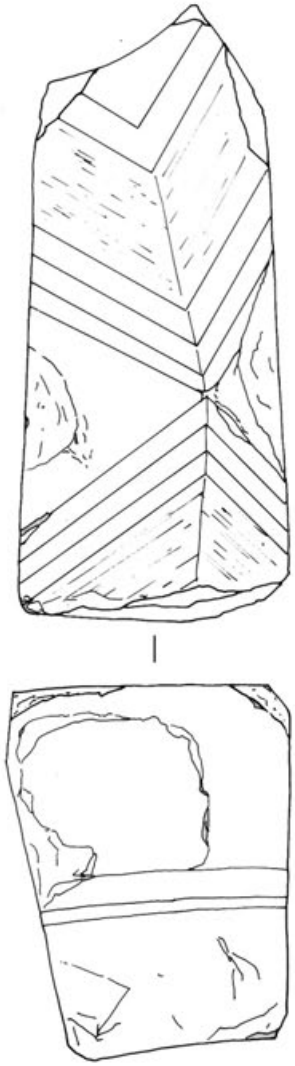

# the south transept of Gloucester Cathedral, 2002-3: archaeological recording

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Gloucester Cathedral Archaeological Report 2002/C

# THE SOUTH TRANSEPT OF GLOUCESTER CATHEDRAL, 2002-3: ARCHAEOLOGICAL RECORDING

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Gloucester Cathedral
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# THE SOUTH TRANSEPT, GLOUCESTER CATHEDRAL

# 2002-2003

# PART I: EXTERNAL WEST FACE

## Introduction

In the spring of 2002 the campaign of repairs to the fabric of the cathedral church moved from the south clerestory of the nave to the west face of the south transept (Fig. 1). This report is the result of archaeological recording carried out between the spring of 2002 and 2003. The recording follows a brief (Heighway 2002) prepared by Carolyn Heighway, Consultant Archaeologist to the Cathedral, which, in summary, required the following:

1. Analysis of the building stone petrology (based on identifications made by Pascal Mychalysin, Master Mason)
2. Analysis of stonework based on stone, tooling and mortar types.
3. Interpretation of the development of the structure.
4. Mason's marks should be recorded at a scale of 1:1 and their positions marked on a base drawing.
5. Reused Romanesque material should be recorded and its position marked on a base drawing.
6. Moulding profiles and archaeological details should be recorded and illustrated where appropriate.

The west face of the turret was drawn by SPB: the remainder of the west face of the transept was recorded on 30 A4 sheets by PM. These were scaled and fitted together by SPB to produce the final drawing on which the archaeological recording is based.

## Previous Research

There is little information about the site of the south transept before the construction of the Romanesque church. A Romano-British mosaic was unearthed in 1867 at a depth of 1m by the south wall of the south transept (Fullbrook-Leggat 1947:36; Heighway 1999, No.70). This part of the cathedral is situated near to the north west corner of the Romano-British defensive circuit so it is probable that the site was occupied by Romano-British, and possibly later, structures.

The transept forms an integral part of the Romanesque eastern arm of the church and was presumably complete by 1100, the date of the dedication of the church (Welander 1991:50). Christopher Wilson has pointed out that the stair vice in the south west turret must have been completed for the circulatory system of the Romanesque eastern arm to function at the upper levels (1985:72). This turret remains intact with two stages of decorative arcading at the top. It has been suggested that the decorated stages at the top of the turrets belong to a second, post-1100, phase of Romanesque construction (Verey 1970:51). An opening from the stair vice in the south-eastern turret to the roof leads has allowed the height of the Romanesque wall head to be estimated as approximately that of the present day, i.e. 14th-century, arrangement (Wilson 1985:70).

The 14th-century re-modelling of the south transept has attracted much comment and speculation from architectural historians during the past 150 years. This interest initially arose from the belief that Gloucester was the birthplace of the Perpendicular style and the south transept and choir were its first manifestation (eg. Spence 1897:34; 1899:144; Massé

1908:65). This view prevailed until the middle of the last century when it was proposed that the mid-14th-century work at Gloucester was a regional expression of the London Court style (Harvey 1944:8; Harvey 1947:48; Hastings 1955). The shift in the origin of the Perpendicular from Gloucester to London is accepted and, as a result, a detailed chronology for the re-modelling of the south transept between 1331 and 1337 has been proposed (Harvey 1961:136; 1979:79; Ashwell 1985:118).

This chronology was based upon the observation, first made in the 19th century (Willis 1860:340), that the design innovation expressed in the tracery of the south window is absent from the east and west windows. The east and west elevation were therefore dated to 1331-4 with the south window being designed and banked, under the influence of William Ramsey with his newly formulated Kentish details, *c.*1335-6 (Harvey 1984:245).

More recently Wilson has suggested that the transept was the work of one Thomas of Canterbury, second architect of St Stephen's Chapel, Westminster, whose death in 1336 would have necessitated the appointment of a new master for the re-modelling of the choir (1990:206).

Dr R. K. Morris has conducted an analysis of the mouldings of the south transept and choir and detected a Kentish element in the former, again suggesting the hand of Thomas of Canterbury. Morris has also pointed out that the accepted dates of 1331-1337 for the re-modelling of the transept are dependant on the involvement of William Ramsey; if Ramsey were not involved the work could have begun as early as 1329 (Lecture to the Friends of Gloucester Cathedral 6/XI/2002).

A recurring theme in the literature on the south transept is the reuse of Romanesque architectural decoration in the re-modelling of the mid 14th century. This reuse was examined by Bernard Ashwell who identified Romanesque roll mouldings framing the south window of the south transept, chevron around the arch of the south window, chevron in the blind arches above the windows and vertical strips of chevron on the south faces of the turrets (1985:117).

The transept was restored in 1867-8 (Heighway 1999:38) with a more limited programme of repairs in 1906-7 (CWB 4); the parapet was repaired in 1881 (CWB 1) and again in 1924 (CWB 8).

### The 11th-century fabric

The 11th-century masonry consists of the south western turret to the level of the third string course, 36.5m AOD, and the curtain wall below the larger southern window to a height of 24m AOD; a small number of 11th-century stones also remain in situ in the buttress against the north face of the south west turret (Figs 2 and 3). The masonry is composed of ashlars laid in roughly level courses with joints typically 10-15mm in thickness. The course heights range from 150-350mm, the majority falling between 200-300mm. Block lengths range from 0.1-1.3m with the majority being between 200-500mm. The basal 2m of masonry contains the larger blocks, above the height of 2m the size of the blocks is not related to their height; the ashlars do not get smaller toward the top of the elevation.

After the joints had been raked out it was possible to see thin pieces of stone or ceramic tile deep in the joints and placed so as to compensate for small variations in the dimensions of the ashlars. These slithers of stone were pieces Blue Lias Limestone, Stonesfield Slate and Old Red Sandstone, as well as Roman brick/tile (Fig. 4).

In a number of places the otherwise level Romanesque courses are interrupted by abrupt changes in course height and in most cases these interruptions can be shown to be the result of later repairs. There are, however, examples of such changes in course height that are not the result of repairs. Two of the most pronounced examples are marked on Fig. 9; in both

cases 11th-century mortar was identified in the joints where the change in course height occurs. A possible explanation for these anomalies is that the course heights were being adjusted, where necessary, so that they match up with the course heights at the angle with the south aisle.

### *Mortar*

The mortar is pink to purple brown in colour with inclusions of various colours visible to the naked eye. It has a fine fraction of clear, orange and pink, rounded to sub-rounded, fine to medium, grains of quartz sand with a smaller amount of similarly sized rock fragments. The coarse fraction is composed of rounded and sub-rounded stones up to 20mm in size with angular fragments of Inferior Oolite up to 10mm across. This type of mortar has been identified in the masonry of the Romanesque parts of the eastern arm and the nave of the church, but contrasts with the mortar used for the top two stages of the turret (see below, 12th century).

### *Tool marks*

The effects of weathering have removed the tooling marks from the surface of all but a few of the ashlars, where they remain the tool marks show a vertical or diagonal 'striated' pattern identified elsewhere on Romanesque stonework at the cathedral. The 15 mason's marks that were identified in the 11th-century masonry are all below 23m AOD, and all but one occur in an area of masonry below the larger window and adjacent to the exterior wall of the south aisle (Figs. 5 and 6). The concentration of marks in this area is due to its sheltered position in the angle formed by the transept and the south aisle. The marks recorded *in situ* in the 11th-century masonry are similar, in size and type, to those identified in the 11th-century work in the south ambulatory and crypt.

Wedge shaped slots were identified at eighteen places in the 11th-century masonry, the distribution of the slots is shown on Fig. 7. The slots are present in section and in profile on the faces of the ashlars (Fig. 8). The width of the slots varies from 80-130mm, the depths between 60-80mm. These are the remains of slots cut for wedges, which were used to split the blocks. The blocks would require dressing after they had been split and the removal of some of the surface of the stone may have removed part of the slot making it appear smaller, or with a shallower profile, than would have been the case when the wedge was in use. The size of the slots suggests that they were cut to split the blocks into roughly their present dimensions, by the abbey's masons, rather than for breaking stone on a larger scale such as may have been the case in a quarry.

### *11th-century turret*

The surviving 11th-century architectural features are restricted to the turret: these are three string courses, four small windows and the plain shafts and bases at the angles of the turret. The lower stage string course has a sunken chamfer (Fig. 10, iv), the second stage has a hollow chamfer (Fig.10, v) and the third string course, marking the upper limit of the 11th-century masonry, has a more complex roll and hollow profile (Fig.10, i).

A number of the stones belonging to this third string course, and those immediately above, were removed or replaced during the repairs. The masons reported, providing a sketch, that the string course was calcined on the top, at the rear, as well as on the back. The calcination appears to have taken place with the string course in its present position as the reddening occurred continuously across several blocks. The top stages of the turret could not have been in place when this burning occurred as stones with the decorative

arcading cover the calcination; there was no evidence of burning on the decorative arcading.

One possible explanation is that the turret originally had a top stage, or spire, of timber that was destroyed by fire and replaced with the decorative two-stage arrangement of stone in the 12th century.

The four small openings have an interior splay, providing light for the stair vice. The lower opening (20.0m AOD) is formed by an arch turned with six voussoirs; the remaining three 11th-century openings, at 25, 32 and 34m AOD, have round heads cut in a single block of stone. The upper two openings have incisions radiating out from the small round heads imitating voussoirs.

### *Stair vice*

The stair vice in the turret contains evidence relating to the upper level circulatory system in the Romanesque church. It has been suggested that the church was designed from the outset with a route around the choir galleries and gallery chapels that began and ended at the western stair turrets of the transepts, rather than continuing through the west walls of the transepts to connect with the nave (Wilson 1985:72). Two Romanesque passageways formerly passed through the wall of the south elevation of the south transept at a height of 30.0m AOD and around 24.0m AOD, as evidenced by the openings, the lower blocked, in the east face of the turret at these levels (Fig. 9). If these passages did connect with the nave then there may be some evidence of them in the turret.

The stair vice has four openings, two blocked, on its eastern side and one, partially blocked and glazed, on the north side at 35.50m AOD. An opening at 20.13m connects with the 14th-century interior passage across the south elevation. Of the two blocked doorways at around 24.0m AOD, one connected with the 11th-century wall passage passing through the south elevation, the second, not mentioned in the literature, may have given access to a 14th-century exterior passage across the south face of the transept, behind the screen of open panel work below the south window. The small doorway at 30.0m AOD now opens into space but prior to the 14th-century re-modelling passed through the south elevation, probably connecting with a clerestory level route around the east end of the church. There are no openings, or former openings, in stair vice through which passageways across the west elevation of the transept could have passed.

Any evidence of passageways across the west elevation of the transept would have been removed from the exterior in the 14th century, when the narrow strip of masonry forming the north elevation of the turret between 30.0m AOD, was re-faced as a result of the reduction in thickness of the main elevations of the transept. Additionally, most of the stonework in the narrow north elevation of the turret was replaced in the 19th century (Fig.18, ii ).

The partially blocked remains of a doorway are located on the north elevation of the south west turret at 35.50m AOD (Fig.18, ii). The opening was formerly 1.6 x 0.5m in size with undecorated reveals; the lower part is blocked leaving an opening (700x500mm) that lights the stair vice and which is now glazed. At the top is a rough lintel of Pea Grit which is set across the angle formed by the turret and parapet. This opening is what remains of an 11th-century doorway giving access to the roof leads from the then top of the turret. It was partially blocked and adapted to function as a window during the 14th century.

The buttress below this opening consists of 14th-century ashlars, apart from a small number of *in situ* Romanesque stones between 26.0 and 30.0m AOD, and an 11th-century

core. This contrasts with the equivalent buttress on the east elevation of the transept where Romanesque masonry survives to a higher level.

### *Fractures*

The major fractures in the 11th-century masonry occur in the turret between 20.0m and 27m AOD (Fig.11). The distribution of these fractures suggests that they are the result of instability created by the thrust of the diagonal tower crossing buttresses being brought in to the turret at this level.

## 12th-century turret: the west elevation of the turret

The string course at the base of the top two stages marks the upper limit of the 11th-century masonry in the stair turret. The profile of this string course is illustrated in Fig. 10, i. It rests on a bed of purple brown Romanesque mortar which also occurs in the joints of the string course. The course of stones that rest on the string course are set in a sandy, poorly consolidated, orange pale brown mortar and this type of mortar was traced throughout the joints in the upper two stages of the turret, as well as being identified in the wall core. This change in mortar marks the boundary between the first phase of Romanesque building (1089-c.1100) and a later episode during which the upper two stages of the turrets were added, still in a Romanesque style at an unspecified date in the 12th century.

The decorative arcading extends around the south and west elevations of the turret with plain ashlar, and a string course at 40m AOD, on the north and east elevations. The decoration on the west elevation consists of three and a half arches of intersecting blind arcading on the lower stage and four bays of blind arcading on the top stage.

The intersecting arcading on the lower stage has multi-scalloped capitals and an angle roll moulding on the voussoirs. The shafts at the angles of the turret have simple attic bases while those in the centre of the arcade are terminated at the base with a stop chamfer. The distance between the shafts is not uniform in the arcading, the northernmost ‘bay’ is 480mm wide while the remaining three ‘bays’ are 430-440mm in width. At the bottom of the three inter-columnar spaces there is a course of blocks with a batter. Two tiers of recessed half circles project from the ashlar further up. The half circles have a diameter of 350mm and are recessed to a depth of 45mm. There is also a small round headed window, 575x110mm, lighting the stair vice, at capital level in the second bay from the north.

The top stage has four bays of blind arcading with scalloped capitals and projecting chevron on the voussoirs: the moulding profile of the voussoirs is illustrated in Fig. 10, ii. The outer shafts at the angles of the turret have crude chamfered circular bases resting on the string course that separates the two stages. The remainder of the shafts on the top stage have chamfered stops.

### *Building materials*

The top two stages of the turret were built using stone from an earlier Romanesque structure (see below) therefore the building materials are similar to those given for the 11th-century work. However a number of differences in building technique and use of materials distinguished the masonry of the upper stages of the turret from the 11th-century stonework below.

The ashlars are smaller and more accurately cut. The course heights range between 200-250mm and the more regular coursing, resulting from a greater standardisation of block lengths, has removed the need for packing material, such as Roman brick or tile, that are used to space blocks of differing lengths in the 11th-century stonework.

The blocks used for the decorative arcading are only shallowly bonded in to the wall core, some by as little as 150mm, and this shallow bonding has contributed to the instability in the west elevation of the turret, resulting in the fractures illustrated in Fig. 11. A further cause of instability is the number of straight joints, passing up through two or more courses, in the stonework of the decorative arcading. The 19th-century repairs also suffered from similarly shallow bonding and have failed to prevent further movement in the wall face, as shown by the cracks that have opened up in 19th-century masonry adjacent to the north angle of the turret.

Masonry belonging to four periods has been identified in the fabric of the top stages of the turret. The petrology of the 12th-century ashlars is Lower Freestone (Painswick stone) as is the 14th-century cornice; Great Oolite from Bath was used for the repairs of 1868 whereas Lower Freestone was again used for the small number of early 20th century replacement stones. Fig.13 shows the 19th and 20th century repairs to the decorative arcading in the top stage of the turret. In places it was possible to trace differing mortars in the joints around such repairs, Fig.14 illustrates such an example showing the joint between the cornice moulding and the course below.

The material in the turret core is predominantly Lower Freestone with a smaller amount of Blue Lias Limestone. Three fragments of Romano-British brick were identified in the 12th-century core, two on the south elevation of the turret, one on the west, as well as fragments of tufa.

### *Green sandstone*

The string course separating the two upper stages consists of two courses of stone; the lower course has a chamfer along its upper edge and this chamfer is continued across the course above. This upper chamfered course, apart from the cylindrical corner stones, had been completely replaced with Bath stone in the second half of the 19th century. On the north elevation of the turret the entire length of this 19th-century course was removed for replacement during the repair process. This showed that the Bath stone repairs were thin, around 70mm, and revealed a course of green sandstone behind them (Fig. 15). The block lengths of this sandstone ranged from 340-230mm, the majority being 340-320mm, the height of the course was 220mm. The sandstone blocks were set in the same type of mortar as the other Romanesque masonry in the top stages of the turret and the faces of the blocks had been crudely cut back to about 250mm from the wall face.

A number of the 19th-century Bath stone repairs to this course were removed on the west elevation of the turret. Here the course of green sandstone was absent, but numerous fragments, up to 200mm in size, could be seen adhering to the Romanesque core; some of these fragments had grey 19th-century mortar on their faces. Evidently the course of green sandstone was also formerly present on the west elevation but had been more thoroughly removed during the 19th-century repairs. The evidence above suggests that the string course of green sandstone originally extended around all four elevations of the 12th-century turret.

Where the stones in the courses immediately above this string were removed a number of small fragments of the green sandstone were also identified in the core. This is interpreted as excess material being incorporated into the core on the completion of the sandstone string course.

This green sandstone was quarried from the Carboniferous Coal Measure Series. Rock with a similar lithology outcrops in the Pennant Sandstone beds from the Forest of Dean. A second possible source could be the Highley formation of Coal Measure Sandstones, which

were quarried beside the River Severn in South Shropshire and south to Worcester, and beyond, in the early 12th century.

*Reused Romanesque architectural elements (Fig.16)*

A number of badly weathered stones were removed from the intersecting arcading for replacement, two of these were found to have the remains of chevron decoration on the back. The positions of the stones (Worked Stone 400 and 401) are marked on Fig. 12.

Worked stone 401 is 350x160x210mm in size; the chevron moulding consists of a fillet-half roll-angle fillet-lozenge-angle fillet-half roll. The final half roll is partially removed and the moulding was probably symmetrical, ending with an additional fillet. The stone has a section of soffit preserved on one face showing that it was a voussoir. The arch from which the stone was derived was miniature, 300-400mm diameter. The type of chevron is Ashwell's type 1, that is with the dag crossing the joint as opposed to being in the centre of the stone, as was the case with later chevron at the cathedral (Ashwell 1985:115).

Worked stone 400 is 250x200x190mm in size and has part of the chevron moulding profile found on 401 with the exception that there is a billet between the dags. The bottom of the block, i.e. that below and at 90 degrees to the chevron, is flat showing that 400 was not originally a voussoir. It could have been a jamb stone to the arch of 401.

A further example of Romanesque decoration turned inward and reused in the intersecting arcading was found on the south elevation. Worked stone 402 was a voussoir extracted from an arch in the arcading; on its inner face is a roll moulding, diameter 140mm, that is cut around 5 degrees out of the perpendicular and with a curved face opposite the roll. It would have originally functioned as a voussoir in an arch with a prominent roll moulding that would not have been dissimilar to the 11th-century decorative arches around the Romanesque ambulatory and radiating chapels.

### 14th-century I

An area of masonry projecting above the south aisle roof, and below the smaller northern window, is judged to belong to the building project that included the re-modelling and vaulting of the south aisle, that is, the project that immediately preceded the re-modelling of the transept. The lower part of this wall was also examined from the south aisle roof space where it is in a better state of preservation. The masonry is supported by the easternmost transverse arch of the south aisle vault and the tooling and mason's marks show that it is constructed with re-used Romanesque ashlars. A later medieval mortar was identified deep in the joints showing that this part of the elevation was rebuilt in the 14th century. This part of the elevation projects 1.233m from the 14th-century wall face and thus may preserve the position of the former Romanesque wall face, at this point.

The petrology of the ashlars is Lower Freestone (Painswick) and the weathering pattern on the surface of a number of the ashlars shows that they are laid with the bedding structures at ninety degrees to the horizontal; these are re-used Romanesque ashlars that have been laid on end, possibly to achieve a greater course height.

Adjoining this small area of masonry, to the south, is a secondary buttress supporting the external diagonal buttress above ('F' in Fig. 9), this secondary buttress abuts the masonry in question rather than being bonded to it.

### 14th-century II

The west face of the transept above 23.90m AOD, excluding the south west angle turret and the slightly earlier 14th-century masonry described above (14th-century I), is judged to

belong to a single campaign of re-modelling; this is the proto-Perpendicular transformation of the transept dated by the *Historia* to between 1329-37 (Hart 1863, i, 46). It includes the buttress against the north side of the south west turret, the main and two secondary buttresses between the windows (Fig.9, D, E, F), the windows, spandrels, diagonal buttress and parapet.

### *Windows*

The two 14th-century windows in the west face of the transept have four centred arches filled with reticulated 'Y' tracery. The windows have been so extensively restored that the bifurcated 'Y' tracery and the upper oculi in both windows, and a single cusp of the central quatrefoil in the northern window, are all that remains of the 14th-century tracery. The design of the tracery is the same for both windows except that it is slightly scaled up for the larger southern window; the windows share the same mouldings.

Both windows were constructed using a combination of newly cut and reused components (Fig.10B). The tracery, capitals and the inner part of the moulded surround are composed of stones cut in the 14th century. The bases, nook shafts, hoodmoulding and outer part of the moulded surround contain reused Romanesque stones (Figs. 17, i, ii, iii, iv).

The stepped chamfer, asymmetrical casement and projecting fillet forming the inner part of the moulding, is part of a Perpendicular moulding used elsewhere in the 14th-century work at the cathedral, for example on the arch connecting the south aisle with the south transept (Harvey 1961: xx). On the windows it is connected by a plain chamfer to a Romanesque roll moulding (150mm diameter) used as a nook shaft below the capitals and continued around the hoodmoulding as a roll, a plain order and an outer roll moulding (150mm), also re-used Romanesque stone. The larger southern window has a beast head hoodmould stop on the north side of the arch. This sculpture dates to the 1990s and replaced a 19th-century beast head.

A perspective diagram (Fig.19) showing the coursing of the south jamb of the northern window illustrates how the freshly cut and reused moulded stones have been combined to create the opening. The inverted cushion capital rests, as a base, on a 14th-century plinth which is cut from the same stone as the stop on the 14th-century mouldings. Above the capital the roll mouldings and reveals are cut from single Romanesque stones for three courses. A fragment of Romanesque roll and reveal rests on top of these three courses and above this is a large 14th-century stone with the full moulded profile and a capital. The upper part of the capital is the work of the 1990s, in Lepine stone. The roll moulding immediately below the capital is therefore a 14th-century reproduction of the Romanesque roll. The diameter of the plain, bell-shaped, capital was determined by the size of the Romanesque roll above and below. The capital on the north side of the southern window is the only medieval capital in the two windows not to have been restored.

Bell-shaped capitals are also fitted to the top of Romanesque shafts on the exterior of the south ambulatory.

It is possible to discern a difference in the finish of the Romanesque and 14th-century worked stone. The Romanesque roll mouldings have a vertical striated type tooling mark and the flat surfaces have diagonal striated axe marks. The 14th-century worked stone has a much finer finish: no tooling marks are visible on the majority of stones, and where they are visible they are the faint marks of a claw.

Certain stones, for example in the plain order of the northern window, have diagonal striated tooling marks except near the lower edge of the stone where there are the marks of a claw. These are Romanesque stones lightly re-dressed in the 14th century. Also in this

order is an isolated calcined stone. Four pieces of Roman brick were identified in the mouldings of the southern window.

A single mason's mark was identified on the moulded surround of the northern window, it is a Romanesque mark occurring on one of the reused moulded stones. The absence of marks on the 14th-century stones is not simply the result of the marks having weathered away, for the 14th-century surface is intact, as evidenced by claw tool marks on many of the stones. This observation was confirmed during work on the interior elevation of the windows where mason's marks were also absent.

*Flying buttress*

The buttress supports the south west angle of the tower. It intersects with a vertical buttress, in the angle formed by the transept and the nave clerestory, at 38.20m AOD and passes down across both bays of the elevation at an angle of 42 degrees, terminating at the vertical buttress which supports the north side of the south west turret at a height of 28m AOD.

Determining the place of the flying buttress in the development of the structure of the transept was one of the primary aims of the archaeological recording. This has proved difficult, mainly because at the points where the buttress is either attached to, or in contact with, the structures of the transept, most of the stonework has been replaced during previous restorations. Neither is it possible, at present, to distinguish mortar used in, for example, the 14th century from that used in the 15th century. A further complicating factor is the need to reconcile any results with the evidence for buttressing the remaining three angles of the tower. Large scale photographs of the buttresses at the NW, NE and SE angles of the tower were produced and are briefly discussed below. However a full assessment of the evidence for the re-modelling of the crossing is beyond the scope of the present report.

The buttress is described, below, from top, the junction with the tower, to bottom, the junction with the south west turret buttress.

Two medieval stones in the buttress survive at the point where the buttress intersects with the parapet, marked 'A' on Fig.9. Figure 18.i shows the point of intersection from the roof of the transept. Here the buttress is not truly flying as it is in part embedded in the ashlar facing stones, and as it passes through the parapet it is possible to see that both parapet mouldings and buttress mouldings are cut from a single block of stone. This, together with the matching chamfer on both buttress and parapet, suggest that the buttress and parapet belong to the same period.

Below the parapet, at this point, are ten courses of distinctive orange coloured Inferior Oolite from North Gloucestershire, termed 'Brockhampton' stone by PM, point 'B' on Fig. 9. This stone type extends across the main and secondary vertical buttresses, the plain ashlar face between the buttresses and window mouldings, and the projecting masonry that supports the flying buttress. It occurs in a limited number of locations in the fabric of the cathedral and so these examples must belong to a single period of construction. Because the 'Brockhampton' stone is surrounded by 19th-century replacement stones its relationship with the architectural elements (i.e. buttresses and window) is unclear. The mortar identified in the joints of the 'Brockhampton' was pale grey brown with flecks of charcoal and of a type used in late medieval times at the cathedral, so that it is not part of the 19th-century restoration. Three of the blocks of Brockhampton, forming the base of the flying buttress, have a roll moulding on the lower angle. This moulding continues down along the lower edge of the buttress, where it is reproduced in Bath stone, and follows the curve of the window below as a hoodmoulding.

At the point where the diagonal buttress intersects with the vertical buttress (marked ‘C’ on Fig.9) all but two fragments of medieval stone in have been replaced in the 19th or early 20th centuries, making it impossible at this point to discern the relationship between vertical and diagonal buttresses. The vertical buttresses (marked D, E, F on Fig.9) are bonded, in part, to each other and F is bonded with the ashlar wall face adjacent to the south. In its lower part F abuts the earlier masonry adjacent to the north (c.1320-9). The vertical buttresses (D, E, F) therefore belong to the 14th-century re-modelling of the transept. The flying buttress support meets vertical buttress ‘F’ at a height 31m AOD. This supporting member is bonded into ‘F’ by a single stone, marked ‘G’ on Fig.9. This stone is ‘in course’ with the masonry in D, E, F, and with the plain ashlar face adjacent to the south; it appears not to have been inserted.

The flying buttress terminates against a stepped back vertical buttress, marked ‘H’ on Fig.9. Here, again, the flying buttress has been replaced with Bath stone while the vertical buttress is also extensively restored, both in the main restoration of the transept in 1868 and possibly earlier in the 19th century, so much so that it was not possible to determine the relationship between flying and vertical buttresses. A number of blocks on the narrow north elevation of the vertical buttress were removed for replacement showing that the core of this buttress, at least to 30m AOD, has the coarse pink mortar associated with Romanesque masonry, and so is 11th-century. The flying buttress was therefore brought down into the 11th-century core, a strip of which was retained, as a vertical buttress, probably to add stability to the south west turret while the west elevation of the transept was dismantled and re-built.

The evidence as to whether the diagonal buttress belongs to the main 14th-century re-modelling of the transept or was inserted in the 15th century with the construction of the tower is equivocal. At points ‘A’, ‘B’ and ‘G’ (Fig.9) what remains of the medieval masonry suggests the former, while at the critical positions ‘C’ and ‘H’ the medieval stonework has been replaced. However the impression remains, especially considering the amount of reconstruction that would have been required to insert the buttress, and for which there is no evidence, that the buttress was built along with the upper part of the elevation *c.* 1329-37.

The buttress has a moulding on its underside (Fig.10, iii). This type of large hollow moulding is found in 14th to early 16th century contexts at the cathedral and so cannot be used as an aid to dating.

On the interior elevation, the diagonal buttress that ‘flies’ across the open panelling in the arch that connects the south aisle with the south transept was clearly constructed along with the Perpendicular ribs, shafts and panels that cover the interior of the transept. Stones carrying the buttress mouldings also have shaft and panel mouldings and extend deeply in to the surrounding stonework in a manner that would not have been possible to achieve had the buttress been inserted. Diagonal buttresses were therefore being built to support the south west crossing pier in the re-modelling of 1329-37, and being carried across openings in a similar way to the exterior example being considered here.

There are diagonal buttresses supporting the other three angles of the tower/crossing, at an equivalent level to the buttress on the west face of the south transept. All terminate at the set of vertical buttresses which divide the respective transepts in to two bays (the equivalent of ‘D’, ‘E’, ‘F’) and all are lighter in construction than the buttress considered here. These buttresses share a number of design features which may suggest that they may have been constructed simultaneously, and yet the evidence of the stonework, where discernable, suggests each buttress is integral with the elevation in which it is embedded. Yet the 14th-

century re-modelling of the north transept is dated to 1368-74 by the abbey's *Historia* (Hart 1863:50), thirty years later than the re-modelling of the south transept.

Further archaeological work is required to produce a narrative account of the development of the crossing and tower between the 13th and 15th centuries.

### *Buttresses and spandrels*

The group of vertical buttresses that divide the upper part of the elevation into two bays (D, E, F on Fig. 9) reinforce the wall at the point where the vault springs and act as a support for the exterior diagonal buttress referred to above. The buttresses are composed of reused Romanesque ashlars set in a pale brown late medieval mortar. Thirteen Romanesque mason's marks were identified on 'D' and 'F': these marks are preserved as a result of being in sheltered locations, concentrated as they are beneath the flying buttress (Figs.5 and 6).

Several courses of masonry can be traced from 'D' across 'E' and 'F' to the 14th-century wall face which separates 'F' from the southern window, suggesting that the buttresses were constructed simultaneously at the same time as the wall thickness was reduced and the present windows installed, that is *c.*1329-37.

The core of the main buttress ('E') was examined at 35m AOD where the moulded stone at the head of the buttress was replaced. It consisted of fragments of Lower Freestone (Painswick stone) set in a pale brown late medieval mortar which shows that the core, as well as the face of the buttress at this level, dates to *c.*1329-37. It is possible that the Romanesque core survives behind the ashlars in the buttress at a lower level.

The masonry above the northern window consists of the 'Brockhampton' stone (discussed above: flying buttress) with the remainder of the spandrels being replaced with Bath stone, *c.*1868. The masonry above and beside the southern window retains most of its medieval ashlars, which are predominantly reused Romanesque stones, supplemented with blocks quarried and cut in the 14th century. The courses are mismatched either side of the window and those on the north (left) side of the arch fall by 150mm between the buttress ('F') and the arch mouldings. The courses are made level at 35.80m AOD, the height of the apex of the arch moulding, above this there is a further course followed by the cornice/parapet mouldings. The thickness of the 14th-century masonry is 0.55m compared to the 1.81m thickness of the original Romanesque wall.

### *Parapet*

The parapet rests on a cornice moulding (36m AOD) that is chamfered back to the base section of the parapet. The cornice was replaced *c.*1868 apart from part of the basal section in the southern bay. At its southern end the parapet has been inserted into the north face of the Romanesque turret, in the north the parapet intersects with the diagonal buttress in a manner that suggests that both parapet and buttress were constructed simultaneously. The remaining medieval stones in the parapet are large, up to 1.5 x 0.6m; the original coursing of the parapet stones has been reconstructed and is illustrated on archive drawings by PM.

The decoration of the parapet is arranged in units, or modules, of open rectangular panels; the units are defined by the larger mullions and are divided in two by smaller mullions creating two 'lights' to each unit. Each light has a trefoil in an ogee arch in open panel work at the top, surmounted by a drip mould.

The mouldings project by 70mm from the plane of the parapet in two places (I and J on Fig. 9). These projections coincide with the vertical buttresses below, effectively carrying the verticals of the buttresses up through the parapet. The width of the vertical buttress,

between the windows, is equal to one unit of the parapet decoration and so may have determined the scale and positioning of the parapet panels. The rhythm of the parapet decoration is interrupted near its southern terminus in order to allow the vertical line, formed by the buttress, to be carried up through the parapet by a mullion.

This parapet design is replicated on the east wall of the south transept and the north transept; it is also combined with panels of large quatrefoils to produce the crenellated screen on the south face of the south transept.

The parapet is interpreted as belonging to the main period of re-modelling of the transept, *c.*1329-37.

### Projectile damage

Traces of damage to the surface of the stones caused by projectiles striking the transept were identified at 16 points on the west face of the transept and at 17 points on the south face of the turret (Fig. 20 for west elevation). There are two types of damage; most numerous are the circular depressions, 30-80mm in diameter,10mm deep, that resemble miniature volcanic craters with a slightly raised rim and a compacted bowl-like surface. Fractures radiated out from this circular 'lip' for 50-100mm (Fig. 21, i). A few of the better preserved examples have an asymmetrical profile from which it is possible to estimate the angle and direction of the shot. Those on the west face all appear to have been fired from the west of the precinct, those on the south face of the turret were fired from the south or south-south east, roughly aligned with St Michael's Gate. The asymmetrical profiles also show that the shot was fired up at the building from within the precinct, or its perimeter, rather than being the result of an assault from further afield. These features may have been caused by small arms fire.

The second form of damage occurs twice on the west face of the turret, at 21m AOD and at 41.5m AOD. These are roughly circular depressions 250mm in diameter with a bowl shaped compacted surface and fractures radiating out into the surrounding stonework for up to 1m. (21, ii). They were caused by larger projectiles, possibly cannon. It is not possible to estimate the distance or direction of fire from the larger cavities.

Bernard Ashwell noted that shot was discovered in a number of the joints in the south elevation of the south west turret during the repairs of 1983 and attributed this damage to the Civil War period (1985:119). While there is a reference to the tower being targeted during the siege of 1643 (Eward 1985:74) this was long-distance fire from south of the city, not from within the precinct, and so would not have produced the damage that has been described. Between 1642 and 1656-7 there was no effective authority to protect the building (information: J. Rhodes), so it is possible that the damage occurred between these dates, perhaps the result of target practice.

### Building materials: summary

#### *11th century*

The 11th-century ashlar face is primarily composed of three varieties of stone: Lower Freestone (Painswick stone) and two types of Pea Grit. Lower Freestone is a white to cream oolitic limestone with few fossils and an even texture. It outcrops along the Cotswold escarpment from Selsley to Birdlip and is the most frequently occurring building material in all the medieval building campaigns at the cathedral.

The 11th-century plinth and the bottom two to four courses masonry are composed of elongated blocks of Pea Grit. The stone is pale brown to grey brown with an un-even

texture and orange ferruginous patches. It contains fossil fragments up to 50mm in size, as well as ooids, and weathers with an un-even surface. The nearest source is the Cotswold escarpment from Haresfield/Standish, in the south, to Crickley or Leckhampton Hills in the north. This variety of Pea Grit has been identified elsewhere in the plinth and lower courses of the eastern arm of the Romanesque church.

The second variety of Pea Grit occurs in the first and second string courses in the turret. It is a yellow to pale grey pisolithic limestone composed of oval pellets around 5mm in size fine shell debris and scattered ooids in a sparry matrix. It is a highly weather resistant stone also identified in weathering positions in the 11th-century eastern arm. The source would be similar to the Pea Grit described above.

In addition to the above, fragments of Roman brick, Old Red Sandstone, Stonesfield Slate and Pennant Sandstone were identified in the joints of the 11th-century masonry, being used to correct variations in the length or height of the ashlars.

The mortar is pink to purple brown in colour with inclusions of various colours visible to the naked eye. It has a fine fraction of clear, orange and pink, rounded to sub-rounded, fine to medium, grains of quartz sand with a smaller amount of similarly sized rock fragments. The coarse fraction is composed of rounded and sub-rounded stones up to 20mm in size with angular fragments of Inferior Oolite up to 10mm across

### *12th century*

The masonry in the upper stages of the turret is mostly composed of material re-cycled from the 11th-century structure. The stones have been re-cut with the original decoration turned inwards. Roman brick and tufa were found in the core along with Blue Lias limestone and Lower Freestone. A course of green Coal Measure Sandstone was used for the string course dividing the upper two stages.

Mortar samples from the 12th-century core show a sandy, poorly consolidated mortar, pale orange/pale brown in colour and poorly sorted with smooth, sub-rounded to sub-angular pebbles up to 20mm in size. This mortar contrasts in colour and texture with the earlier Romanesque mortars identified so far at the cathedral caused by a change in the source and proportions of the component materials, perhaps around the middle of the 12th century.

### *14th century I*

The small area of masonry above the south aisle vault is composed of reused Romanesque ashlars of Lower Freestone with a small number of larger blocks which were presumably freshly quarried.

### *14th century II*

The re-modelling of the transept was carried out using a combination of reused Romanesque and newly quarried stone. Newly quarried Lower Freestone was used for the inner mouldings and tracery in the windows, for the parapet and exterior tower buttress. A small quantity of distinctive orange arenaceous oolitic limestone from the Lower Inferior Oolite of the North Cotswolds (‘Brockhampton’), again freshly quarried, was used for the cornice and some plinths and sills.

Reused Romanesque plain ashlars were used for the spandrels and vertical buttresses while stones with Romanesque decoration occur in the outer part of the window mouldings. The location of reused Romanesque architectural decoration is shown in Fig. 17, iv. The

Roman brick/tile identified in the 14th-century masonry is similarly material re-cycled from the dismantled 11th-century structure.

The 14th-century mortar is white to cream in colour, well sorted with a high proportion of fine grained sand and flecks of charcoal visible to the naked eye. It is similar is character and composition to other late medieval mortars used at the cathedral.

### *19th century*

The extent of the 19th- and early 20th-century repairs are illustrated in Fig. 22 where the elevation is shown with this work subtracted.

The restoration of 1868 was carried out using stone from the Great Oolite Series that was quarried from the hills around Bath. Three varieties have been identified; the most frequently occurring is a medium grained, cream to buff/brown, cross-bedded, sparry oolitic limestone. There is little fossil and the ooids weather out from the surface, when the stone is exposed, leaving the sparry matrix prominent. The stone resembles Coombe Down Oolite or Bath Oolite

The two other types of Bath stone identified in the fabric are similar to the variety described above but are shelly with a coarser texture. These occur far less frequently and are used in weathering positions.

The 19th-century mortar is dark grey in colour, hard, brittle, and composed of well sorted fine-grained material.

### *20th century*

The repairs carried out in 1908 were carried out using a particularly pure and white variety of Lower Freestone; the associated mortar was not identified. Limited repairs carried out in the 1983, on the south elevation of the transept, and in the 1990s, on the west, were done with Lepine Stone.

## Figures: part I

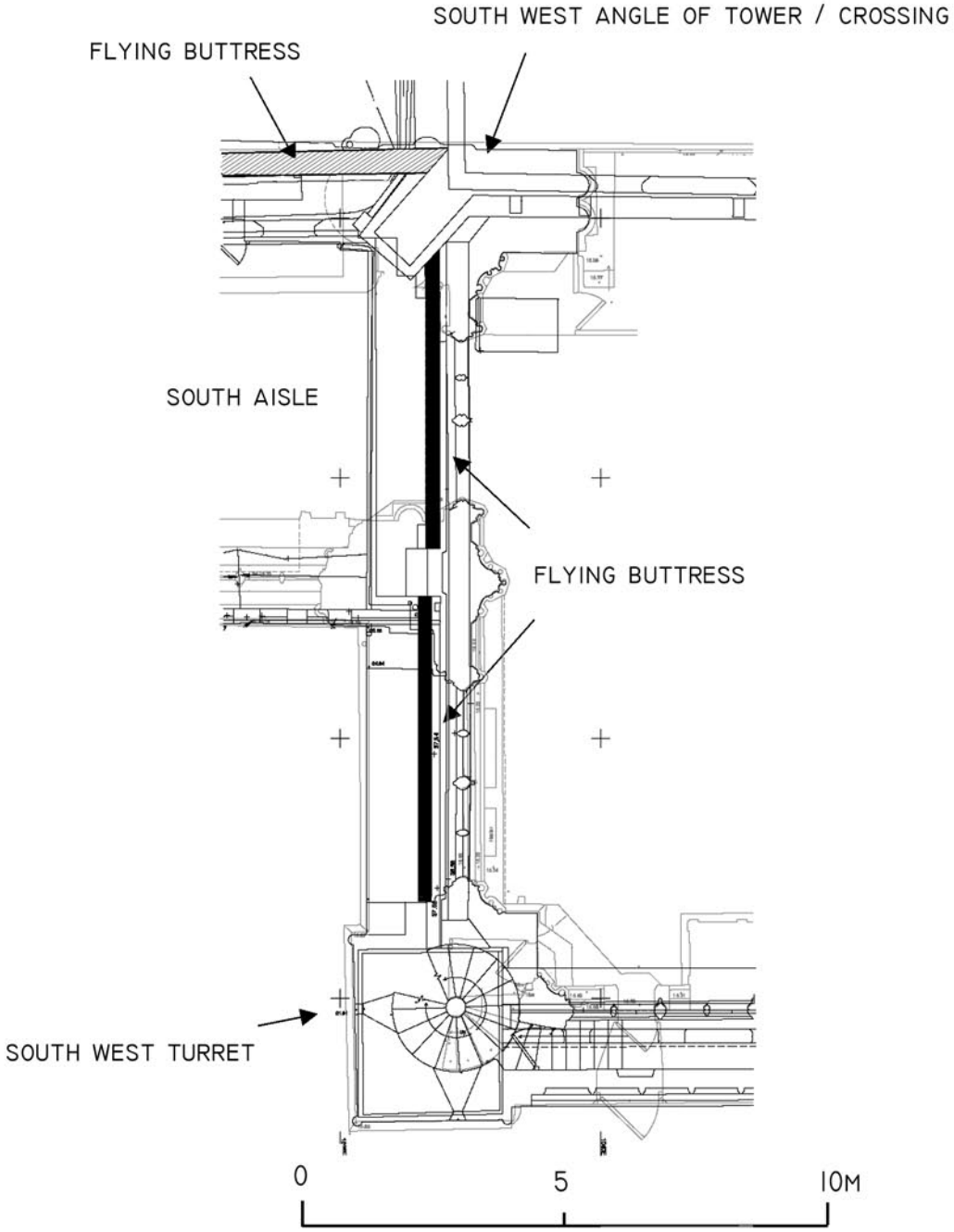
1. Plan (based on plan survey 2001 by CSL, Worcester)
2. Elevation with petrological identifications
3. Interpretation
4. Distribution of Roman brick / tile
5. Mason’s marks-location
6. Mason’s marks
7. Distribution of wedge marks
8. Wedge marks
9. Location of features in text
10. Mouldings
11. Distribution of fractures
12. Top stages of turret-petrological identifications
13. Repairs to 12th-century decoration
14. Mortars in cornice joint
15. Green sandstone string course
16. Reused 11th-century decoration

17, I. Reused Romanesque capitals as bases, N window
17, II. Reused Romanesque capitals as bases, S window
17, III. Reused Romanesque capitals as bases, drawings

17, IV. Reused Romanesque architectural decoration
18. Flying buttress from E / turret opening
19. Perspective diagram of N window, S jamb mouldings
20. Projectile damage, distribution
21. Projectile damage, photographs
22. Medieval stones.

FIG.1 GLOUCESTER CATHEDRAL ~ SOUTH TRANSEPT, WEST ELEVATION

PLAN



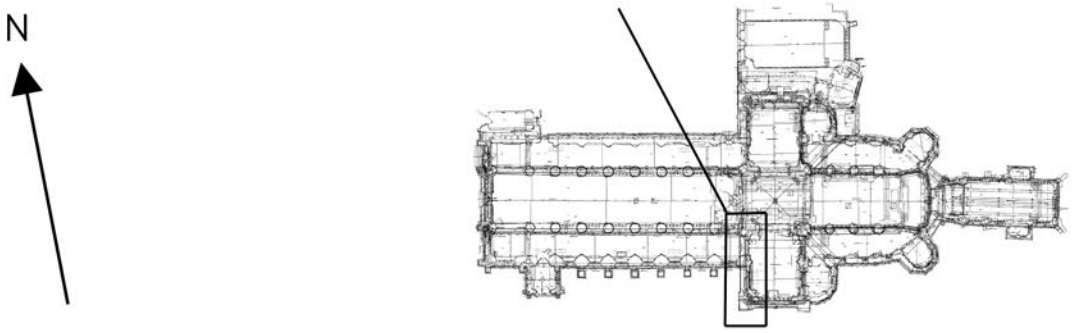



FIG. 2 GLOUCESTER CATHEDRAL ~ SOUTH TRANSEPT, WEST ELEVATION

PETROLOGY

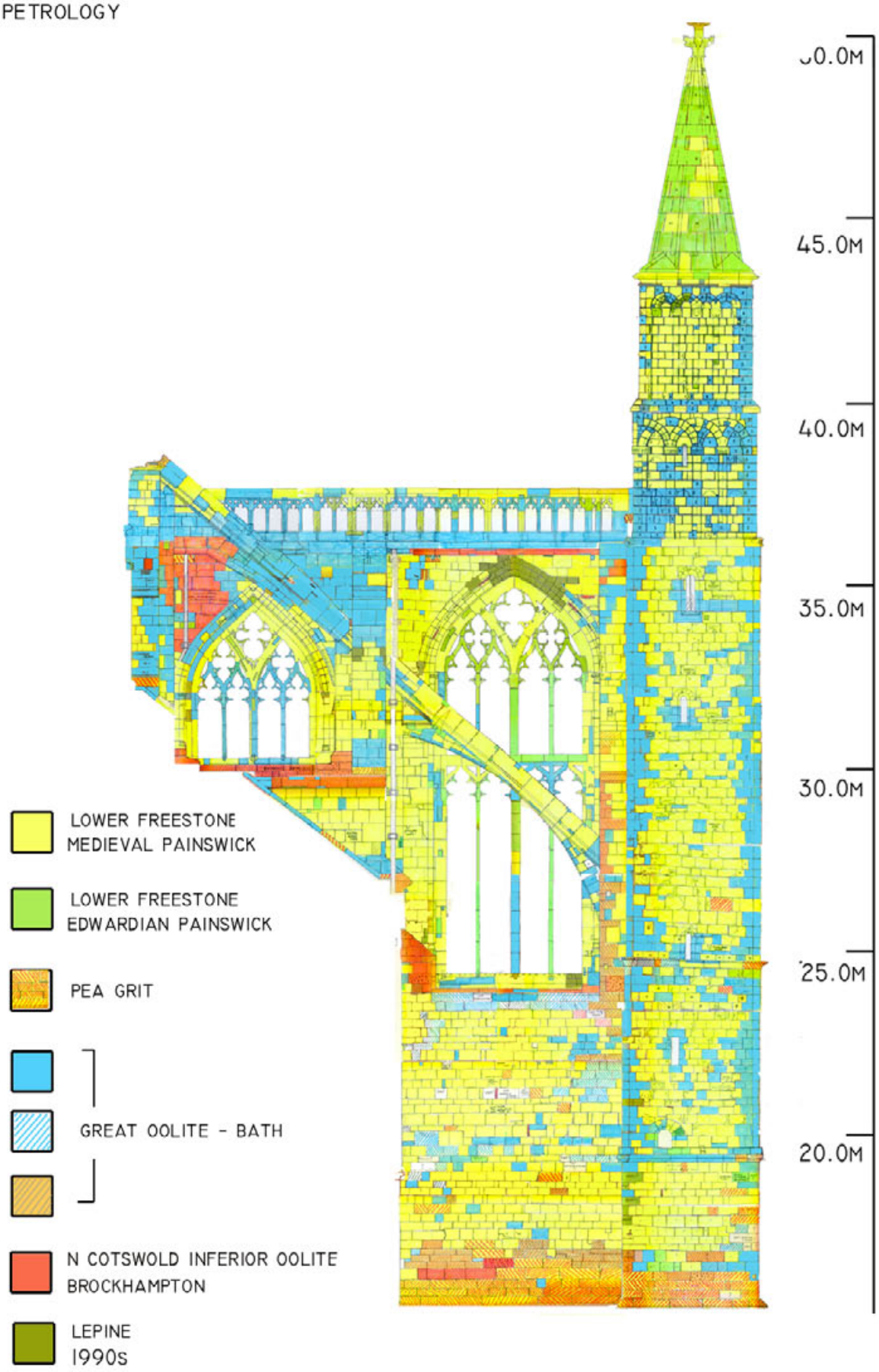


FIG.3 GLOUCESTER CATHEDRAL S TRANSEPT~W ELEVATION

INTERPRETATION

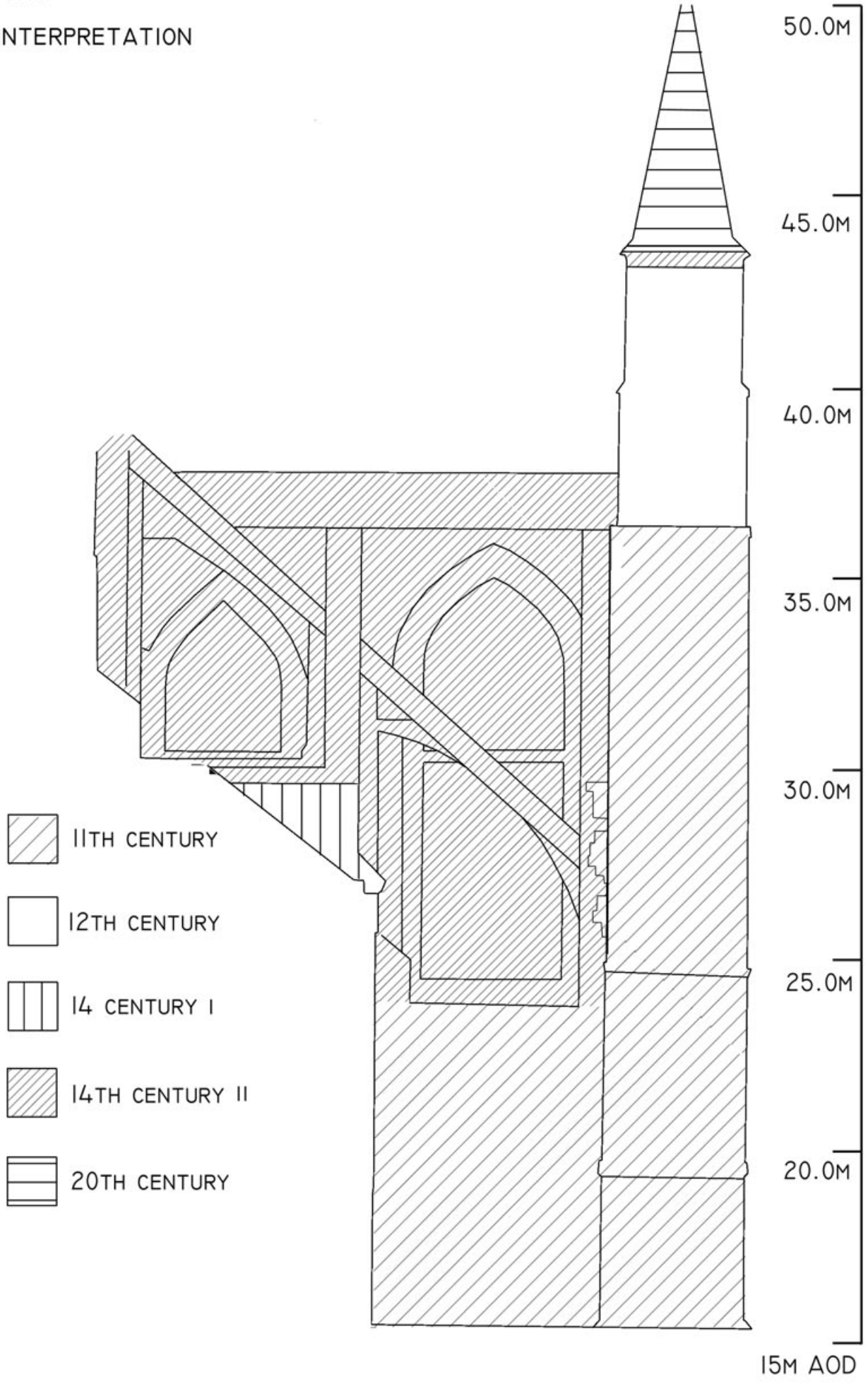


FIG. 4 GLOUCESTER CATHEDRAL ~ SOUTH TRANSEPT, WEST ELEVATION

DISTRIBUTION OF ROMAN BRICK / TILE

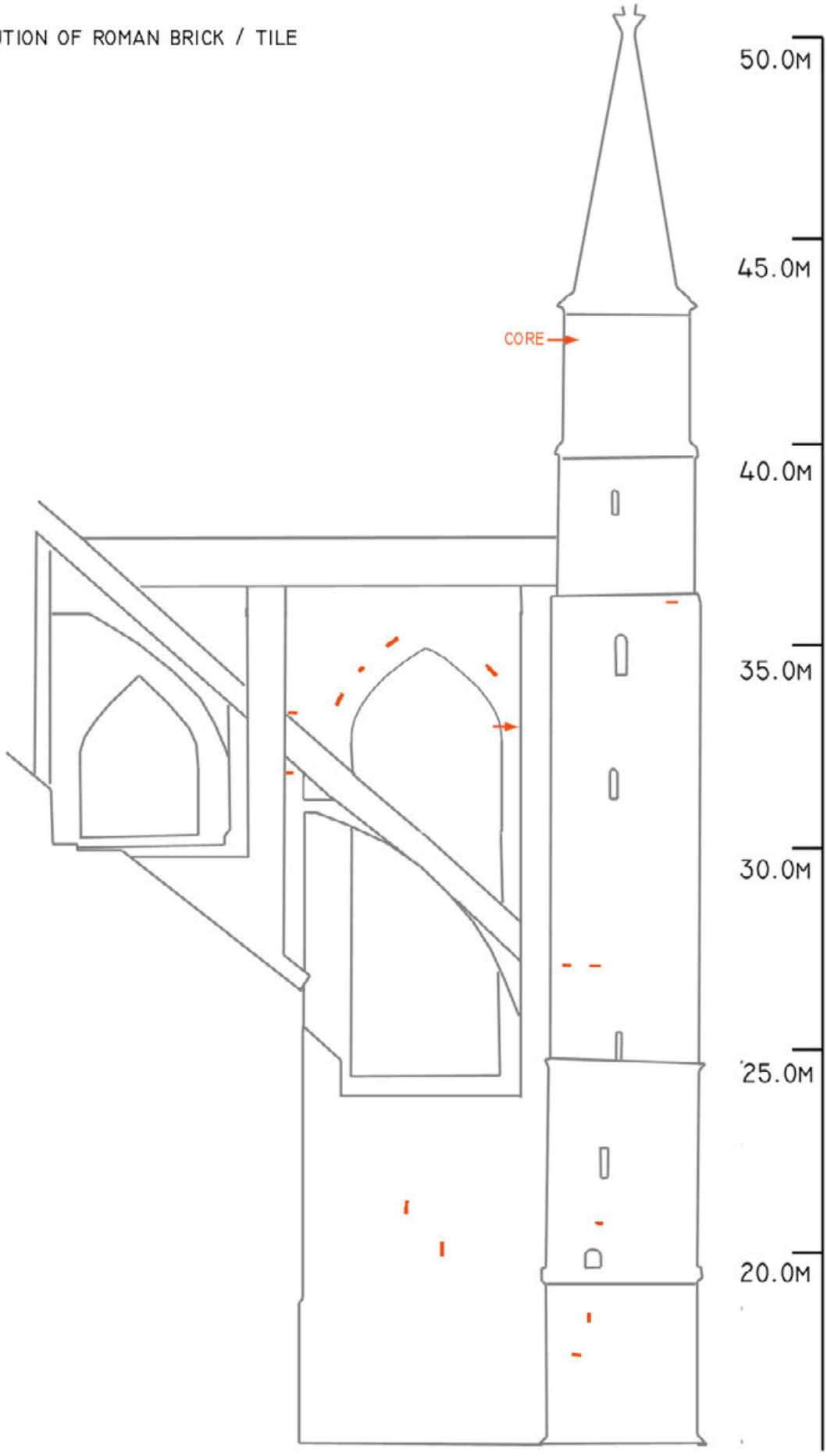


FIG.5 GLOUCESTER CATHEDRAL ~ SOUTH TRANSEPT, WEST ELEVATION
MASON'S MARKS LOCATION

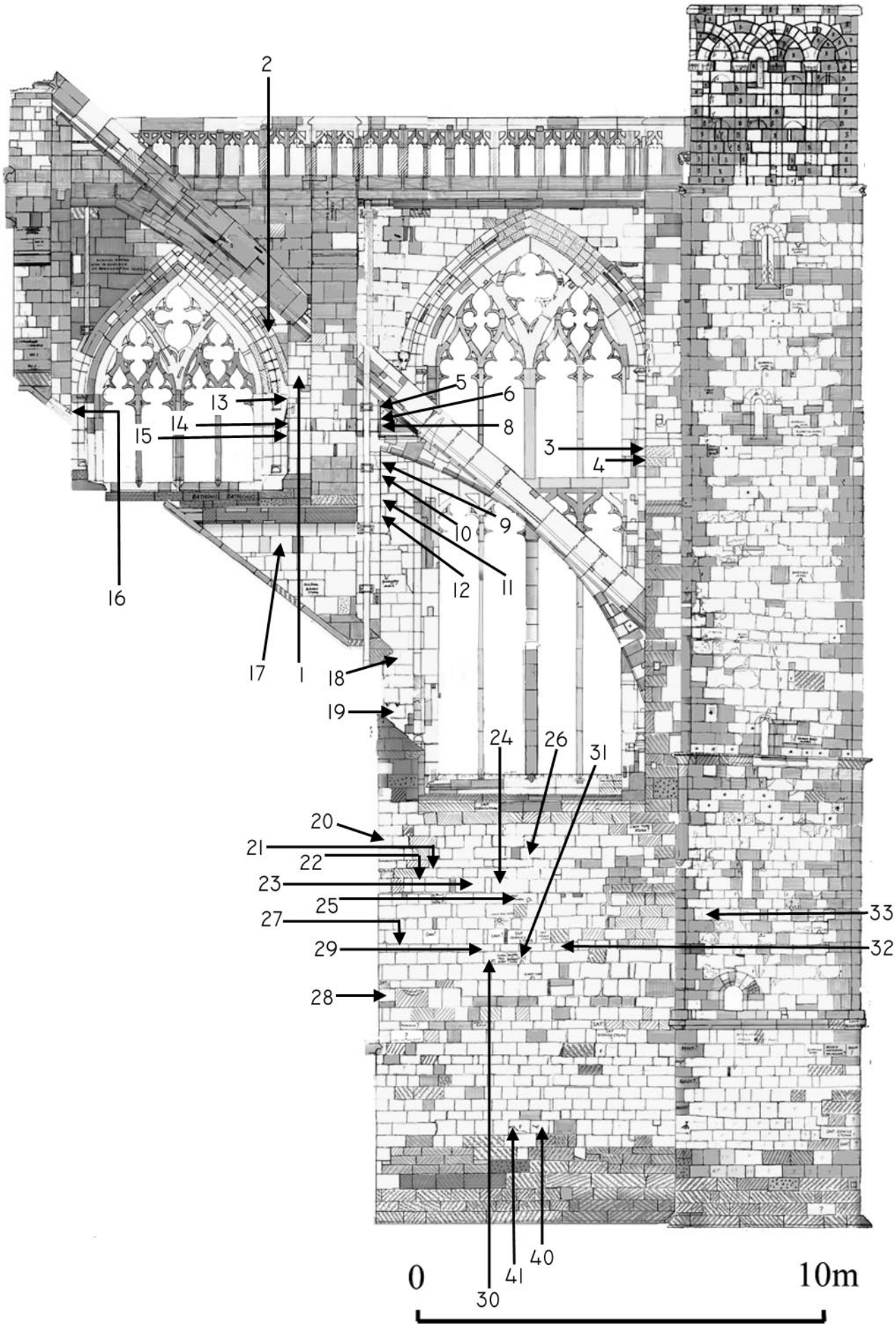


FIG.6 GLOUCESTER CATHEDRAL SOUTH TRANSEPT ~ WEST ELEVATION
MASON'S MARKS 1:4 SCALE

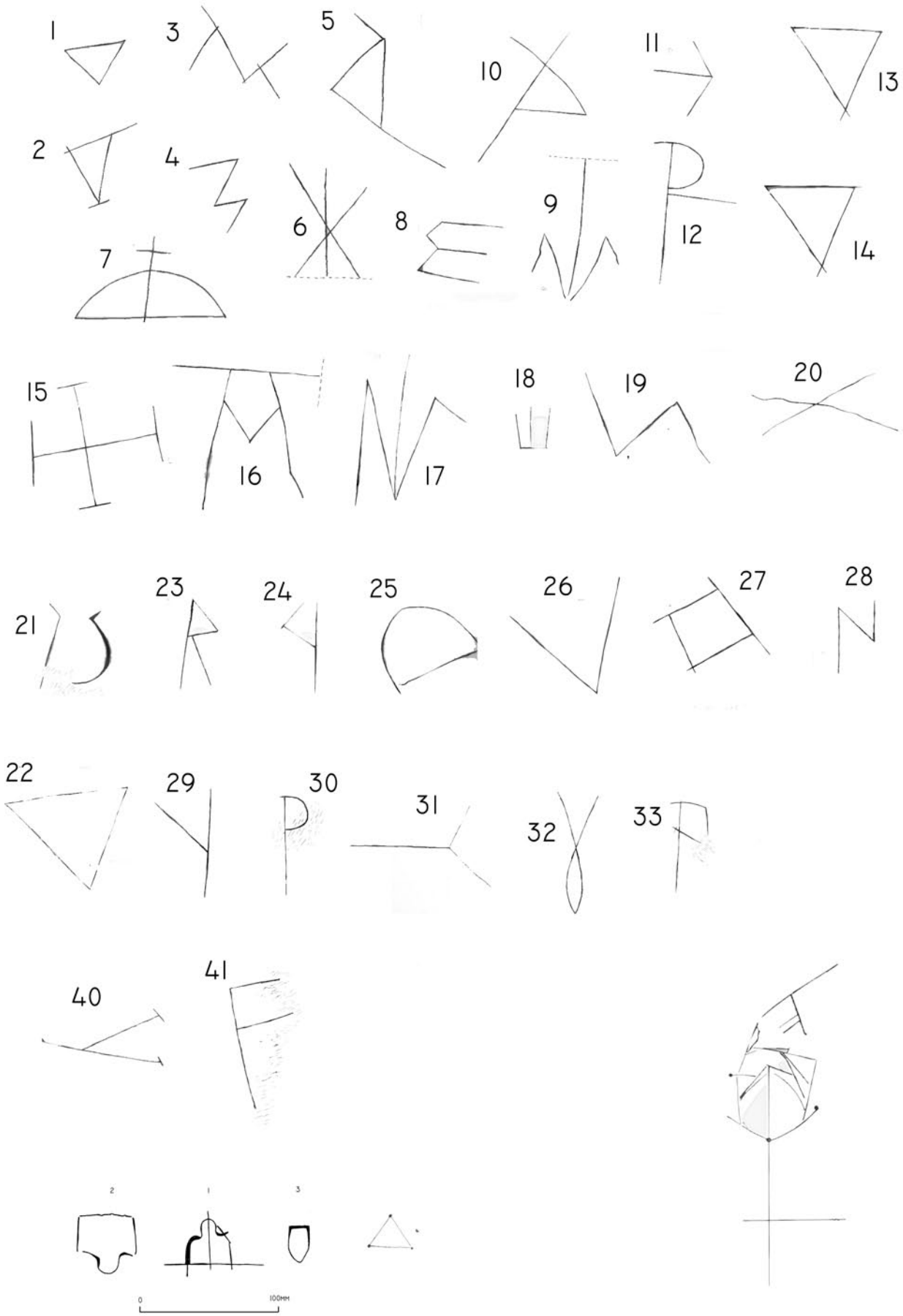


FIG.7 GLOUCESTER CATHEDRAL ~ SOUTH TRANSEPT, WEST ELEVATION
LOCATION OF WEDGE MARKS

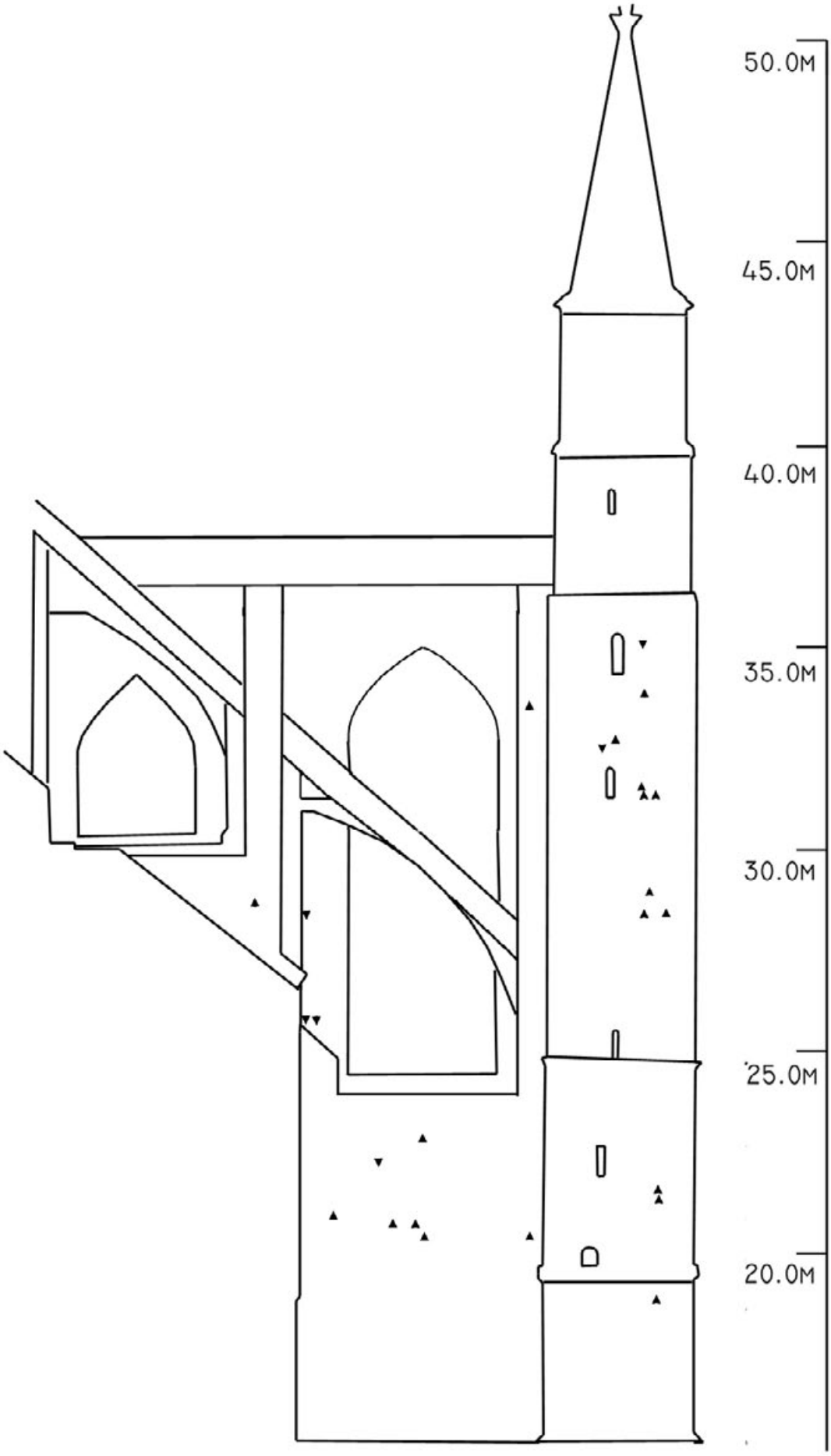
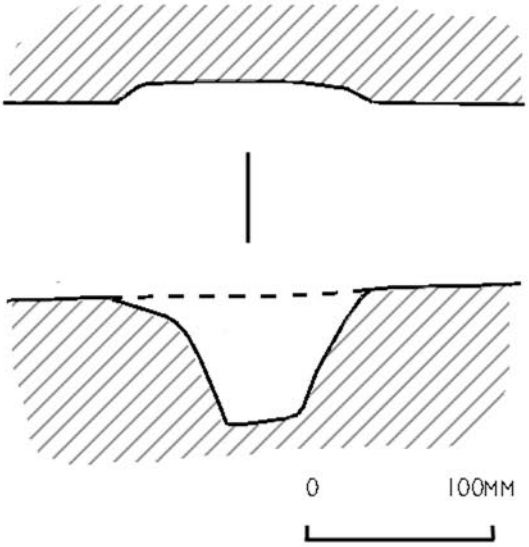


FIG.8 GLOUCESTER CATHEDRAL ~ SOUTH TRANSEPT, WEST ELEVATION
WEDGE MARKS

I. WEDGE MARK 1:4




II. PHOTOGRAPH OF THREE WEDGE MARKS IN PROFILE

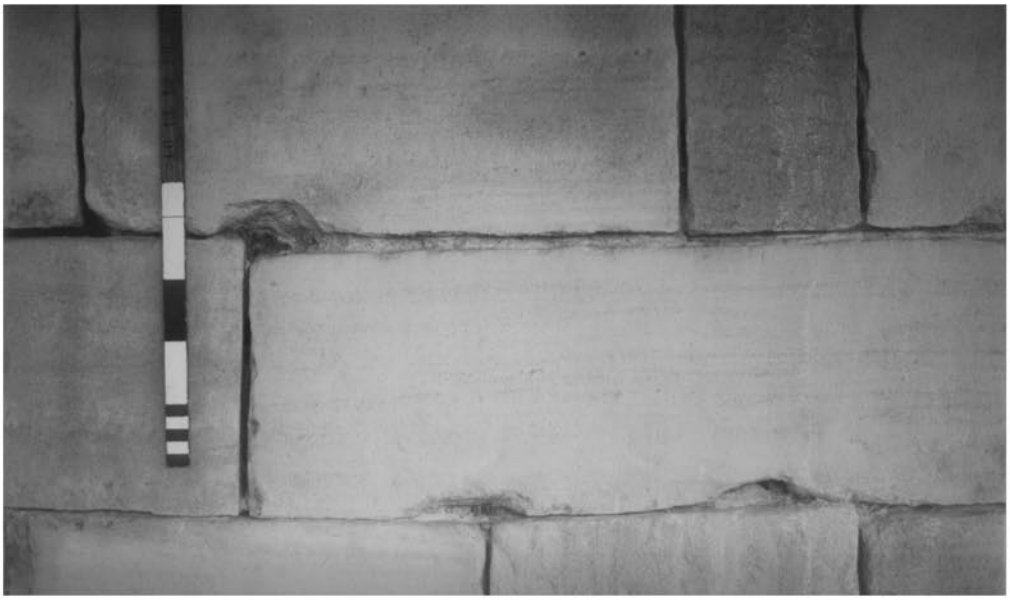


FIG.9 GLOUCESTER CATHEDRAL ~ SOUTH TRANSEPT, WEST ELEVATION
FEATURES / LOCATIONS CITED IN TEXT

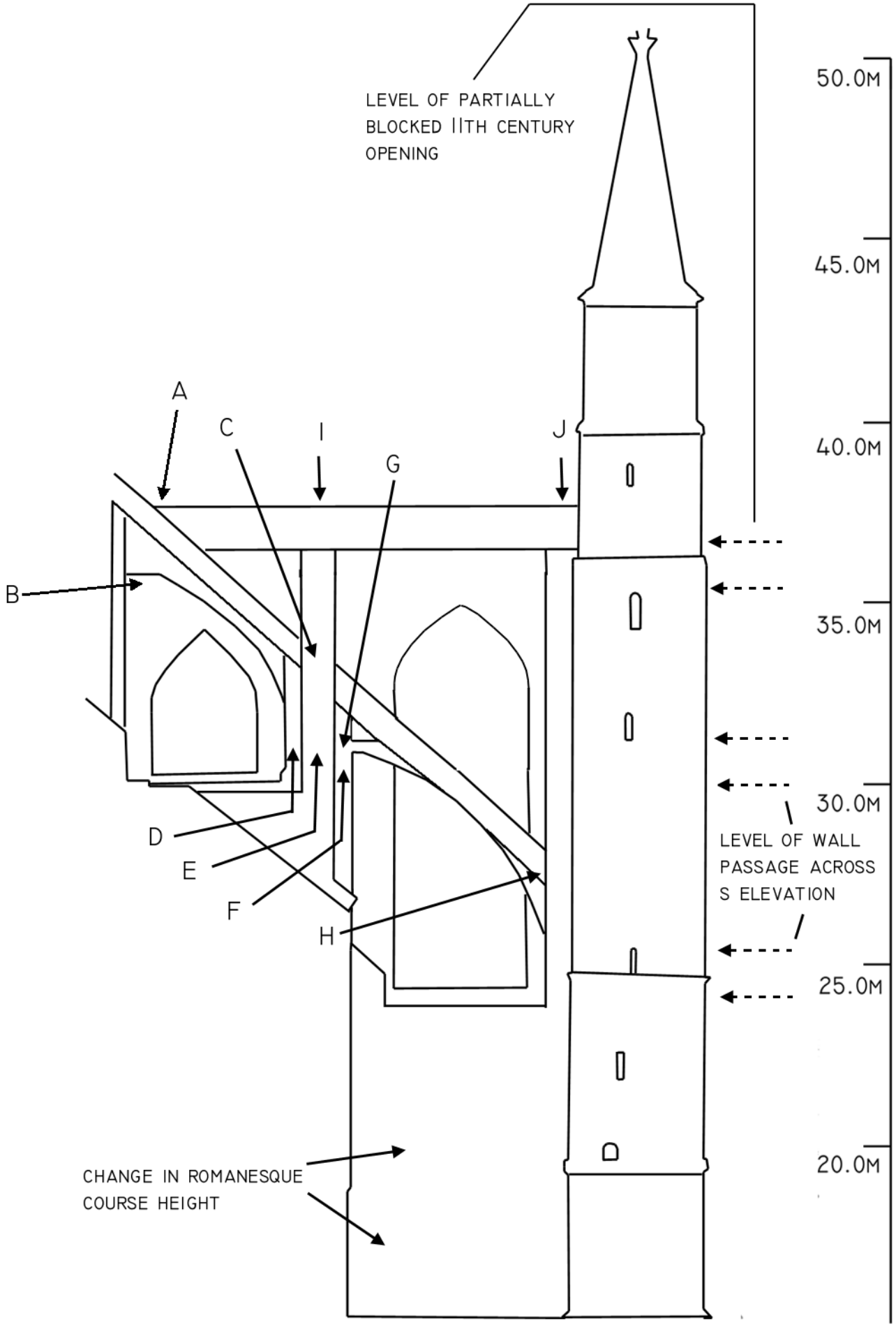
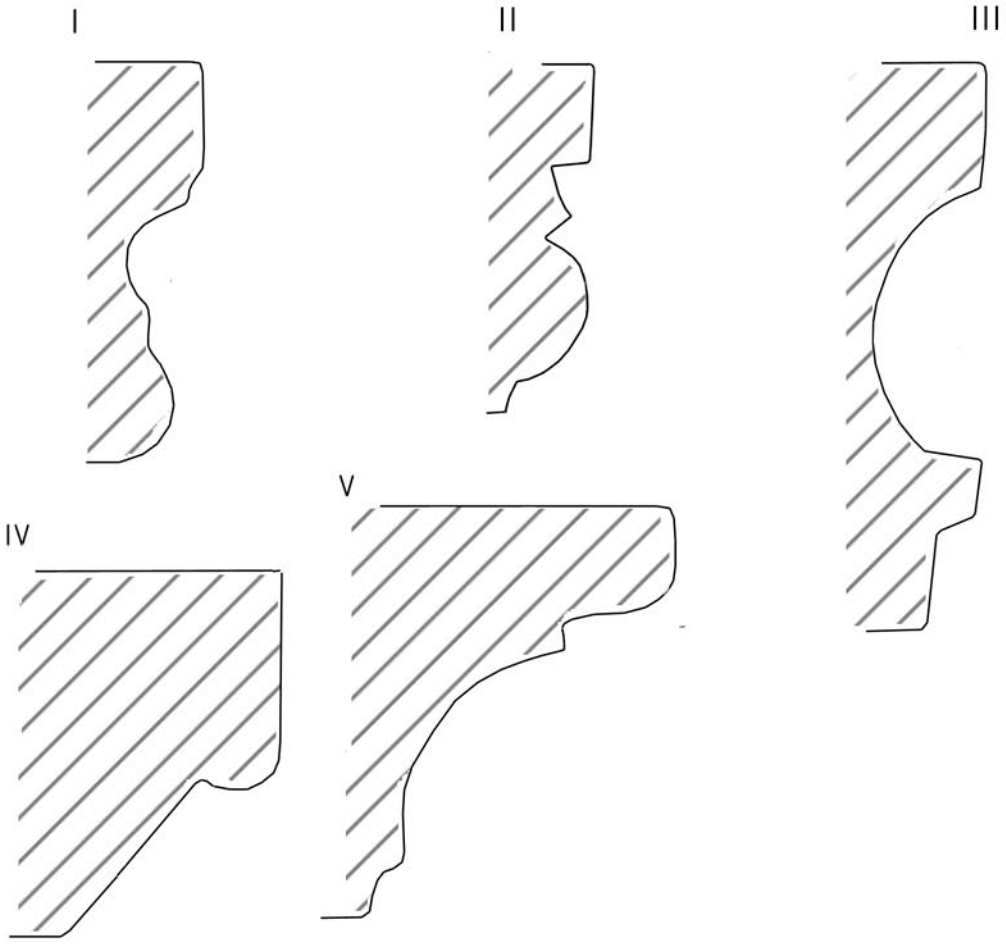


FIG.10 GLOUCESTER CATHEDRAL ~ SOUTH TRANSEPT, WEST ELEVATION
MOULDINGS 1:4 SCALE




10B

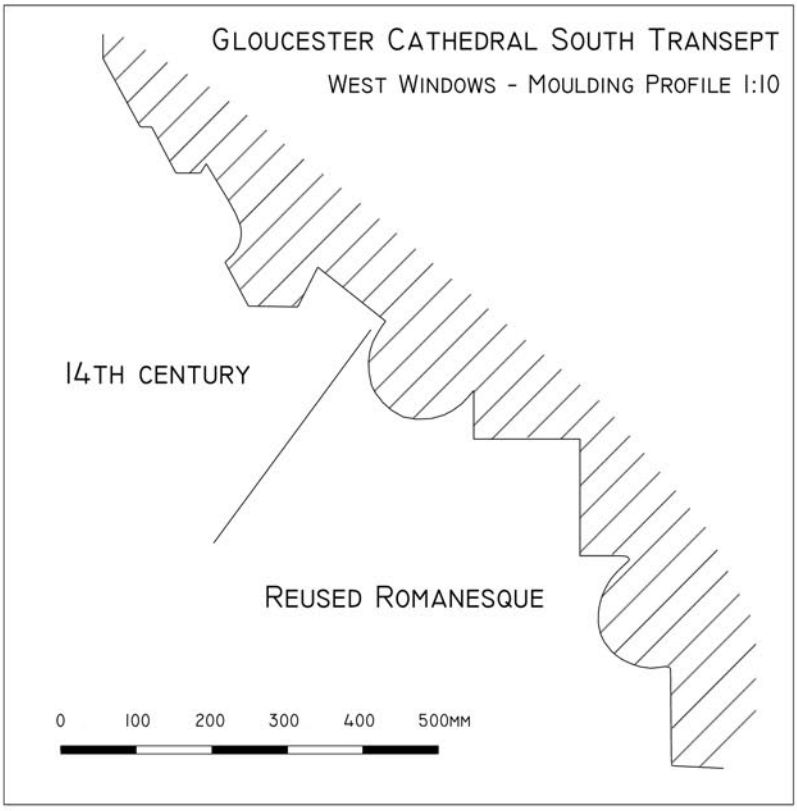


FIG.11 GLOUCESTER CATHEDRAL ~ SOUTH TRANSEPT, WEST ELEVATION
MAJOR FRACTURES IN THE MASONRY

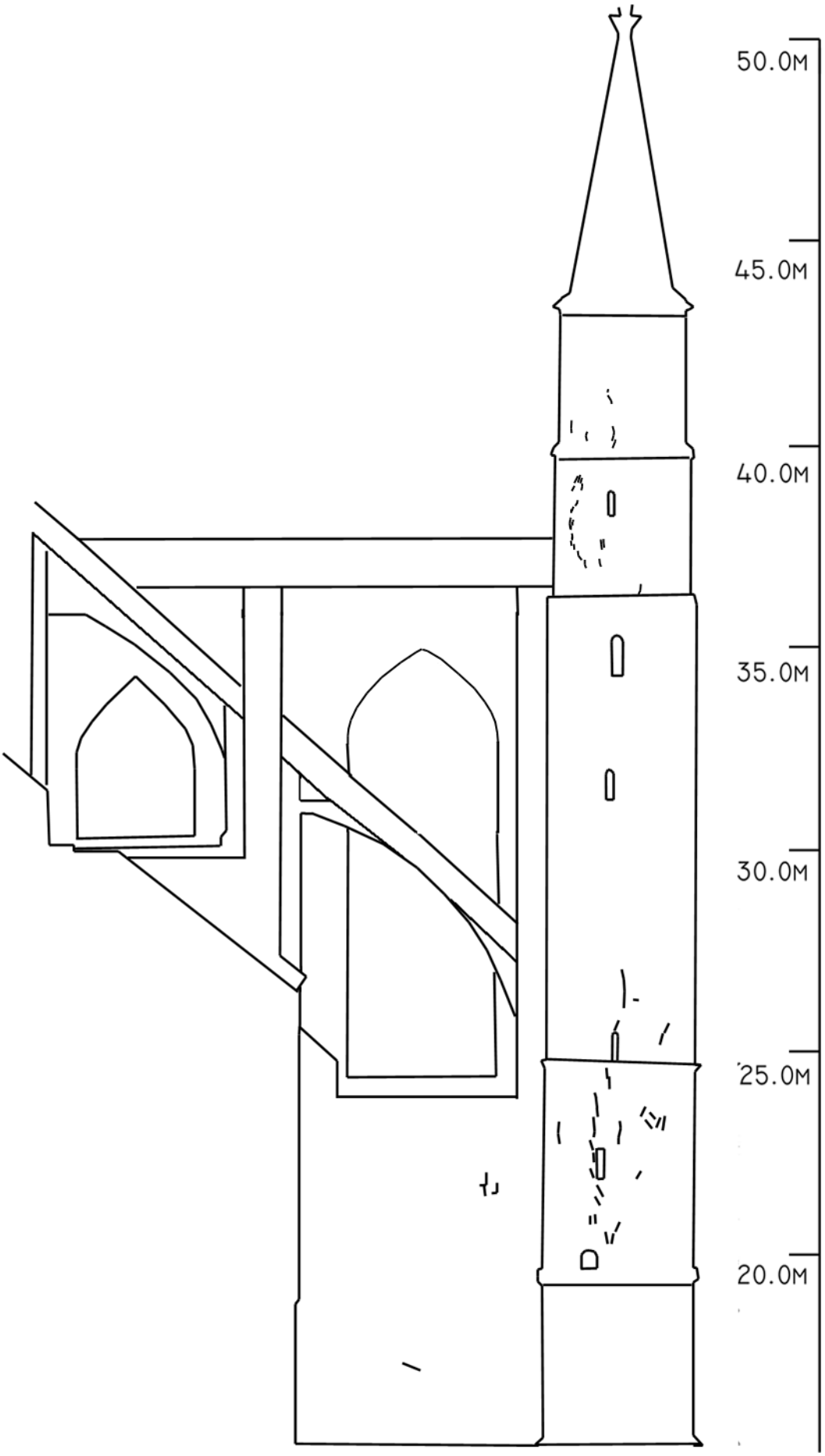
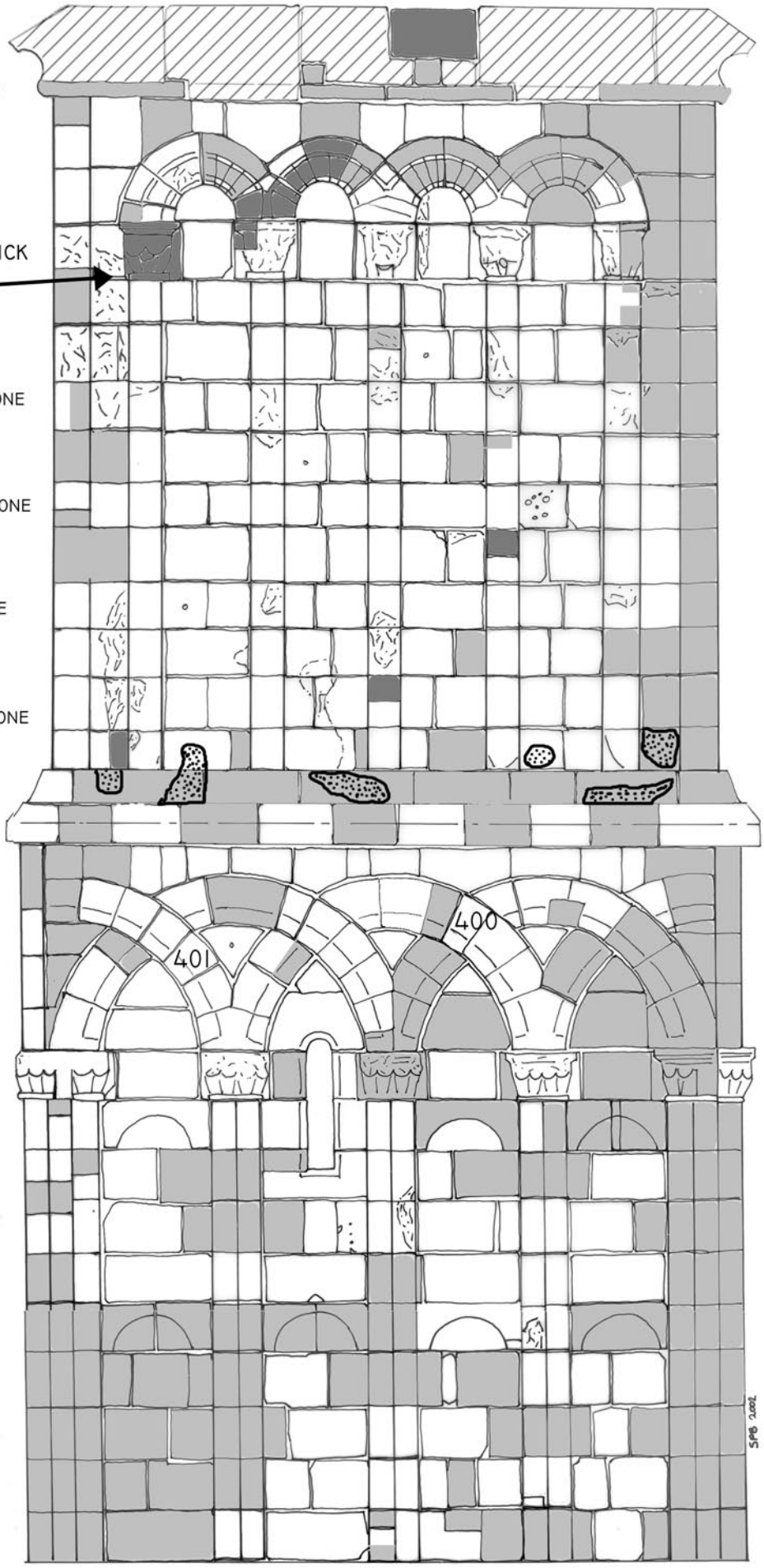


FIG. 12

BUILDING MATERIALS

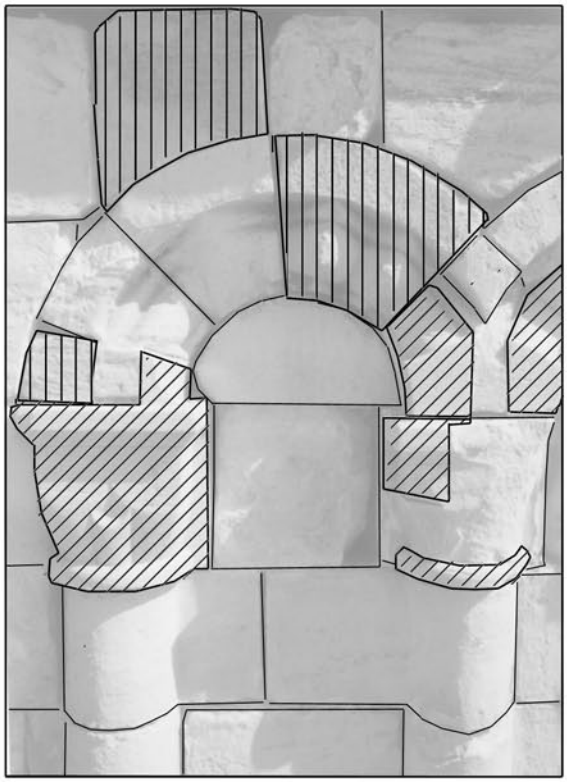



GLOUCESTER CATHEDRAL ~ S TRANSEPT, SW TURRET

0 WEST ELEVATION 3M

FIG.13 GLOUCESTER CATHEDRAL ~ SOUTH TRANSEPT, WEST ELEVATION

DETAIL OF REPAIRS TO DECORATIVE ARCADING, UPPER STAGE, TURRET



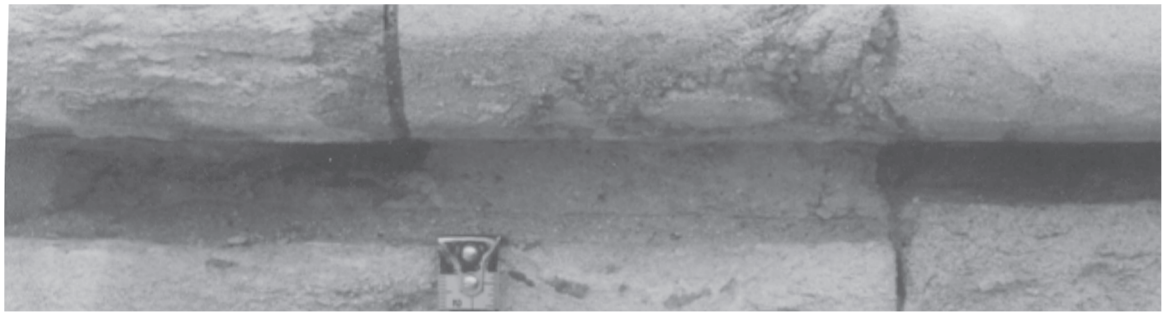
LOWER FREESTONE
c12

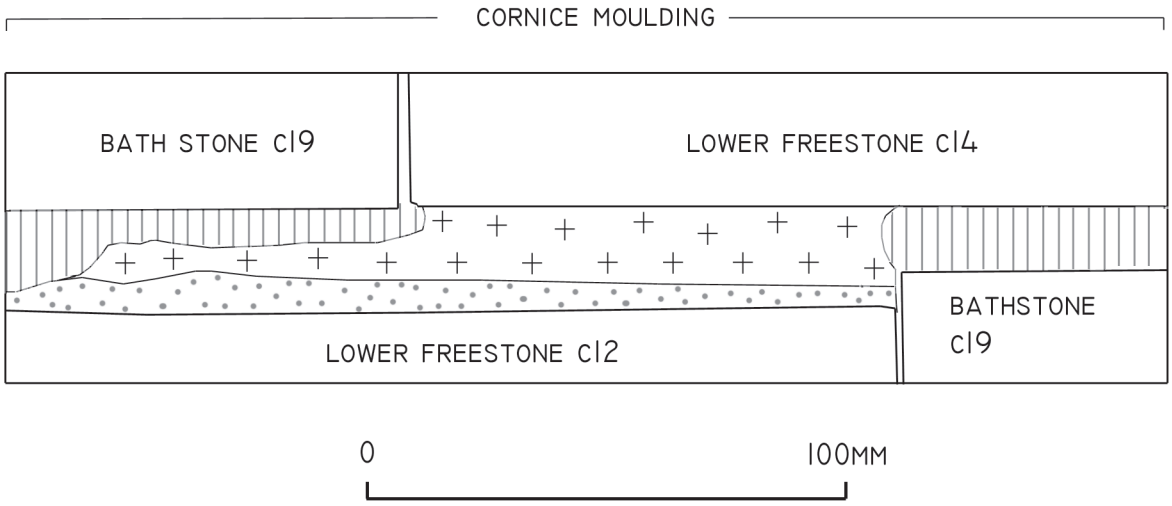
BATH STONE
c19

LOWER FREESTONE
c20

FIG.14 GLOUCESTER CATHEDRAL SOUTH TRANSEPT ~ WEST ELEVATION

DETAILS OF BUILDING MORTARS IN THE CORNICE JOINT OF THE TURRET






12TH CENTURY MORTAR

14TH CENTURY MORTAR

19TH CENTURY MORTAR

FIG.15 GLOUCESTER CATHEDRAL ~ SOUTH TRANSEPT, SOUTH WEST TURRET

12TH CENTURY SANDSTONE STRING COURSE REVEALED DURING REPAIRS

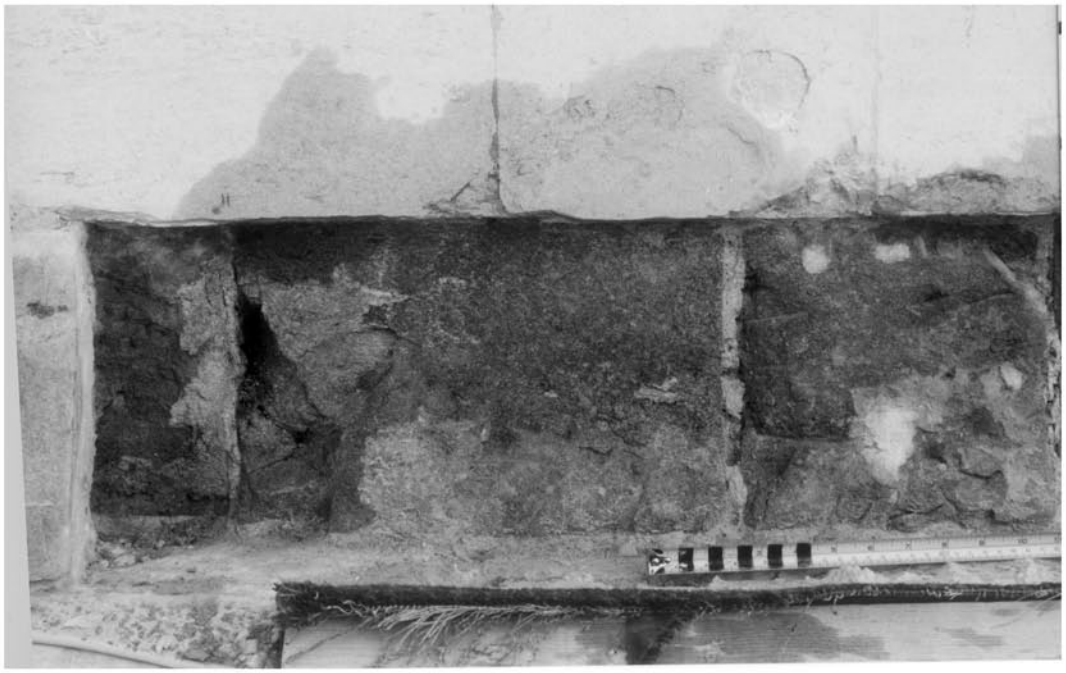


FIG. 16 GLOUCESTER CATHEDRAL ~ SOUTH TRANSEPT, SOUTH WEST TURRET

REUSED ROMANESQUE STONE 1:4 SCALE

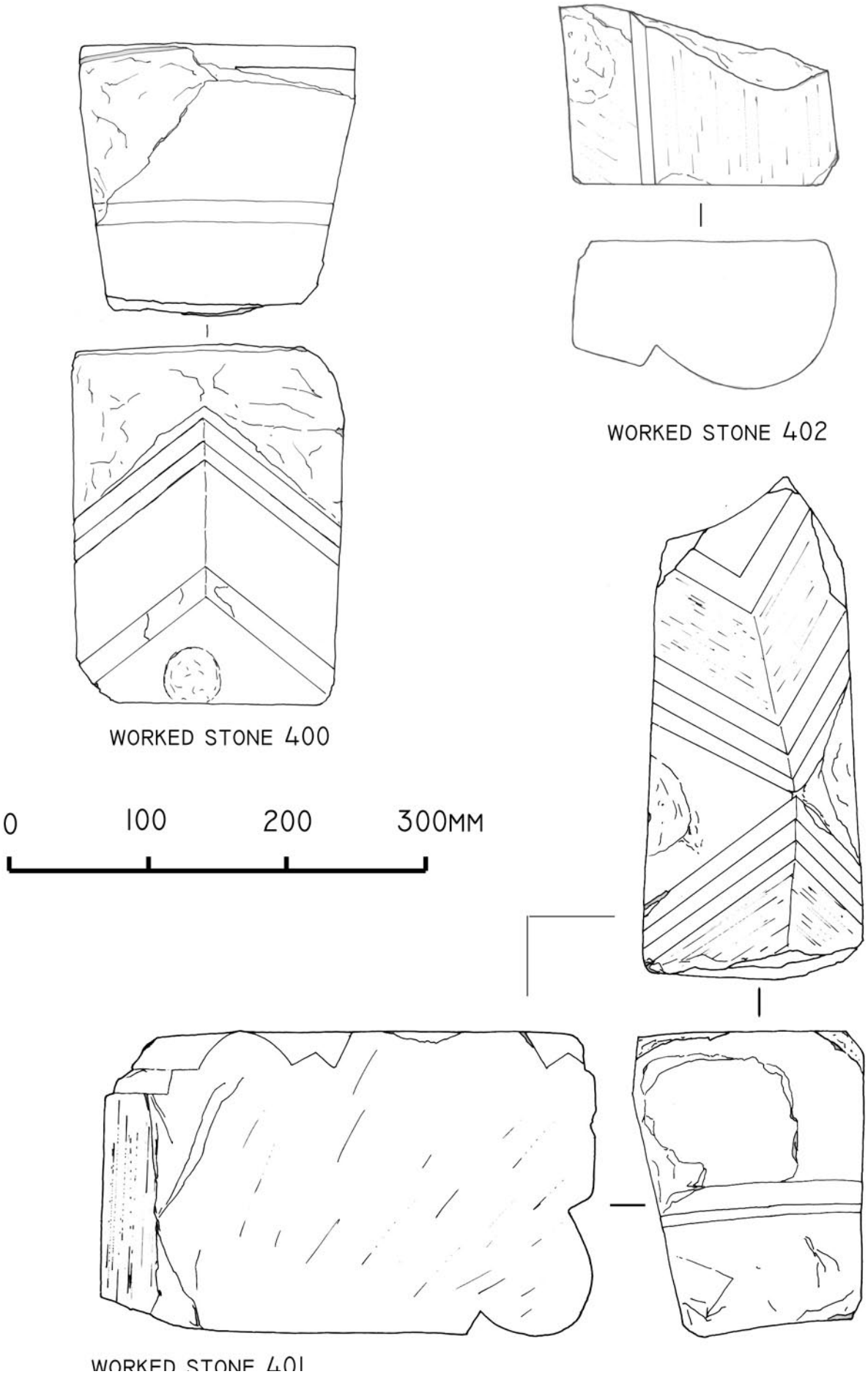


FIG.17,1 ROMANESQUE CAPITALS REUSED AS BASES, NORTH WINDOW

N JAMB

S JAMB

FIG.17,11 ROMANESQUE CAPITALS REUSED AS BASES, SOUTH WINDOW

N JAMB

S JAMB

FIG.17,III GLOUCESTER CATHEDRAL ~ SOUTH TRANSEPT, WEST ELEVATION
ROMANESQUE CAPITALS REUSED AS EARLY PERPENDICULAR BASES

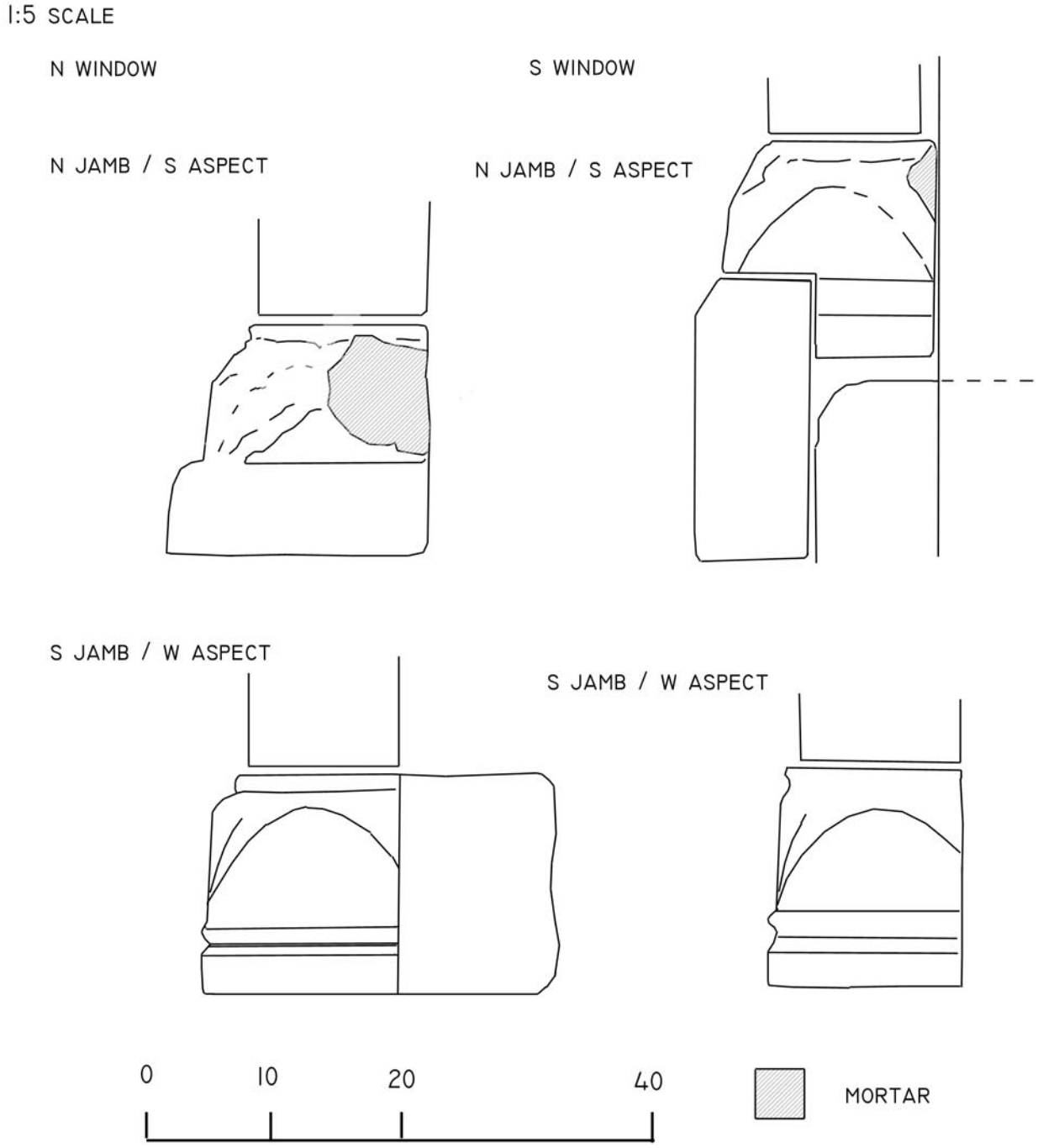


FIG.18 GLOUCESTER CATHEDRAL ~ SOUTH TRANSEPT, WEST ELEVATION

I. FLYING BUTTRESS / PARAPET FROM E

II. N ELEVATION OF TURRET AT 35M AOD

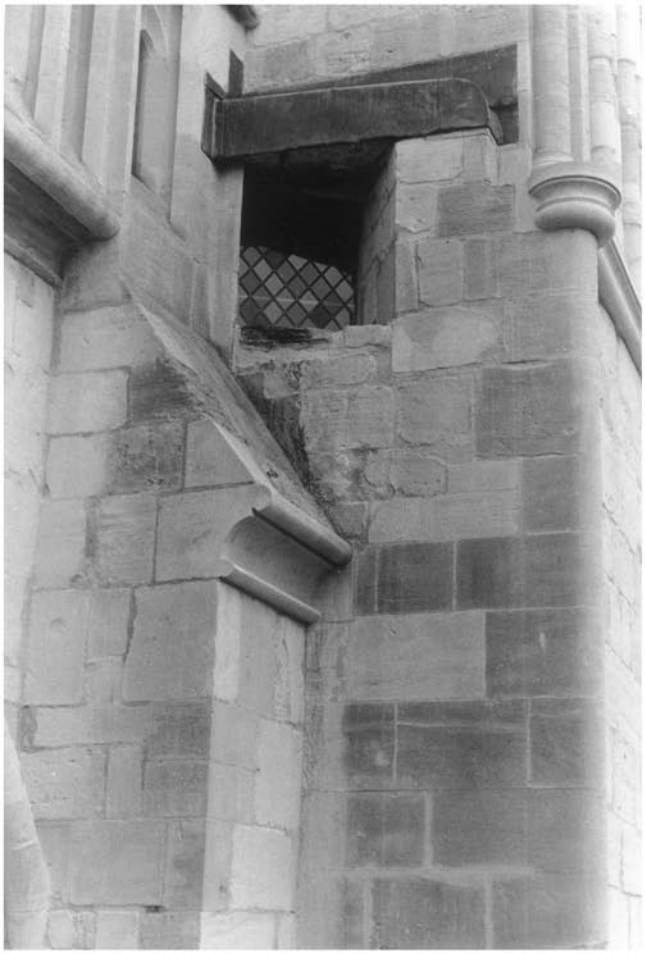
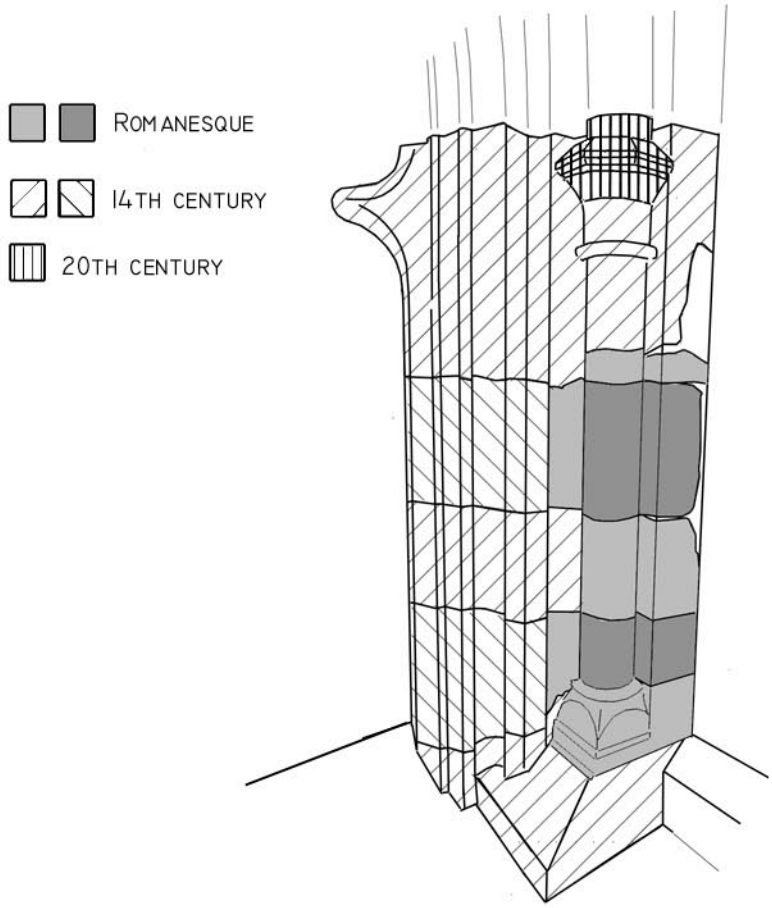


FIG.19 GLOUCESTER CATHEDRAL ~ SOUTH TRANSEPT, WEST ELEVATION

NORTH WINDOW ~ SOUTH JAMB, DETAILS OF CONSTRUCTION



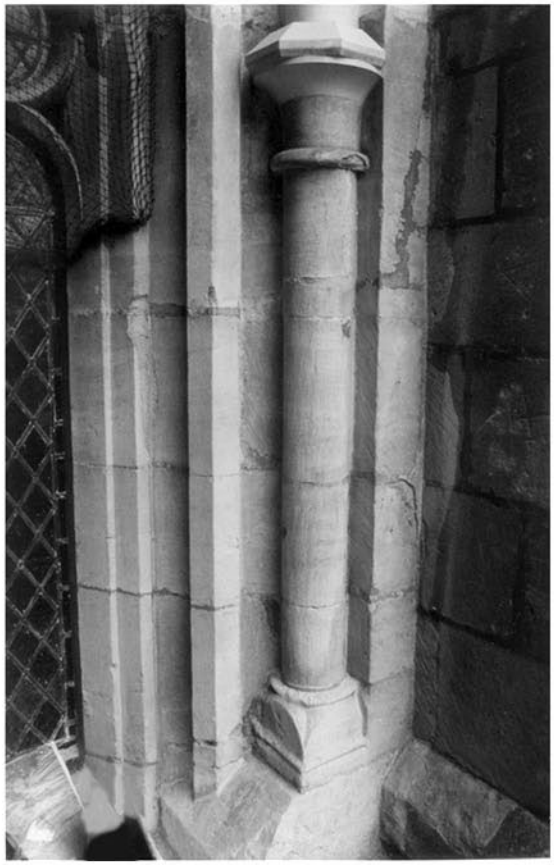



FIG.20 GLOUCESTER CATHEDRAL ~ SOUTH TRANSEPT, WEST ELEVATION

PROJECTILE DAMAGE

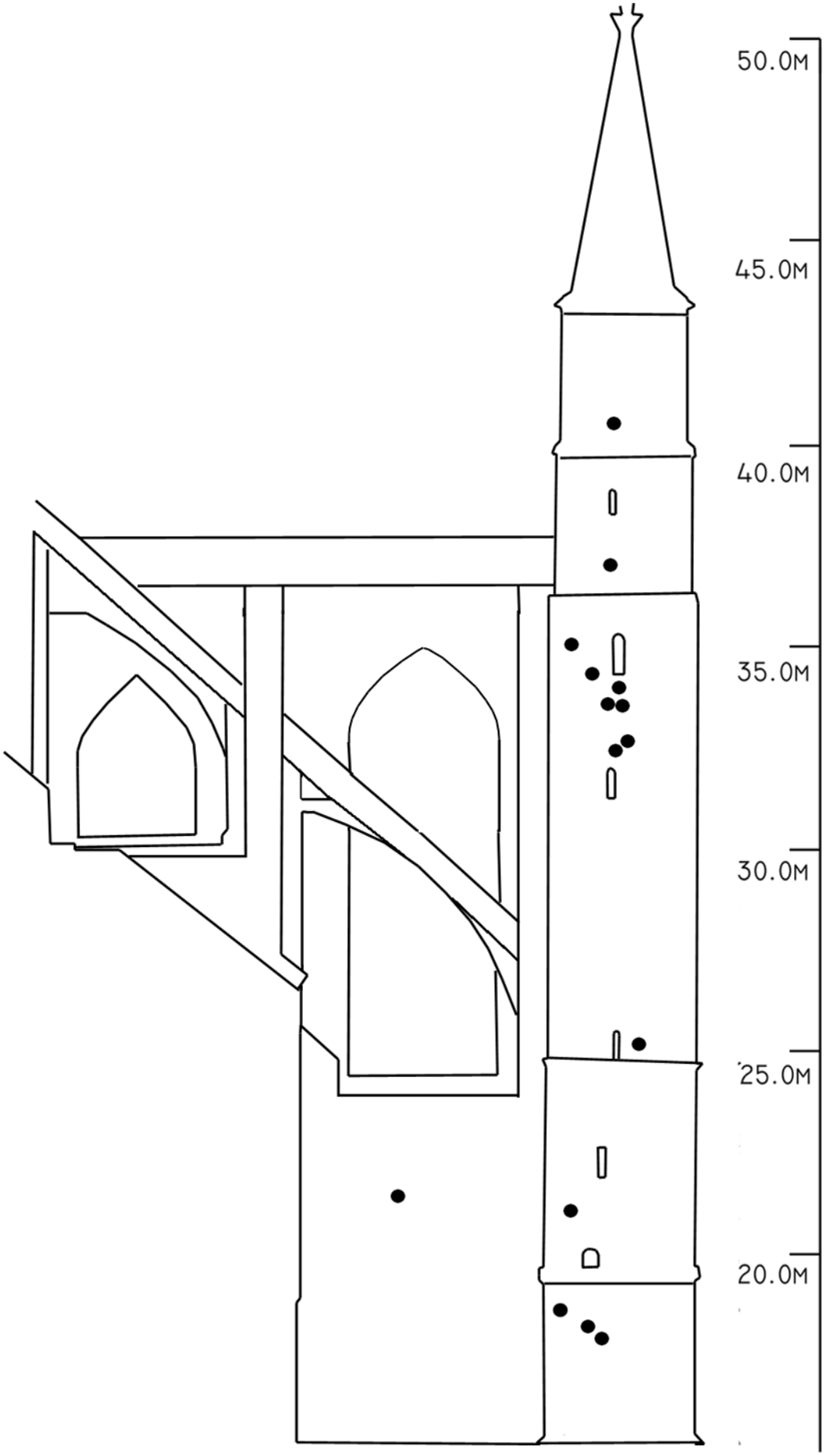


FIG.21 GLOUCESTER CATHEDRAL ~ SOUTH TRANSEPT, WEST ELEVATION

PROJECTILE DAMAGE

.I

.II

FIG.22 GLOUCESTER CATHEDRAL SOUTH TRANSEPT ~ WEST ELEVATION

MEDIEVAL STONES

THE SOUTH TRANSEPT, GLOUCESTER CATHEDRAL

2002-2003

PART II: INTERIOR WEST FACE

## INTRODUCTION

During the spring of 2003 scaffolding was erected against the west elevation of the interior of the south transept, to give access to the windows and adjacent masonry for the purposes of repair. A limited amount of archaeological recording and photography was carried out alongside these repairs. The partial access provided by the scaffold and the absence of an elevation drawing makes detailed analysis impossible; this report consists of a series of archaeological observations, illustrations and a diagram of the elevation. A full description and chronology for the west wall of the transept is given in Heighway 2002 and Bagshaw and Heighway 2003.

Fig.1 shows the interior west wall of the transept in elevation and plan.

## STRUCTURAL DEVELOPMENT

The only 11th-century masonry remaining *in situ* is the stair turret and possibly the blank infilling of the panelling below the larger southern window (Fig. 2). The masonry in this panelling was not repaired or accessible; however it is possible to see that the Perpendicular panelling has been inserted in to this stonework as opposed to being constructed along with it. In the remaining panels in the transept single courses of blocks can be traced through the projecting panel frames and the flat wall surface, demonstrating that these areas were wholly rebuilt in *c*.1329-37. As the buttress clearly belongs to the 14th century re-modelling the interpretation drawing shows only the work of two periods: I : 1089-1100, II: 1329-37.

In addition to the medieval work repairs belonging to the restoration of 1867-8 were also identified. These repairs are characterised by the use of Great Oolite from Bath. The amount of stone replaced on the interior in 1867 was very small when compared to that on the exterior of the elevation (see above). For example much of the medieval tracery remains on the interior where it has been replaced outside. Iron tie bars were inserted across the windows and deep into the masonry either side, where they were grouted with lead. This grouting failed to prevent the bars from rusting, expanding and causing serious damage in the form of fractures through individual stones and the distortion of larger areas of masonry. Both windows had the tie bars at the level of the springing point of the arch, while the southern window had a second bar at a height of approximately 27m AOD. This second bar caused the window mouldings to swell out by up to 100mm on the exterior elevation. Much of the 2003 repair work consisted of removing the remains of the bars from the masonry and replacing the damaged stones.

## 11TH CENTURY

The north east angle of the 11th-century stair turret extends in to the south west angle of the transept. The turret was not repaired nor accessible, except at the very top. The masonry appears to be 11th-century for its entire height; the string course at 24.60m AOD corresponds with a string course on the exterior of the turret at that height, while those at 31.80 and 33.30 match a pair of strings preserved in the Romanesque masonry against the

north elevation of the south east turret. Christopher Wilson has suggested that clerestory level arcading extended around the exterior of the eastern arm of the Romanesque church between these levels (1985:72; pls. xiid, xiie).

The ashlars between the two upper strings were accessible on the north elevation of the turret. The surface of these stones show very faint Romanesque mason's marks and diagonal striated tooling marks but with the distinctive marks of a claw partially obliterating the earlier tooling. These are Romanesque blocks that were lightly re-dressed in *situ* during the 14th-century re-modelling.

## 14TH CENTURY FLYING BUTTRESS

The buttress that crosses the opening in the northern bay supports the south west pier of the crossing and, ultimately, the tower. It was examined and photographed before being re-pointed, with a view to establishing the relationship of the buttress with the surrounding masonry.

The diagonal buttress mouldings continue across the panelling on either side of the opening spanned by the buttress. Fig.3,I shows these mouldings crossing the panel to the north of the opening (location A). Here it is possible to see that the stone upon which the buttress moulding is cut is large and extends deeply in to the surrounding mouldings in a way that would be difficult, or impossible, to achieve had the diagonal moulding been inserted after the panelling and cluster of shafts were completed.

Fig.3, II shows the buttress moulding in the panel to the south of the opening into the south aisle (location B). Again the 45 degree moulding has not simply been inserted; it is cut on three stones each extending deep in to the surrounding masonry and each carrying shaft and panel mouldings. In both of these examples the buttress mouldings are purely decorative, performing no structural function.

Similar observations were made where the underside of the buttress intersects with the vertical panelling. Single blocks have buttress, panel and wall shaft mouldings confirming that shafts, panels and buttress belong to a single period of construction. Photographs were taken at these points and are included in the archive.

## MASON'S MARKS

The windows, panelling and wall shaft dividing the bays were examined under a raking light for mason's marks. Just one mark was identified, on an undecorated ashlar at the top of the panel between the southern window and the vault shaft (Fig. 4,6, Fig. 5). The mark is a type not before identified at the cathedral, in fact its complex design and geometric forms suggest that it is not a banker mark. It may be a sketch done by a mason when working out a design. This mark is not Romanesque, denoting reused stone, and considering its position almost certainly dates from 1329-37.

A small area of the vault was examined and five mason's marks were recorded. These marks were all on minor ribs in the lunette of the southern window (marks and locations shown in Figs. 4 and 5). Marks 1 and 2 are sketches of the projecting bowtell, a distinctive moulding that is characteristic of the Perpendicular re-modelling of the transept, and which decorate the ribs on which the marks are scratched. Mark 2 shows the moulding with its setting out lines. Again these are not banker marks; they may have been scratched on roughed out rib forms to denote the moulding profile that was to be applied. Marks 4 and 5 are arrows, both point down, or toward the edge of the rib with a moulding. They may have indicated to the mason which side of a roughed out rib to carve.

These possible explanations for the marks do not account for their distribution. A survey of the vault would be required before a discussion of the marks can progress.

### Reused Romanesque masonry

In contrast to the masonry on the exterior of the elevation no reused Romanesque decoration was identified in the interior. Undecorated Romanesque stone may have used for the infill of the panel north of the larger southern window, elsewhere the large size of the blocks indicate that the stone was freshly quarried.

### Petrology

Two types of stone were identified: Lower Freestone (Lower Inferior Oolite) and stone from the Great Oolite Series from the hills around Bath. Lower Freestone is a white to cream oolitic limestone with few fossils and an even texture. All of the medieval masonry that was examined was constructed using this stone which can be quarried out of the Cotswold escarpment.

The Bath stone was used for the 1867-8 repairs, it is a medium grained, cream to buff/brown, cross-bedded, sparry oolitic limestone.

## Figures: Part II

1. West elevation of south transept: interior
2. West elevation of south transept: interior; interpretation
3. West elevation of south transept: interior
4. West elevation of south transept: interior : masons' marks
5. West elevation of south transept: interior : masons' marks .

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FIG. 1 GLOUCESTER CATHEDRAL SOUTH TRANSEPT ~ WEST ELEVATION, INTERIOR

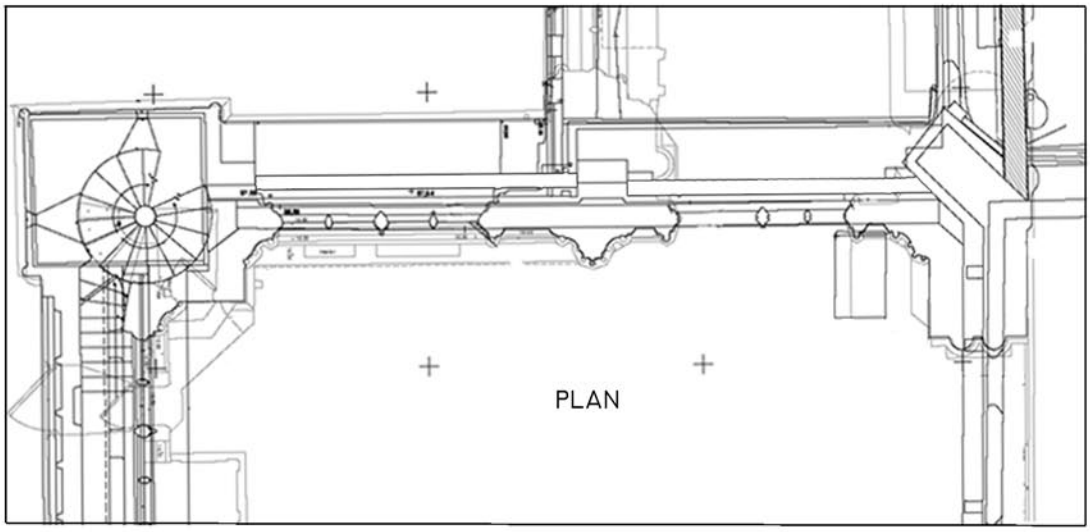
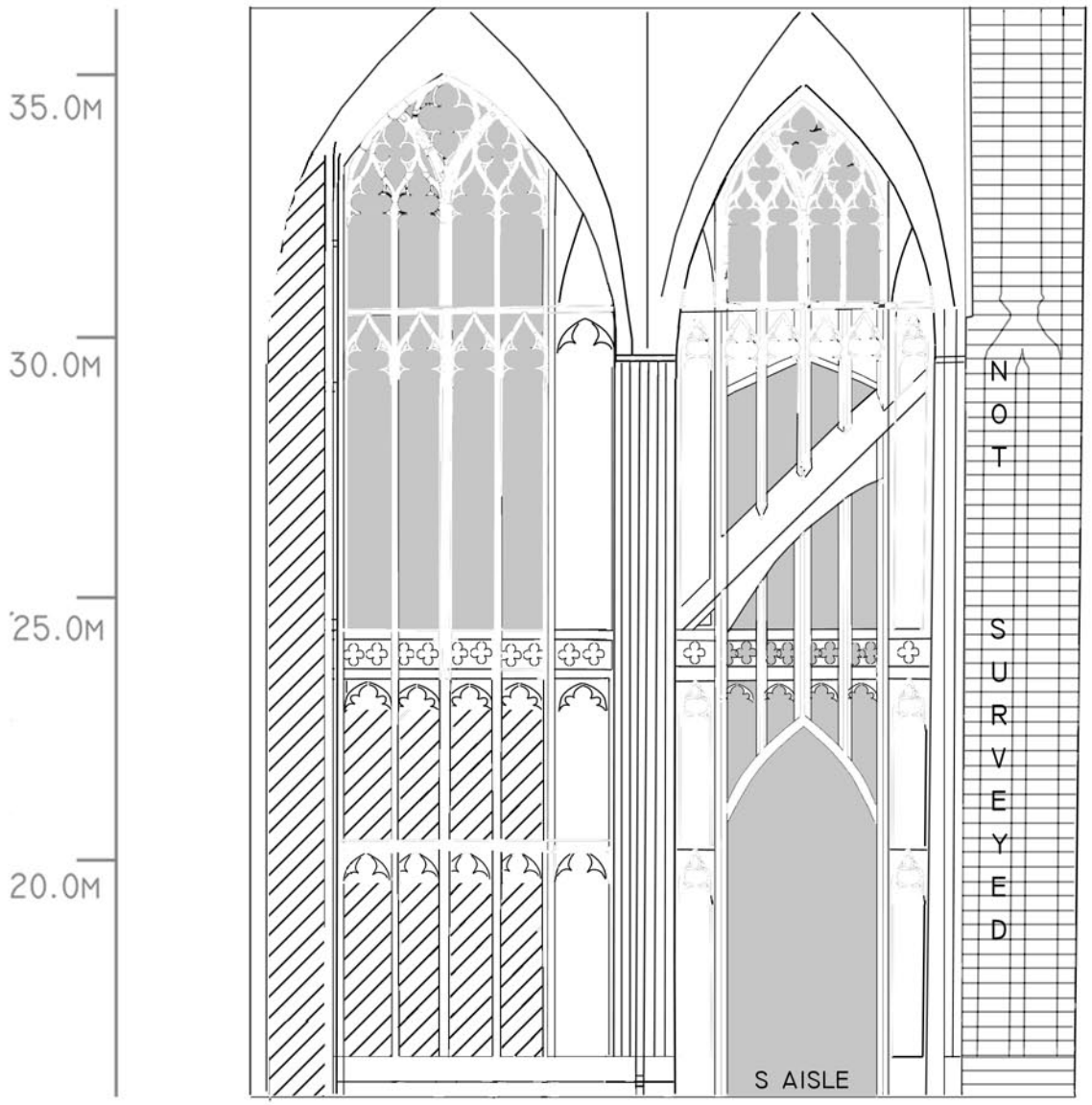



FIG.2 GLOUCESTER CATHEDRAL SOUTH TRANSEPT ~ WEST ELEVATION, INTERIOR INTERPRETATION



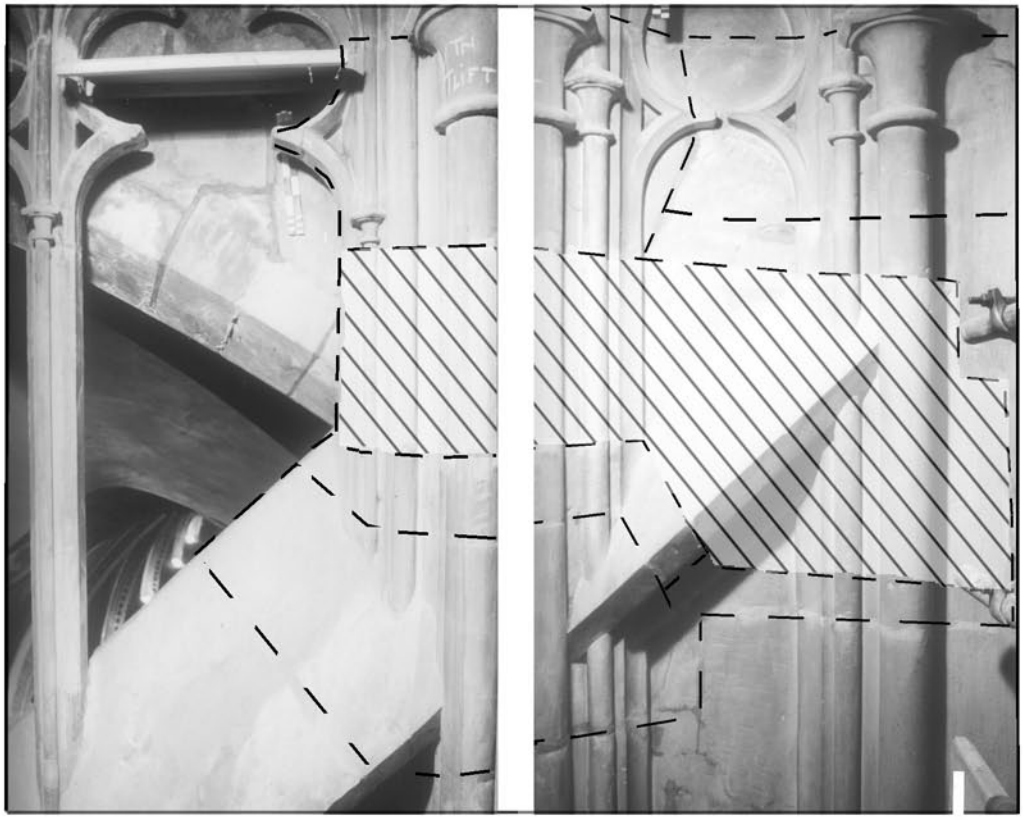

1089-1100

1329-37

NOT SURVEYED

FIG. 3 GLOUCESTER CATHEDRAL SOUTH TRANSEPT ~ WEST ELEVATION, INTERIOR

I. LOCATION A



0 1M APPROX

MAJOR JOINTS

II. LOCATION B

SINGLE STONE WITH WALLSHAFT BUTTRESS AND PANEL MOULDINGS

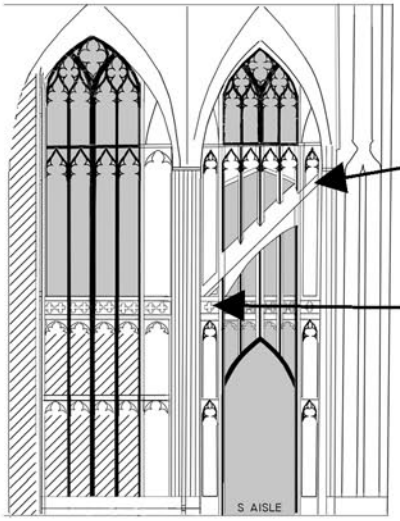


FIG.4 GLOUCESTER CATHEDRAL SOUTH TRANSEPT ~ WEST ELEVATION, INTERIOR

MASON'S MARKS SCALE 1:4

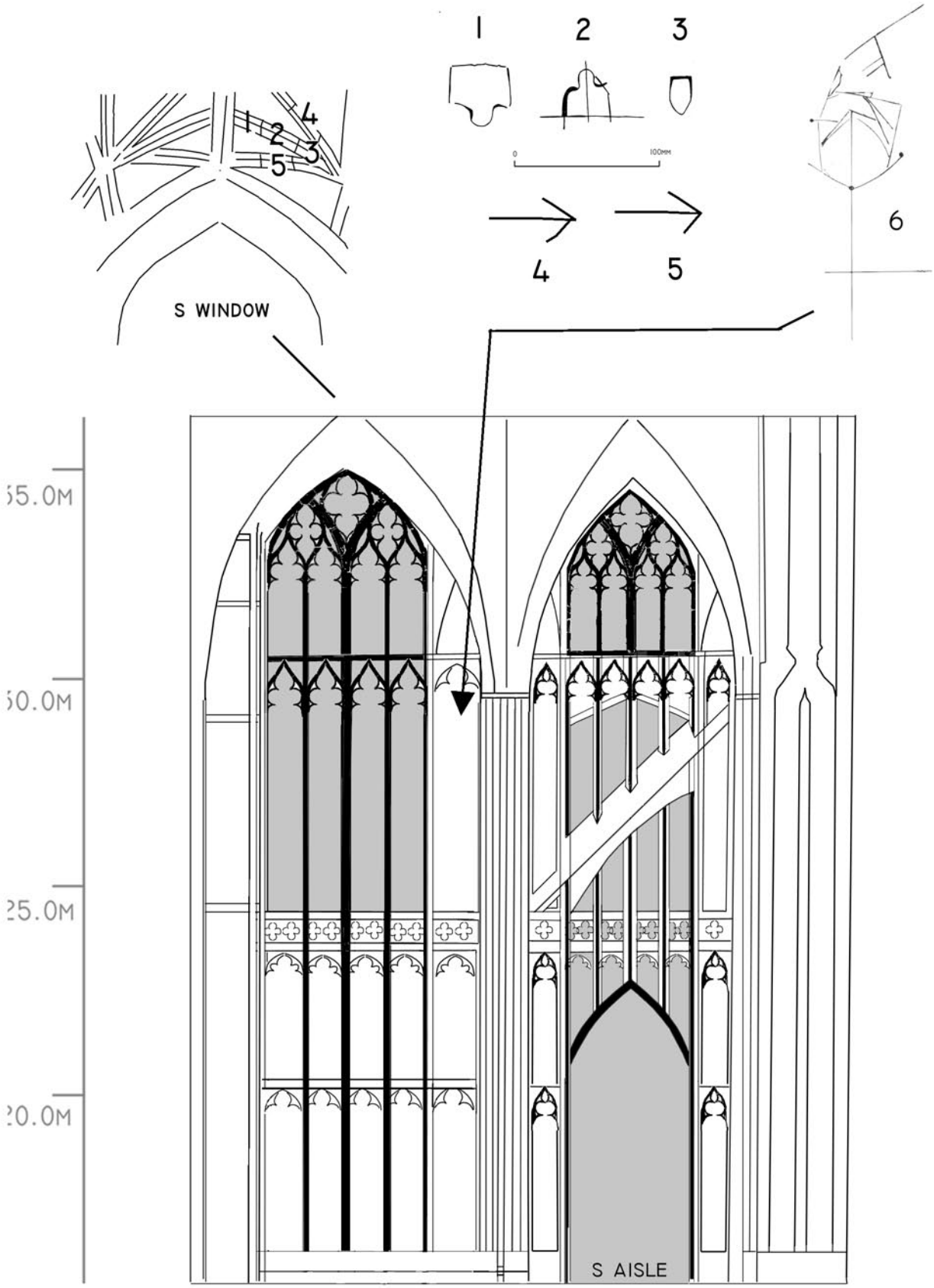


FIG.5 GLOUCESTER CATHEDRAL SOUTH TRANSEPT ~ WEST ELEVATION, INTERIOR

MASON'S MARKS