here. The plinths of both walls are constructed of ashlar blocks of Reigate Stone topped with a string course of Sussex or Petworth Marble (Lower Cretaceous West Sussex/Kent) (**Figures 20, 29 and 30**) rather than Purbeck Marble (Lower Cretaceous Isle of Purbeck) (Gill 2003, 5). These marbles or winklestones can be distinguished by the presence of the larger species of freshwater snail, *Paludina sussexeinsis* in Sussex Marble in contrast to the smaller *Paludina carinifera* in Purbeck Marble. The plinth consists of nine courses of Reigate Stone ashlar topped with a Sussex Marble string course. Below the foundations comprise seven offset courses of Reigate Stone ashlar with a further two string courses of Sussex Marble. One of the ashlar blocks of Reigate Stone was sampled for thin-section analysis (S3; **Figure 30; Plate 103**).

- 5.8.5 The Sussex Marble course at the top of the plinth observed in the viewing pit reappears some 20 metres to the east at the base of the Inner Curtain Wall below an emerging course of large rectangular ashlar blocks of relict medieval Kentish Ragstone *sensu stricto* (**Figures 29 and 31; Plate 30**). An intermittent line of medieval peg tiles in fabric 2271 (1180-1450) is also visible at the same level as the Sussex Marble plinth coping. The same Sussex Marble plinth coping and seven offsets was also observed in 1958 during the excavation of a trench against the south-west jamb of the Bloody Tower (Gill, 2003, 4).
- 5.8.6 Light brown sandy gravel mortar (Type A) was observed both in the primary fabric of the plinths of the Bell Tower and the Inner Curtain Wall

#### **Ashlar base**

##### *Medieval Ashlar*

- 5.8.7 Detailed hand specimen petrological analysis of this 25 metre stretch of the Inner Curtain Wall has identified very little extant medieval ashlar still surviving in its construction. The usual repertoire of medieval freestone materials for London (Reigate Stone, Caen Stone, Taynton Stone, Purbeck Marble, well-dressed Kentish Ragstone) are poorly represented in the ashlar, and those that are found are usually in a broken-up or highly degraded state. Instead the great variety of stone types identified (29 in all) point to major phases of later post-medieval restoration.
- 5.8.8 A patch of *in situ* medieval Kentish Ragstone ashlar is visible above a large block of post-medieval replacement Ancaster freestone at the base of the eastern recorded section of Inner Curtain Wall (**Figures 29 and 31**). A number of Kentish Ragstone medieval ashlar blocks are also visible above the viewing pit at the west end of the recorded section of wall (**Figures 29 and 30**). An ashlar block of Bembridge Limestone

lies immediately above the Sussex Marble plinth coping in the viewing pit. This stone type is also present in Norman builds in the White Tower (Worssam and Sanderson 1998).

- 5.8.9 It is likely that some of the highly corroded ashlar blocks of orange Taynton Stone in the western part of the recorded section of inner Curtain Wall comes from the original Inner Curtain Wall or has been reused from the Bell Tower (**Figures 29 and 30**).

#### *Post-medieval ashlar replacement*

- 5.8.10 Most of the medieval ashlar, such as Kentish Ragstone and Reigate Stone, at the base of the Inner Curtain Wall has been replaced due to its poor weathering as a result of its geochemically unstable nature. The base of the recorded Inner Curtain Wall has seen wholesale late post-medieval stone replacement (**Figures 29, 30 and 31; Plate 8**).
- 5.8.11 Large (up to 1 metre) blocks of often crisply dressed Magnesian Limestone, a dolomitic limestone from the Permian rocks of Nottinghamshire and Yorkshire have been used as replacement ashlar at the base of the western side of the recorded Inner Curtain Wall up to a height of 7 metres above ground surface (**Figures 29 and 30**). Samples S4 and S5 were taken for thin-section analysis (**Figure 30; Plates 105 and 106**). This was the main stone type used for the construction of the House of Parliament 1839-1852 (Lott and Richardson 1997). It was also used at the Tower of London in the upgrading of the Devereux Tower in the late 19<sup>th</sup> century (Palmer and Shaffrey 2011, 14) and as a replacement ashlar in the adjoining Bell Tower in the 19<sup>th</sup> century.
- 5.8.12 Other later post-medieval replacement ashlar, atypical of medieval construction, from this now Magnesian Limestone part of the Inner Curtain Wall include Chilmark Stone, Ketton Stone and Portland Stone. These stone types were also used in the 19<sup>th</sup> and early 20<sup>th</sup> centuries as replacement material in the Bell Tower. A rather unusual, even exotic, repertoire of stone types is visible at about 6 metres above ground surface between the two western ground floor windows. These include rounded Carboniferous Sandstones, Sarsens, and Basalts even an interglacial raised beach deposit, most of which may be have once been cobblestones.
- 5.8.13 The Magnesian Limestone ashlar in the Inner Curtain Wall and the rubblestone adjacent to the Bell Tower has been decorated with fragments of black knapped flint (**Plate 35**). This decoration is known as galleting and is also visible in the north elevation (Elevation A) of the Bell Tower, again in association with 19<sup>th</sup> century replacement Magnesian Limestone (**Figure 15**). The Magnesian Limestone ashlar in the Inner Curtain Wall is visible in photographs taken in the 19<sup>th</sup> and early 20<sup>th</sup> centuries indicating that it was in place before say the 1860s when perhaps the earliest photographs were taken (**Plates E, H to K, R and W**).
- 5.8.14 The ashlar in the eastern part of the recorded Inner Curtain Wall up to a height of 3m above ground surface is comprised of a unique type of Lincolnshire Limestone, not

evident anywhere else in the Tower or at least not used on this scale. Ancaster Freestone is a fine grained, fawn brown soft sparry shelly oolitic limestone from the Bajocian (Middle Jurassic) of southern and central Lincolnshire (**Figures 29 and 31**). It is porous and its susceptibility to weathering is shown by large chunks flaking off and discolouring dark brown along narrow linear bands (**Plate 36**). One sample (S6) was removed for thin-section analysis (**Figure 31; Plate 110**). This area of stone replacement lacks the galletting of the western area of stone replacement and is clearly a separate post-medieval event (compare **Figures 30 and 31**). The introduction of the canals and railways in the late 18<sup>th</sup> and 19<sup>th</sup> centuries, respectively, made it economically viable to transport large quantities of Permian (Magnesian Limestone) and Jurassic freestones (Ancaster Stone; Ketton Stone) from the East Midlands and Yorkshire to London. In amongst the Ancaster Freestone are a number of blocks of harder Box/Bath Limestone from the Middle Jurassic of the South Cotswolds and Magnesian Limestone indicating the unsuitability of Ancaster Freestone at the Tower.

### ***Rubblestone***

- 5.8.15 Primary medieval rubble stone is far more apparent than primary ashlar in the Inner Curtain Wall. For example, small angular blocks of hard Kentish Ragstone occurs immediately above the Ancaster Freestone ashlar in the eastern part of the recorded section of the Inner Curtain Wall from about 3m to 4m above ground surface (**Figures 29 and 31**). This area roughly equate with Context J (**Figure 31**; Gill, 2003, figs 7 and 12). This hard sandy limestone constitutes over 95% of the original stone and is present in a similar proportion in the rubble walling of the Bell Tower.
- 5.8.16 Gill (2003, figs 7 and 12) recognised individual medieval construction lifts by changes in the size and shape of the stone and labeled them contexts H to J. These construction lifts could not be defined so easily by stone type. Basal lift J contains fewer Purbeck Limestone fragments than the overlying lift I, while the uppermost lift H has none at all (**Figures 29 and 31**). The construction break at about 7 metres above ground surface at the top of construction lift H (Gill, 2003, figs 7 and 12) possibly represents the top of the medieval wall as seen in Haiward and Gascoyne's 1597 birds eye view (**Figure 4**).

### ***Window jambs and sills***

- 5.8.17 The three small first floor windows to the east of the large window with a balcony have sills in the recorded part of the Inner Curtain Wall have sills of Bargate Stone, Ketton Stone and Portland Whit Bed, which are all common post-medieval stone types (**Figures 29 and 31**). All three windows are illustrated in Anthony Salvin's c.1860 drawing of the south elevation of the Bell Tower and Queen's House (**Figure 8**). Salvin's drawing also shows cement render? or ashlar? down the jambs of the large window with a balcony

and the window below. This work shown in 19<sup>th</sup> and early 20<sup>th</sup> century photographs (**Plates E, H, I and R**), although it is no longer extant today (**Figures 29, 30 and 32; Plates 8 and 9**).

- 5.8.18 The easternmost small ground floor window in the recorded section of the Inner Curtain Wall appears to have been inserted after Anthony Salvin's c.1860 drawing of the south elevation of the Bell Tower and Queen's House (compare **Figures 8 and 29**). It is clearly visible in photographs taken c.1900 (**Plates H and I**) surrounded by roughcast/pebbledash render. It was therefore probably inserted in the late 19<sup>th</sup> century. Its sill, jambs and lintel are constructed of Magnesian Limestone and Portland Stone.

#### ***Tudor/Stuart Brick***

- 5.8.19 Two clusters of relict red Tudor/Stuart brickwork of 16<sup>th</sup> and 17<sup>th</sup> century (1450-1700) date are visible in the recorded part of the Inner Curtain Wall (**Figures 29, 32 and 33**). The westernmost group occurs at about 10 metres above ground surface level close to the Bell Tower (**Figures 29 and 32**). These thin poorly made bricks are in fine sandy fabric 3033. They are roughly in the same position as the hidden stone splay, which was uncovered during the 2003 conservation work (Gill, 2003, 7-8, figs 4, 12 and 13). The stone splay was uncovered when five loose bricks were removed. High quality brickwork moulded to the angle of the splay and fine internal plaster were observed. This has been interpreted as an angled projecting structure forming part of a first floor walkway linking the Queen's House to a double-gabled building (now removed) to the east of the Byward Tower. The double-gabled building and link are shown on Haiward and Gascoyne's Survey of 1597 (**Figure 4**).
- 5.8.20 The other cluster of relict red Tudor/Stuart brickwork of 16<sup>th</sup> and 17<sup>th</sup> century date lies at about 11 metres above ground surface at first floor level in the eastern part of the recorded Inner Curtain Wall (**Figures 29 and 33**). This brickwork forms the south elevation of No.7 Tower Green, which is thought to have been constructed in the mid-17<sup>th</sup> century.

#### ***Late post-medieval brickwork***

- 5.8.21 The upper 4 metres of the south elevation of the Queen's House/Inner Curtain Wall is constructed of brickwork in Flemish bond. The same brickwork surrounds two of the larger ground and first floor windows in the stone part of this wall. Hand specimen analysis show that the bricks are purple-brown post-Great Fire bricks (1664-1900) in fabric 3032. On their side, the bricks are quite narrow (98-103mm), conforming in size to government brick tax legislation brought in during the mid-1770s. Coping stones along the top of the wall were lifted during the conservation work exposing the uppermost bricks, which were seen to have a relatively deep frog. This feature was first introduced about 1750, although it only became common after 1850. The bricks are bonded in a light brown hard gravel mortar similar to that used in the brickwork of the staircase turret

chimneystack and parapet of the Bell Tower. The bricks most likely date from 1850 to 1900 and suggest a major phase of renovation was carried out at this time. Anthony Salvin may have been carried out the renovations possibly in accordance with his c.1860 drawing of the south elevation of the Bell Tower and the Inner Curtain Wall. This drawing shows stone jambs to the larger ground and first floor windows. These are visible in the 19<sup>th</sup> century photograph (**Plate E**) taken by J. Davis Burton who was taking photographs in the 1860s. They are also visible in the c.1900 photographs (**Plates H and I**). They may have been removed in the 20<sup>th</sup> century when the Virginia Creeper and roughcast/pebbledash render were removed. It is possible that the brickwork was added to the Bell Tower and Inner Curtain Wall at the same time that the stonework was covered in roughcast/pebbledash render.

## 6 CONCLUSION

- 6.1.1 Conservation works on the Bell Tower and adjacent Inner Curtain Wall permitted detailed analysis of their historic fabric. A total of 48 stone types and 10 types of ceramic building material (including Roman, medieval and Tudor/Stuart) were identified. Five types of mortar and render were also identified.
- 6.1.2 The Bell Tower has been attributed a build date on stylistic grounds of c.1190-1200, and thus, almost certainly, formed part of the strengthened outer defences of the castle built by Justiciar William Longchamp, Bishop of Ely, for Richard I, the Lionheart (Impey, 2008, pp142-3). The adjacent Inner Curtain Wall was built at the same time since its below ground foundations are identical to that of the Bell Tower as shown in the viewing pit excavated at the corner of the two structures in 1928. These below ground foundations were originally washed by the Thames and buried in the 13<sup>th</sup> century when the Outer Ward was constructed, which has ensured the preservation of medieval fabric here. The plinth and lower off set foundations of both walls are now exposed in the viewing pit. The former is constructed of ashlar blocks of Reigate Stone topped with a string course of Sussex Marble. This Sussex Marble string course reappears some 20 metres to the east at the base of the Inner Curtain Wall below an emerging course of large rectangular ashlar blocks of relict medieval Kentish Ragstone *sensu stricto*. The same Sussex Marble plinth coping and seven offsets was also observed in 1958 during the excavation of a trench against the south-west jamb of the Bloody Tower.
- 6.1.3 The base of the Bell Tower and adjacent Inner Curtain Wall is constructed of facing blocks of ashlar. Relict medieval Kentish Ragstone *sensu stricto*, green Reigate Stone ashlar and occasional orange Taynton Stone survive in some areas of the base although much has been replaced over the years. The exception is the sheltered Elevation A and an adjoining 2 metre section of Elevation B, where up to 95% of the primary medieval Reigate Stone has survived although heavily weathered. A number of putlog holes were also identified within the primary ashlar of Elevation A. The unstable geochemistry of Reigate Stone coupled with its high porosity has made it prone to deterioration and less has survived in the more exposed elevations (B-F) of the Bell Tower and Inner Curtain Wall. Here, the medieval ashlar has been mainly replaced with harder materials including, green Chilmark Stone, Ketton Stone, Magnesian Limestone and Ancaster Freestone and some poor quality green Kentish Ragstone. Ketton Stone and Ancaster Freestone are from the East Midlands, while Magnesian Limestone is from north-east England. The introduction of canals and railways in the late 18<sup>th</sup> century and mid 19<sup>th</sup> century, respectively, enabled these materials to be transported to London in bulk. Photographs of the Bell Tower and Inner Curtain Wall taken in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries show that much of this material was in place in the late 19<sup>th</sup> century.
- 6.1.4 Above the ashlar at the base of the Bell Tower and adjacent Inner Curtain Wall large areas of medieval Kentish Ragstone rubble walling is still intact in both structures. The



rubble was bonded in a medieval brown gravel mortar, which was also seen in the interior Upper Chamber. Two medieval Kentish Ragstone string courses survive in some of the Bell Tower elevations, although some have been removed entirely. In one elevation the lower string course is constructed of primary Reigate Stone. Photographs of the Bell Tower and Inner Curtain Wall taken in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries show that the rubble walling was covered with roughcast/pebbledash render in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries giving the appearance that the walls were entirely constructed with ashlar (**Plate H**). Vegetation, particularly Virginia Creeper, was encouraged to grow up the walls at this time further adding to the ashlar appearance of the walls. The roughcast/pebbledash render was removed from the walls of the Bell Tower after 1904 (**Plate L**) and before 13<sup>th</sup> June 1924 (**Plates Q to X**) and most likely c.1924 just before the 1924 dated photographs were taken. Photographs taken in 1924 still show the pebbledash render on the Inner Curtain Wall albeit covered almost totally with Virginia Creeper (**Plates R, U and W**).

- 6.1.5 The Bell Tower originally had five arrow loops at lower level in each of its main elevations. Four remain and a window replaced the northern one probably in the 19<sup>th</sup> century. Some medieval Caen Stone is present in two of its arrow loops, however most of the dressing stone had been replaced with a variety of post-medieval freestone material.
- 6.1.6 Traces of paired medieval windows are present in the upper part of three elevations of the Bell Tower in the form of window heads of tabular Kentish Ragstone blocks arranged in a fan shaped pattern. The Purbeck Limestone sill of a former window opening suggests that a window opening was blocked in the south-west elevation. All the windows at upper level in the Bell Tower were inserted. These have dressings in Magnesian Limestone, Portland Stone and Caen Stone. It is possible that all were inserted in the mid or late 19<sup>th</sup> century and the roughcast/pebbledash render was used to cover up the ghosts of the former medieval windows. Magnesian Limestone, Chilmark Stone, poor quality Kentish Ragstone, Portland Stone and Ketton Stone has been used to replace the quoin stones in the Bell Tower in the 19<sup>th</sup> and 20<sup>th</sup> centuries.
- 6.1.7 Relict Tudor/Stuart brickwork in the Inner Curtain Wall and the external elevations of the Bell Tower staircase turret suggest 16<sup>th</sup> or 17<sup>th</sup> century alterations to these structures.
- 6.1.8 The brickwork at the top of the Inner Curtain Wall is constructed of post-Great Fire bricks of 1780 to 1900 date. Late 19<sup>th</sup> century photographs of this wall show the brickwork already in place (**Plates A to E**). Anthony Salvin's drawing of the elevation c.1860 also shows the brickwork although it is not known if this is existing or proposed (**Figure 8**). Brickwork at the top of the elevations of the Bell Tower stair turret is constructed of post-Great Fire bricks of 1850 to 1900 date. The inner side of the Bell Tower parapet is also constructed in post-Great Fire bricks of 1850 to 1900 date. Late 19<sup>th</sup> and early 20<sup>th</sup> century photographs show the outer side of the Bell Tower parapet as constructed in

brickwork. This was replaced with Kentish Ragstone in 'crazy paving' style after 1904 (**Plate L**) and before 13<sup>th</sup> June 1924 (**Plates Q to X**) and most likely c.1924 at the same time that the roughcast/pebbledash render was removed. Anthony Salvin's drawing of the elevation c.1860 also shows the parapet although it is not known if this is existing or proposed (**Figure 8**).

- 6.1.9 The interior walls of the upper Bell Chamber are constructed mainly in medieval Kentish Ragstone rubble with Reigate Stone quoins. Moulded Reigate Stone is used for the rere-arches to the windows and Reigate Stone ashlar lines the walls to the stair vice.
- 6.1.10 The fireplace is thought to have been inserted in the 14<sup>th</sup> century. Behind the fireplace, the brick-lined flue is constructed in red early post-medieval bricks dating to 1450-1700. This is probably the chimney recorded as being cut into the wall by the bricklayer William Browne in 1609-10. The head of the fireplace is constructed of post-Great Fire bricks dating to 1780 to 1900. It appears to have been rebuilt and raised in order to take a range.
- 6.1.11 Blocking of a doorway into an earlier Constable's House at first-floor level from the lobby is constructed in post-Great Fire bricks dating to 1700 to 1900. Bricks of this date are also used around an inserted slanted window and to block the east window in the stair vice.
- 6.1.12 Post-Great Fire bricks dating to 1780 to 1900 were used around the doorway onto the Bell Tower roof, to create a partition wall between the main chamber and the lobby, around most of the windows in the upper main chamber as well as around the window that lights the garderobe passage. Bricks of this date were also used to raise the height of the ceiling in the main chamber. The purpose of these 19<sup>th</sup> century alterations appears to have been to create a kitchen in the main upper chamber of the Bell Tower. A porch was added to the entrance passage to the main chamber c.1904 complete with reused arrow loop in its west elevation to light the space.
- 6.1.13 The archaeological building recording work has established that the Bell Tower and adjacent Inner Curtain Wall were originally mainly constructed of Kentish Ragstone *sensu stricto* with some Reigate Stone and the occasional use of Taynton Stone, Sussex Marble and Caen Stone. Both structures had an ashlar base with rubble walling above. Relict Tudor/Stuart brickwork show that both were altered in the 16<sup>th</sup> and 17<sup>th</sup> centuries. By the late 19<sup>th</sup> century, alterations included the construction of brick parapets to both structures, the replacement of paired medieval windows in the upper part of the Bell Tower with rectangular windows with stone dressings and central keystones, the replacement of one arrow loop with a rectangular window, the insertion and/or rebuilding of quoins, the replacement of stone ashlar at the base of the walls, the replacement of stone ashlar in the dressings of the arrow loops, the addition of roughcast/pebbledash render to the rubble walling of both structures, the blocking of a doorway from the upper chamber to an earlier Constable's House, the construction of a partition wall to create a

lobby for the upper main chamber, the raising of the ceiling of the main chamber, the raising of the head of the fireplace to take a range, the blocking of a window in the stair vice and the introduction of new stone types. By c.1900 the small toilet window had been inserted into the Bell Tower and a similar small window had been inserted in the Inner Curtain Wall. A porch was added c.1904. By 13<sup>th</sup> June 1924, the roughcast/pebbledash render had been removed from the walls of the Bell Tower and its brick parapet had been rebuilt externally in Kentish Ragstone in a 'crazy paving' pattern. After 1924 the roughcast/pebbledash render and Virginia Creeper were removed from the adjacent Inner Curtain Wall.

- 6.1.14 These works suggest that the Bell Tower underwent considerable alteration in the 19<sup>th</sup> century perhaps to convert it to a kitchen. The walls of both the Bell Tower and Inner Curtain Wall also underwent considerable refurbishment at this time. These works demonstrate that 19<sup>th</sup> and early 20<sup>th</sup> century restoration principles were radically different to early 21<sup>st</sup> century conservation principles.
- 6.1.15 The results of this archaeological building recording work has considerably increased our understanding of the development of Bell Tower and Inner Curtain Wall and it is recommended that they are published in an article.

## **7 ACKNOWLEDGEMENTS**

- 7.1 Pre-Construct Archaeology Limited would like to thank Historic Royal Palaces for commissioning the historic building recording of the Bell Tower and adjacent Inner Curtain Wall. The help and assistance of Alex Attelsey, Alden Gregory and George Roberts at Historic Royal Palaces is gratefully acknowledged.
- 7.2 The historic building recording was managed for Pre-Construct Archaeology by Charlotte Matthews. The on-site recording and photographic survey was carried out by Kevin Hayward and Strephon Duckering, respectively. Kevin Hayward and Charlotte Matthews wrote this report and Mark Roughley prepared the illustrations.

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## APPENDIX 1: Stone and ceramic building material types in the Bell Tower and Inner Curtain Wall (Water Lane)

Thirty-eight stone types and ten ceramic building material fabrics were identified in the Bell Tower and recorded parts of the Inner Curtain Wall (Water Lane). Thin-section analysis was carried out on seven stone samples (S1 to S7) and two mortar samples (M1 and M2). One objective was to distinguish the similar looking Reigate Stone (primary medieval ashlar material) from the poor quality glauconitic Kentish Ragstone, a common 19<sup>th</sup> century replacement stone for the Tower (cf Develin Tower; Hayward & Garwood 2015). The location of the samples is shown on **Figures 15, 16, 30 and 31**. Photomicrographs of the thin sections, including some for comparison from earlier research (Hayward 2009; Hayward & Garwood 2015), have been shown here (**Plates 102 to 110**) as well as the thin-sectioned mortar (**Plates 111 and 112**). The stone types are described below and are presented in approximate order of frequency. The following elevation numbers have been used in this Appendix:

Elevation	Elevation	Figure No.
Elevation A	North Elevation of the Bell Tower	Figure 15
Elevation B	North-West Facing Elevation of the Bell Tower	Figure 16
Elevation C	West Elevation of the Bell Tower	Figure 17
Elevation D	South West Elevation of the Bell Tower	Figure 18
Elevation E	South Elevation of the Bell Tower	Figure 19
Elevation F	South-East Elevation of the Bell Tower	Figure 20

### Kentish Ragstone (2 Types)

The most common material type in the wall facing not only of the Bell Tower but also the Develin Tower (Hayward and Garwood 2015); Devereux Tower (Palmer and Shaffrey 2011) and the White Tower (Worssam and Tatton-Brown 2008) is Kentish Ragstone, a hard medium-grained calcareous sandstone quarried from the Lower Greensand (Hythe Beds) of Kent. Lithological variability, however, warranted further sub-division into two sub-types, each characteristic of a particular building phase in the history of the Bell Tower.

#### *Kentish Ragstone sensu stricto*

This hard compact light-grey variant containing no visible fossils is the type used extensively by the Romans for the construction of the city wall as well as the rubble-stone and rough-facing ashlar of the earliest masonry of the White Tower (Worssam and Tatton-Brown 2008). This lithotype also has no glauconite or coarse quartz but often contains black chert, enhancing further still the robustness of this building stone. Chert rich Kentish Ragstone was quarried from the uppermost part of the Hythe Formation from the Maidstone area, above a bed termed by quarryman as the Flint Lane (Worssam and Sanderson 1998). A thin section of this stone from the Outer Curtain Wall, adjacent to the Develin Tower, showed that it contained bolivinid foraminifera microfossils (Hayward and Garwood 2015).

It is the characteristic and dominant (95%) medieval stone type in the 11 metre (from 5 to 16 metres

above ground surface) high rubble walling of the external elevations of the Bell Tower, and is ubiquitous in the rubble core interior of the Upper Chamber. Its durability meant that in the main it was fashioned into small (5-25cm) very poorly dressed angular blocks. It was laid in the characteristic primary brown gravel sandy mortar (Type A, see **Appendix 2**). This is the consistent medieval mortar type used for the Bell Tower's original construction. It lacks the better worked sub-rectangular (*Petit Appareil* Masonry style) (Allen 2010) workmanship typical of the 14<sup>th</sup> century defences of the Develin Tower (Hayward and Garwood 2015) where the blocks were tightly wedged together, with little or no mortar, forming a near impenetrable barrier to external weathering. Nevertheless some better-worked small rectangular blocks formed string courses at 6 metres (elevations A and C only) and 9 metres (all elevations) of the Bell Tower. At 13 metres in elevations A to C, elongate blocks of tabular Kentish Ragstone, arranged in a fan-like manner delineated the upper part of two former original windows in each of these elevations. The interior chamber had the same arrangement surrounding the Reigate Stone pointed Gothic re-arches to Windows 1 to 3, and smaller Gothic Arch. Finally, the parapet of the Bell Tower was refaced c.1924 using just Kentish Ragstone in a 'crazy paving' style. This style was also seen in the south elevation of the Develin Tower (Hayward and Garwood 2015). Both were pointed in a similar looking hard 20<sup>th</sup> century gravel mortar (Type B).

Examples of relict render (Type R1) from Elevations C to F, were present on Kentish Ragstone blocks at 6-7 metres high and may have come from reused material. These types of render are present in the batter of the 1070 White Tower (Hayward 2015a).

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Kentish Ragstone (hard sometimes cherty)	Medieval – small angular rubble blocks and better worked string courses, tabular blocks used as dressing for arrow loops. Early C20 ashlar crazy paving	Dominates (95%) the upper two thirds of the medieval rubble core of all 6 external elevations (5-16m), all rubble stone walling of the interior chamber, stairwell, lobby and garderobe. 100% 20 <sup>th</sup> century builds arranged in a crazy paving style in the porch and parapet. Also all string courses at 9 metres (A-F) and 6 metres (A and C), upper window arches (A-C).

### ***Kentish Ragstone – poorer quality***

The second sub-type a softer green-brown-grey Ragstone, containing visible grains of the green mineral glauconite and marine bivalve shells of *Exogyra* was associated with large, regular ashlar blocks of between 40cm and 80cm across. This rock was far more prone to weathering than the cherty Kentish Ragstone, due to the presence of the unstable iron-clay mineral glauconite making it more liable to fragment, spall and flake off as large onion-skin fragments when exposed to the cold and the wet, rather like Reigate Stone. The difference being that Reigate Stone has no visible fossils, is finer and lacks a harder granular core and chert in this rock. The rock somewhat resembles Hassock Stone, which inter-beds with Kentish Ragstone at outcrop however it is far more likely this is



an inferior version of Maidstone Kentish Ragstone, quarried from another part of the Lower Greensand (Hythe Beds) of the North Weald of Kent. In thin-section, there was a notable difference in lithology between this poor quality Kentish Ragstone (sample from the east elevation of the Develin Tower (**Plate 104**; Hayward & Garwood 2015)) and Reigate Stone (samples from putlog 1 of Elevation A (S2; **Figure 15**; **Plate 102**) and the basal ashlar in the pit at the junction of the Bell Tower and the Inner Curtain Wall (S3; **Figure 30**; **Plate 103**).

It was occasionally used as large 40cm sub-rectangular ashlar blocks and quoins along with 19<sup>th</sup> century Magnesian Limestone replacement stone in the lowermost right half of Elevation B including some quoins at the junction of Elevations B and C. Elsewhere, it was used in the surrounds of the lower replacement window of Elevation A and in 19<sup>th</sup> or early 20<sup>th</sup> century Reigate Stone along with Kentish Ragstone *sensu-stricto* that was arranged in a crazy-paving fashion immediately above the basal two metres of freestone ashlar in Elevations D and F. Essentially, this post-medieval material only replaced Reigate Stone to any degree along those elevations (B to F) that were exposed to the prevailing wind. As such, Elevation A and the lower left hand side of Elevation B contain mainly primary Reigate Stone, whilst it is now only occasionally present in the Inner Curtain Wall.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Kentish Ragstone (poor quality Victorian Type)	Late post-medieval - Large ashlar and occasional quoin blocks	Post-medieval replacement material basal 4-5 metres external Elevations B-F

#### **Magnesian Limestone (pale cream- yellow – orange shelly and oolitic dolomitic limestone)**

A range of different coloured (buff-yellow-orange) dolomitised shelly, laminated and oolitic Magnesian Limestones from the Cadeby Formation (Upper Permian) of South Yorkshire (Lott and Cooper 2005) were used together as replacement ashlar, quoin and window jambs in the later post-medieval basal exterior elevations of the Bell Tower and Inner Curtain Wall (Water Lane). These have been subdivided on the stone-by-stone elevations into yellow, orange oolitic, laminated (stromatolitic) and the common pale cream variants. Thin-sections of three of these sub-types (S4, S5 and S7) were sampled in order to distinguish these fine hard freestone materials (**Plates 105 to 107**). For the purposes of this appendix, it was only necessary to describe the Magnesian Limestone as a group especially as all types are often found together, however each subtype is distinguished on the stone-by-stone elevation drawings.

Their use proportionally as replacement ashlar in the lowermost 5 metres in 5 of the 6 elevations (B to F) of the Bell Tower varies considerably. **Figure 14** shows that halfway across elevation B there is a sudden increase in its use with large 1 metre blocks often with dowel holes. This group of much larger Magnesian Limestone blocks only occurs in this elevation, and as quoins at the junction of Elevation A and the Inner Curtain Wall (Mint Lane) and Elevations B and C and is likely to represent a single phase of replacement in the Bell Tower. Contrast this with the much smaller ashlar blocks that

constitute upwards of 50% of all replacement blocks from Elevations C and F. Finally there is the wholesale use of Magnesian Limestone in the upper windows of external elevations A and B (**Figures 14 to 16**).

Similarly, a 10 metre section along the lower western part of the Inner Curtain Wall saw wholesale replacement in Magnesian Limestone between courses 1 and 22 using all variants.

During which time period was Magnesian Limestone used as a replacement freestone material in the Bell Tower? In London as a whole, Anston Stone (another type of Magnesian Limestone) was widely used for the 1839-1852 construction of the House of Parliament (Lott and Richardson 1997), but closer to home it was employed on a grand-scale in the later 19<sup>th</sup> century upgrading of the Tower of London including the Devereux Tower (Palmer and Shaffrey 2011, 14). With this in mind it would seem likely that a mid-late 19<sup>th</sup> century date is the best fit, with this work perhaps going on at the same time as major brick refurbishment of the external stairwell, chimneys and upper five metres of Queens House.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Magnesian Limestone	External ashlar, quoin and window jamb replacement material 19th century	Ashlar replacement basal courses external elevations A-F and basal 22 courses along 10 metre section of lower western Inner Curtain Wall; quoins B/C and A/Inner Curtain Wall (Mint Street); Upper Window dressing in Elevations A and B

#### **Reigate Stone (fine glauconitic calcareous siltstone)**

This low-density, poorly cemented micaceous greensand exploited from the Upper Greensand quarries of Reigate-Mertsham in enormous quantity for use in medieval London, was originally the key ashlar material type for the basal 5 metres of the external elevation of the Bell Tower. Thin-sections of samples taken from Reigate Stone covering Putlog 1 of Elevation A (S2; **Figure 15; Plate 102**) and primary medieval Reigate Stone ashlar in the foundations in the viewing pit at the junction of the Bell Tower and Inner Curtain Wall (S3; **Plate 104**) display the high porosity and largely glauconitic texture with quartz specular rods. It has in places undergone replacement because of its susceptibility to weathering and pollution using comparable green freestones such as poor quality Kentish Ragstone and Chilmark Stone as well as the paler cream Magnesian Limestone. Replacement has mainly occurred along elevations of the Bell Tower (B-F), exposed to the prevailing wind. Primary Reigate Stone ashlar has survived largely intact (95%) in Elevation A and the left hand side of Elevation B, where the Tower is largely shielded from the prevailing wind. Elevations D to F contain only a moderate quantity (30%) of surviving Reigate Stone ashlar (**Figure 14**). When encountered the ashlar dressings were weathered back, with extensive cratering up to 50mm deep indicating prolonged exposure. The following properties of Reigate Stone make it susceptible to rapid chemical and structural degradation including cracking, splitting, rusting and breakage and hence unsuitable as a

walling material.

Because of its susceptibility to weathering and pollution it has since undergone extensive replacement using comparable green freestones such as poor quality Kentish Ragstone and Chilmark Stone. This leaves at best only a moderate quantity (30%) of surviving ashlar from Elevation D-F as shown in the **Figure 14**. Elevations A-C contain appreciably less. When encountered the ashlar dressings were weathered back, with extensive cratering up to 50mm deep indicating prolonged exposure. The following properties of Reigate Stone make it susceptible to rapid chemical and structural degradation including cracking, splitting, rusting and breakage and hence unsuitable as a walling material.

- It has a high overall porosity 30% (Sowan 2000, 145) which enhances water infiltration and subsequent freeze-thaw damage. South facing walls with greater diurnal temperature variation which are more prone to freeze-thaw action merely accelerate the process. Within 20 to 30 years of use the rock can degrade rapidly (de Domingo 1994, 241)
- Chemistry – The green mineral glauconite, a common constituent of Reigate Stone is unstable iron-rich clay. It rapidly breaks down and oxidises red-brown when exposed to water, enhancing the rocks already high porosity thus accelerating chemical and physical weathering still further.
- Unlike the harder Lower Greensands, the silica in the Reigate Stone is chemically precipitated and much finer. Because of this the rock lacks the robust siliceous framework of coarser grained sandstones making it physical and chemical weathering.
- Its low density can also make it structurally unsound under a heavy loading. Subsequent chemical and physical weathering can accelerate failure over time.

Internally, the fabric remains intact and constitutes up to 95% of all ashlar material present in the lobby, entrance passage, stair vice and Upper Chamber as well as all the mouldings used in the rere-arches.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Reigate Stone	External Medieval ashlar and reused degraded ashlar and rubble in rubble core Internal medieval ashlar, soffit and arched segments	All external elevations (A-F) of the Bell Tower surviving ashlar varying in proportion from 95% (A) to 30% (D-F) according to how exposed the tower walls are to the prevailing wind. Interior: 95% of ashlar from the medieval stair vice and soffit. All ashlar in the lobby, entrance passage. Upper Chamber - all the moulded rere-arches of the Upper Chamber, ashlar surround of medieval fireplace and ashlar blocks

### Chilmark Stone

This light green glauconitic sandy limestone with discrete watermarks or calcite veins comes from the Upper Jurassic (Portlandian) from the Vale of Wardour in Wiltshire. Its use as a suitable replacement

stone for Reigate Stone not only for quoins along a 5 metre section (6-11 metres) across external elevations A to F of the Bell Tower, but as a string course at 16 metres (Elevations A to F) and ashlar (Elevations A to C) is because of its comparable lime green colour coupled with its greater ability to withstand external weathering due to its more robust fine quartz rich limestone texture. A thin section sample (S1) was taken from the uppermost string course in Elevation A in order to confirm its identification due to its similar colour to Reigate Stone. **Plate 108** highlights its textural differences with Reigate Stone and its similarity to a sample from Chicks Grove Quarry, Wiltshire (**Plate 109**; Hayward 2009).

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Chilmark Stone	18 <sup>th</sup> /19 <sup>th</sup> /20 <sup>th</sup> century post-medieval replacement quoin and string course. Early modern–ashlar replacement for Reigate Stone.	Weathered quoin replacement material in a 5 metre section (between 6-11 metres) Junctions A/B; B/C; C/D D/E; E/F. String course at 16 metres height (all elevations). Fresh ashlar replacement bottom 5 courses of Elevations A; B; C

### Portland Whit Bed (grain prominent white oolite)

This rock quarried from the Upper Jurassic of the Isle of Portland on the Dorset coast (Portland Whit Bed) is a common ashlar and quoin material type for the Bell Tower and Inner Curtain Wall (Water Lane), but proportions are still much lower than elsewhere in the Tower of London (Hayward and Garwood 2015; Palmer and Shaffrey, 2011; Worssam and Sanderson, 1998).

This is an open-textured, durable, fine white-grey oolitic freestone<sup>1</sup> with small oyster fragments. Its white colour and the fact that it is durable and could be quarried into large blocks (Leary 1989) coupled with the economic advantages bestowed upon it by its maritime locality and a hard but highly porous texture of up to 23.1% (Leary, 1989) contributed to its popularity in the later post-medieval period.

Use in the external elevations includes replacement jambs for the upper window of Elevation C and lower arrow loop of elevation B, and in conjunction with Ketton Stone as ashlar replacement in Elevation E. Fresh, crisply dressed Portland Stone quoins also define the eastern, western and northern elevations of the staircase turret. Finally, they form a small part of the repertoire of replacement post-medieval ashlar materials used in the lower western section of the Inner Curtain Wall.

<sup>1</sup> Even-grained limestone or sandstone with an open-textured porous core, which enables the rock to be worked or carved in any direction (Stanier 2000).

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Portland Stone (Whit Bed)	Post-medieval quoins, ashlar, replacement window jambs	Common - quoins - eastern, western and northern elevations of Staircase Turret Window jamb replacement and arrow loops Elevations B and C Ashlar replacement Inner Curtain Wall

### Purbeck Limestone

As elsewhere in the Tower (Palmer and Shaffrey 2011, 14; Hayward and Garwood 2015), these common slabby, shell-rich calcareous mudstones are associated with the later post-medieval building phases characterised by the extensive use of Portland Stone. These robust materials were quarried on a very large scale from different horizons of the Lower Cretaceous of the Isle of Purbeck for paving slabs, rubble stone, lintels and roofing slates etc for use in London especially from the late 17<sup>th</sup> century onwards. Three broad sub-types are identified.

#### **Type A (banded shell)**

A hard, uneven, pale-grey laminated shelly mudstone dominated by the small bivalve *Corbula*, a common fossil from the lowermost Cretaceous of Durlston Bay, Swanage is the most common. Its flaggy laminated nature means it is limited in its use to either flagstones, as shown by their dominant use to floor the Entrance Passage, Lobby and Upper Chamber of the Interior Bell Tower and as infill material.

#### **Type B (black-oyster shell)**

Examples of this black-oyster rich Purbeck Limestone comparable with a rock termed by quarryman as *Thornback* or are possibly the Cinder-Bed are far less common but used in conjunction with the *Corbula* Purbeck as infill material

#### **Type C (large oyster shell)**

A very large two metre section of these highly fossiliferous oyster rich rock was present in Elevation D and may outline the base of a possible window. This may represent the Intermarine member of the Purbeck succession.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Purbeck Limestone (standard Corbula type); black oyster (Thornback); and very large oyster beds (Intermarine Member)	Medieval flagstones and post-medieval infill around replacement quoins, ashlar and window Jambs.	Type A – in all the flooring of the Upper Chamber, Entrance Passage and Lobby, also throughout the medieval rubble fabric of the Inner curtain Wall as post-medieval infill material. Type B – very rare post-medieval infill material Type C – 2 examples Elevation D large block defining outline of a possible window?

### **Taynton/Burford stone (banded spar prominent oolitic limestone)**

Present in very small quantities is this normally robust variable rusty-brown to pale-grey banded shelly oolitic grainstone (Dunham 1962). It is comparable with a range of rock types quarried from the Middle Jurassic (Bathonian) of the Windrush Valley in West Oxfordshire. It has been identified in tombstones and monumental architecture from as early as the 1<sup>st</sup> century AD in Roman London (Hayward 2009), and on a much grander scale from the 11<sup>th</sup> century onwards in large ecclesiastical (Blows and Worssam 2011; Hayward in prep.a) and defensive projects (Hayward 2015; Palmer and Shaffrey, 2011; Worssam and Sanderson, 1998) in medieval London. All the medieval examples are the orange Taynton, and have extensive deep weathering as shown by pitted Taynton Stone in the Inner Curtain Wall lower western section. Indeed, it says much for the exposed position and vulnerability of the Bell Tower to external elements that even this toughest primary freestone is in a very poor state of preservation or has degraded completely. There are a couple of crisper paler quoins used at the juncture of Elevation D and E; these are likely to be Burford stone and are later post-medieval (Victorian) replacement materials.

<b>Material type</b>	<b>Use in Bell Tower and Inner Curtain Wall</b>	<b>Whereabouts</b>
Taynton/ Burford stone	Degraded medieval ashlar Taynton Stone and fresh post-medieval quoin– Burford stone	Taynton Stone Very rare primary ashlar 2 weathered examples external Elevations A and B. More common lower western section of Inner Curtain Wall These are highly pitted “primary” examples of ashlar in the lower western section of Inner Curtain Burford stone – two example as replacement quoin Elevation D/E.

### **Caen Stone (yellow packstone)**

This condensed, pale-yellow to pale-orange fine-grained pelletal packstone (Dunham 1962) identified as Calcaires de Caen limestone from the Middle Jurassic (Bathonian) of Normandy is a rock type that forms part of the package of freestone types (Purbeck Marble, Reigate Stone, Taynton Stone) used in major medieval ecclesiastical (Hayward in prep. a; Samuel 2011; Blows and Worssam 2011) and defensive (Worssam and Sanderson 1998; Harris 2008) projects in London.

Considering the frequency of its use in the Tower (e.g. White Tower), very few examples have actually been identified both in the external and internal elevations of the Bell Tower. It is only present in external elevations D-F nearly always as primary window jamb freestone material surrounding the lower arrow loops of elevations D and E. It is here that more primary medieval Reigate Stone survives too, perhaps because of protection from the elements. Thus in reality, a good deal more of Caen Stone quoins and window dressings may have been used in the original Bell Tower. Internally, however, only the occasional ashlar block has been identified.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Caen Stone	Window Jambs and ashlar	Externally – Elevations D and E window jambs lower loop Internally – Rare Ashlar Stairwell Vice

### Yorkstone (laminated sandstone)

This fine pale olive-green micaceous sandstone was sourced to the Elland Flags from the Lower Coal Measures of the Leeds-Bradford-Elland District (Godwin 1984, 1). Its main use in the Bell Tower was as Victorian/early modern paving and cap stone. Large (1 metre) square slabs were used to floor the 1904 Porch and replace a couple of medieval Purbeck Limestone paving slabs in the Upper Chamber floor. Other than their occasional use along with Post-Great Fire Brick as replacement Victorian building material in the Stair Vice, their other main purpose was to cap the entire circumference of the parapet of the Bell Tower. These flagstones are likely to date from the second half of the 19<sup>th</sup> century onwards when Yorkstone was quarried a huge scale in West Yorkshire, with 40 active mines employing 1100 people at the turn of the century, especially at Brighouse and Rastrick (Godwin 1984, 1).

Material type	Use in Develin Tower	Whereabouts
Yorkstone	19 <sup>th</sup> /20 <sup>th</sup> century coping stone/paving material.	Interior Porch floor and replacement flooring in Upper Chamber. Coping stone for the parapet of the Bell Tower.

### Purbeck Marble (gastropod rich packstone)

Although Purbeck Marble comes from the same geological formation as the Purbeck Limestone, it needs to be considered separately. This is because this hard, light-grey condensed fossil rich limestone dominated by the small 10mm freshwater gastropod *Paludina carinifera* was extensively used in Roman and medieval London (Hayward in prep a; Samuel 2011.) especially in tombstones and monumental architecture.

Its use and occurrence in the external face of the Bell Tower and Inner Curtain Wall is similar to that elsewhere in the Tower (Palmer and Shaffrey, 2011; Worssam and Sanderson, 1998, Hayward and Garwood 2015), it appears only sporadically as occasional blocks and flaggy units in the medieval core of the rubble stone wall. This is because the limestone is prone to extensive external weathering, resulting in severe degradation of the heterogeneous shelly limestone fabric. It occurs in clusters and can constitute up to 10% of the medieval rubble core.

It is because of this susceptibility that far more Purbeck Marble has been identified in the interior of the Bell Tower. Its use is almost entirely restricted to supporting lintels along the ceiling of the entrance passageway and for the garderobe passage as well as the 14<sup>th</sup> century square headed cupboard in the Upper Chamber.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Purbeck Marble	Rubblestone and Lintels	Rare/moderate Medieval rubblestone – in external elevations of A-F and Inner Curtain Wall Common later medieval Lintel material interior of entrance and garderobe passage towards Upper chamber.

#### **Ketton Stone (open-grained golden yellow oolitic grainstone)**

Ooid prominent, porous grainstone (Dunham 1962). Comparable to related building stones (e.g. Casterton stone) of Middle Jurassic (Bajocian) of Rutland and South Lincolnshire. These golden yellow oolitic limestones were identified as replacement post-medieval quoin material at the junction of external elevations C and D and D and E between 2 and 6.5 metres and to a lesser extent between E and F. There is also a concerted programme of ashlar stone replacement using this as ashlar in Elevation E (**Figure 19**). It is possible that this material was added in and around the early 20<sup>th</sup> century material as Ketton Stone can be identified in the c.1904 construction of the Porch. Ketton Stone is also used in ashlar replacement from the lower western section of the Inner Curtain Wall.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Ketton/ Casterton stone	Late Post-medieval Replacement material Quoin and Ashlar	Moderate Quoin replacement probably early 20 <sup>th</sup> century between external elevations C/D D/E and E/F of Bell Tower, 1904 ashlar and jambs Porch. Lower Western Section Inner Curtain Wall

#### **Ancaster freestone (soft very fine grained buff-light brown shelly oolitic grainstone)**

Very large, (0.5metres – 1metre), badly weathered rectangular ashlar blocks of Ancaster freestone from the Middle Jurassic (Bajocian) of Central Lincolnshire were used along an entire 12 metre stretch of the Inner Curtain wall. They form the basal 10 courses of the lower eastern section, above which there is a rapid transition to Kentish rubble core with an abrupt change westwards to Magnesian Limestone ashlar. These are clearly unsuitable late post-medieval 19<sup>th</sup>-20<sup>th</sup> century replacement materials, prone to flaking off as large slithers of stone probably due to their high overall porosity enhanced by weathering and pollution.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Ancaster freestone	Late post-medieval ashlar replacement materials	Moderate – concentrate entirely along a 12 metre stretch of the easternmost basal 10 course of the Inner Curtain

#### **Dundry Stone (yellow crinoid-rich bioclastic grainstone)**

This stone type was present just two post-medieval quoins in the 1904 Porch. The rock came from the Middle Jurassic (Bajocian) to the south of Bristol. This area became easily accessible to London following the construction of the Kennet and Avon Canal and later the railways. Elsewhere in the



Tower, it has been identified in late post-medieval replacement quoins at the junction of the Outer Curtain Wall and South Elevation of the Develin Tower (Hayward and Garwood 2015)

Material type	Use in Bell Tower	Whereabouts
Dundry Stone	Victorian/Edwardian replacement quoin	Two post-medieval quoins in the 1904 Porch

### Calcaire Grossier (Ditrupe Limestone)

This distinctive pale grey earthy limestone with worm tubes and large *amphistogeniid* foraminifera in thin-section had only previously been identified in London from the Tower of London in degraded material identified in early surviving areas of the external northern curtain wall of the Devereux Tower (Palmer and Shaffrey 2011, 15) and post-medieval fragments from the uppermost north elevation of the Develin Tower (Hayward and Garwood 2015). Just one weathered example was identified in the eastern elevation of the stair turret in Bell Tower. The importance of this stone in our understanding of stone building materials in London as a whole cannot be underestimated. The rock is Tertiary (Miocene) in age quarried from the banks of the Oise, a tributary of the Seine, some 200km inland from the north coast of France. Elsewhere in England it was only identified in architectural fragments from the Neronian proto-palace at Fishbourne and late first to early second century Richborough (Hayward 2009), monumental sculpture from a West Sussex villa (Black et. al. 2012) and the Saxon Reculver Cross and Column (Worssam and Tatton-Brown 1990) and at Winchester (Tweddle et. al. 1995). Its recycling within the Tower would therefore suggest derivation from a proximal Roman (funerary or architectural) or Saxon (e.g. All-Hallows) source or as ballast from a Roman or Saxon feature from further afield.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Calcaire Grossier	Roman origin architectural material reused as Late Post-medieval rubble infill material	East Elevation of the Staircase Turret East Elevation

### Bath-stone Box-Corsham-Bath Type (fine oolitic grainstone)

The opening up of 18<sup>th</sup> and 19<sup>th</sup> century freestone quarries in the Bath/Box area exploiting these fawn coloured fine, shelly oolitic grainstones from the Bathonian (Middle Jurassic) of the South Cotswolds came about due to the advent of the 18<sup>th</sup> century canal systems and then the mid -19<sup>th</sup> century Great Western Railway. Their use in the Bell Tower was limited to 19<sup>th</sup> century window jamb of the upper window in Elevation E.

Material type	Use in Bell Tower	Whereabouts
Bath Stone Box-Corsham-Bath type	Post-medieval window jamb surround	External elevation E replacement upper window jamb surround

### Quarr-stone (white skeletal grainstone)

A good indicator of early medieval quarrying, this hard skeletal limestone or “featherbed” quarried from the Bembridge Limestone Formation Tertiary (Oligocene) of the Isle of Wight coast does not continue to have been used after the 12<sup>th</sup> century as the quarries on the Isle of Wight by then had most of the quality stone taken out. Its presence in the occasional block from the north and east elevation of the stair turret, the medieval core of Elevation B and Elevation F of the Bell Tower suggests derivation from an earlier medieval building from the Tower. The most obvious candidate would have been the White Tower and its use only in first construction phase (1067-83) (Harris, 2008, 42; Sanderson 1998; Worssam and Sanderson 1998)

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Quarr stone	Medieval origin (pre 1200) Reused Ashlar blocks	Rare - Medieval core of Elevations B and F; North and East Elevation Stair Turret

### Bembridge limestone

Another rock from the Bembridge Limestone Formation Tertiary (Oligocene) of the Isle of Wight coast, was identified in rubblestone from the lower western section of the Inner Curtain Wall, just below the large window. This too is only recorded as a very early Norman ashlar material from the White Tower (Worssam and Sanderson 1998)

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Bembridge Limestone	Medieval origin (pre 1200) rubble	Very rare - One example reused in post-medieval rubble just below large window of the Inner Curtain Wall

### Tufa (calcareous spring water deposit)

A second rock type associated with the earlier 11<sup>th</sup> and 12<sup>th</sup> century development of the Tower, having been effectively worked out by the 13<sup>th</sup> century (Worssam and Sanderson 1998, 2) is the low-density white chemically precipitated tufa. As with the Develin (Hayward and Garwood 2015) and Devereux Tower (Palmer and Shaffrey 2011) it is rarely present. Here only present as a piece of medieval rubble core in the lower eastern section of the Inner Curtain Wall.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Tufa	Medieval (pre 1200) rubble	Very rare – one example in the medieval rubble core in the lower eastern section of the Inner Curtain Wall

### Sussex Marble (gastropod rich packstone)

This hard, light-grey condensed fossil rich limestone from the Lower Cretaceous (Wealden) of Sussex and Kent, was identified from three string courses from the medieval foundation base of the 1190 Bell

Tower and Inner Curtain Wall. Previously described as a Purbeck Marble, the uppermost of these string courses can be traced along the base of Elevation F of the Bell Tower and the adjacent lower western section of the Inner Curtain Wall and again from an emerging course, 20 metres east at the base of the lower western section of the Inner Curtain Wall foundation. Its identification in two sections of the Inner Curtain Wall would suggest that the 1190 foundation to the Bell Tower and a stretch of Inner Curtain Wall were constructed at the same time. A further two courses at 2 and 2.5 metres below the top plinths were present in the deeper lower western section of the Inner Curtain Wall foundation. Flaggy examples of Sussex Marble possibly plinth fragments also turn up in the medieval core of the Inner Curtain Wall and Bell Tower (A-D;F). This rock resembles Purbeck Marble but with a larger fossil snail species.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Sussex Marble	3 Medieval plinth courses	1190 medieval foundation base of the Bell Tower and basal sections of the Inner Curtain Wall

### Reused Cobblestones

The incorporation of hard crystalline metamorphic and igneous rock cobbles, pavers and setts in to the 19<sup>th</sup> century fabric of the Tower of London has been observed elsewhere e.g. Develin Tower (Hayward and Garwood, 2015). As the underlying bedrock of the south-east and south-central England consists in the main of soft geologically recent sediments and sedimentary rocks, these would have been acquired from older harder rocks from Cornwall, Wales, Northern England or Scotland. These occur in two separate areas of the Bell Tower/Inner Curtain Wall: first in the 19<sup>th</sup> century post-medieval eastern and northern elevations of the Staircase Turret and secondly in the extensive later post-medieval repairs of the Inner Curtain Wall. Three material types are present:

### Coarse and Fine granites

Coarse white granite, probably from Aberdeen was identified in the occasional cobble from post-medieval repairs to the upper western section of Inner Curtain Wall close to the large window.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Coarse (Aberdeen) Granite	Reused cobble as post-medieval rubblestone	Very rare - Upper western section Inner Curtain Wall close to Window. Eastern elevation of Staircase Turret. External Elevation E Bell Tower

### Metagabbro

A coarsely crystalline dark-grey to black basic igneous rock identifiable as gabbro may have come from Cornwall (St Keverne – The Lizard) and brought along with other cobblestone materials (granite,

serpentine and basalt) that have been identified in the Tower (Hayward and Garwood 2015). It is found in the occasional reused cobble from the eastern external elevation of the staircase turret, post-medieval repairs to the lower sections of the Inner Curtain wall and Elevation C of the Bell Tower.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Metagabbro	Reused cobble as post-medieval rubblestone	Very rare – Lower sections Inner Curtain Wall Eastern Elevation of Staircase Turret and External Elevation C Bell Tower

### **Basalt**

Fine black basalt was the most common crystalline cobblestone to be reused in the post-medieval fabric of the Bell Tower/Inner Curtain Wall. This may have come from the same quarries that exploited the gabbro at St Keverne (Hayward and Garwood 2015). Notable concentrations are found in the northern and eastern elevations of the staircase turret, and occurs sporadically in post-medieval repairs in most external elevations of the Inner Curtain Wall and Bell Tower

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Basalt	Late post-medieval sett reused as 20 <sup>th</sup> century replacement rubble	Rare but concentrations in the post-medieval north and east elevations of the Staircase turret and sporadically in most external elevations of the Inner Curtain Wall and Bell Tower

### **Sarsen**

Fine hard light grey cryptocrystalline quartz sandstones lithologically comparable Tertiary (Palaeogene) sarsens were identified in clusters associated with post-medieval repairs to the lower western section of the Inner Curtain Wall and eastern and northern elevations of the staircase turret. Although associated with Tertiary boulders from Wessex, this group is likely to have come from riverside deposits close to Windsor Castle, where this stone has been used in the past. Because the rock, when weathered has a smooth hard skin this may suggest that this group derived from cobble stones, a possibility, considering these materials were found here with basalt cobbles.

Material type	Use in Bell Tower and Inner Curtain Wall and Inner Curtain Wall	Whereabouts
Sarsen	Possible reused cobbles used as post-medieval rubble	Rare but notable concentrations in the post-medieval repairs to the lower western section of the Inner Curtain and eastern and northern elevations of the Staircase Turret

### **Flint**

The use of flint is intricately associated with Victorian repairs and especially embellishment of the

lower and uppermost stone masonry sections of the Inner Curtain Wall. Indeed, it is a feature of the replacement Magnesian Limestone, Sarsen and other post-medieval ashlar in these areas to be encircled by fragments of fractured flint or galleting. The contrast brought about by the black flint and the paler freestones may have served to emphasise each blocks outline. An alternative hypothesis is of course that they protected the rock against weathering or damage to the surrounding mortar. The eastern and northern sections of the staircase turret also have these features but flint is only occasionally present in the external elevations of the Bell Tower.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Flint	As small fractured flint used around replacement post-medieval ashlar possible decorative	Post-medieval rebuilds of the Inner Curtain Wall and eastern and northern sections of the staircase turret.

### Chalk

It is not surprising that this soft, white foraminiferal limestone from the Upper Cretaceous Chalk of the Thames Valley has nearly all been identified in the Interior Upper Chamber as small ashlar blocks used in the medieval barrel vaulting.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Chalk	Ashlar internal chamber	Medieval ashlar in some of the barrel vaulting of the Upper Chamber

### North Wales Slate

Very hard metamorphosed dark slate from the Palaeozoic deposits from North Wales was only present at chimney/brick junction of the staircase turret.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
North Wales Slate	Victorian Waterproof Sealant/levelling course	Late Victorian Juncture of brick and terracotta chimney top of staircase turret Bell Tower

### Thanet Sandstone

This material type occurs as water worn boulders or doggers made of a pale grey-brown fine grained sandstone with large bivalves of *Arctica morrisi* and sourced to the Tertiary Thanet Beds from the Isle of Thanet Kent. They are found in the external medieval rubble core of Elevations B-F in the Bell Tower, accounting for up to 5% of all rubble rock as in the case of Elevation E. They are found as discrete bands either 20 or 40 courses from the base of the Tower. They, along with the associated Kentish Ragstone coated in render probably derive from the White Tower or another early Norman structure. Thanet boulders are present in the base of the 1070 White Tower batter (Hayward 2015a) and in the White Tower itself (Sanderson 1998; Worssam and Sanderson 1998).

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Thanet sandstone	Reused Norman Rubble in medieval core as elongated water worn blocks External elevations B-F	Rare - Present in external elevations B-F but especially in courses 25-30 B and courses 40-50 E-F and renovations to lower west section of Inner Curtain Wall

### Unidentifiable Rock Types

With four of the stone materials it was not possible to assign them to a specific outcrop source.

#### a) *Calcareous sandstone with oolite and shell grains*

A hard light-grey robust sandstone with occasional fossils, which may be Bargate stone from the Lower Cretaceous (Sandgate Beds) from the Godalming/Guildford area. This rock has been identified from Roman London, (Hayward pers. obs.) but here its identification in a later post-medieval sill would suggest a post-medieval consignment to the Tower.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Bargate stone	Sill Fragment	Very Rare 1 example Lower Eastern section of the Inner Curtain Wall beneath far east window.

#### b) *Muddy Mollusc Rock – Sub Facies of the Thanet Sandstone*

It was not possible to determine the geological source of a dark-grey mollusc rich calcareous mudstone. It was identified in three sizeable rubble blocks from Elevations B and E. In each case their association with Thanet Sandstone may suggest that they too have come from the Eocene of the Isle of Thanet, perhaps as softer foreshore deposits. Furthermore, as Thanet Sandstone is associated with the earliest Norman development of the White Tower keep (Worssam and Sanderson 1998; Hayward 2015a), then these softer materials may derive from this structure too.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Muddy mollusc rock	Rubblestone as ashlar infill	Very Rare – 3 examples Elevations B and E possibly reused Norman material

#### c) *Carboniferous Sandstones*

A cluster of dark grey to grey-green exceptionally hard fine sandstones associated with late post-medieval repairs to the lower western section of the Inner Curtain Wall bear a strong resemblance to Carboniferous Sandstones from the Culm Measures of North Devon. They differ from Yorkstone

which is olive green and finely laminated. It is possible that these more robust may conceivably have been used once as cobbles and like the surrounding basalts and sarsens have merely been reincorporated into the fabric of the Tower. The advent of the railways made it possible for large consignments of older Palaeozoic sediments and igneous rocks to be transported into London.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Carboniferous Sandstones	Replacement ashlar and rubblestone	Rare – limited to late post-medieval repairs to the lower western section of the Inner Curtain Wall

#### ***d) Raised Beach Deposit***

A curious hard concretionary pebbly deposit cemented with nacreous geologically recent marine bivalves is almost certainly an interglacial, coastal raised beach deposit. There are numerous outcrops throughout the coast of the British Isles. One possible source is Dorset where Ipswichian deposits are found in the Purbeck-Portland area close to outcrops of Upper Jurassic limestone used so extensively in post-medieval periods in the Tower.

Material type	Use in Bell Tower and Inner Curtain Wall	Whereabouts
Raised Beach Deposit	Replacement rubblestone	Very Rare – 1 example associated with replacement Magnesian Limestone ashlar beneath the large window from the lower western section of the Inner Curtain Wall

### **Ceramic Building Materials**

The date, fabrics and distribution of ten types of ceramic building material (brick, roofing tile, floor tile) are assessed below in chronological order.

#### ***Roman Brick***

Just four examples of very fragmentary tile, defined by the very fine red brickearth fabric 2452<sup>2</sup> (AD55-160) were identified in the medieval rubble core. The paucity of Roman building material (also seen in the stone) would indicate that little material was salvaged from the Roman Town Wall for use in the Bell Tower.

#### ***Medieval peg tile***

Fragments identified from watching brief incursions behind ashlar from the bottom 2 metres of Elevation A, identify fragments of very thin, sometimes glazed peg tile mixed with the primary gravel mortar (Type A) and Kentish Ragstone of the 1190 Bell Tower. Fabric 2271 dates from 1180-1450,

<sup>2</sup> Museum of London Fabric Series

just ten years prior to the construction of the Bell Tower, providing a useful *terminus post quem* for this structure. A levelling course in the fabric was also spotted immediately above the Sussex Marble string course, some 20 metres east of the Bell Tower along the Inner Curtain Wall.

### **Medieval yellow brick**

A handful of large 230mm relatively thin (55mm) medieval bricks in the mottled cream/red fabric 3031nr3042 were identified in the medieval fabric from four elevations (A-C; E) at more or less the same height (c15-20 courses up from the base). This fabric is identical to the large brick used in the adjoining Beauchamp Tower from 1281 and also present in the adjacent Causeway (Hayward 2015b), both of which are large Edward I building programmes. Their use at this one level, nearly 100 years after the construction of the 1190 Bell Tower may not be significant and may merely represent a late 13<sup>th</sup> century repair programme using a ready stockpile of Beauchamp bricks.

### **Tudor/Stuart Brick**

Poorly made, shallow (45-55mm) wide, (110-130mm) red Tudor/Stuart bricks made from local brick earth, fabric 3033 (1450-1700) are a feature of the fireplace cut in the Upper Chamber wall by William Browne in 1609-10 (TNA E 351/3244). Complete with sunken margins, traces of the relict early 17<sup>th</sup> century chimney breast and flues can be picked in the eastern, southern, western and southern external elevations of the Staircase Turret. These are all bonded by a soft cream light brown mortar (Type C). Elsewhere, two distinct clusters locate in the upper western section of the Inner Curtain Wall adjacent to the westernmost bay window and then again in the upper eastern section in a line of 6 courses. Where present they are usually arranged in Old English Bond.

### **Post-medieval Peg tile**

As well as occasionally being used as being the primary roofing material type for the Queens House (and therefore not incorporated into this report), unglazed post-medieval red sandy 2276 peg tiles (1480-1900) when laid flat are used as levelling or waterproof courses, such as halfway up the chimney stack assessed from the Queens House as part of the recording of the eastern upper section of the Inner Curtain Wall and beneath the easternmost bay window from western upper section of this stretch of wall. A layer of tile was also placed between the uppermost course of soldier post great fire bricks and the underlying courses in the eastern external elevation of the Staircase Turret.

### **Post-Great Fire Bricks**

By far the most common brick fabric from the Bell Tower and Queens House, the purple-red clinker rich post great fire brick 3032 (1664-1900) is normally a small frogged brick with dimensions of 210mm long x 98-102mm wide x 60mm conforming in size to those brought in through government legislation in 1776 until late 19<sup>th</sup> century on brick size. Such bricks are used in the uppermost 9 courses of the Upper Chamber, associated with the raising of the Bell Tower roof, and those making up the innermost skin of the parapet of the Bell Tower Elevation. Similarly much of the fireplace of the Upper Chamber, Chimney Breast, and uppermost external courses of the staircase turret are made



from this same brick fabric and bonded in the same type of brown hard gravel mortar (Type B). The brick lining the embrasures of the Upper Chamber also uses this combination.

The other key area, where a combination of this fabric, form and mortar are used together is in the brick surround of a number of bay windows and the uppermost 5 metres of the south elevation of the Queens House/ Inner Curtain Wall.

#### **Yellow Estuarine Bricks**

Very few Medway yellow bricks (1780-1940), were present, those that were identified were used in the western exterior elevation of the staircase turret.

#### **Terracotta Chimney Pot**

It was not possible to identify, from the stamp name *PATENT STEVENS EXHAUST CHIMNEY POT* on the Bell Tower Chimney Pot who, where and when the terracotta manufacturer was in operation. Given the fabric date of the underlying post Great Fire bricks (1850-1900), it is unlikely to be before the late 19<sup>th</sup> century.

#### **Fletton Bricks**

Evidence for 20<sup>th</sup> century repair is provided by one deeply frogged Fletton Brick, fabric 3038 (1890 – present day) quarried from the Oxford Clays of Peterborough. This was recorded at the edge of the northern external elevation of the Staircase Turret.

<b>Material type</b>	<b>Samples</b>	<b>Proportion</b>	<b>Use in Bell Tower and Inner Curtain Wall</b>	<b>Whereabouts</b>
Roman Tile		<1%	Fragments used in the medieval rubble core	Very rare; 1 fragment each in Elevations A and B and rubble core of Upper sections of Inner Curtain Wall
Medieval peg tile		<1%	2271 thin sometimes glazed (1180-1450) levelling courses and reused fragments into rubble core	Fragments Identified in watching brief incursions in the 1190 rubble and mortar of external elevation A and immediately above the emerging Sussex Marble string course of the 1190 foundation 20 metres to the west of the Bell Tower along the Inner curtain Wall
Medieval brick		<1%	Large Beauchamp Bricks 3031nr3042 (1281+)	All found at the same level at Elevations A-C and E
Tudor/Stuart brick		5%	Red brick 3033 (1400-1700) construction bricks	1609-10 Chimney Breast Interior Upper Chamber, flue and relict (lower) chimney breasts and flues in the eastern, southern, western and southern external elevations of

				the Staircase Turret. Two sections of brick facing Upper Inner Curtain Wall
Post-medieval peg tile		<1%	2276 (1480-1900) levelling courses	Beneath uppermost course of brick from the eastern external elevation of the staircase turret and bay windows and within chimney stacks from the uppermost Inner curtain wall
Post Great Fire Brick		15%	3032 (1664-1900) construction bricks most however of a size (98mm-102mm wide) conforming to the standards of the brick tax legislation of 1776-late 19 <sup>th</sup> century	Chimney stack, all elevations of the stair turret of the Bell Tower, uppermost metre of the Bell Tower. Interior Upper Chamber, repairs, fireplace, embrasures, interior window surround (Windows 1-3) door infill of lobby, interior brick surround of windows inserted along the garderobe. Uppermost 5 meters of Queens House facing Inner Curtain Wall (Water Lane) and bay window surround
Yellow Estuarine Brick		<1%	3035 (1780-1940) construction bricks	Very Rare – western external elevation of the Staircase Turret
Terracotta		<1%	3033 (1880-Present Day) Brick Chimney stamped <i>PATENT STEVENS EXHAUST CHIMNEY POT</i>	Used in the chimney pot for fireplace in the Upper Chamber of Bell Tower
Fletton Brick		<1%	3038 (1890- Present Day) construction brick	Very rare – 1 example northern elevation of staircase turret
Replacement 3033 bricks		<1%	3033 (20 <sup>th</sup> century) replica Tudor construction bricks	

## **APPENDIX 2 Mortar types used in the Bell Tower**

The need to constantly preserve and repoint the exposed Bell Tower medieval rubble stone walling is shown by the presence of roughcast/pebble-dash render in late 19<sup>th</sup> and early 20<sup>th</sup> century photographs (**Plates A to L**) and by the presence of a robust 19<sup>th</sup> and 20<sup>th</sup> century very hard pale grey (10YR 7/2) to light yellow-brown (2.5Y 6/3) gravel facing mortar (Type B) masking large areas of the external elevations of the Bell Tower. This obscured other facing and bedding mortar types. Only where mortar was removed for repointing or stone was replaced during the conservation works was the bedding mortar exposed.

### **Medieval type**

A fawn – yellow (2.5 YR 8/8), loose brown gravel mortar (Type A) was used for the medieval primary build of the Bell Tower. It was present in all the external elevations when exposed during the conservation works. It was also present in the exposed wall foundations in the viewing pit (base of Elevation F and adjoining Inner Curtain Wall) including some emerging ashlar a further 20 metres to the east. This original bedding mortar is more apparent in the interior of the Bell Tower in the walls of the Upper Chamber, Lobby and staircase.

Thin sections of both the internal (M1; **Plate 111**) and external (M2; **Plate 112**) primary mortar show the basic, but nevertheless important ingredients of a lime rich purple stained ferroan calcite containing the numerous small sub-angular quartz fragments.

Traces of a remnant hard white (5Y 8/1) gritty lime render (Type R1) were identified on some Kentish Ragstone from the medieval rubble walling in elevations D-F along courses 35-40. A similar render has been identified in the White Tower Batter (Hayward 2015).

### **Early Post-medieval type**

Tudor/Stuart bricks in fabric 3033 (1450-1700) were in very light fawn (2.5YR 8/6) fine sandy lime mortar with chalk inclusions (Type C). The bricks were found in the chimney breast of the fireplace in the Upper Chamber and in the external elevations of the Staircase Turret. The former probably relate to the documented 1608/1609 alterations to the fireplace.

### **Later Post-medieval types**

Types B, D and E (see Table below) are all 19<sup>th</sup> to 20<sup>th</sup> century hard mortars, which relate to different building campaigns. Portland Type E was used in the c.1904 lobby, whilst Types B and D relate to 19<sup>th</sup> and 20<sup>th</sup> century alterations and repairs.

### Mortar types used in the Bell Tower

Mortar Type	Description	Use at the Bell Tower
A	<b>Fawn – yellow (2.5 YR 8/8), loose brown gravel mortar</b>	Primary medieval bedding mortar for all the external elevations (A-F) of the Bell Tower. Only exposed during conservation works. Samples from putlog holes in Elevation A. It is also present in the exposed wall foundations of the Bell Tower and Inner Curtain Wall in the viewing pit including some emerging ashlar of the Inner Curtain Wall a further 20 metres to the east. Bedding mortar for the exposed rubble walling interior throughout the Upper Chamber.
B	<b>Very hard pale grey (10YR 7/2) to light yellow-brown (2.5Y 6/3) gravel mortar.</b> Variable inclusions of large angular brown flint up to 30mm across	19 <sup>th</sup> and 20 <sup>th</sup> century mortar. Used to face and bond all the external elevations (A-F) of the Bell Tower. Entire height of Bell Tower including the uppermost Ragstone 'crazy-paving' parapet. Used in brickwork of the chimneystack and all external elevations of the stair turret of the Bell Tower. Used in Upper Chamber: repairs, fireplace, embrasures, internal surrounds to Windows 1-3, blocked doorway in lobby, internal brick surrounds to inserted windows along the garderobe passage.
C	<b>Very light fawn (2.5YR 8/6) fine sandy lime mortar with inclusions of chalk and flint</b>	Tudor/Stuart brickwork is bonded in this mortar. Found in external elevations of the Staircase Turret and in fireplace (1608/1609).
D	<b>Very hard grey (2.5 YR 6/1) to dark grey (2.5 YR 4/1) gravel mortar.</b> Variable inclusions of large angular brown flint up to 30mm across, sometimes	19 <sup>th</sup> and 20 <sup>th</sup> century mortar. Patchwork repairs to Elevation F and in a section of Ragstone from Elevation A immediately below the inserted lower window.
E	<b>Very hard cream (7.5YR 8/1) Portland type mortar</b>	Associated with Ragstone 'crazy-paving' in the external and internal elevations of the c.1904 Porch.
R1	<b>Hard white (5Y 8/1) gritty lime render</b> Thin veneer consisting of regular small (<0.3mm) angular quartz set within softer white lime matrix	Medieval render on the external face of reused Ragstone from the rubble walling in elevations D-F along courses 35-40 associated with Thanet Beds. Possibly originally from the White Tower or another Norman structure.

## APPENDIX 3: Oasis Form

**OASIS ID: preconst1-241639**

### Project details

Project name	Archaeological Building Recording of Bell Tower and adj Inner Curtain Wall, HM Tower of London
Short description of the project	Pre-Construct Archaeology Limited was commissioned by Historic Royal Palaces to undertake archaeological building recording (including petrographic survey) at the Bell Tower and adjacent Inner Curtain Wall, HM Tower of London, London Borough of Tower Hamlets. The recording was carried out in 2015 as a condition of Scheduled Monument Consent for conservation work. The Bell Tower and adjacent Inner Curtain Wall are Grade I listed and were built c.1190-1200. The Bell Tower is important because it was here that Sir Thomas More was probably imprisoned in 1535. The archaeological building recording work has established that the Bell Tower and adjacent Inner Curtain Wall were originally mainly constructed of Kentish Ragstone sensu stricto and Reigate Stone with the occasional use of Taynton Stone, Sussex Marble and Caen Stone. Both structures had an ashlar base with rubble walling above. Relict Tudor/Stuart brickwork shows that both were altered in the 16th/17th centuries. By the late 19th century, alterations included the construction of brick parapets to both structures, the replacement of windows and an arrow loop with a window, the rebuilding and/or insertion of quoins, the replacement of stone ashlar, the addition of roughcast/pebbledash render to the rubble walling of both structures and the introduction of new stone types. A porch was added c.1904. By 1924, the roughcast/pebbledash render had been removed from the walls of the Bell Tower and its brick parapet had been rebuilt externally in Kentish Ragstone. After 1924 the roughcast/pebbledash render was removed from the adjacent Inner Curtain Wall.
Project dates	Start: 13-01-2015 End: 11-09-2015
Previous/future work	Yes / Yes
Any associated project reference codes	TOL149 - Sitecode
Type of project	Building Recording
Site status	Scheduled Monument (SM)
Site status	Listed Building
Site status	World Heritage Site
Site status	Conservation Area
Current Land use	Other 2 - In use as a building
Monument type	TOWER Medieval
Monument type	INNER CURTAIN WALL Medieval
Methods & techniques	""Annotated Sketch"", ""Dendrochronological Survey"", ""Laser Scanning"", ""Photogrammetric Survey"", ""Photographic Survey"", ""Survey/Recording Of Fabric/Structure""
Prompt	Scheduled Monument Consent

### Project location

Country	England
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Site location	GREATER LONDON CITY OF WESTMINSTER CITY OF WESTMINSTER Bell Tower and adjacent Inner Curtain Wall, Tower of London
Postcode	EC3N 4AE
Site coordinates	TQ 33515 80507 51.507200735257 -0.07593558691 51 30 25 N 000 04 33 W Point

#### Project creators

Name of Organisation	Pre-Construct Archaeology Limited
Project brief originator	Alden Gregory, Historic Royal Palaces
Project design originator	Charlotte Matthews
Project director/manager	Charlotte Matthews
Project supervisor	Kevin Hayward
Type of sponsor/funding body	Historic Royal Palaces
Name of sponsor/funding body	Historic Royal Palaces

#### Project archives

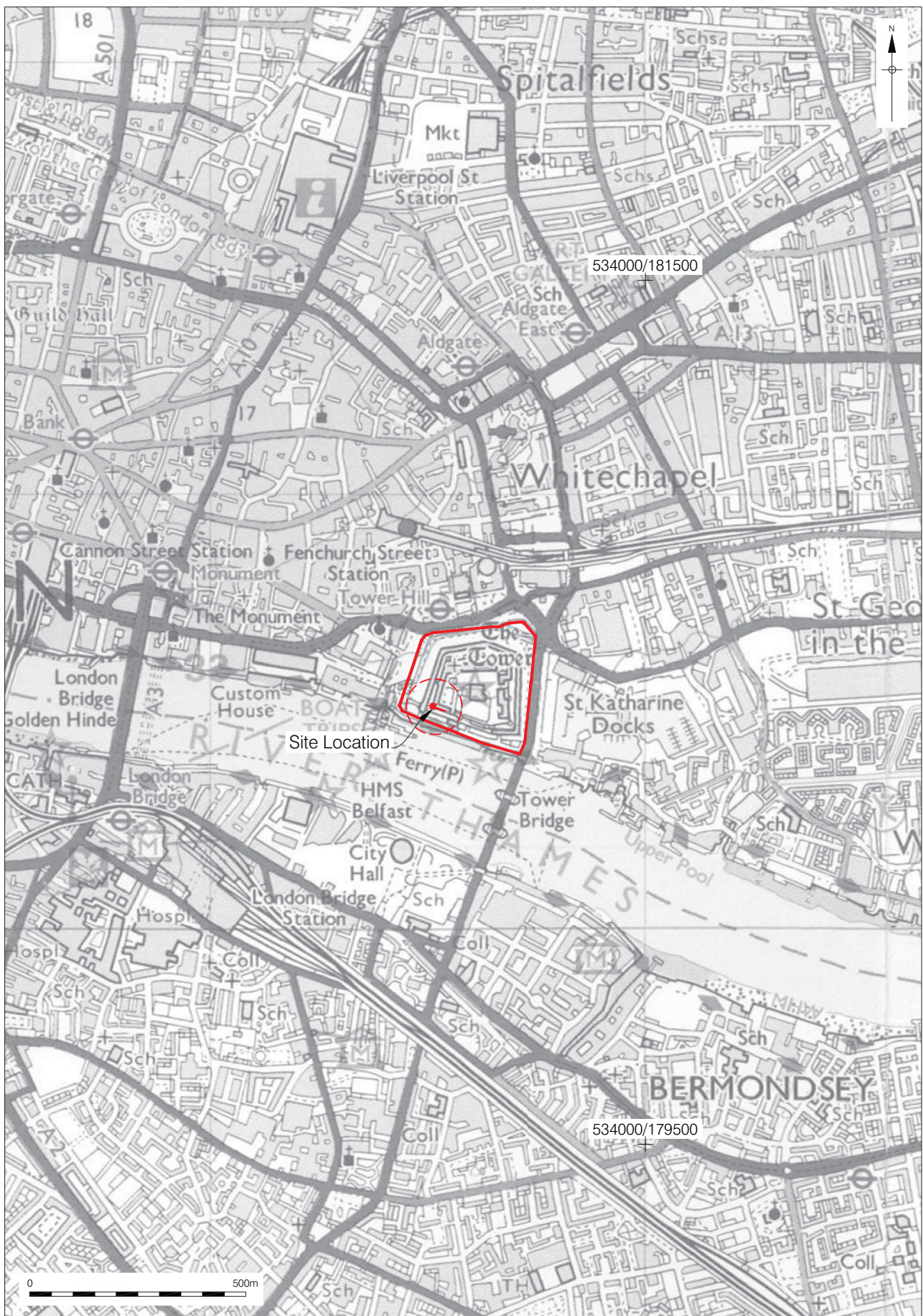
Physical Archive Exists?	No
Digital Archive recipient	Historic Royal Palaces
Digital Archive ID	TOL149
Digital Media available	"Images raster / digital photography", "Survey", "Text"
Paper Archive recipient	Historic Royal Palaces
Paper Archive ID	TOL149
Paper Media available	"Drawing", "Plan", "Report", "Survey "

#### Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Assessment Report on Archaeological Building Recording (inc petrographic survey) and Watching Brief at Bell Tower and adj Inner Curtain Wall, HM Tower of London, LB of Tower Hamlets
Author(s)/Editor(s)	Hayward, K. and Matthews, C.
Other bibliographic details	PCA Report No R12359
Date	2016

Issuer or publisher	Pre Construct Archaeology Limited
Place of issue or publication	Brockley, London
Description	A4 report
Entered by	Charlotte Matthews (cmatthews@pre-construct.com)
Entered on	8 February 2016

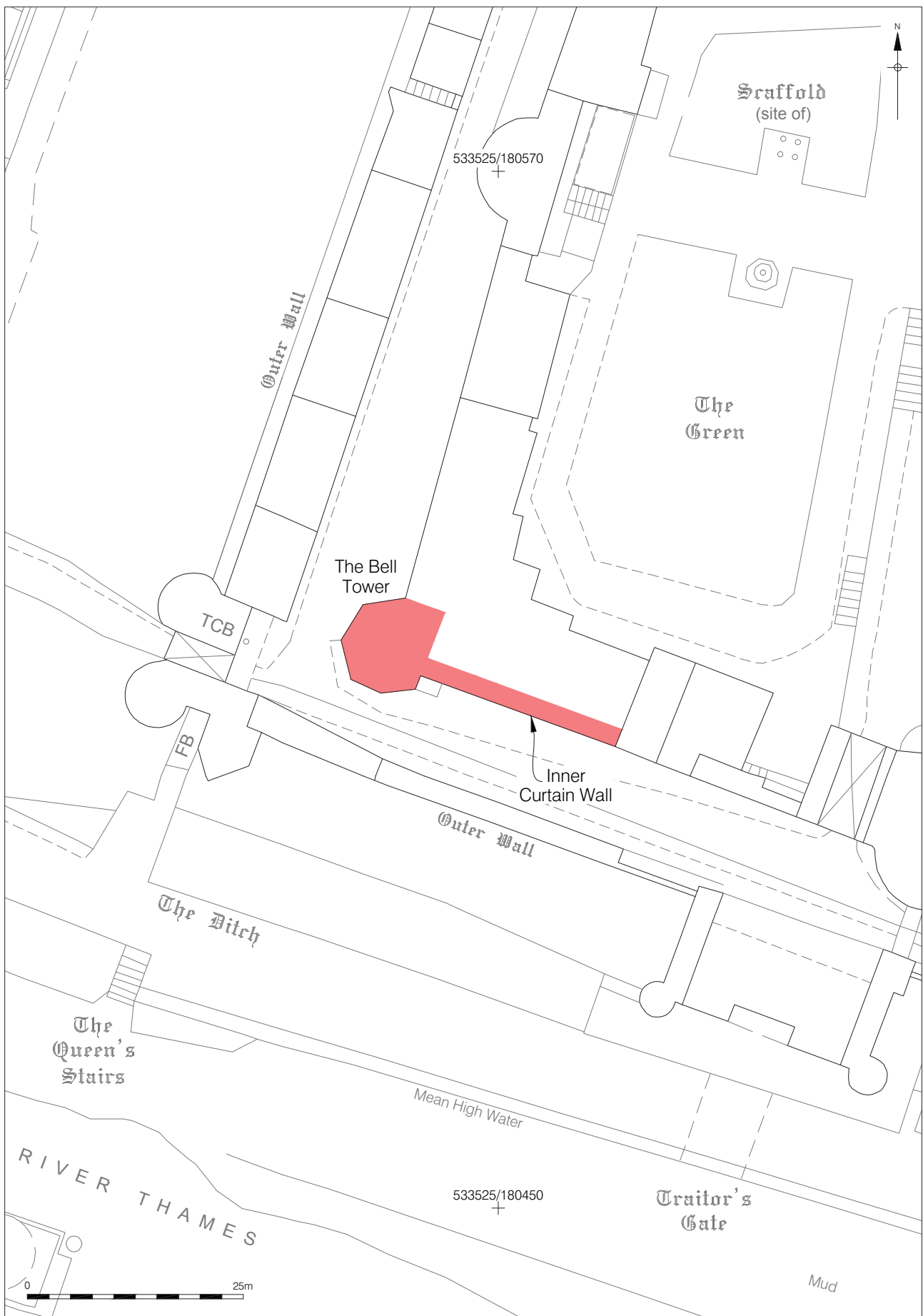




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 10/12/15 MR

Figure 1  
 Site Location  
 1:12,500 at A4





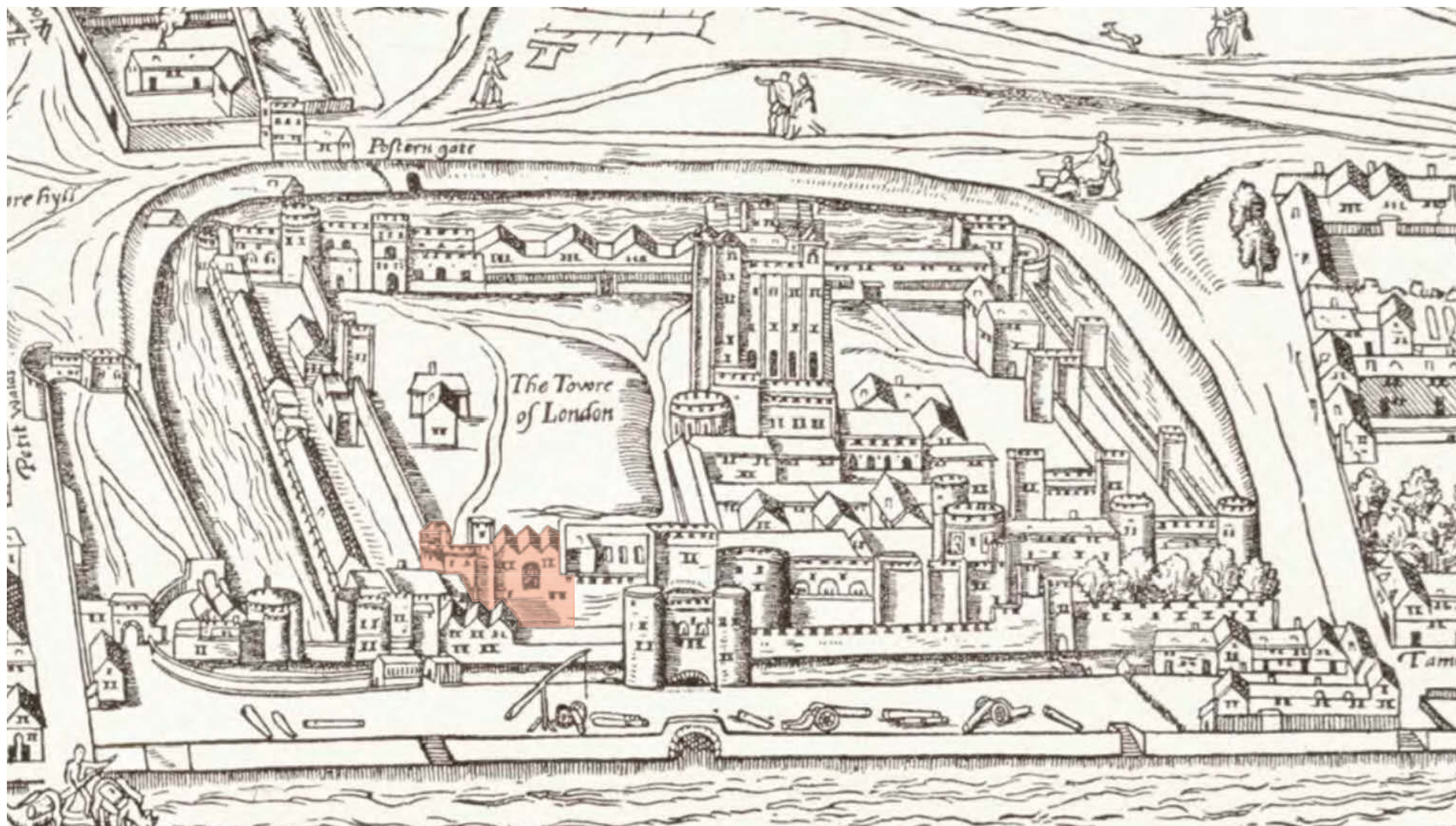


Figure 3  
Detail from the Agas Map of London 1561, produced c.1633, showing the  
tall tracery window at the south end of the Lieutenant's Great Hall  
(no scale)



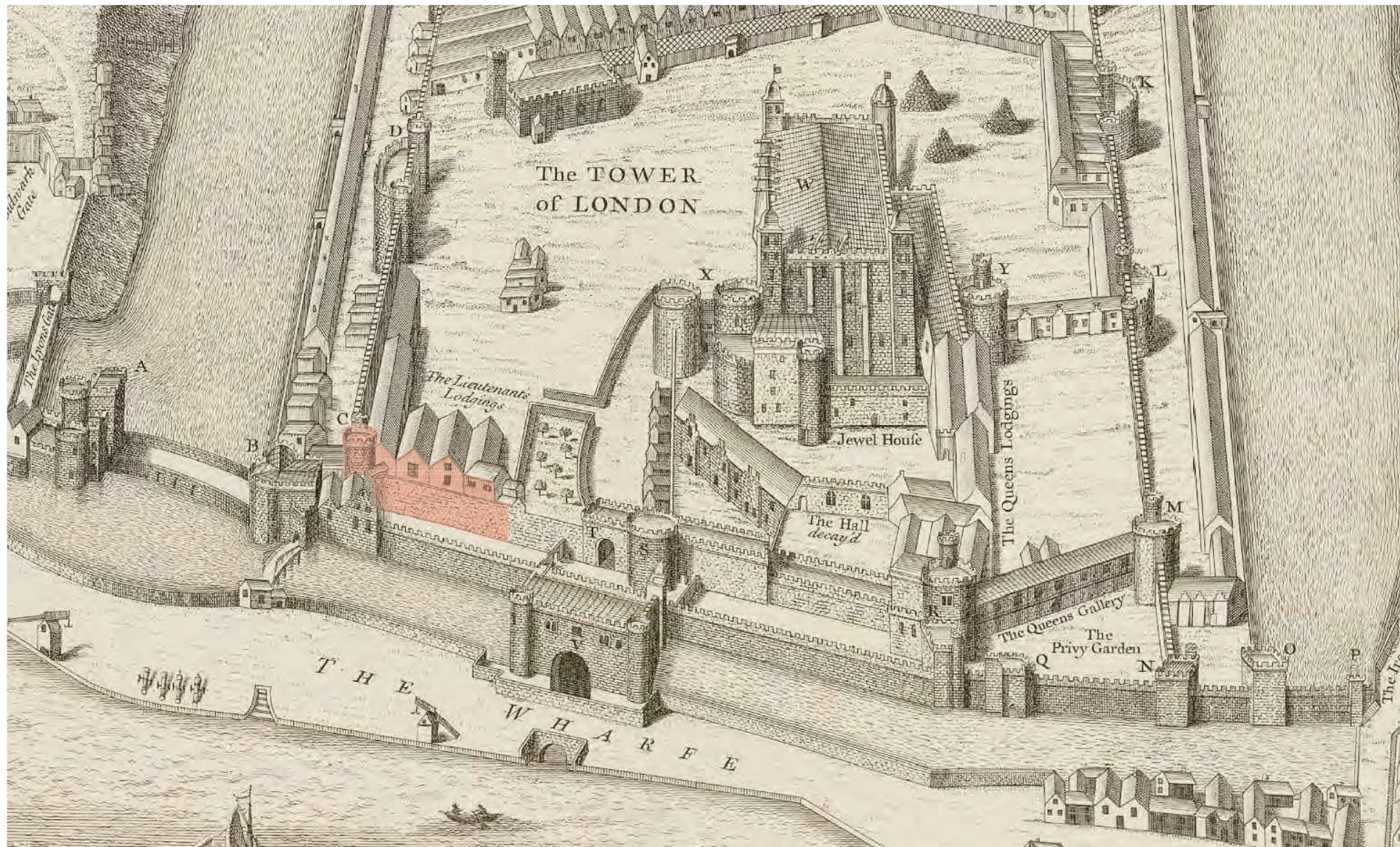


Figure 4  
 Copy of Haiward and Gascoyne's Survey of 1597 made for the Society of Antiquaries in 1741  
 (The Society of Antiquaries of London)  
 (no scale)





Figure 5  
View of the Tower from the Thames (south) drawn by Wenceslas Hollar in 1637-41, including a detail showing the large traceried window at the south end of the Lieutenant's Great Hall (British Museum 1859-8-6-389; TNA WORK 5/13 f.20v) (no scale)

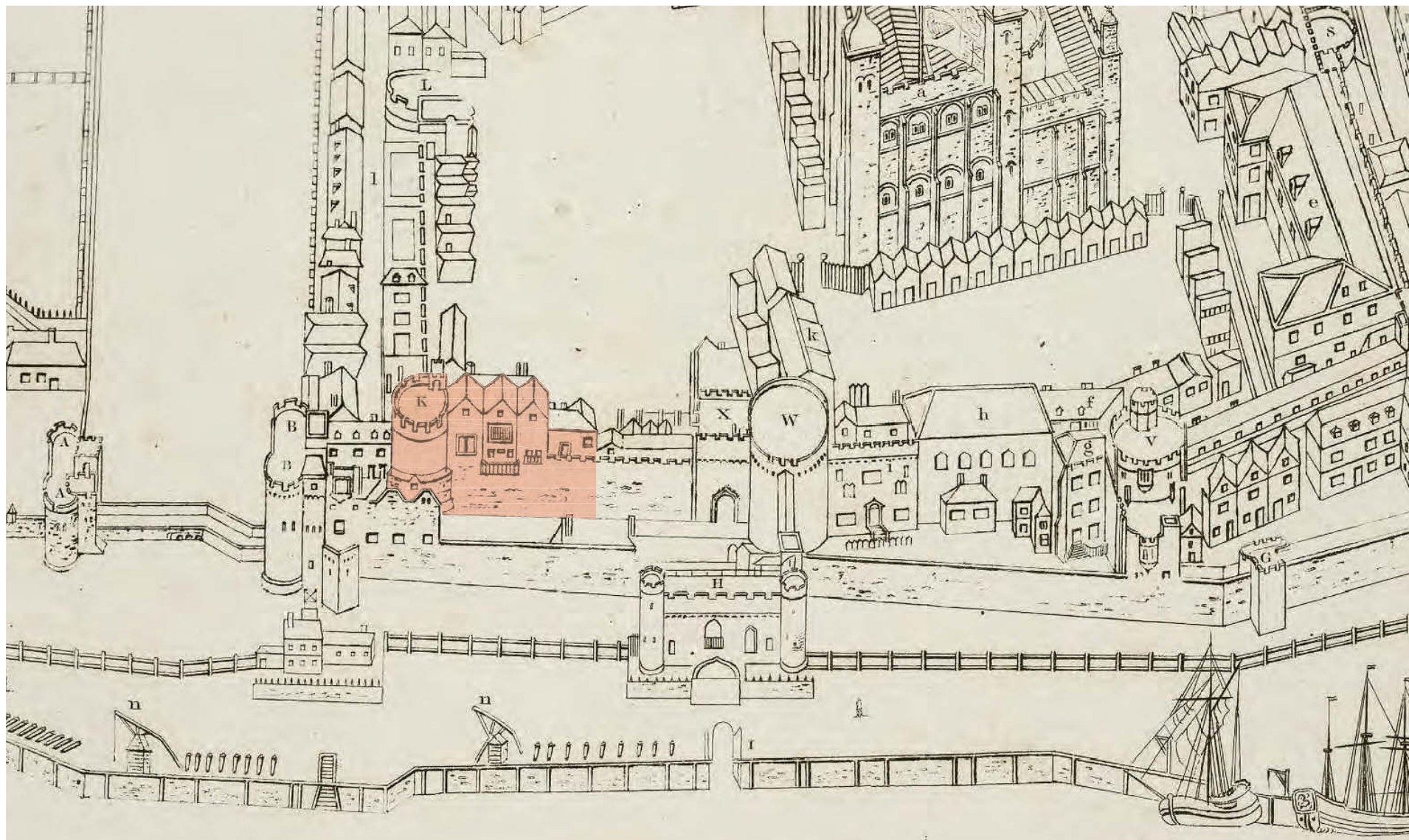


Figure 6  
Detail of Holcroft Blood 'birds-eye' view of the Tower, 1688  
(no scale)



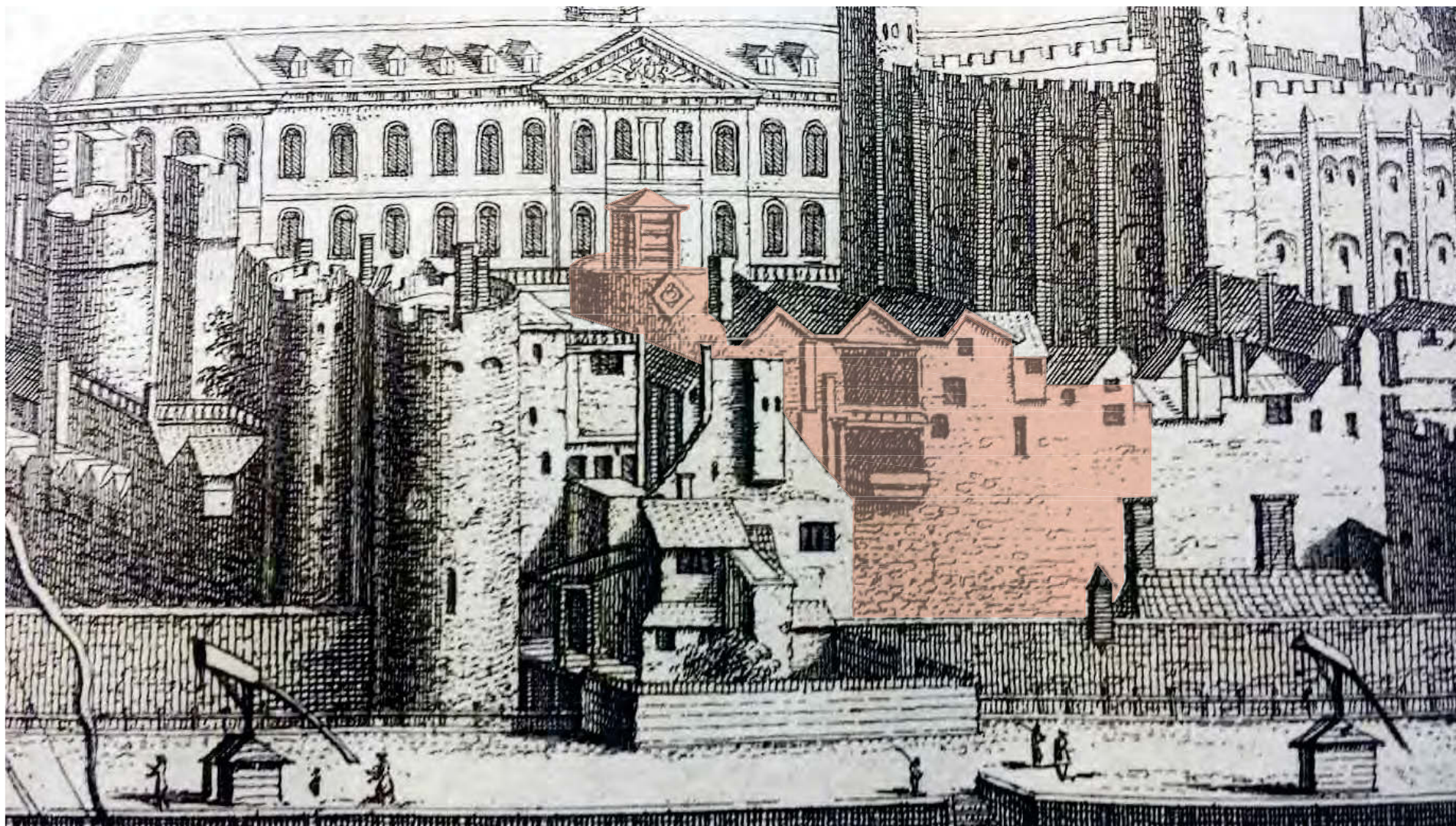
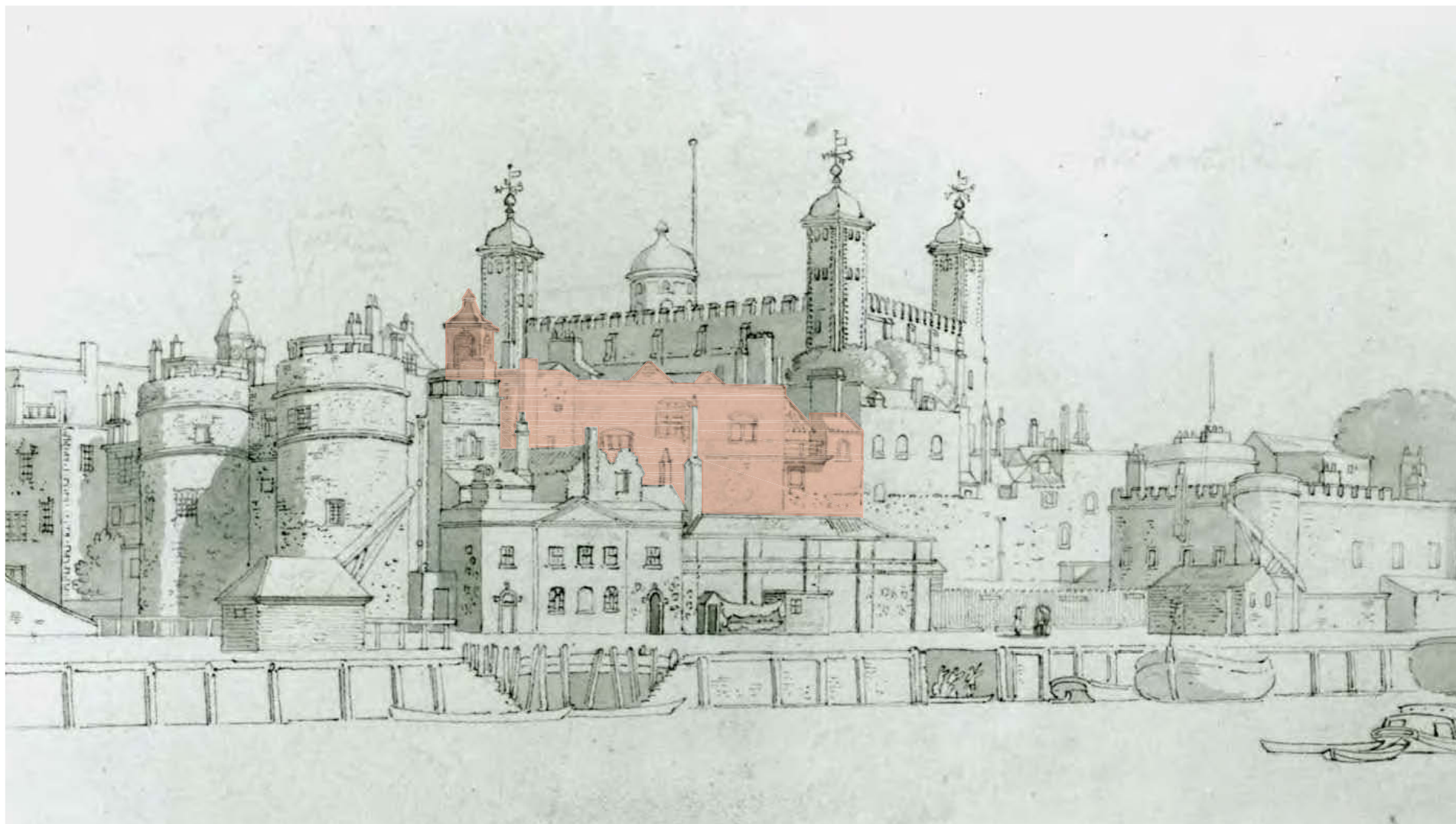


Figure 7a  
View of the Queen's House from the south, from William Maitland's History and Survey of London  
(1756) showing the mullion and transom windows and the balcony that was added in 1669-70  
(no scale)





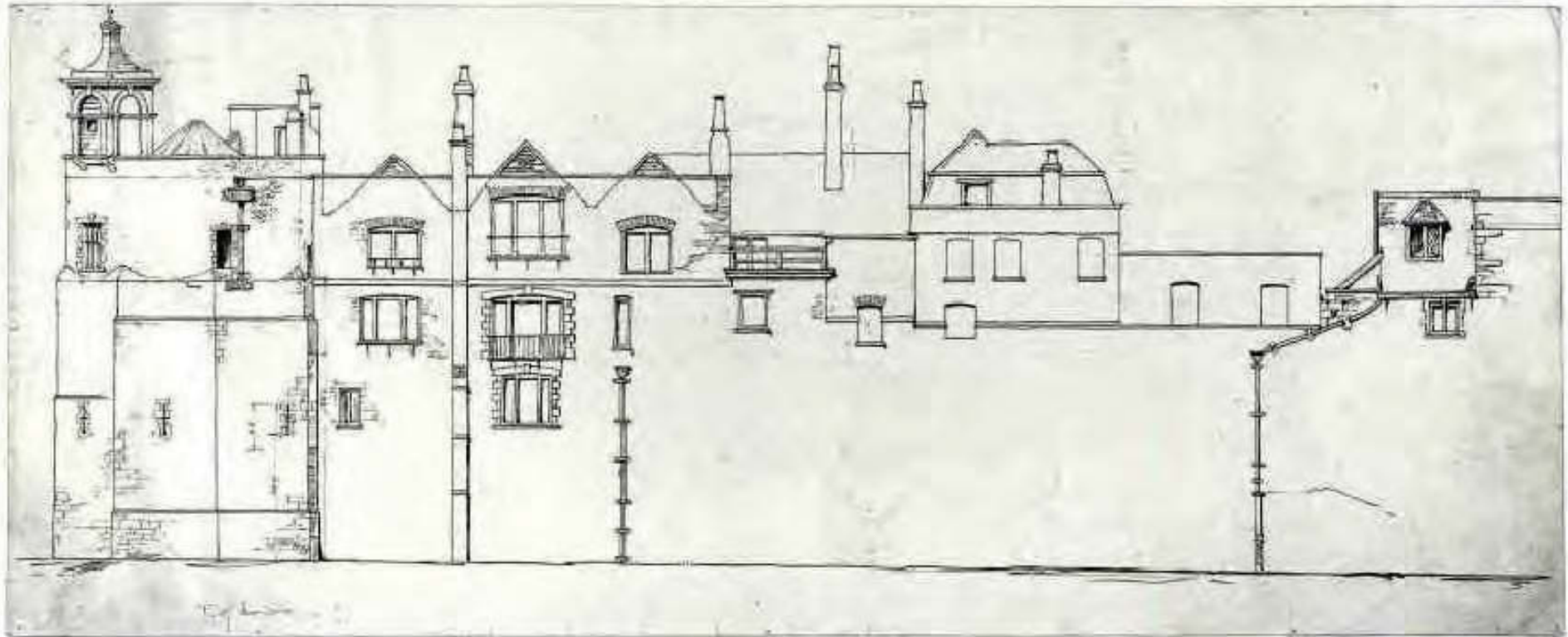


Figure 8  
South elevation of the Bell Tower and Inner Curtain Wall c.1860 by Anthony Salvin  
(Royal Armouries A2/543)  
(no scale)



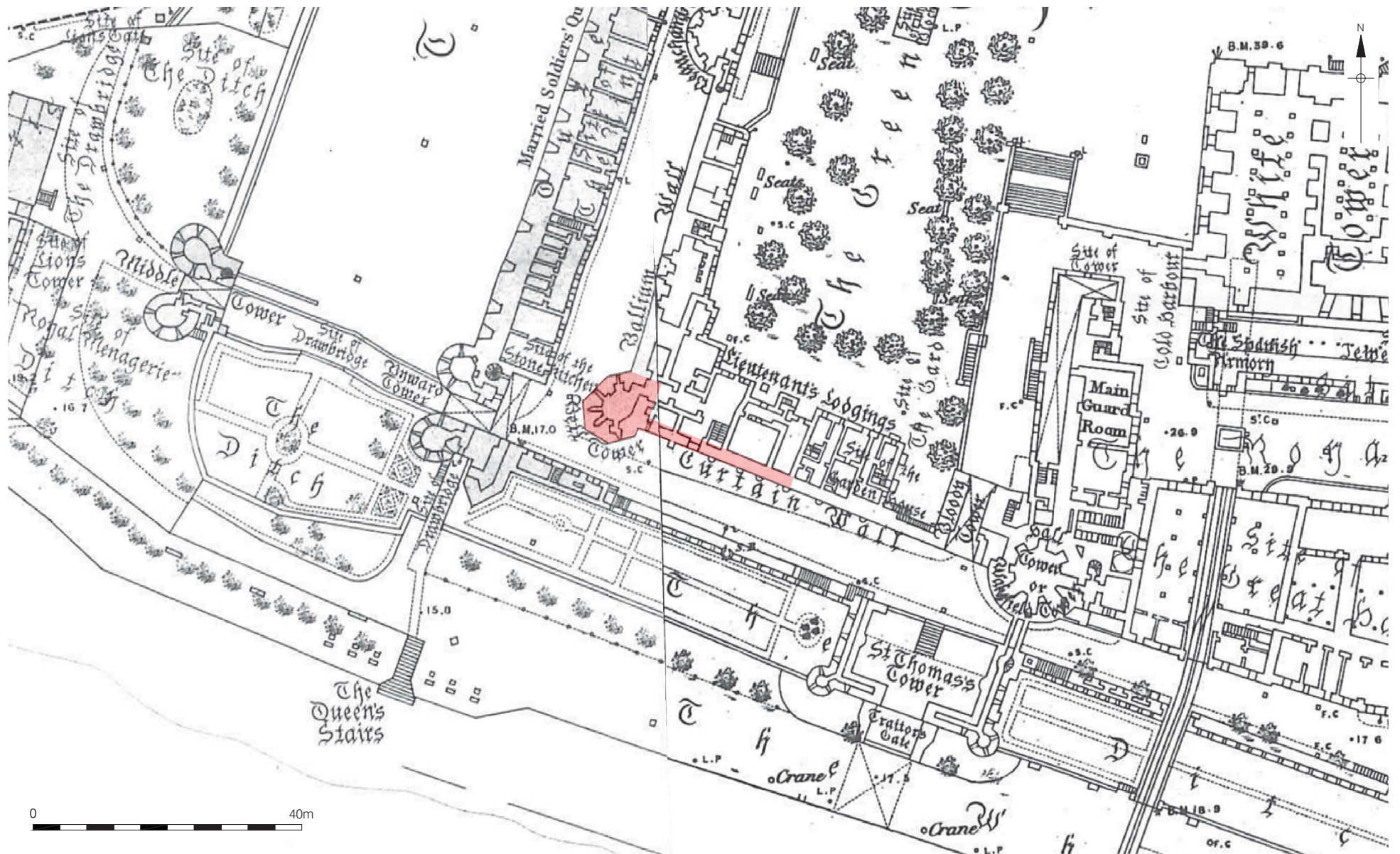


Figure 9  
First Edition Ordnance Survey map, 1872-73  
1:800 at A4



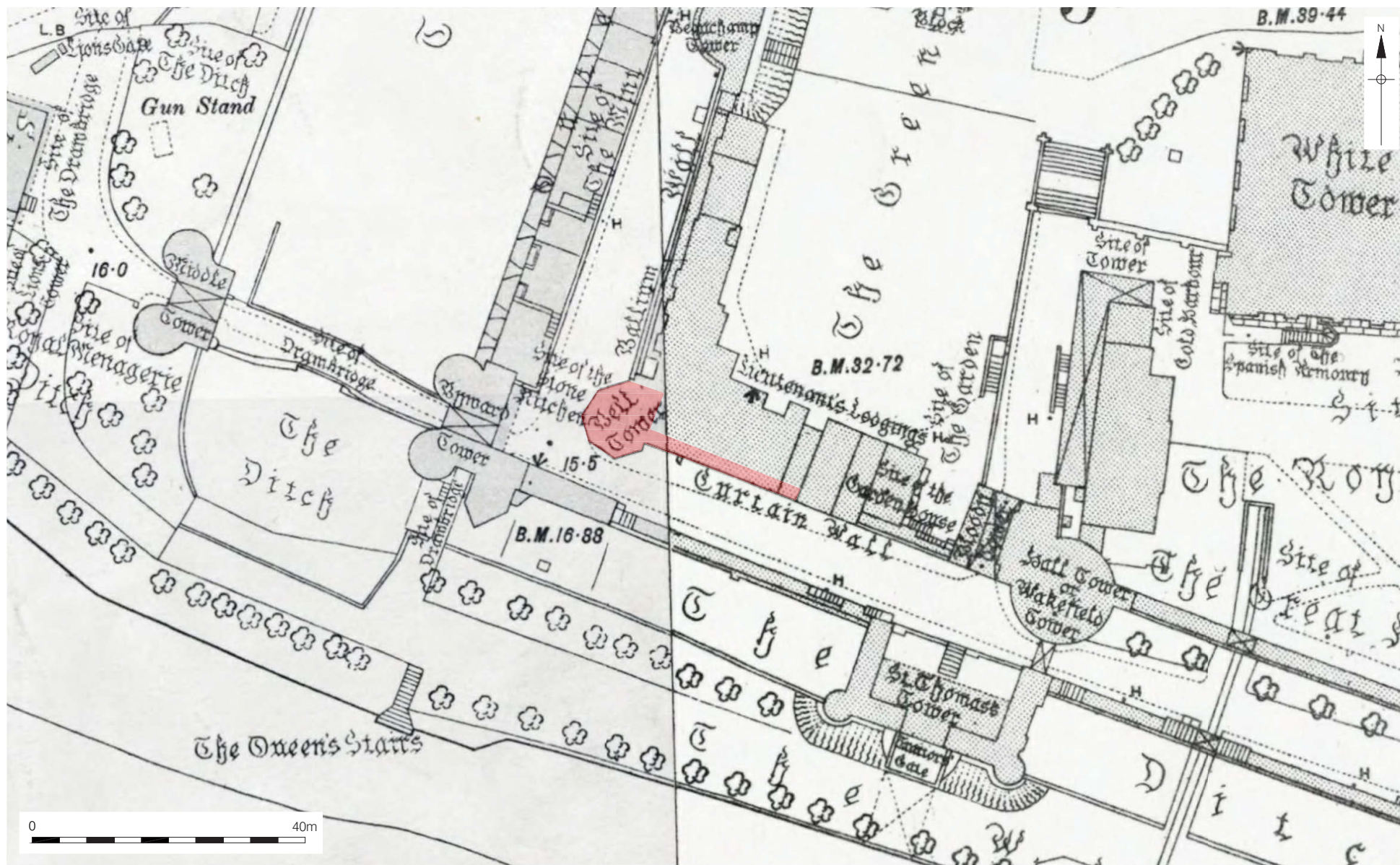
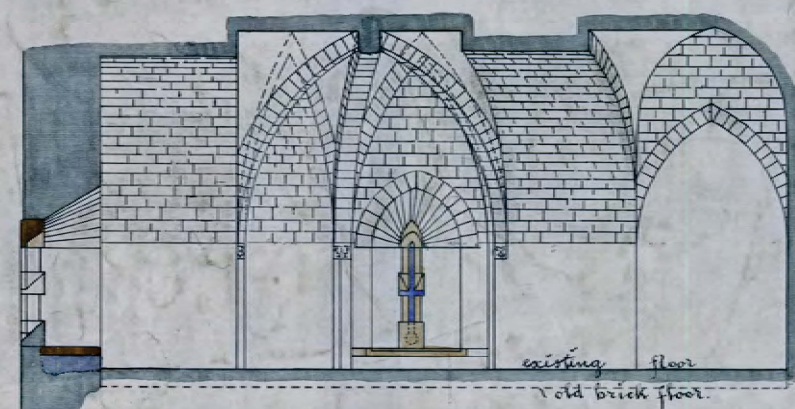


Figure 10  
Second Edition Ordnance Survey map, 1896  
1:800 at A4

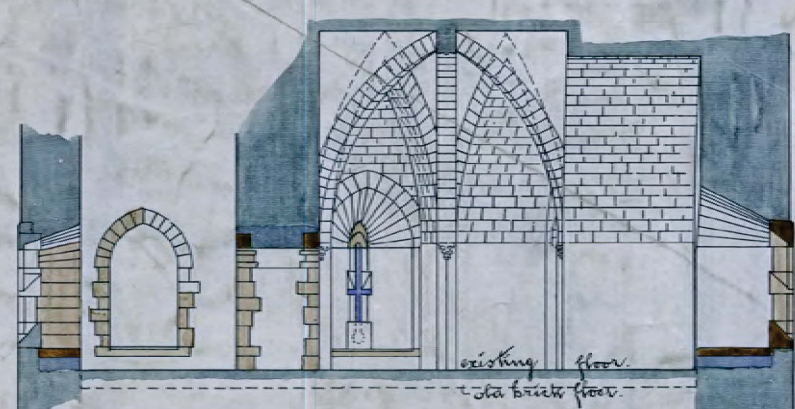


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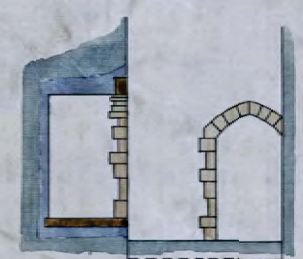
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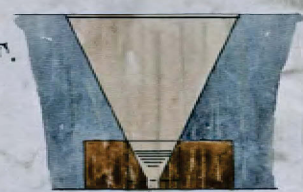
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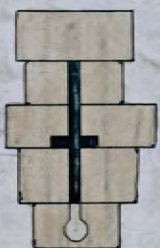
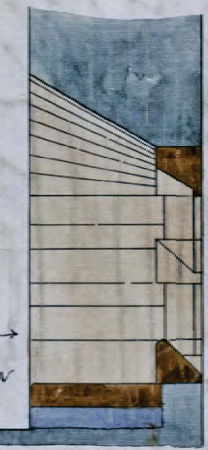
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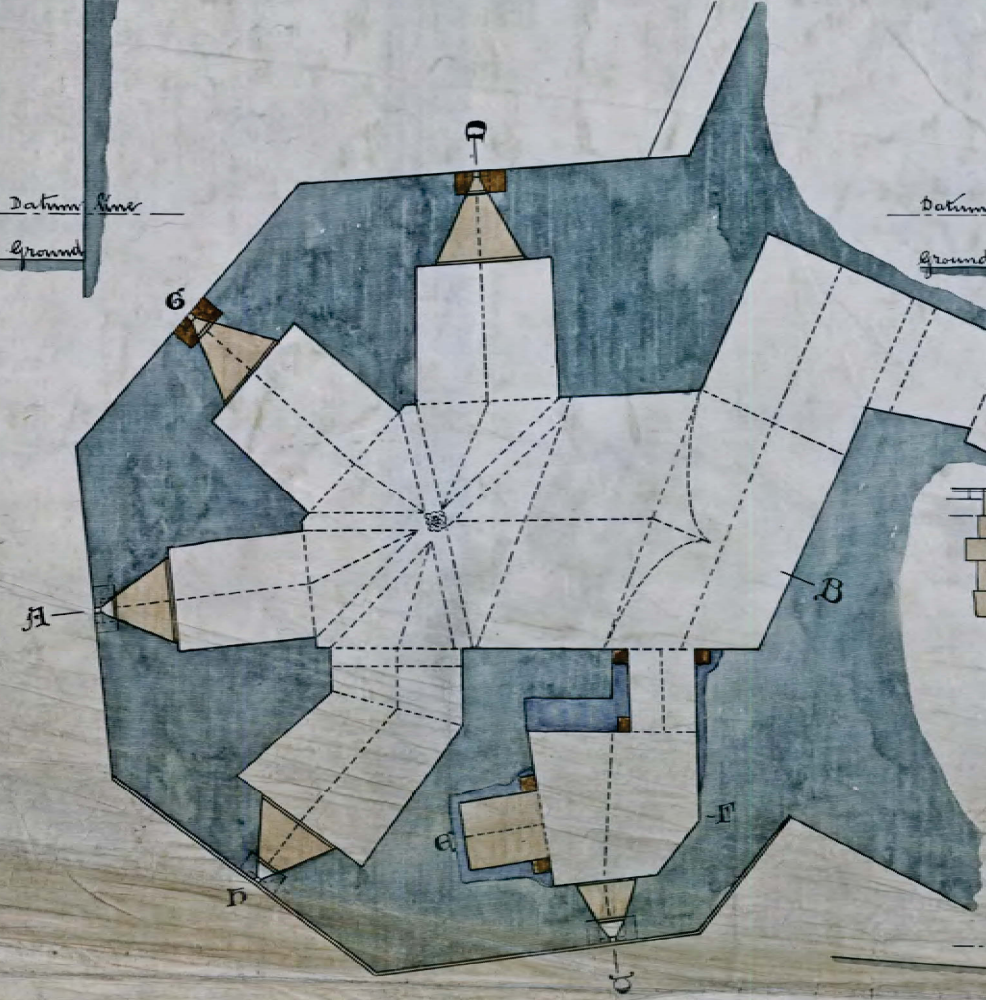
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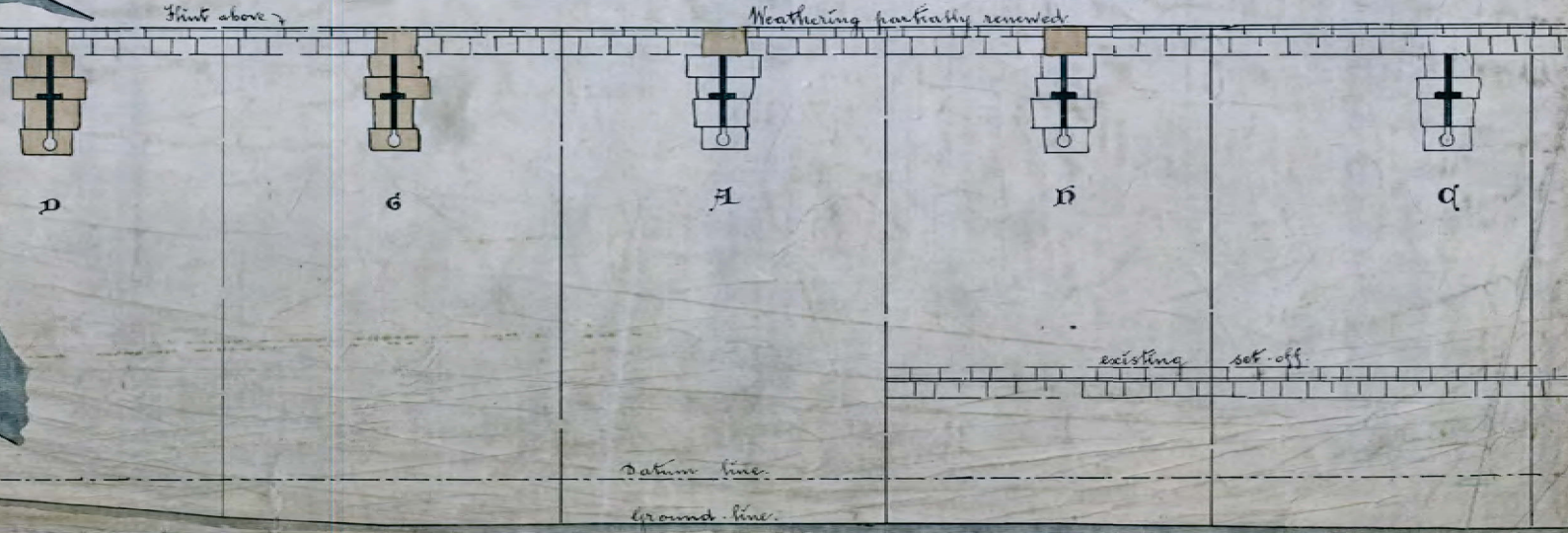
Plan



Outside



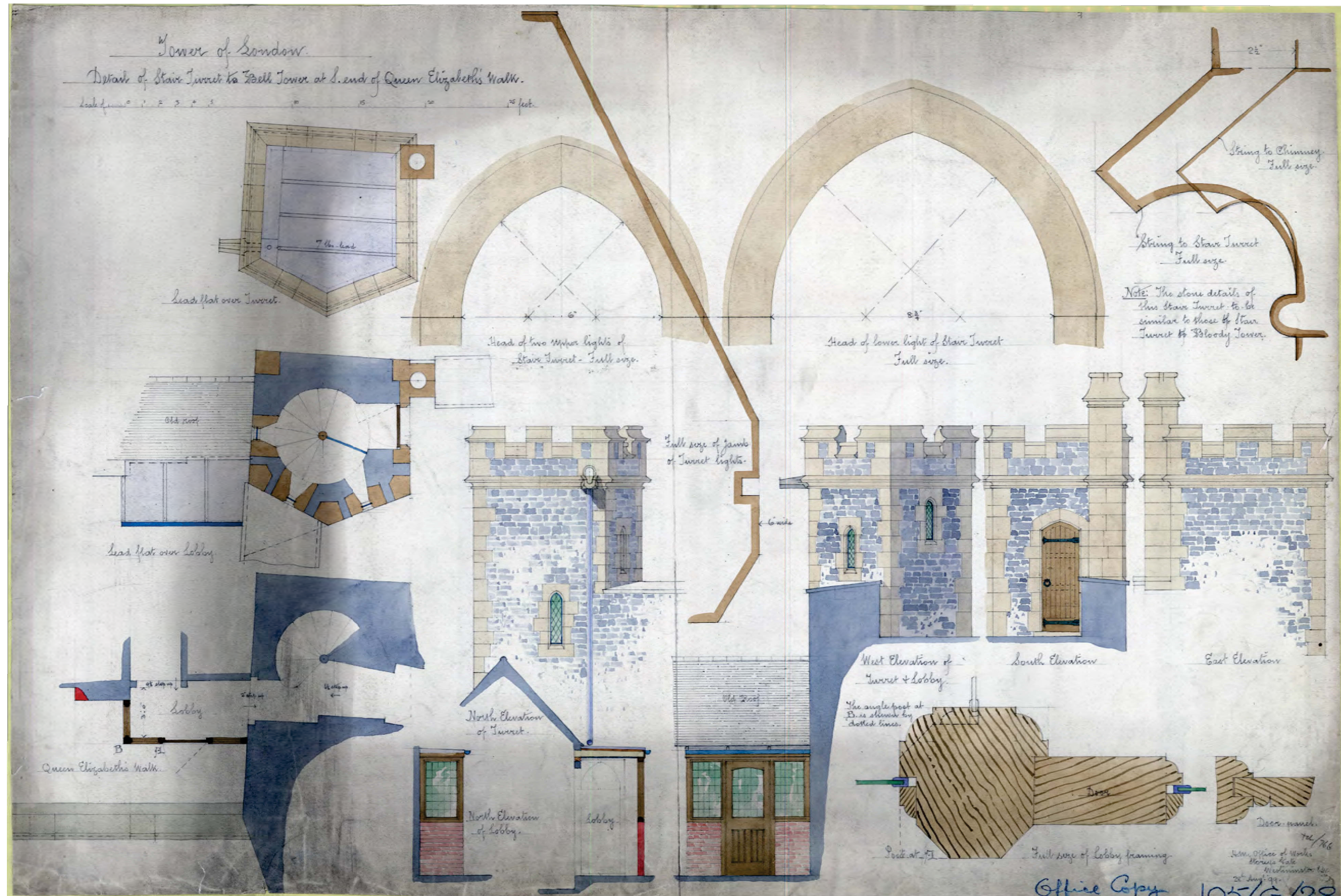
Plan of ground floor



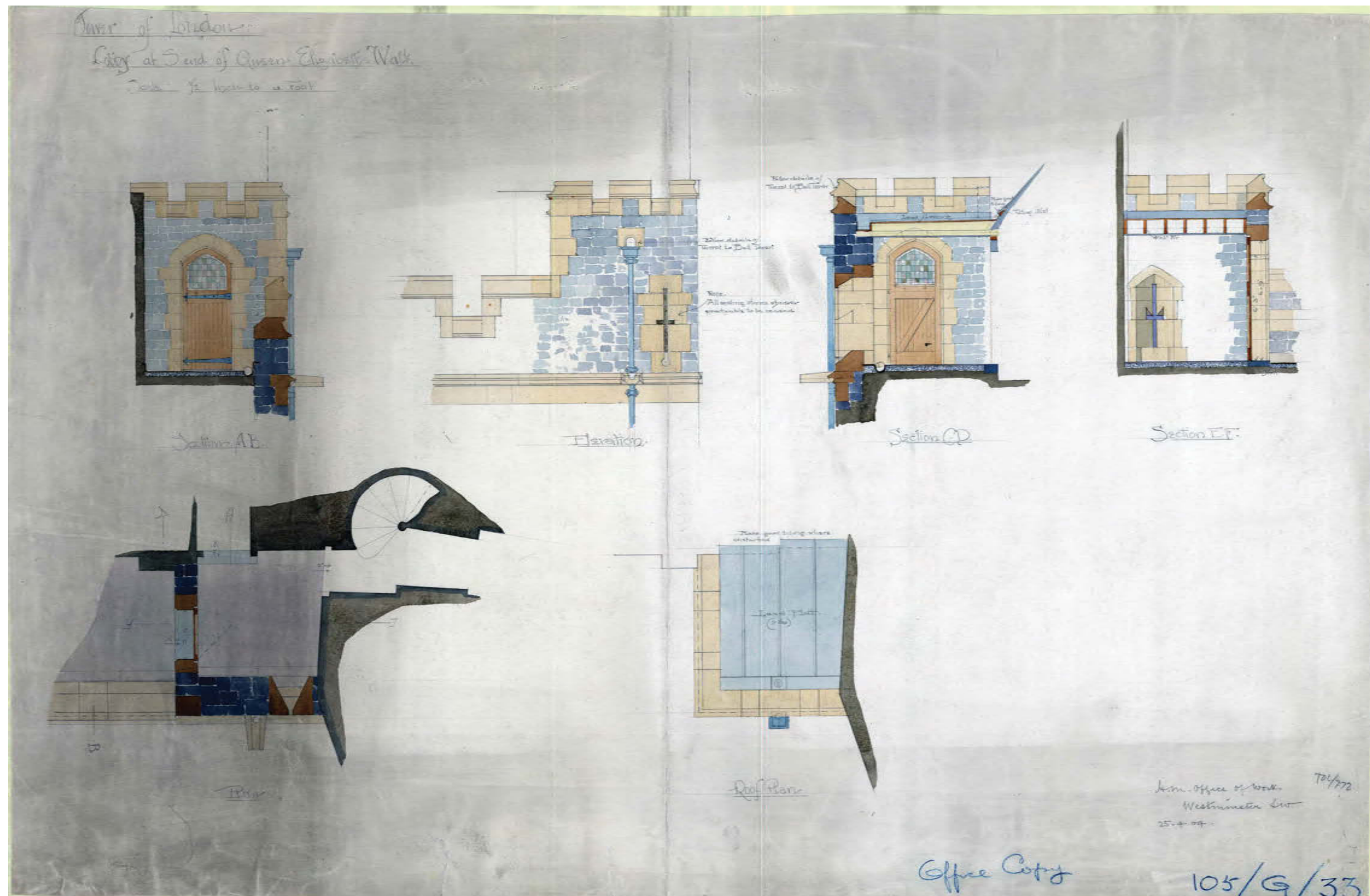
Projected elevation of lower portion of Bell Tower

TOL/762 105/2/101

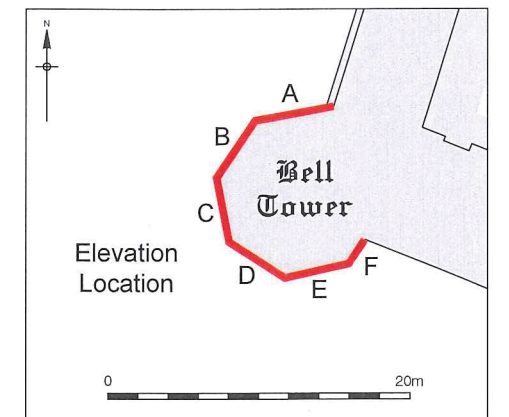






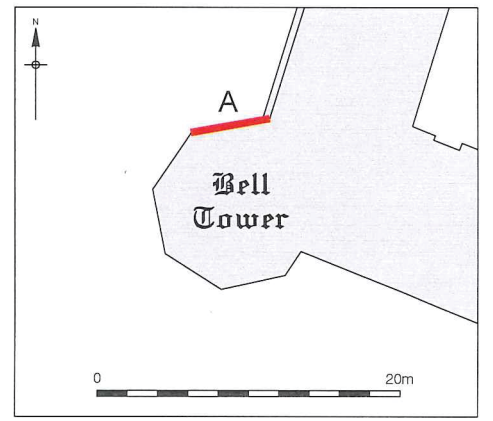
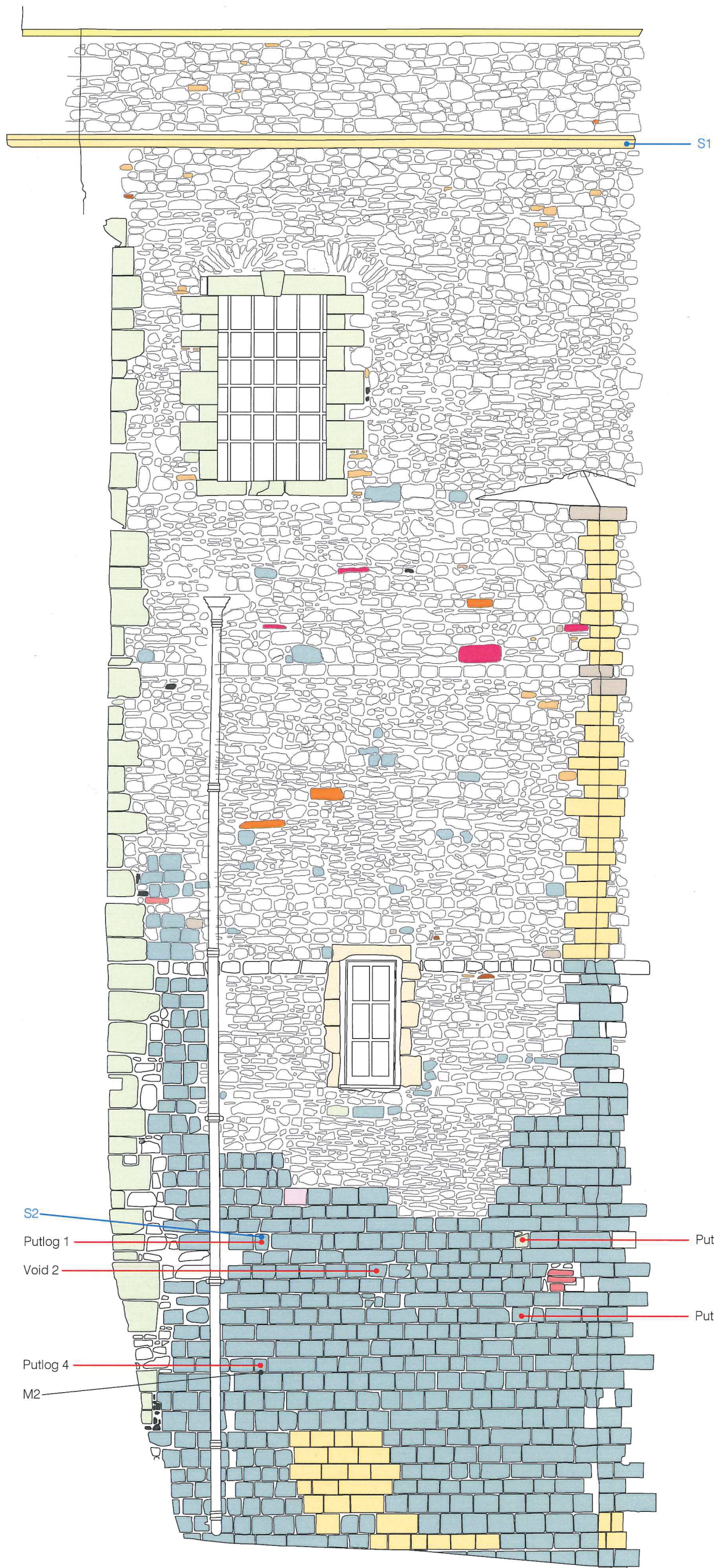






- |                                 |                                 |
|---------------------------------|---------------------------------|
| Aberdeen Granite                | Muddy Mollusc Rock              |
| Basalt                          | Portland stone                  |
| Bath Stone                      | Purbeck Limestone               |
| Caen stone                      | Purbeck Limestone - Thornback   |
| Chalk                           | Purbeck Limestone - Broken Beds |
| Chilmark Stone                  | Purbeck Marble                  |
| Kentish Ragstone                | Quarrstone                      |
| Poor quality Kentish Ragstone   | Reigate stone                   |
| Ketton stone                    | Portland stone                  |
| Magnesian Limestone             | Sarsen                          |
| Magnesian Limestone - yellow    | Sussex Marble                   |
| Magnesian Limestone - oolitic   | Taynton stone                   |
| Magnesian Limestone - laminated | Thanet Sandstone                |
| Metagabbro                      | York stone                      |
| Medieval brick                  | Roman Brick                     |
| Post-Medieval Peg Tile          |                                 |

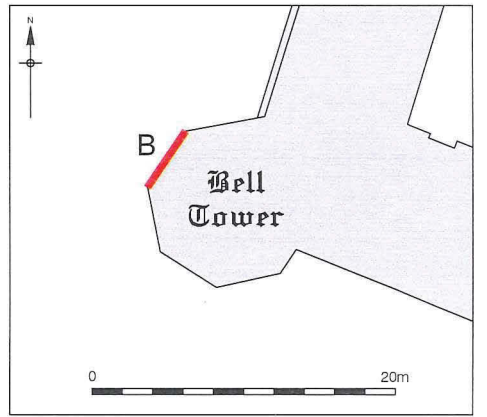
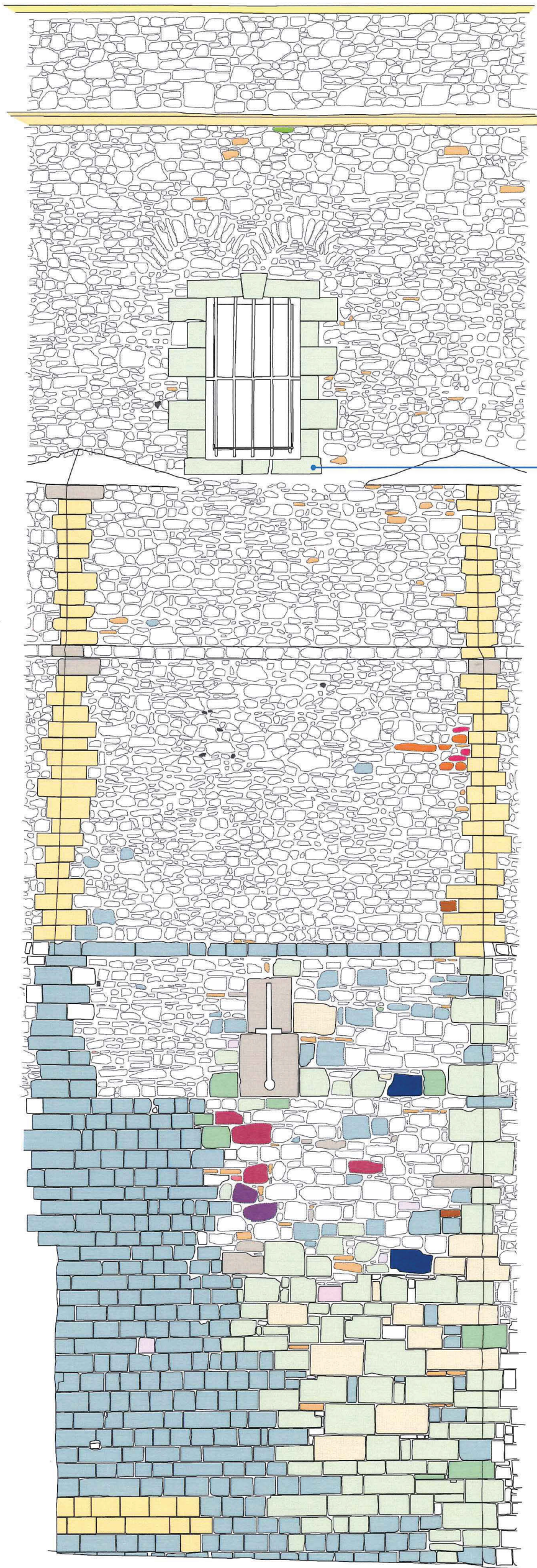




- Chilmark Stone
- Flint
- Kentish Ragstone
- Poor quality Kentish Ragstone
- Magnesian Limestone
- Portland stone
- Purbeck Limestone
- Purbeck Marble
- Purbeck Limestone - Thornback
- Reigate stone
- Sussex Marble
- Taynton stone
- York stone
- Roman Brick
- Medieval brick

- Mortar sample
- Stone sample
- Putlog Location

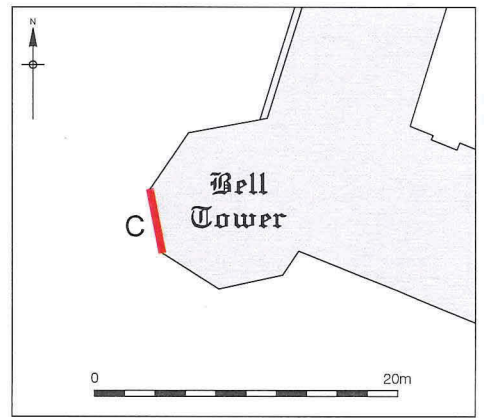
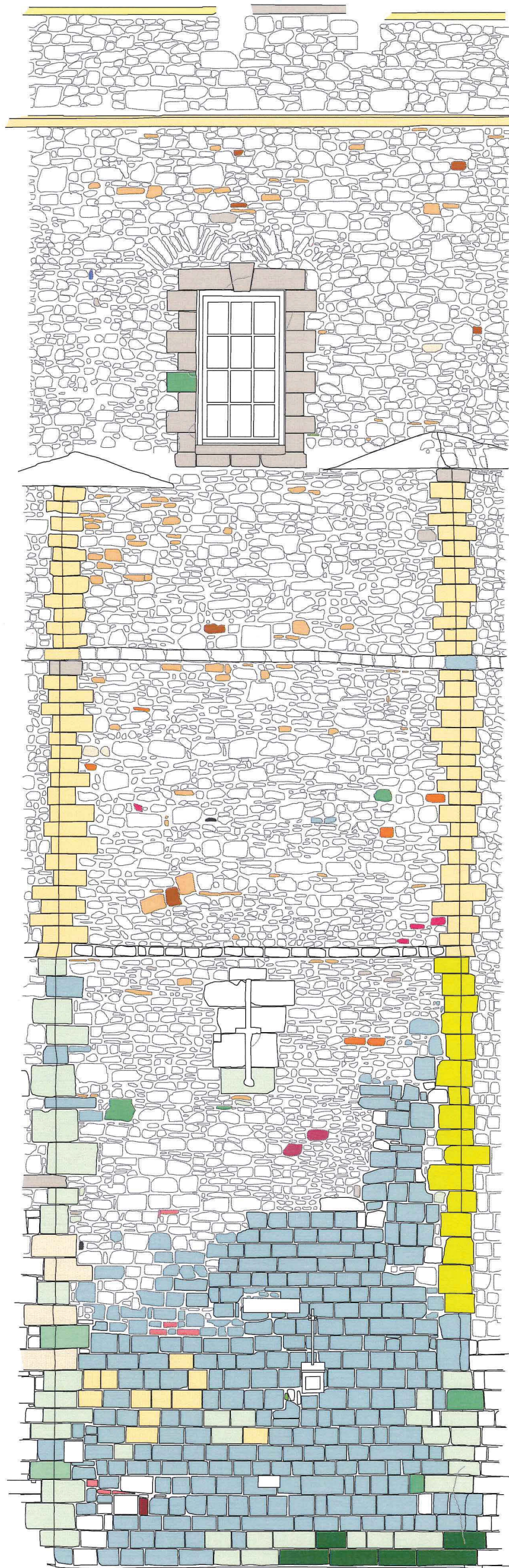




- Chalk
- Chilmark Stone
- Flint
- Kentish Ragstone
- Poor quality Kentish Ragstone
- Magnesian Limestone
- Magnesian Limestone - yellow
- Muddy Mollusc Rock
- Portland stone
- Purbeck Limestone
- Purbeck Limestone - Thornback
- Purbeck Marble
- Quarrstone
- Reigate stone
- Sussex Marble
- Taynton stone
- Thanet Sandstone
- York stone
- Roman Brick
- Medieval brick
- Post-Medieval Peg Tile

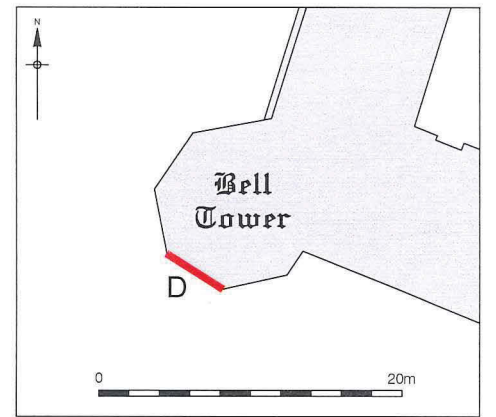
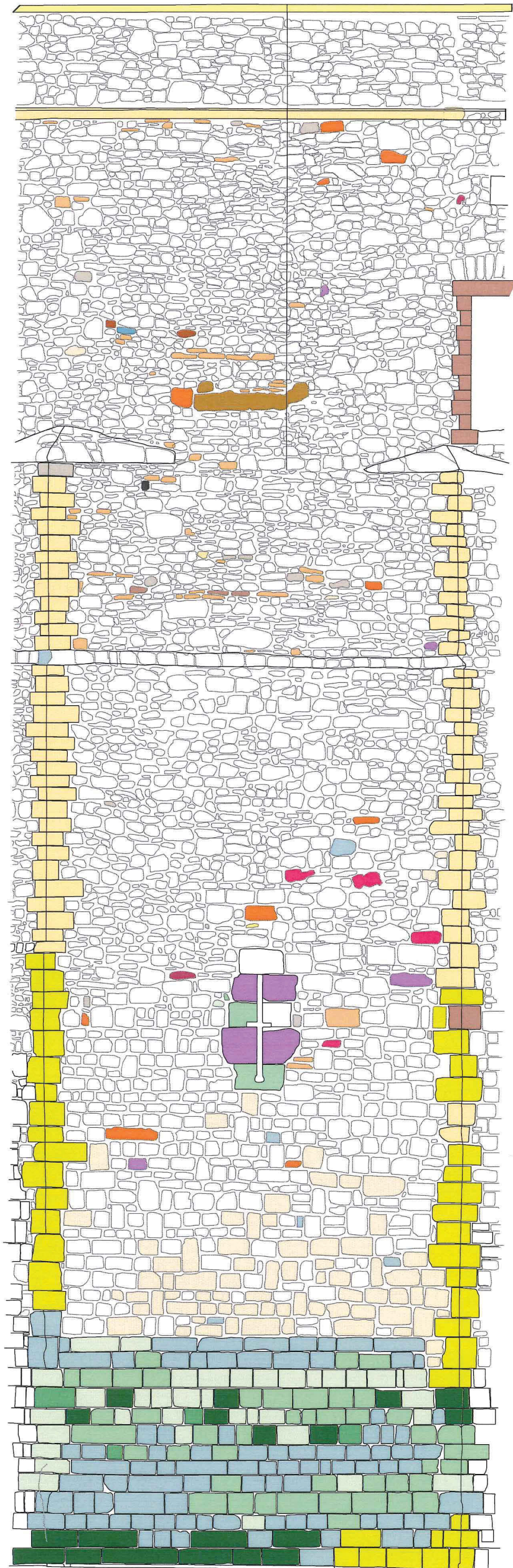
Stone sample





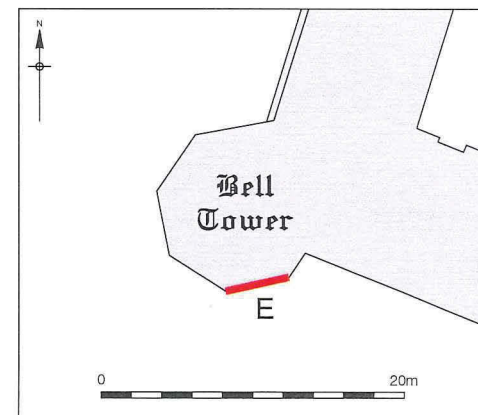
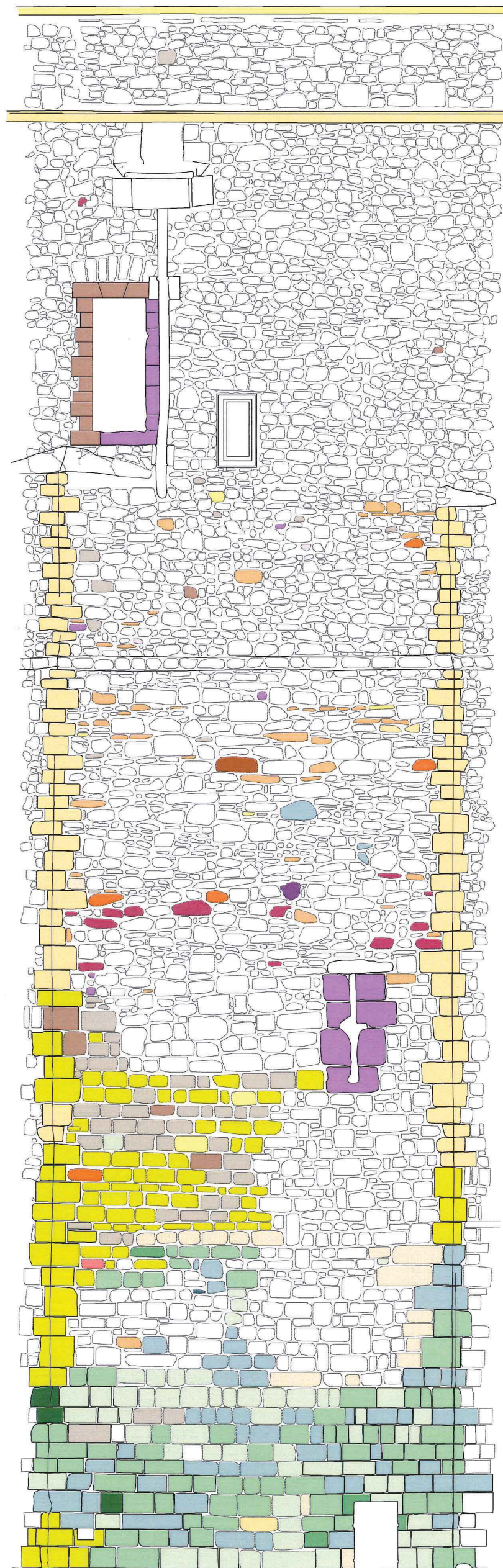
- Basalt
- Chilmark Stone
- Flint
- Kentish Ragstone
- Poor quality Kentish Ragstone
- Ketton stone
- Magnesian Limestone
- Magnesian Limestone - yellow
- Magnesian Limestone - oolitic
- Magnesian Limestone - laminated
- Metagabbro
- Portland stone
- Purbeck Limestone
- Purbeck Limestone - Thornback
- Purbeck Marble
- Reigate stone
- Sussex Marble
- Thanet Sandstone
- York stone
- Medieval brick
- Post-Medieval Peg Tile





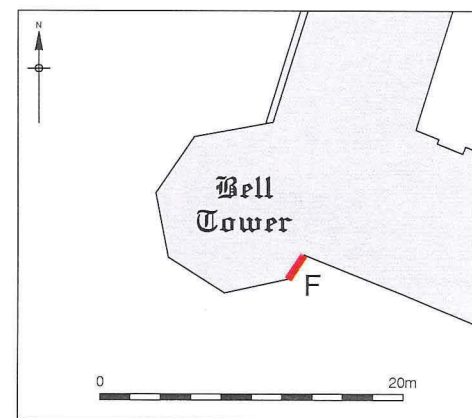
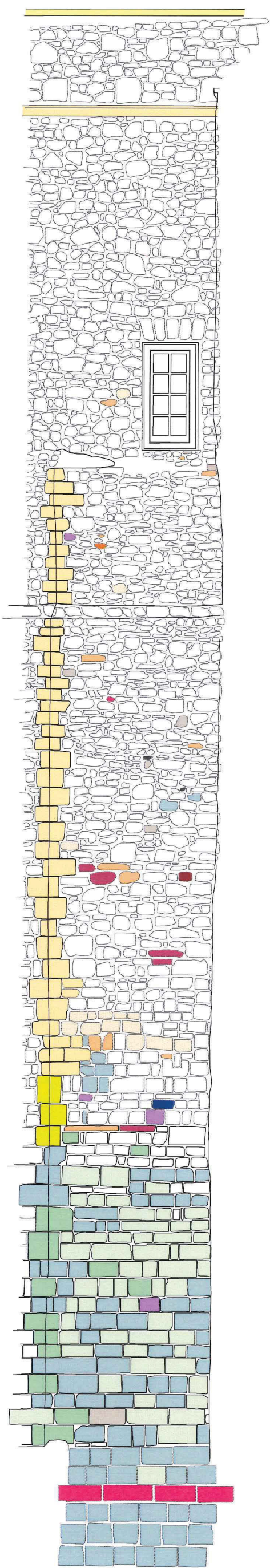
- Bath Stone
- Caen stone
- Chilmark Stone
- Flint
- Kentish Ragstone
- Poor quality Kentish Ragstone
- Ketton stone
- Magnesian Limestone
- Magnesian Limestone - yellow
- Magnesian Limestone - oolitic
- Magnesian Limestone - laminated
- Portland stone
- Purbeck Limestone
- Purbeck Limestone - Thornback
- Purbeck Limestone - Broken Beds
- Purbeck Marble
- Reigate stone
- Sarsen
- Sussex Marble
- Thanet Sandstone
- York stone





- Aberdeen Granite
- Bath Stone
- Caen stone
- Chalk
- Chilmark Stone
- Kentish Ragstone
- Poor quality Kentish Ragstone
- Ketton stone
- Magnesian Limestone
- Magnesian Limestone - yellow
- Magnesian Limestone - oolitic
- Magnesian Limestone - laminated
- Muddy Mollusc Rock
- Purbeck Limestone
- Purbeck Limestone - Thornback
- Purbeck Marble
- Reigate stone
- Portland stone
- Thanet Sandstone
- York stone
- Medieval brick





- Basalt
- Caen stone
- Chilmark Stone
- Flint
- Kentish Ragstone
- Poor quality Kentish Ragstone
- Ketton stone
- Magnesian Limestone
- Magnesian Limestone - yellow
- Purbeck Limestone
- Purbeck Marble
- Portland stone
- Quarrstone
- Reigate stone
- Sussex Marble
- Thanet Sandstone
- York stone

- Clipsham/Dundry Stone
- Kentish Ragstone
- Ketton stone

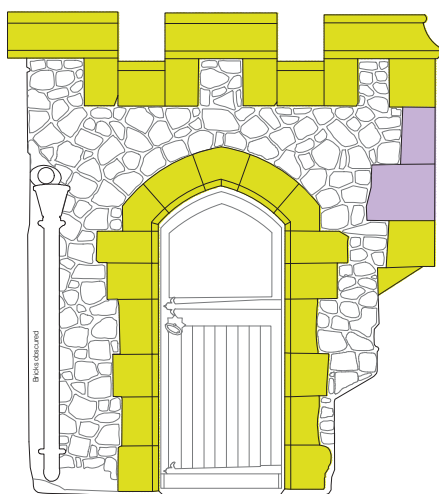
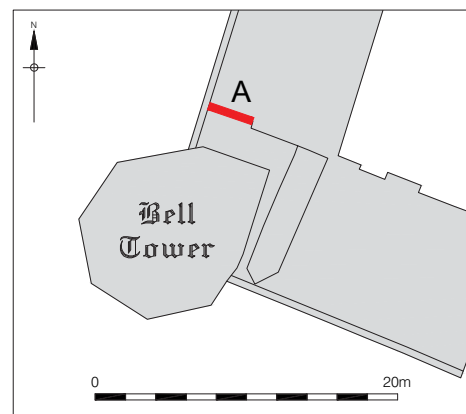


Figure 21  
 Stone types in North Elevation A of the  
 c.1904 porch to the Bell Tower  
 Elevation - 1:50 and Inset - 1:500 at A4

Basalt	Quarrstone	Fletton Brick
Caen stone	Reigate stone	Modern Replacement Brick
Chilmark Stone	Sarsen	Post-Great Fire Brick
Flint	Taynton stone	Post-Medieval Peg Tile
Kentish Ragstone	York stone	Tudor brick
Portland stone		
Purbeck Limestone		

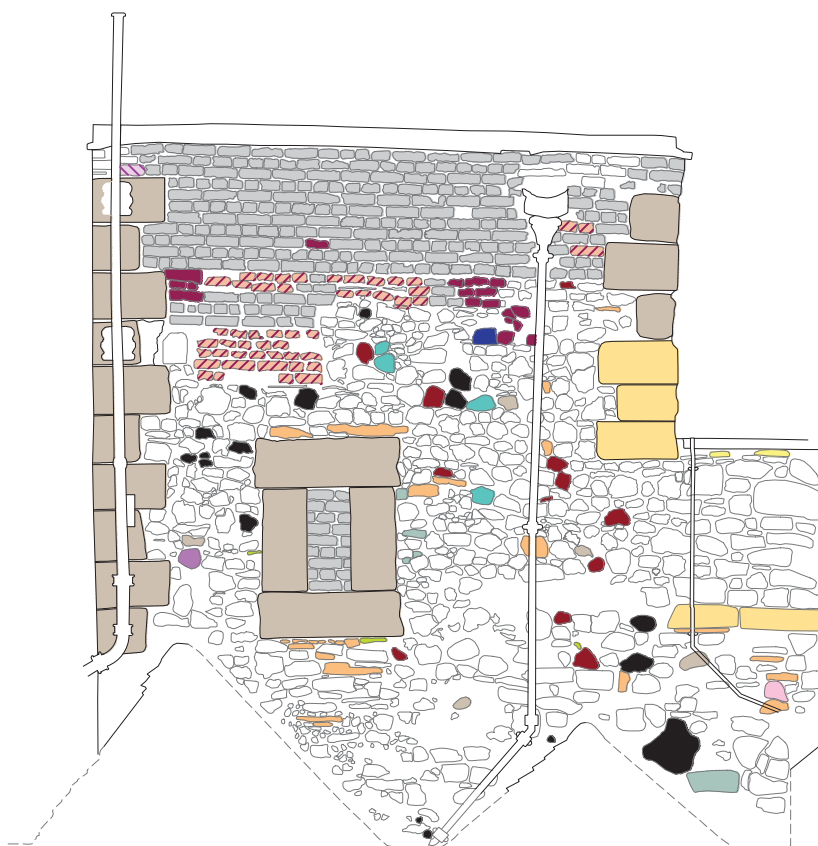
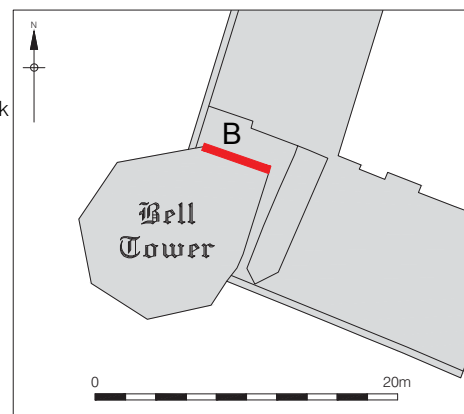























Figure 22  
Stone and brick types in the North Elevation B of the  
Stair Turret to the Bell Tower  
Elevation - 1:50 and Inset - 1:500 at A4

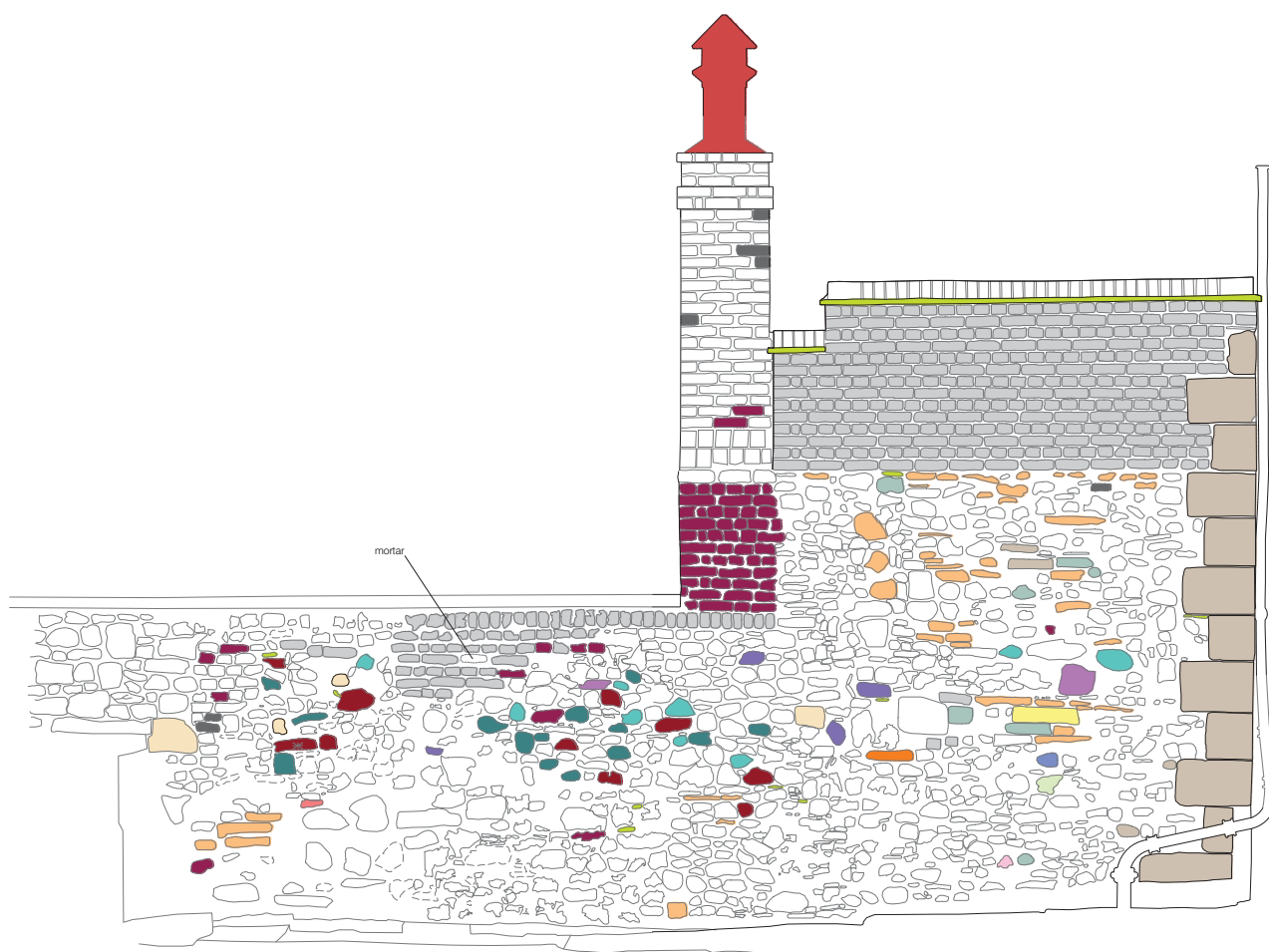
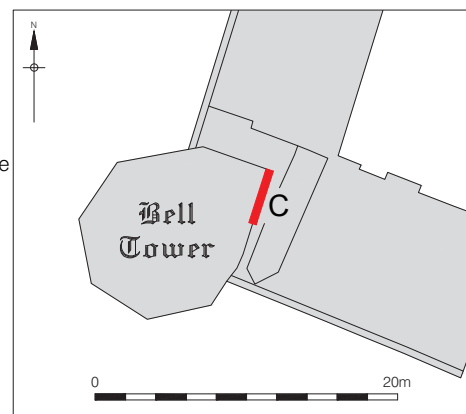


Figure 23  
Stone and brick types in the East Elevation C of the  
Stair Turret to the Bell Tower  
Elevation - 1:50 and Inset - 1:500 at A4

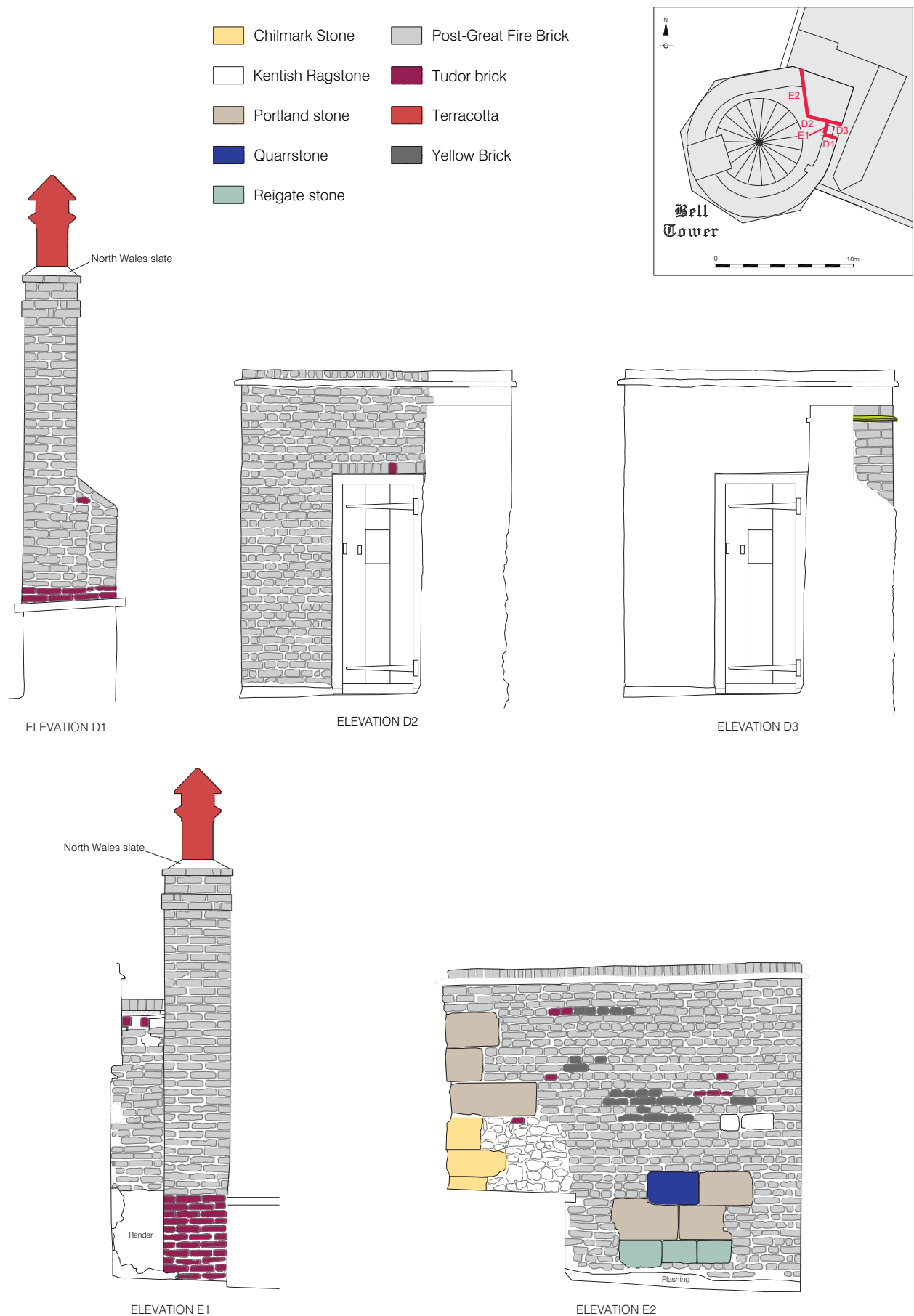
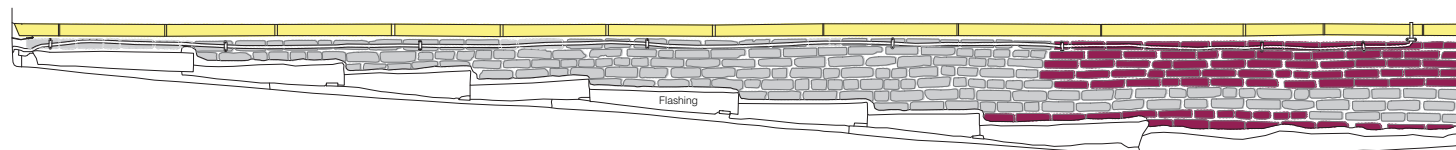
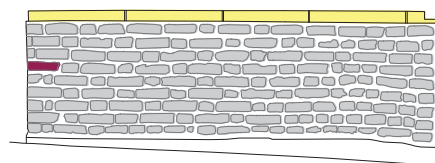


Figure 24  
Stone and brick types in Elevations D1 to D3 and E1 and E2 of the  
Stair Turret to the Bell Tower  
Elevations - 1:50 and Inset - 1:400 at A4

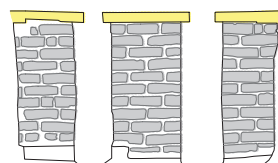




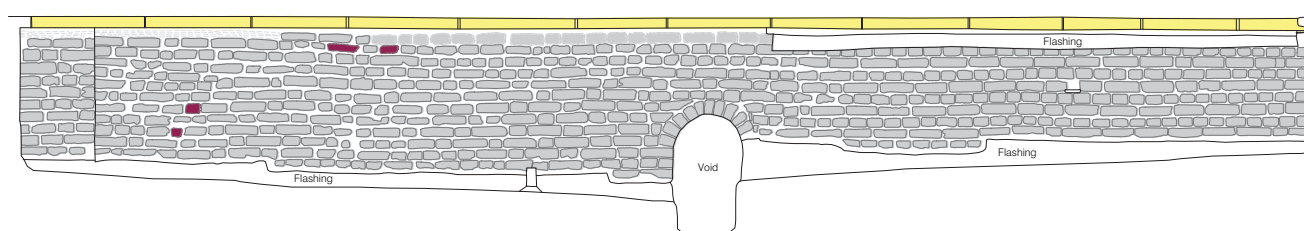
ELEVATION F1



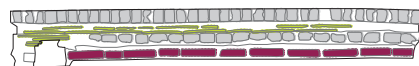
ELEVATION F2



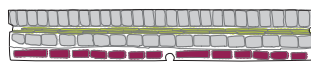
ELEVATION F3



ELEVATION F4



ELEVATION G1



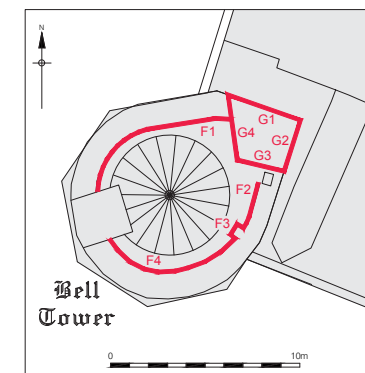
ELEVATION G2



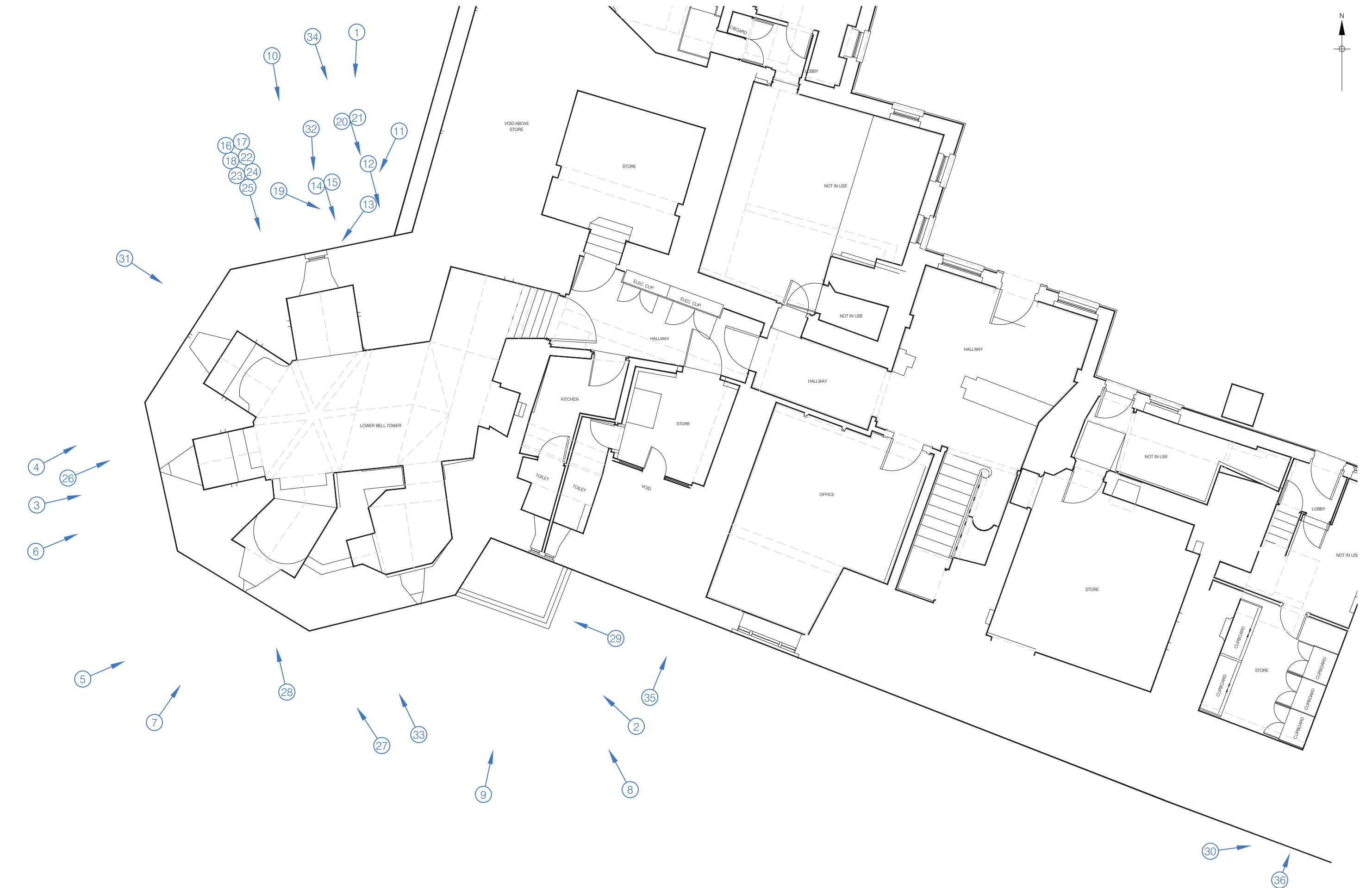
ELEVATION G3







ELEVATION G4



- York stone
- Post-Great Fire Brick
- Tudor brick

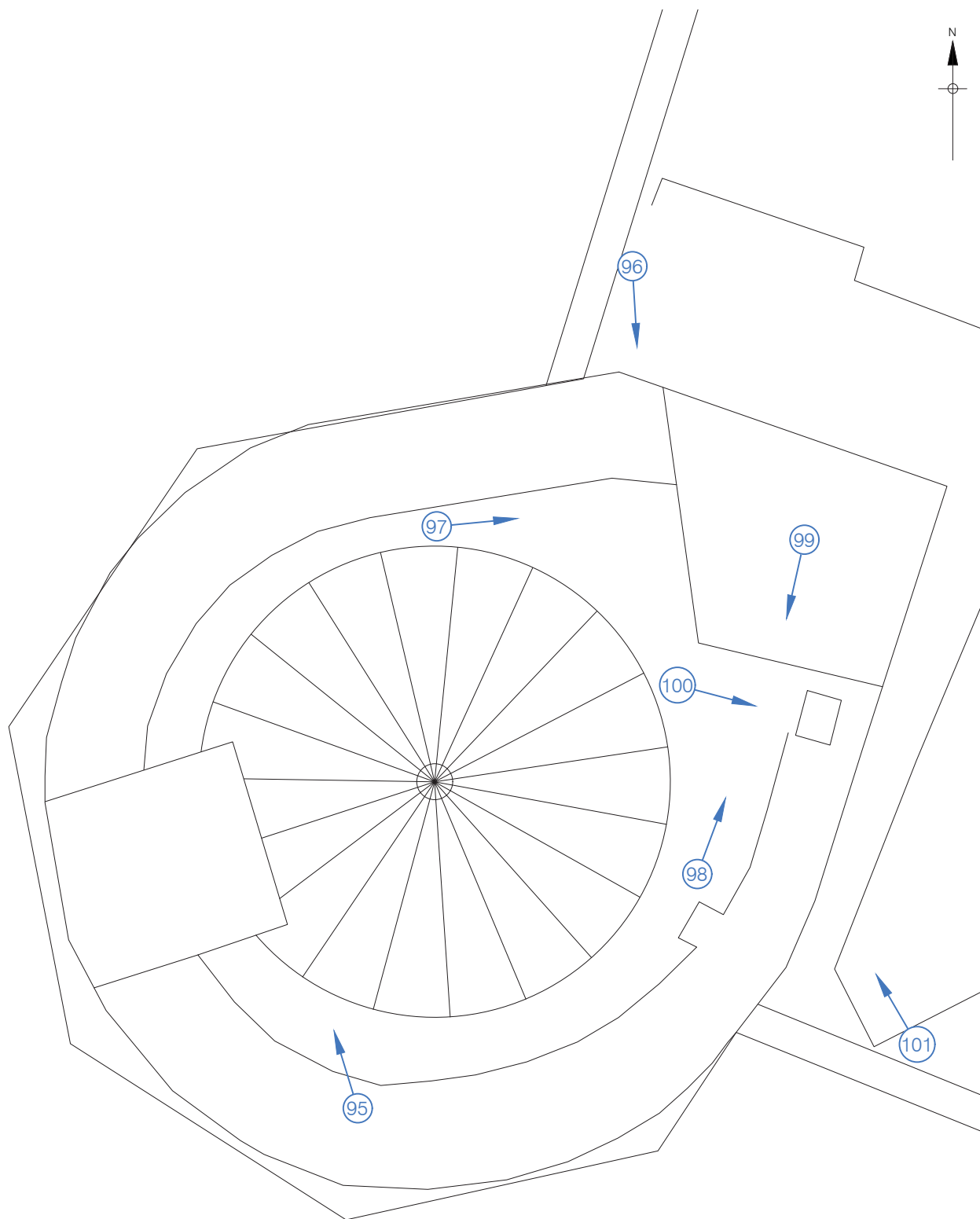




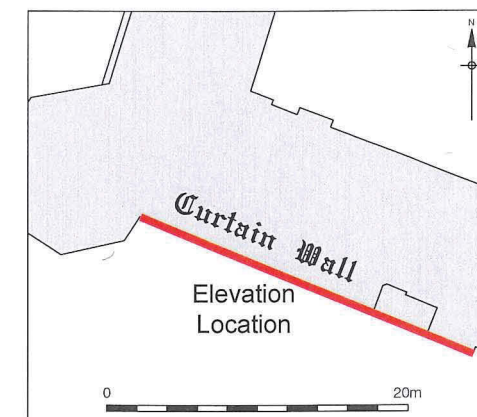
-  Plate image above
-  Plate in upper stairwell
-  1904
-  19th Century

0 2.5m

Figure 27  
Plan of the upper Chamber of the Bell Tower with Plate Locations  
1:50 at A3

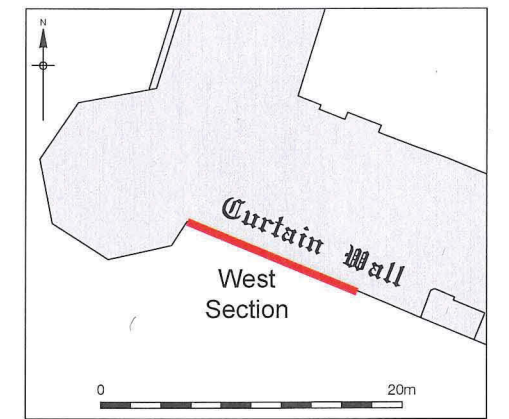
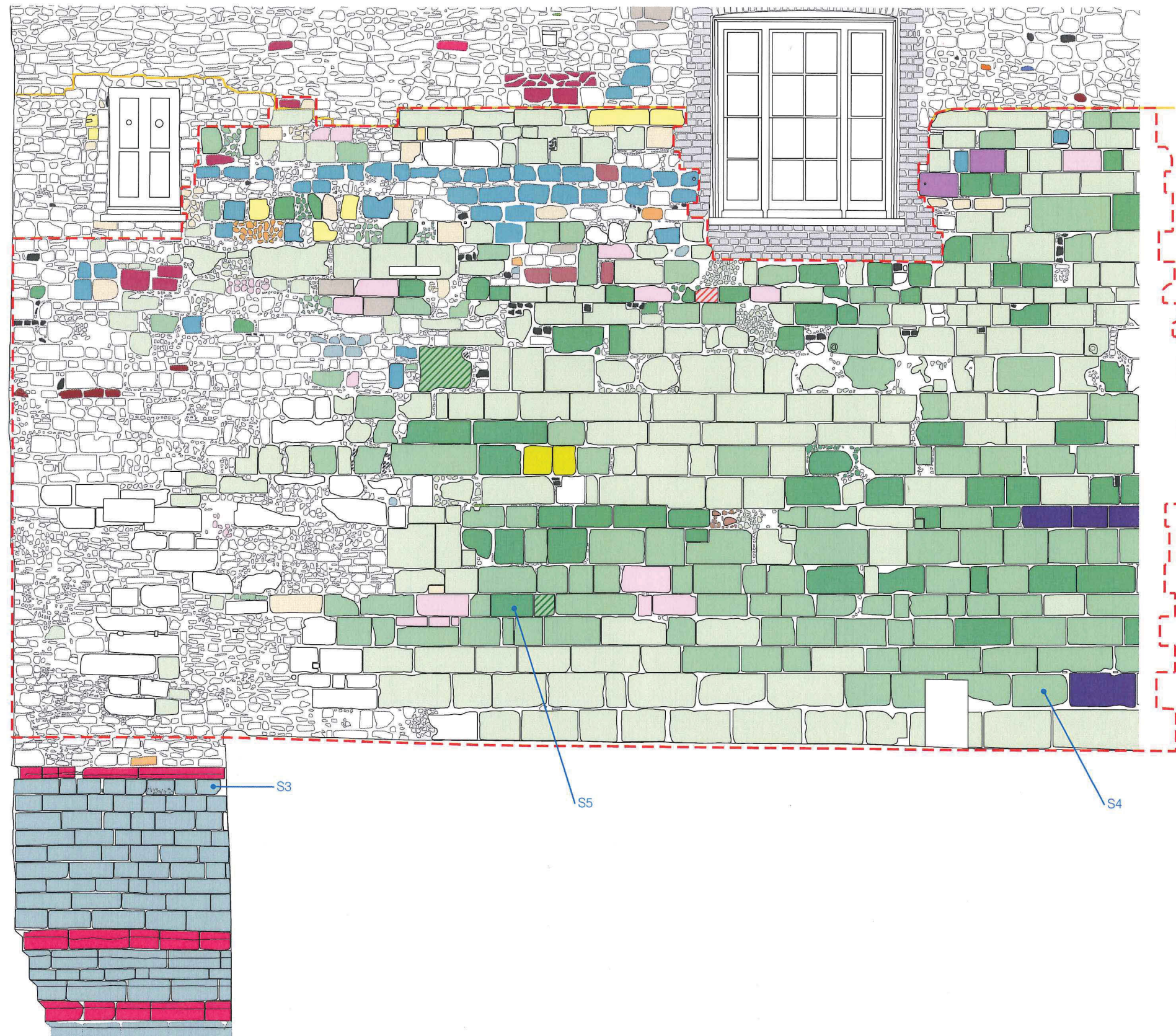






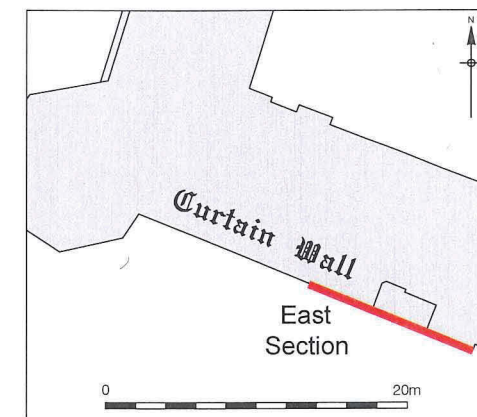
- |                               |                               |
|-------------------------------|-------------------------------|
| Aberdeen Granite              | Magnesian Limestone - oolitic |
| Ancaster Freestone            | Magnesian Limestone - orange  |
| Bargate stone                 | Metagabbro                    |
| Basalt                        | Portland stone                |
| Bath Stone                    | Purbeck Limestone             |
| Bembridge Limestone           | Purbeck Marble                |
| Caen stone                    | Purbeck Limestone - Thornback |
| Carboniferous Sandstone       | Raised Beach Deposit          |
| Chilmark Stone                | Reigate stone                 |
| Flint                         | Sarsen                        |
| Kentish Ragstone              | Sussex Marble                 |
| Poor quality Kentish Ragstone | Taynton stone                 |
| Ketton stone                  | Thanet Sandstone              |
| Magnesian Limestone           | Tufa                          |
| Magnesian Limestone - yellow  | York stone                    |
| Medieval brick                | Terracotta                    |
| Post-Great Fire Brick         | Tudor brick                   |
| Post-Medieval Peg Tile        | Yellow Brick                  |
| Roman Brick                   |                               |





- |                                 |                     |
|---------------------------------|---------------------|
| ■ Ancaster Freestone            | ■ Metagabbro        |
| ■ Basalt                        | ■ Portland stone    |
| ■ Bath Stone                    | ■ Purbeck Limestone |
| ■ Bembridge Limestone           | ■ Purbeck Marble    |
| ■ Caen stone                    | ■ Reigate stone     |
| ■ Carboniferous Sandstone       | ■ Sarsen            |
| ■ Chilmark Stone                | ■ Sussex Marble     |
| ■ Flint                         | ■ Taynton stone     |
| ■ Kentish Ragstone              | ■ Thanet Sandstone  |
| ■ Poor quality Kentish Ragstone | ■ York stone        |
| ■ Ketton stone                  |                     |
| ■ Magnesian Limestone           |                     |
| ■ Magnesian Limestone - yellow  |                     |
| ■ Magnesian Limestone - oolitic |                     |
| ■ Magnesian Limestone - orange  |                     |
| ■ Raised Beach Deposit          |                     |
| ■ Post-Great Fire Brick         |                     |
| ■ Post-Medieval Peg Tile        |                     |
| □ Area of Flint Galletting      |                     |
| — Major Construction Break      |                     |
| ● Stone sample                  |                     |





- Ancaster Freestone
- Bargate stone
- Bath Stone
- Caen stone
- Flint
- Kentish Ragstone
- Ketton stone
- Magnesian Limestone
- Magnesian Limestone - yellow
- Magnesian Limestone - oolitic
- Metagabbro
- Portland stone
- Purbeck Limestone
- Purbeck Marble
- Purbeck Limestone - Thornback
- Raised Beach Deposit
- Sussex Marble
- Taynton stone
- Thanet Sandstone
- Tufa
- Medieval brick
- Post-Great Fire Brick
- Post-Medieval Peg Tile
- Area of Flint Galletting
- Major Construction Break
- Construction Lifts

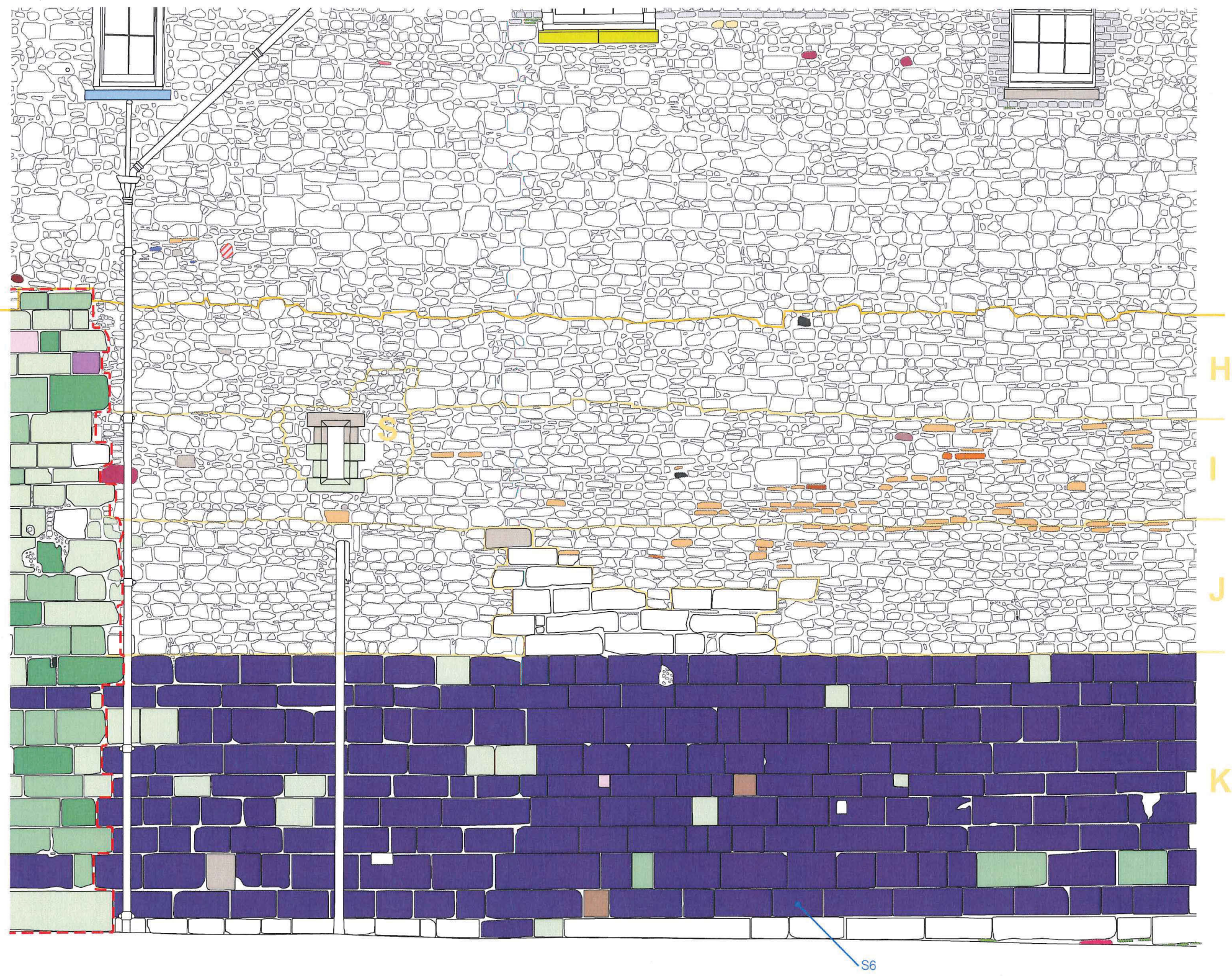
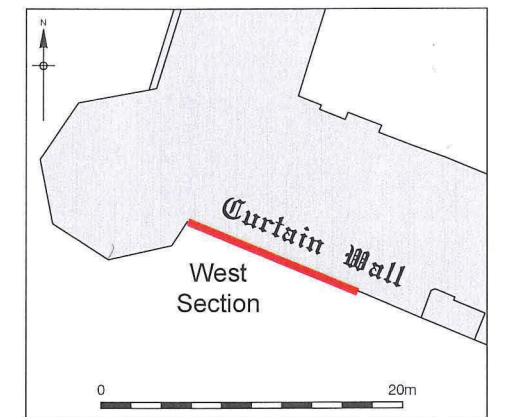


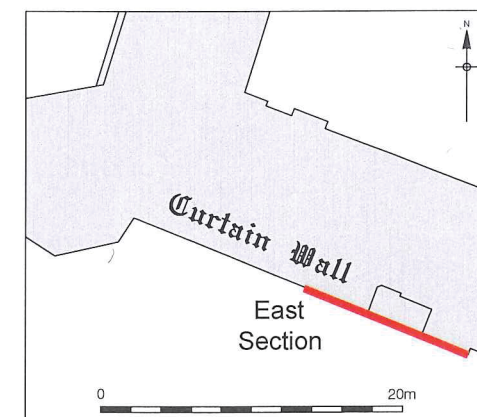
Figure 31  
Stone and brick types in the lower eastern section of the surveyed Curtain Wall  
Elevation - 1:50 and Inset - 1:500 at A3





- Aberdeen Granite
- Flint
- Kentish Ragstone
- Poor quality Kentish Ragstone
- Magnesian Limestone
- Magnesian Limestone - yellow
- Portland stone
- Purbeck Limestone
- Purbeck Marble
- Sarsen
- Sussex Marble
- Taynton stone
- Thanet Sandstone
- York stone
- Medieval brick
- Post-Great Fire Brick
- Post-Medieval Peg Tile
- Roman Brick
- Tudor brick





- Chilmark Stone
- Flint
- Kentish Ragstone
- Ketton stone
- Magnesian Limestone - yellow
- Portland stone
- Thanet Sandstone
- York stone
- Tudor brick
- Post-Great Fire Brick
- Post-Medieval Peg Tile
- Roman Brick
- Terracotta
- Yellow Brick





Plate A: Nineteenth century photograph of the Bell Tower and adjacent Inner Curtain Wall, looking west



Plate B: York and Son photograph taken between 1870 and 1900 of the Bell Tower and adjacent Inner Curtain Wall, looking west (Historic England NMR Reference No: CC97/01043)



Plate C: York and Son stereo view of the Bell Tower and adjacent Inner Curtain Wall, looking north-east taken between 1870 and 1900 (Historic England NMR Reference No: CC97/01294)



Plate D: York and Son photograph taken between 1870 and 1900 of the Bell Tower and adjacent Inner Curtain Wall, looking north-east (Historic England NMR Reference No: CC97/01041)



Plate E: Nineteenth century photograph by J. Davis Burton of the Bell Tower and adjacent Inner Curtain Wall, looking west (© Historic England NMR Ref. Red Box File No. 3596: BB83/5822)





Plate F: Photograph taken c.1890 by G.N. Kent of the Byward Tower with the Bell Tower on the right, looking west (© Historic England NMR Ref. Red Box File No. 3596: AA92/355)

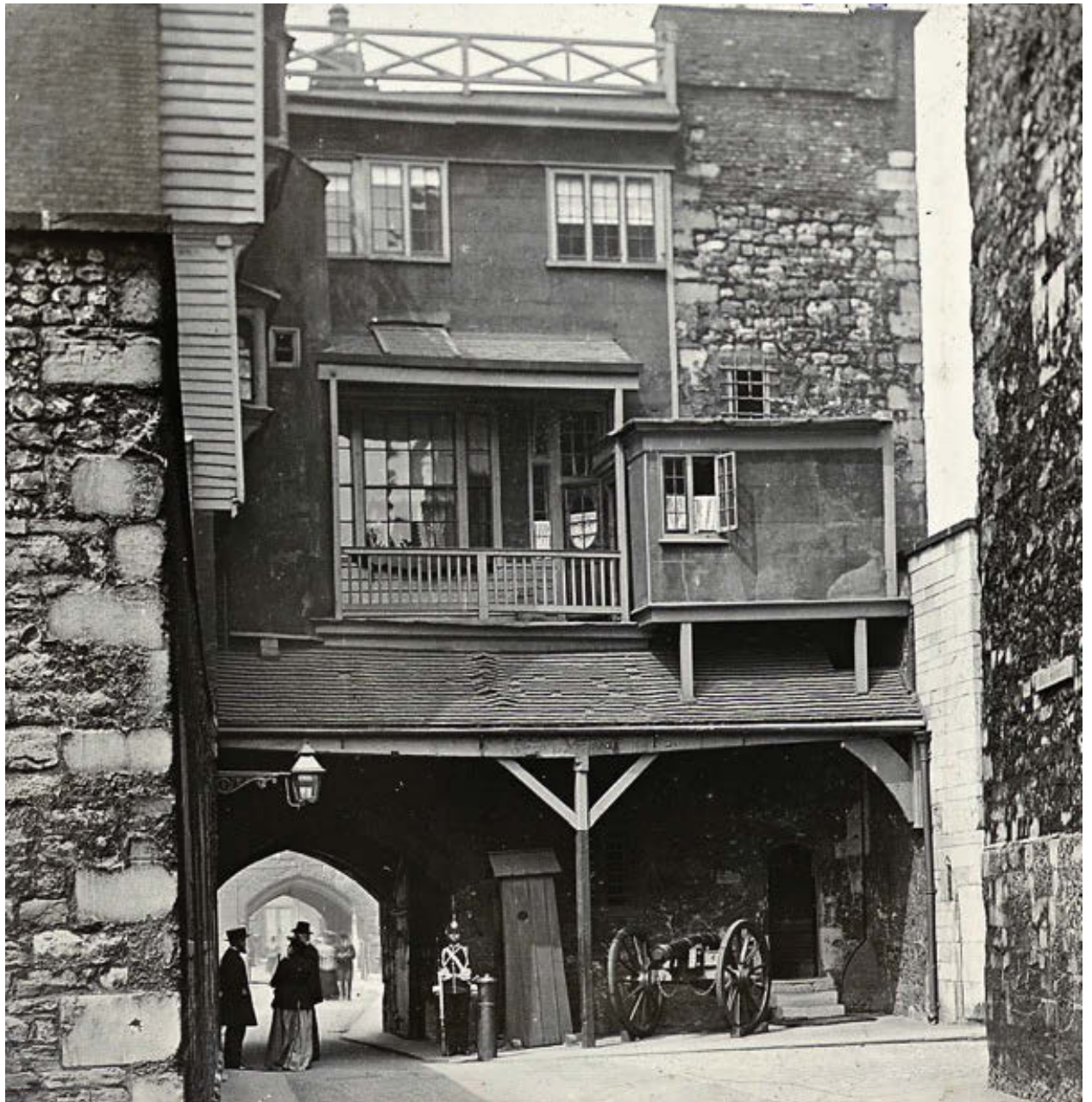


Plate G: Photograph taken c.1900 of the Byward Tower with the stonework of the Bell Tower on the far right hand side, looking west





#### THE BELL AND BYWARD TOWERS.

ATELY on passing through the Byward Tower one reaches the Bell Tower, crowned with a small turret in which the alarm bell used to hang. Many prisoners have occupied this Tower, and the walls of a passage that leads from it to the Beauchamp Tower are still marked with their names. On the river-front, between the Byward and Bell Towers, were the "Queen's Stairs," where royalty landed, and which formed one of the three entrances of the Tower. The building adjoining the Bell Tower is known as the

be escaped through the bravery of his wife, who disguised him as a weeping woman, and followed him to lodgings in Drury Lane, and afterwards fled with him to Calais, to the disgust of George I. The Byward Tower, with the Middle Tower, formed for a short time the prison of five of the Cato Street conspirators—Brunt, Harrison, Tidd, Monaghan, and Wilson. They were all condemned to death, and their execution took place on Tyburn. One of them attempted to drown himself in the River Thames.

Plate H: Photograph taken c.1900 of the Bell Tower and the adjacent Inner Curtain Wall, looking west



Plate I: Photograph taken c.1900 of the Bell Tower and the adjacent Inner Curtain Wall, looking north-west



Plate J: Early 20<sup>th</sup> century photograph of the Bell Tower and the adjacent Inner Curtain Wall, looking west  
(© Historic England NMR Ref. Red Box File No. 3596: BB68/9468)





Plate K: Early 20<sup>th</sup> century photograph of the Bell Tower and the adjacent Inner Curtain Wall, looking west (© Historic England NMR Ref. Red Box File No. 3596: BB73/5480 Photographer CPS156)



Plate L: Early 20<sup>th</sup> century photograph (after 1904) of the Bell Tower, looking south (© Historic England NMR Ref. Red Box File No. 3596: BB73/5477 Photographer CPS153)



Plate M: Late 19<sup>th</sup>/early 20<sup>th</sup> century photograph of the interior of the Upper Bell Tower, looking south (© Historic England NMR Ref. Red Box File No. 3596: BB68/9472)

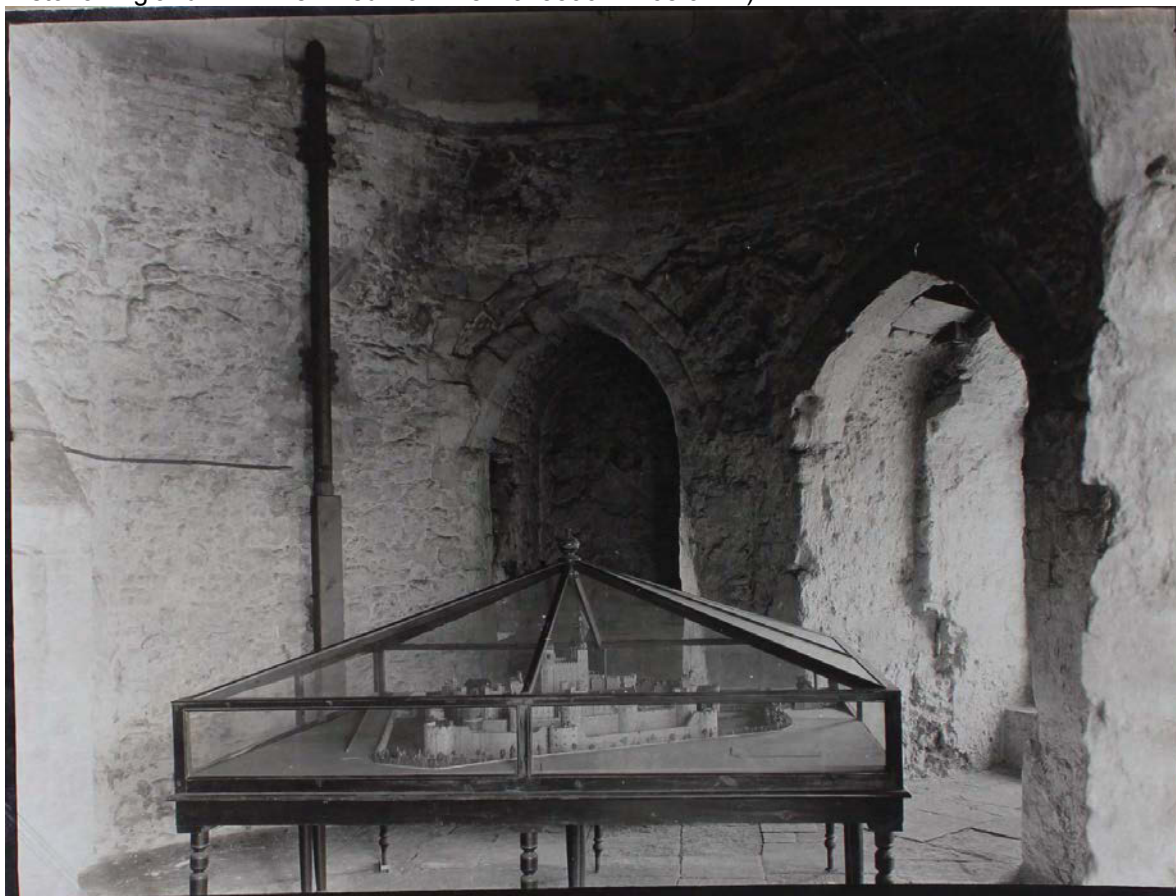


Plate N: Late 19<sup>th</sup>/early 20<sup>th</sup> century photograph of the interior of the Upper Bell Tower, looking south (© Historic England NMR Ref. Red Box File No. 3596: BB68/9472)





Plate O: Illustrated London News Sept 24<sup>th</sup> 1910 photograph of the interior of the Upper Bell Tower, looking south (© Historic England NMR Ref. Red Box File No. 3596/35)





PRISON ROOM IN BELL TOWER.

BISHOP FISHER of Rochester, the first notable prisoner confined in the Bell Tower, was one of the victims of Henry VIII., to whose grandmother he had been confessor. He vehemently opposed the King's divorce from Catherine, and professed belief in the Maid of Kent, who predicted the rapidly-approaching death of the King if the divorce were granted. Fisher remained in the Tower for three months, and was executed on Tower Hill when eighty years of age. His head was placed on a spike on London Bridge, whence it was removed after a fortnight and thrown into the Thames, as the crowds that gathered round it obstructed the traffic. The Maid of Kent was imprisoned in the Nun's Bower, a room in the Coldharbour Tower, which formerly stood where now is the Guard-house at the south of the White

Tower. Anne Boleyn is said to have been imprisoned in the Bell Tower, and probably here also Elizabeth, while princess, was confined by her half-sister Mary on a charge of being privy to Wyatt's conspiracy. She was treated with great severity, being allowed intercourse only with her examiners, who failed to draw from her any statement that could be used in her disfavour. At first she was forbidden to leave her room, and when permitted to go into the garden was attended by three officials. The parapet walk still retains the name of "Queen Elizabeth's Walk." The Countess of Lennox was also brought here on the marriage of her son Lord Darnley with Mary Queen of Scots, and was not released till his death.

Plate P: Early 20<sup>th</sup> century photograph of the interior of the Upper Bell Tower, looking south



Plate Q: Photograph taken 13<sup>th</sup> June 1924 of the Bell Tower, looking south-east (© Historic England NMR Ref. Red Box File No. 3596: BB75/7715)





Plate R: Photograph taken 25<sup>th</sup> June 1924 of the Bell Tower and the adjacent Inner Curtain Wall, looking north-west (© Historic England NMR Ref. Red Box File No. 3596: BB76/200)



Plate S: Photograph taken 25<sup>th</sup> July 1924 of the Bell Tower, looking south (© Historic England NMR Ref. Red Box File No. 3596: BB75/7779)



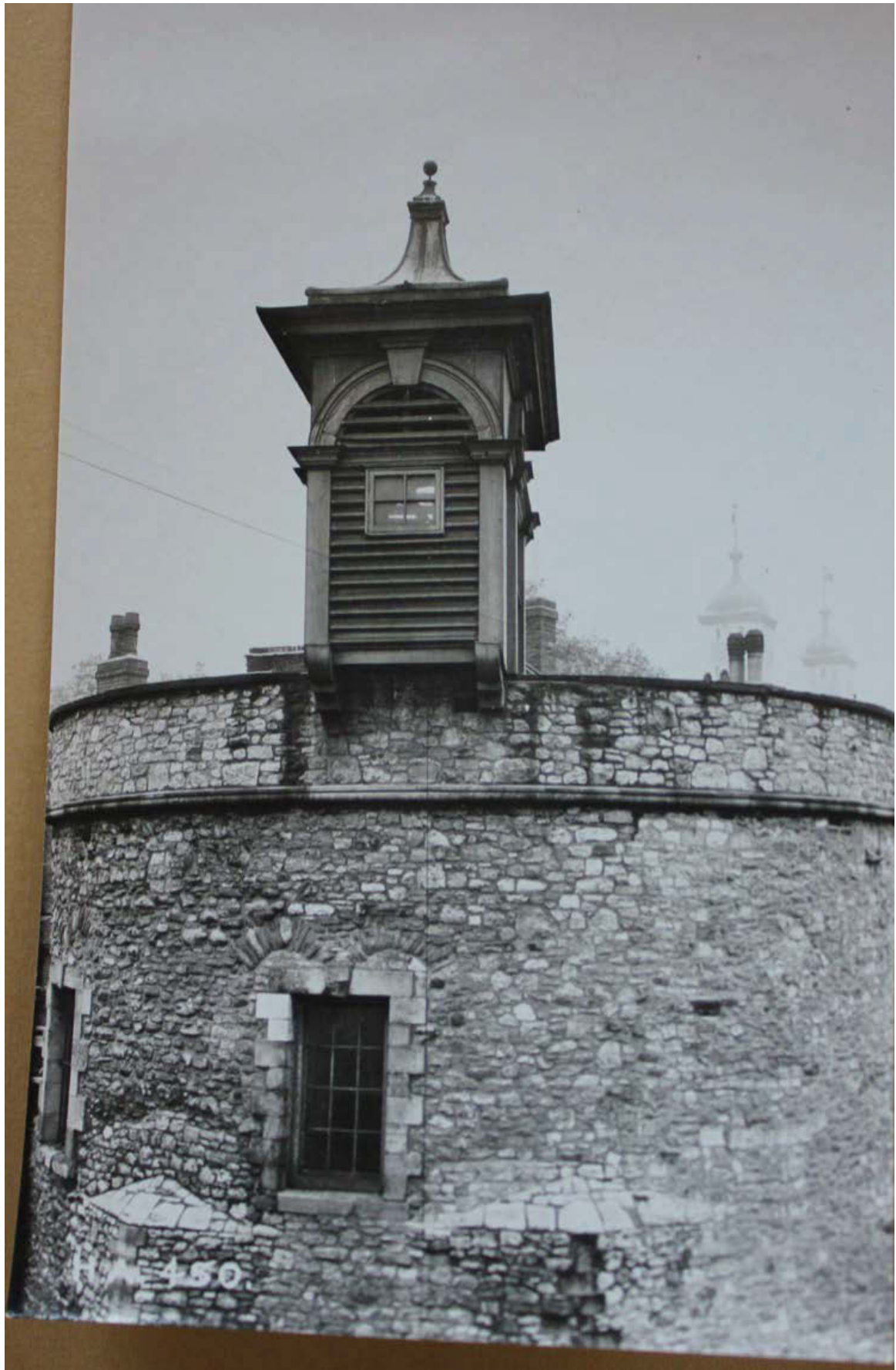


Plate T: Photograph taken 29<sup>th</sup> July 1924 of the Bell Tower, looking east (© Historic England NMR Ref. Red Box File No. 3596: BB75/7791)



Plate U: Photograph taken 30<sup>th</sup> July 1924 of the Bell Tower and the adjacent Inner Curtain Wall, looking west (© Historic England NMR Ref. Red Box File No. 3596: BB74/24)

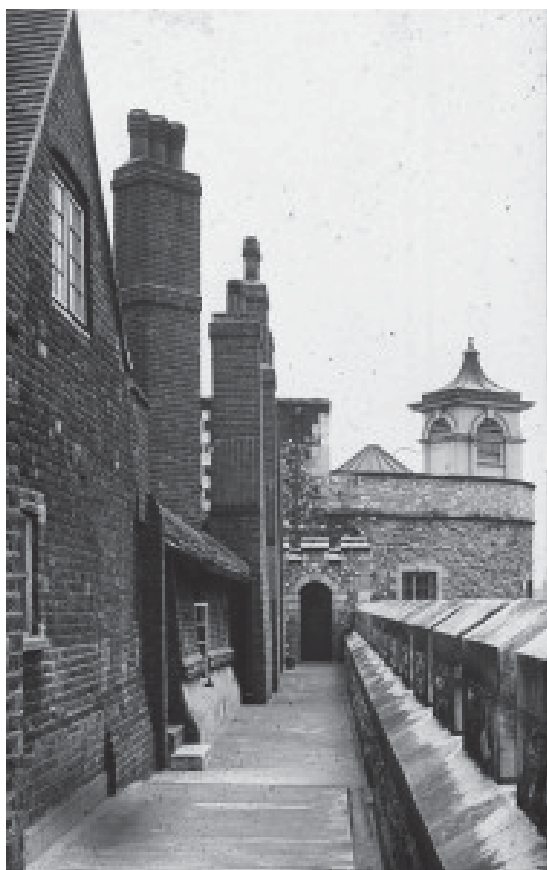


Plate V: Early 20<sup>th</sup> century photograph (c.1924?) of the Bell Tower, looking south

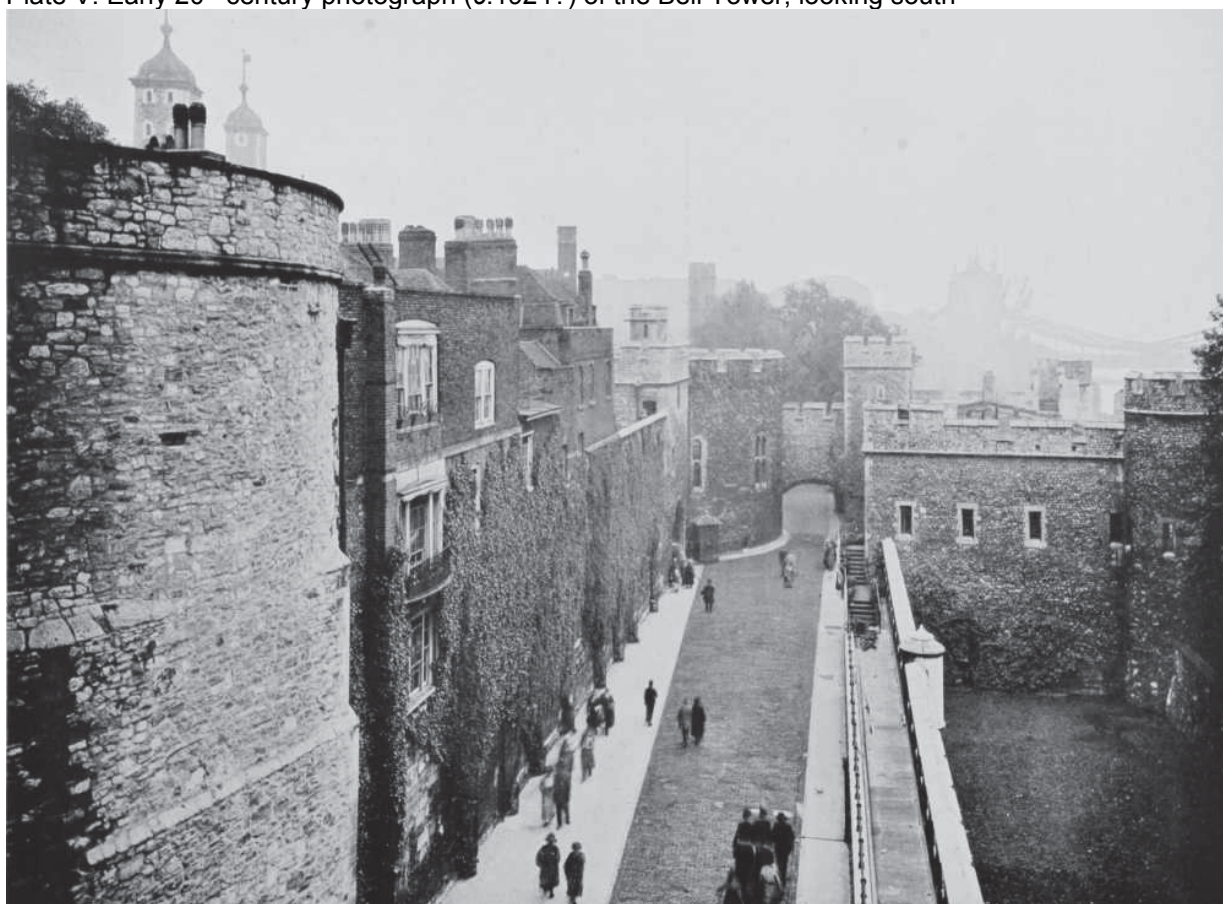


Plate W: Photograph taken c.1930 of the Bell Tower and Inner Curtain Wall, looking east (RCHM(E), 1930)





Plate X: Photograph taken c.1930 of the Bell Tower (right) and the Inner Curtain Wall looking north (RCHM(E), 1930)





Plate 1: Bell Tower and adjacent Inner Curtain Wall, looking south-east (photograph provided by HRP)





Plate 2: East side of the Bell Tower and adjacent Inner Curtain Wall, looking north-west (photograph provided by HRP)





Plate 3: Bell Tower and adjacent Inner Curtain Wall, looking north-east (photograph provided by HRP)

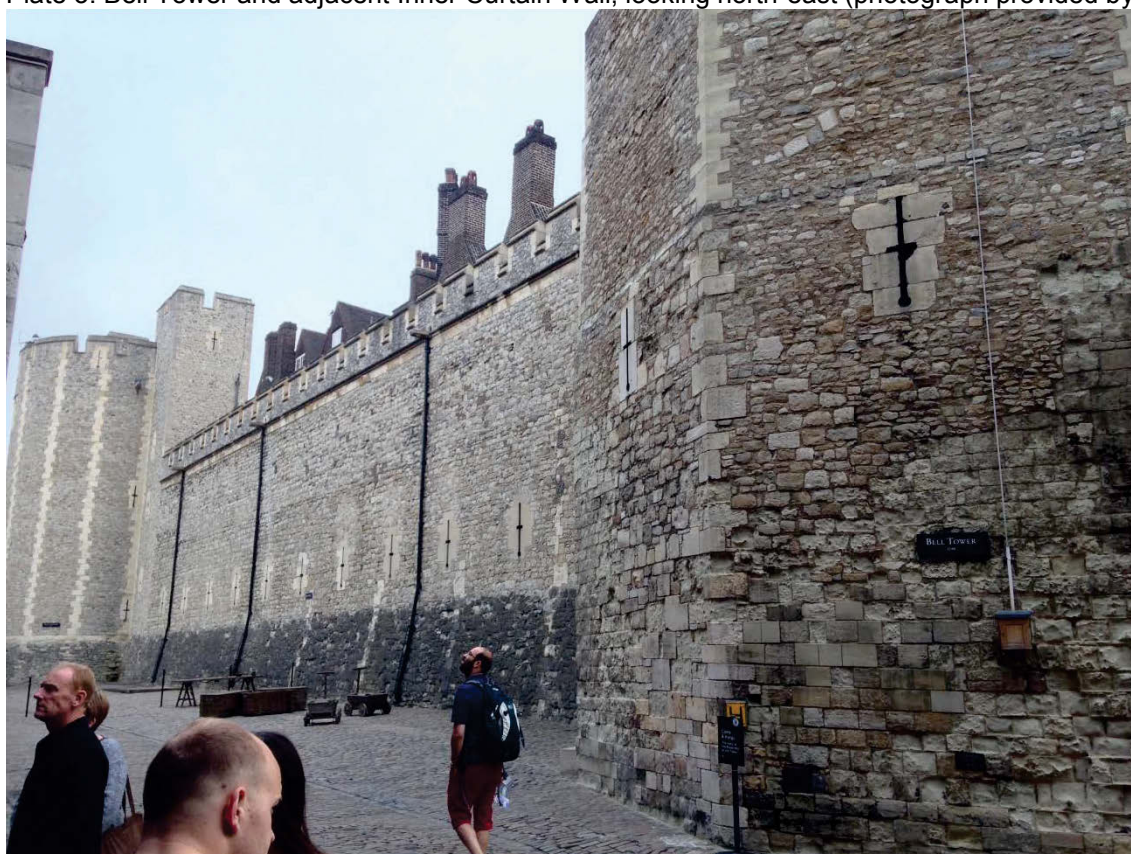


Plate 4: Bell Tower (right) and adjacent Inner Curtain Wall, looking north-east (photograph provided by HRP)





Plate 5: Bell Tower and adjacent Inner Curtain Wall, looking north-east (photograph provided by HRP)



Plate 6: South-west side of the Bell Tower, looking north-east (photograph provided by HRP)





Plate 7: South side of the Bell Tower and adjacent Inner Curtain Wall, looking north (photograph provided by HRP)





Plate 8: East side of the Bell Tower and adjacent Inner Curtain Wall, looking north-west (photograph provided by HRP)





Plate 9: South side of the Bell Tower (left) and adjacent Inner Curtain Wall, looking north (photograph provided by HRP)



Plate 10: Elevation A: lower basal course 2m replacement of Kentish Ragstone ashlar



Plate 11: Putlog 1 in Elevation A, looking south





Plate 12: Putlog 1 in Elevation A, looking south



Plate 13: Putlog 1 and Void 2 in Elevation A, looking south



Plate 14: Void 2 in Elevation A, looking south





Plate 15: Void 2 in Elevation A, looking south



Plate 16: Putlog 3 in Elevation A, looking south





Plate 17: Putlog 3 in Elevation A, looking south



Plate 18: Putlog 3 in Elevation A, looking south

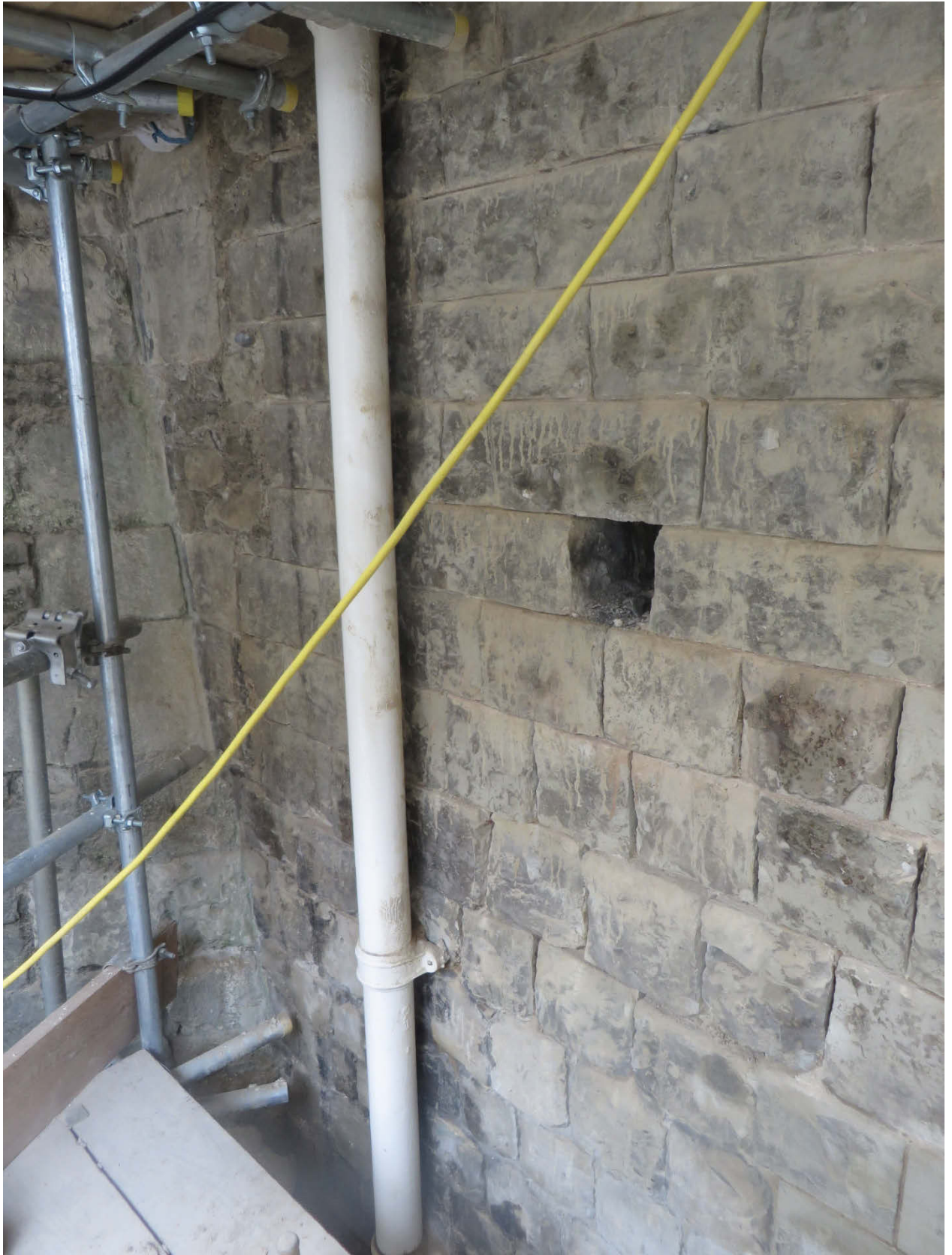


Plate 19: Putlog 4 in Elevation A, looking south-east





Plate 20: Putlog 4 in Elevation A, looking south





Plate 21: Putlog 4 in Elevation A, looking south



Plate 22: Putlog 5 in Elevation A, looking south





Plate 23: Putlog 5 in Elevation A, looking south-west



Plate 24: Putlog 5 in Elevation A, looking south





Plate 25: Putlog 5 in Elevation A, looking south



Plate 26: Medieval brick (Beauchamp Tower type) in Elevation C, looking east





Plate 27: Basal ashlar in Elevation D, looking north-west



Plate 28: Weathered primary Reigate ashlar, replacement Magnesian limestone and soft Kentish Ragstone in the base of Elevation D, looking north-west





Plate 29: Viewing pit excavated in 1928 exposing the (now) below ground foundations of the Bell Tower (ahead) and Inner Curtain Wall/south elevation of the Queen's House (right), looking west





Plate 30: Base of the Inner Curtain Wall with emerging medieval Sussex Marble and Kentish Ragstone, above the ashlar has all been replaced, looking north-west



Plate 31: Section of Kentish Ragstone rubble wall in the Bell Tower showing underlying brown medieval mortar during re-pointing of Elevation B, looking south-east



Plate 32: Relict medieval window heads in Elevation A above 19<sup>th</sup> century window head of Magnesian Limestone





Plate 33: Original Caen Stone jambs to arrow loop in Elevation E, looking north-east





Plate 34: Nineteenth century Magnesian Limestone quoins at the north-east side of Elevation A at its junction with Inner Curtain Wall along Mint Street, looking south





Plate 35: Flint galetting in amongst the mid 19<sup>th</sup> century replacement Magnesian Limestone at the west end of the Inner Curtain Wall



Plate 36: Weathering of Ancaster Freestone in the eastern part of the recorded Inner Curtain Wall



Plate 37: Doorway into the upper part of the Bell Tower from c.1904 porch, looking south





Plate 38: Lower part of the west wall of the porch on the north side of upper part of the Bell Tower, looking west



Plate 39: Upper part of the west wall of the porch on the north side of upper part of the Bell Tower, looking west





Plate 40: North wall of the porch on the north side of upper part of the Bell Tower, looking north





Plate 41: Stair vice in the upper part of the Bell Tower, looking north





Plate 42: Blocked window in the wall of the stair vice in the upper part of the Bell Tower, looking east (ToL149 D100 039)





Plate 43: Ashlar walls of the stair vice in the upper part of the Bell Tower, looking south-east (D100 40)





Plate 44: Ashlar walls of the stair vice in the upper part of the Bell Tower, looking south (D100 41)





Plate 45: Rendered area in the walls of the stair vice in the upper part of the Bell Tower, looking south-east (D100 46)





Plate 46: Rendered area in the walls of the stair vice in the upper part of the Bell Tower, looking south-east (D100 42)



Plate 47: Rendered area in the walls of the stair vice in the upper part of the Bell Tower, looking south (D100 43)





Plate 48: Doorway to the roof at the top of the stair vice in the upper part of the Bell Tower, looking south (D100 44)





Plate 49: Wall on the east side of the doorway to the roof at the top of the stair vice in the upper part of the Bell Tower, looking east (D100 47)



Plate 50: Wall at the top of the stair vice in the upper part of the Bell Tower, looking north (D100 48)





Plate 51: Wall at the top of the stair vice in the upper part of the Bell Tower, looking east (D100 45)





Plate 52: Top of the stair vice in the upper part of the Bell Tower, looking up and east (D100 49)





Plate 53: Looking up and south-east at the stair vice in the upper part of the Bell Tower (D100 50)





Plate 54: Looking up and east at the stair vice in the upper part of the Bell Tower (D100 52)



Plate 55: Passage and stair vice in the upper part of the Bell Tower, looking north





Plate 56: South wall of the lobby in the upper part of the Bell Tower, looking south





Plate 57: West wall of the lobby and passage in the upper part of the Bell Tower, looking north-west



Plate 58: Stonework above the lobby in the upper part of the Bell Tower, looking up with the north-west to the right





Plate 59: East wall of the lobby in the upper part of the Bell Tower, looking east





Plate 60: Garderobe passage leading south from the lobby in the upper part of the Bell Tower, looking south





Plate 61: Garderobe passage in the upper part of the Bell Tower, looking north from the toilet





Plate 62: Toilet at the end of the garderobe passage in the upper part of the Bell Tower, looking south





Plate 63: Stone barrel vaulted ceiling over the toilet at the end of the garderobe passage in the upper part of the Bell Tower, looking south





Plate 64: Window in the toilet in the upper part of the Bell Tower, looking east



Plate 65: Window in the garderobe passage in the upper part of the Bell Tower, looking east





Plate 66: Main Chamber in the upper part of the Bell Tower, looking north



Plate 67: Main Chamber in the upper part of the Bell Tower, looking north





Plate 68: Main Chamber in the upper part of the Bell Tower, looking east



Plate 69: Fireplace in the Main Chamber in the upper part of the Bell Tower, looking east



Plate 70: Main Chamber in the upper part of the Bell Tower with Window 1 to the right, looking south





Plate 71: Blocked opening in the Main Chamber in the upper part of the Bell Tower, looking south





Plate 72: Window 6 in the Main Chamber in the upper part of the Bell Tower, looking south





Plate 73: Blocked opening in the Main Chamber in the upper part of the Bell Tower, looking south



Plate 74: Windows 1 (left) and 2 (right) in the Main Chamber in the upper part of the Bell Tower, looking west





Plate 75: Window 1 in the Main Chamber in the upper part of the Bell Tower, looking west





Plate 76: Window 1 in the Main Chamber in the upper part of the Bell Tower, looking west





Plate77: Soffit of arch over window opening 1 in the Main Chamber in the upper part of the Bell Tower, looking up and west



Plate 78: Niche in the north side of Window opening 1 in the Main Chamber in the upper part of the Bell Tower, looking west





Plate 79: Niche in the north side of Window opening 1 in the Main Chamber in the upper part of the Bell Tower, looking north





Plate 80: Niche in the north side of Window opening 1 in the Main Chamber in the upper part of the Bell Tower, looking north





Plate 81: South sides of Window openings 1 and 2 in the Main Chamber in the upper part of the Bell Tower, looking south





Plate 82: South side of Window opening 2 in the Main Chamber in the upper part of the Bell Tower, looking south





Plate 83: North side of Window opening 2 in the Main Chamber in the upper part of the Bell Tower, looking north



Plate 84: Window 3 in the Main Chamber in the upper part of the Bell Tower, looking north





Plate 85: Window 3 in the Main Chamber in the upper part of the Bell Tower, looking north





Plate 86: West side of Window opening 3 in the Main Chamber in the upper part of the Bell Tower, looking west





Plate 87: Niche in the west side of Window opening 3 in the Main Chamber in the upper part of the Bell Tower, looking west





Plate 88: Head of the niche in the west side of Window opening 3 in the Main Chamber in the upper part of the Bell Tower, looking west





Plate 89: Niche in the east side of Window opening 3 in the Main Chamber in the upper part of the Bell Tower, looking east





Plate 90: Small cupboard in the north wall of the Main Chamber in the upper part of the Bell Tower, looking north





Plate 91: Flagstone floor in the Main Chamber in the upper part of the Bell Tower, looking north-east



Plate 92: Flagstone floor in the Main Chamber in the upper part of the Bell Tower, looking north





Plate 93: Flagstone floor in the Main Chamber in the upper part of the Bell Tower, looking west

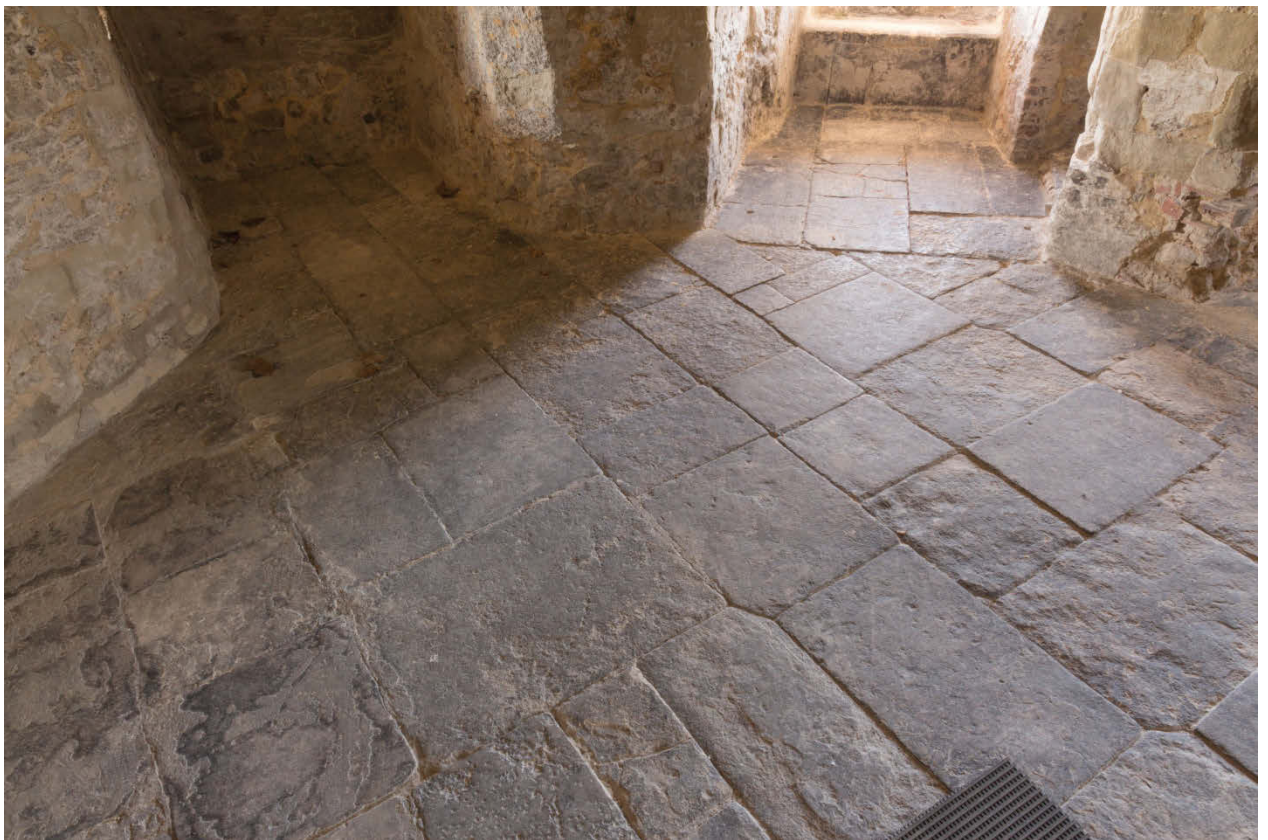


Plate 94: Flagstone floor in the Main Chamber in the upper part of the Bell Tower, looking south-west





Plate 95: Bell turret (left) and roof of the Bell Tower, looking north



Plate 96: North elevation of the stair turret after conservation and the removal of scaffolding, looking south-east





Plate 97: West elevation of the stair turret after conservation and the removal of scaffolding, looking east



Plate 98: South elevation of the stair turret after conservation and the removal of scaffolding, looking north





Plate 99: North side of the south elevation of the stair turret during conservation, looking south



Plate 100: West elevation of the chimneystack, looking north-east





Plate 101: East elevation of the Bell Tower and its stair turret after conservation and the removal of scaffolding, looking north

# PCA

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