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Roman building practice in Aphrodisias

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Anastylosis and architectural conservation have long been an important part of the archaeological program at Aphrodisias. Since the early 1980s, restoration and conservation work has been carried out on various monuments, including the Tetrapylon (1983-91),[1] the Temple of Aphrodite (2003-4),[2] the South Building[3] (fig. 17.1) and Propylon[4] of the Sebasteion (2004 to the present), and the Doric *logeion* of the Theatre (2011-12).[5] This paper will present observations on Roman architectural practice in marble structures made during work on these projects. The buildings range in date from the late 1st c. B.C. to the 2nd c. A.D. I focus on such issues as logistics, construction techniques, and the workflow of construction. The information gained from these restoration and conservation projects sheds light on how the monuments were actually built and has increased our understanding of architectural practice under the Roman Empire.

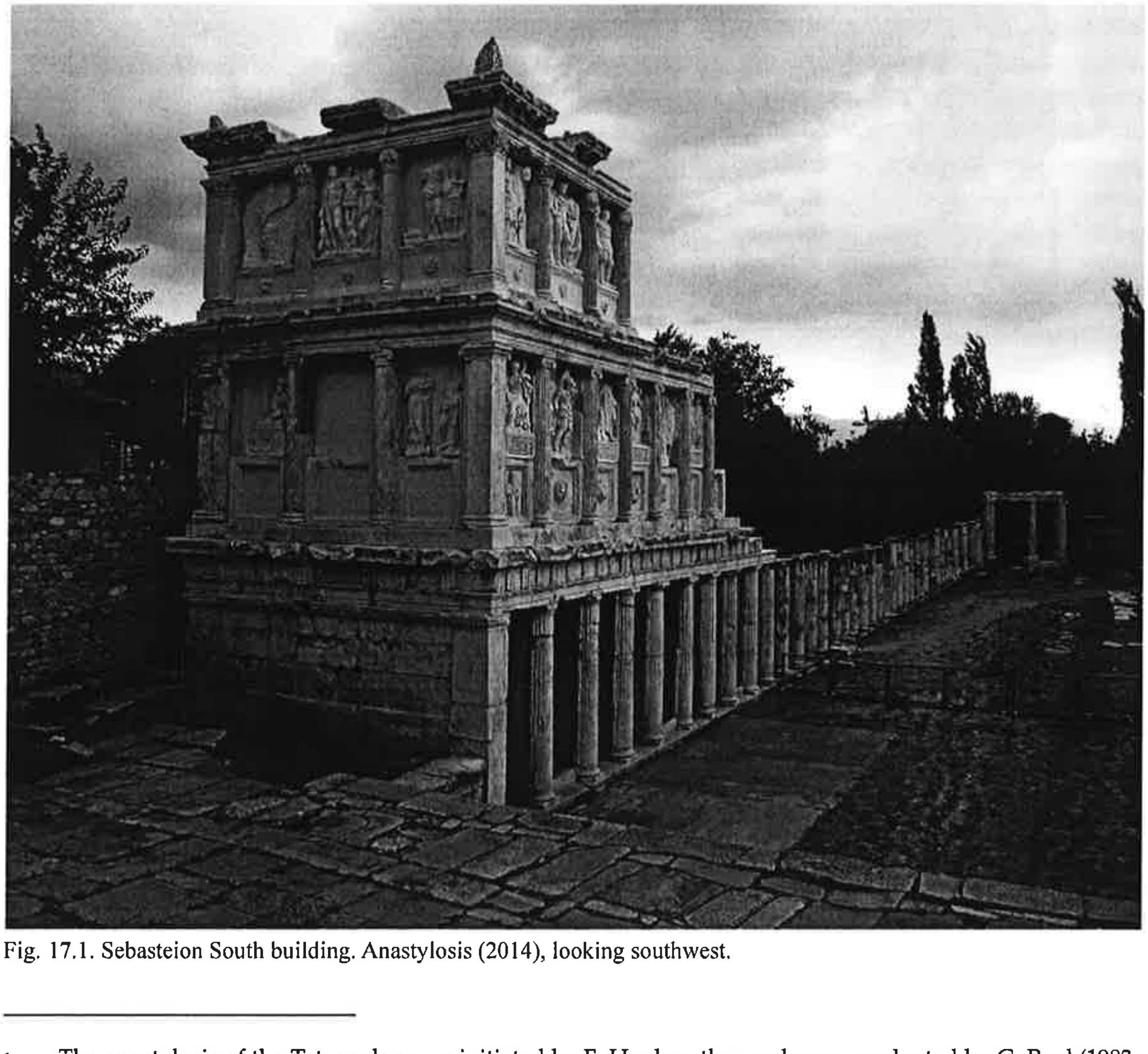

Fig. 17.1. Sebasteion South building. Anastylosis (2014), looking southwest.

1 The anastylosis of the Tetrapylon was initiated by F. Hueber; the work was conducted by G. Paul (1983-91) and Th. Kaefer (1989-91). See Paul 1996; Outschar 1996.
2 See especially Theodorescu 1990.
3 See below and chapt. 18.
4 For preliminary results, see Hueber 1987, 101-6; Outschar 1987, 107-13.
5 See de Chaisemartin and Theodorescu 1991; Theodorescu 1996. For its date, see Reynolds 1991.

Fig. 17.2. Sebasteion Propylon. Computer reconstruction of W façade.

Planning *versus* execution

Before construction began, the structure was planned and the foundation laid out according to a predetermined design and specifications. The stylobate of the lowest storey had to be carefully constructed, and the positions and placement of columns were precisely calculated. In the case of the South Building of the Sebasteion, a system of setting lines marked the axes of the columns and the size of their bases (fig. 18.13 below).

Curvature and optical refinements were sometimes part of the planning process.[6] A good example can be seen in the Propylon of the Sebasteion (fig. 17.2). The architraves of its *aediculae* which frame the entrance stairways project at a slightly oblique angle, achieved simply by tapering the external width of the architrave by 2 cm per meter (fig. 17.3). The result is that, at the level of the architraves, the space between the *aediculae* is wider at the front by some 6 cm than at the back of the gate. Its main purpose was to enhance the visual impact of the stairways that provided access from the main N–S street to the west into the Sebasteion complex to the east.

6 According to Hueber (1987), the North Building of the Sebasteion posesses a curvature. On the South Building a curvature could not be detected, but that was not to be expected since the anastylosis encompasses only 3 rooms and 9 intercolumnations.

In the production of marble blocks one would expect the sizes of a building's components to correspond closely with prescribed dimensions, but this was not the case in the buildings that we have investigated. The architectural blocks delivered to the construction sites often did not follow the specifications suggested by the original design. For example, the South Building of the Sebasteion was planned with up to 45 identical pieces for each of various categories of element (e.g., architraves and columns) but the marble blocks delivered to the construction site all have different dimensions. The plan was adapted accordingly so that these components could be used in the construction. In the case of the architraves their lengths vary by up to 7 cm, which shows that the position of the vertical joints was not so important and could be shifted away from the axes of the columns. The lengths of the frieze and cornice blocks also differed, nor were the heights of bases and capitals uniform. This lack of consistency in the sizing of the blocks should not be viewed as a result of incompetent craftsmanship; rather, it reflects an important rôle for the quarry in determining the best — that is, most economical — division of the available stone for the elements required.

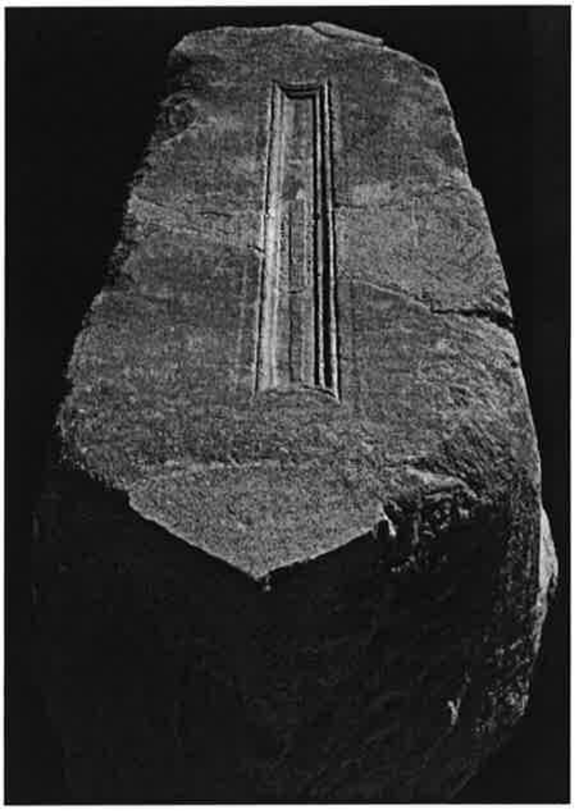

Fig. 17.3. Sebasteion Propylon. Tapered architrave.

The use of a specific marble block in a structure was directly related to its quality and grade. Apart from the matter of size, pieces to be used for high-stress architectural components (e.g., columns and architraves) had to be highly resilient to tensile and compressive strain. Since defects in the materials would compromise a building's structural integrity, the marble used for the high-stress components could not have any flaws. If a suitable block was available, even it had less than optimal dimensions, the masons would make the necessary adjustments on site to accommodate the piece. For example, if a suitable architrave block was a little short, it was used anyway and a longer specimen be chosen for the adjacent position to make up the difference. Conversely, the quality requirements for frieze and cornice blocks were less demanding: the structural strain imposed on them was lower, and their lengths and positions could simply be adjusted according to the available raw material.

These problems were probably anticipated and taken into consideration during the planning phase. The Doric and Ionic columns in the South Building were planned in such a way that the upper and lower parts of the columns were carved with the base and the capital, respectively. This allowed considerable flexibility in the height of the middle section of each shaft. Similar measures were taken in the lower storey of the Propylon, where the Ionic columns of the lower storey also consisted of three parts.

All these measures facilitated the choice and selection of raw materials, lent flexibility to the construction logistics, and lowered the overall costs. Buildings that required large elements such as monolithic columns and architraves with wide spans were expensive. When the proper raw material was not available, adjustments to the original plan were made during construction to increase work efficiency and lower costs. Irregularities and mistakes (whether from human error, financial issues, or pressure of time) might occur during construction and might not be corrected deliberately. A spiral-fluted column from the Tetrapylon is a good example (fig. 17.4): the fluting of one

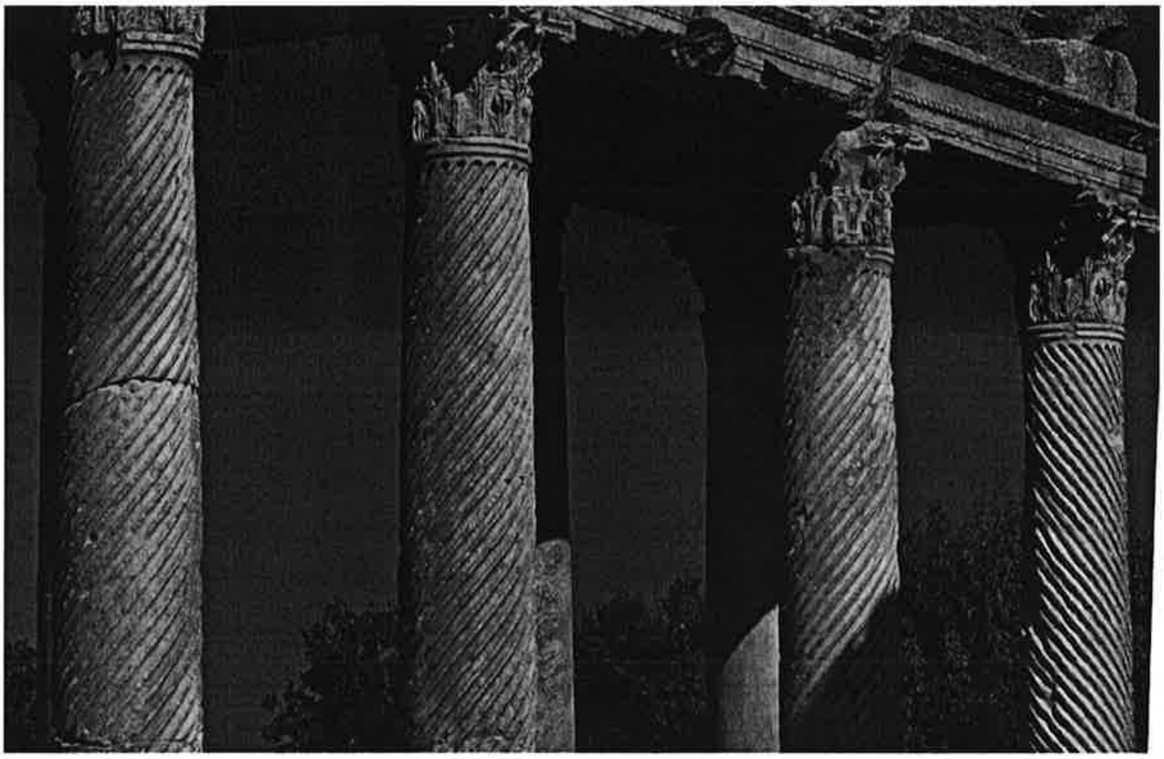

Fig. 17.4. Tetrapylon. Column spiral fluting in the wrong direction in second row of columns from the west.

of the columns in the second row of the E part does not fit into the established pattern of clockwise and counter-clockwise spiral-fluted columns, but, despite this mistake, the column was built in with no attempt to conceal the problem.[7]

Prefabricated building parts

With the exception of the sculptural parts, such as reliefs, the buildings that we have restored and conserved were constructed for the most part with prefabricated blocks. Before these blocks were installed in their final positions, their forms, dimensions and decoration were already largely complete; only the final finishing was carried out at the construction site. Horizontal joints were usually connected with iron clamps, and vertical connections with dowels. All blocks were designed for their specific positions in the building and were normally set in place without the use of mortar.[8]

At the quarry, the raw blocks were roughly hewn into the required shapes — columns, bases, and capitals into cylinders; architraves, friezes, and cornices into rectangular blocks. Large amounts of marble rubble and chips in the area of the city's quarries testify to this first step.[9] The raw forms were then transported to workshops, whether near the quarry or near the construction site, and processed further before being installed in their final positions. This intermediate step of prefabrication was necessary because work could be carried out more efficiently on the ground or on a workbench than on a construction scaffold. Ideally, workshops would be located on the route between the quarry and the city; at Aphrodisias the quarries lay only 3 km from the centre and workshops were probably located outside the city.

In the case of the Sebasteion, intermediate dressing of the blocks at the construction site can be excluded because of the insufficient space there: the narrow avenue between the two portico

7 The possibility that the entire building was made from re-used material is still under discussion. That may be another explanation for this mistake. See Paul 1996, 211.

8 See, e.g., Adam 2005, 20-58 and 106-18.

9 On the quarries of Aphrodisias, see Rockwell 1996, Long 2012b and chapt. 16.

Fig. 17.5. Aphrodisias: column pedestals and bases from South Agora (left) and Tetrapylon (right).

buildings would have provided barely enough space for the necessary scaffolding and cranes. Intermediate processing of the blocks on the building site would also have hindered work and slowed down the pace of the construction. The dressing of the architectural blocks into their final form for the Sebasteion would have produced, by our estimate, *c.*3000 tons of chips.[10] The marble chips resulting from the prefabrication could be used in foundations or in lime kilns.

The Tetrapylon offers a good example of the prefabrication process while revealing the standardization of elements. The 16 columns vary in height by up to 15 cm. This can be partly explained by the gradient of the street on which the Tetrapylon stands. As it slopes gradually from north to south, the stylobate of the N and S parts have different levels, with the result that the columns needed capitals of different heights, yet two capitals of an identical prefabricated type were used. To compensate for the difference in height, one had its lower part cut down by *c.*5 cm, regardless of its decoration.[11] Note that the column pedestals and bases are identical in size and profile with pieces that were used in the "South Agora" during the 2nd c. A.D. (fig. 17.5).[12]

The prefabricated components are not at all crude: they embody thoughtful and sophisticated designs. Some elements, such as frieze and cornice blocks, were carved in such a way that the vertical joints are cleverly concealed at the edges of the decoration — for example, at the connections between triglyphs and metopes on the Doric frieze (figs. 17.6-17.7). This kind of refined detailing is found in the Theatre *scaena* in the late 1st c. B.C. as well as in the Sebasteion.

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10 This amount of material would fill the Avenue of the Sebasteion up to a height of 3 m. Altogether the Sebasteion required *c.*7000 tonnes of marble as building material, which equals about 15,000 tonnes of raw material in the quarry, or a solid block of 10 x 10 x 60 m.

11 Paul 1996, 209.

12 Outschar 1996, 222 fig. 25.

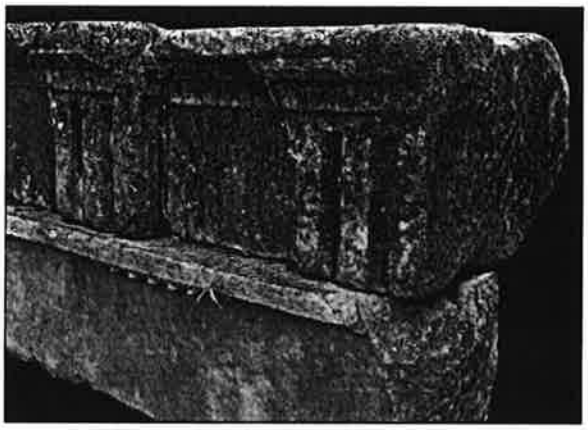

Fig. 17.6. Sebasteion. Vertical joints between blocks concealed by junction of triglyphs and metopes.

Fig. 17.7. Sebasteion. Corinthian cornice block with vertical joint at edge of modillion.

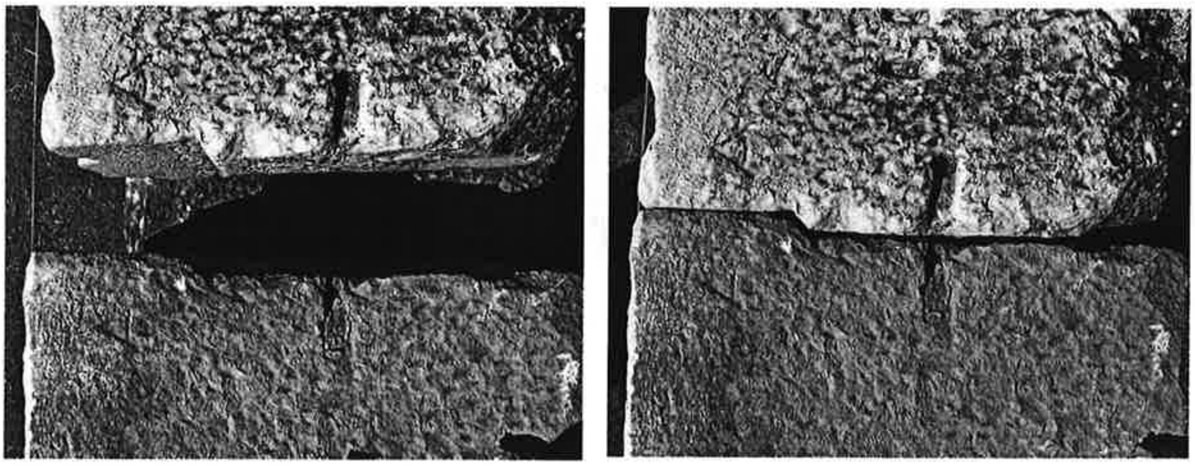

Fig. 17.8. Gaudin's Fountain. Joining frieze blocks.

The entablatures of the Tetrapylon and Gaudin's Fountain both have very wide spans; in order to relieve the stress on the architraves, the frieze blocks were conceived as flat arches (fig. 17.8). While the front faces of the blocks display a strictly vertical seam, concealed load-bearing surfaces on the ends of the blocks, towards their rear, took the bevelled shape of a voussoir, transferring the vertial load more efficiently onto the columns. Complex engineering features of this sort seem already to have been taken into consideration during the design process and were incorporated in the stage of prefabrication.

Work on the building

The Sebasteion anastylosis project has given valuable insights into the technique and procedures of construction. Many of the figured reliefs and all of the blocks were prefabricated before being delivered to the construction site for installation. During the reconstruction of the South Building, we learned that, in order to achieve a proper fit between the blocks, the installation of the different elements needed to follow a defined sequence. For example, a prefabricated relief and its associated base must be set in place first and then the adjacent column could be fitted to the relief and its base (fig. 17.9). This required a considerable amount of organization and coordination; for example, if a relief did not arrive on time, the whole construction process would come to a halt, and some reliefs would have to be finished on the building.[13]

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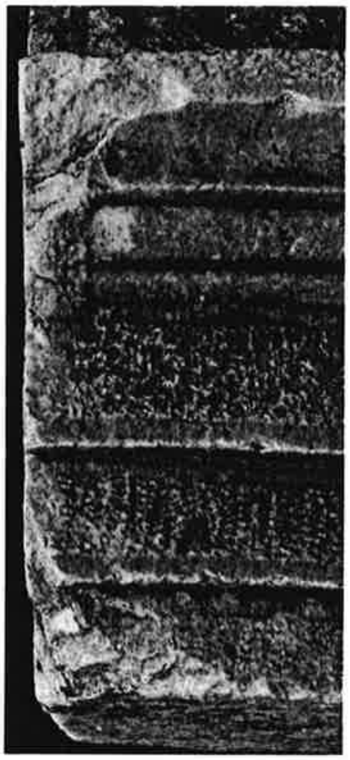
13 Smith 2013b, 37-40.

Fig. 17.9. Sebasteion. South building: (left) two reliefs joining waisted half-column; (right) back of half-column with adjoining reliefs.

Fig. 17.10. Sebasteion. South building. Corinthian capital, top view front and back.

Clamp cuttings, dowel-holes, and pry holes were worked once the blocks were positioned on the building. Bearing surfaces too were worked as needed. This can be seen from lewis holes that have been reduced in depth. Normally, the necessary adjustments were moderate, but occasionally lewis holes were worked off almost entirely and became unusable.

Modifications were sometimes made on the lower part of a block in order to line up continuous decoration. For example, one side of the top of a Corinthian capital was cut down to have the architrave sitting at the correct height, so that its decoration (profiles, fasciae) lined up with that of the neighbouring block (fig. 17.10). Various 'unfinished' examples indicate that decoration close to joints between blocks was normally finished once the neighbouring pieces were put in place (figs. 17.11-17.12). This can be seen in all kinds of continuous mouldings, such as bead-and-reel and egg-and-dart, and in the fluting of columns. This allowed flexibility and facilitated any necessary corrections between two adjacent pieces. A notable mistake can be seen on an Ionic column and its capital in the first room of the South Building in the Sebasteion (fig. 17.13). The capital broke while the fluting in the upper part of the column was being finished. The capital was repaired with a clamp, but the right part of the column and the capital were deliberately left unfinished in order to avoid possible further damage to the piece. The fluting of columns was often left unfinished. An example can be found in the Corinthian columns of Rooms 1 and 2 in the South Building where the lower parts of the columns and their bases were put in place and left partly unfinished.



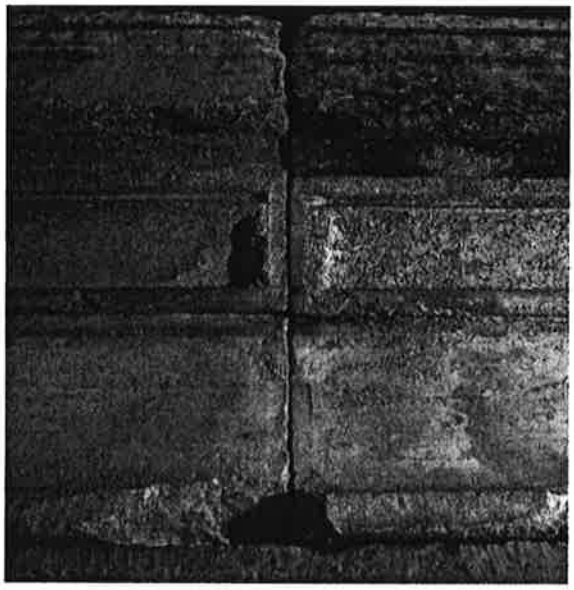


Fig. 17.12 (above). Sebasteion. Propylon, podium crown moulding, with unfinish at joint.

Fig. 17.11. Agora Gate. Unfinished moulding at joint.

Fig. 17.13. Sebasteion. South building, Ionic capital, front and back.

Further aspects of the building process can be seen in the Sebasteion where the Propylon and the North Building were financed by one family, the South Building and the Temple by another.[14] The lack of coordination and management between the two projects can be seen clearly at the SW corner of the interior avenue where the Propylon and the South Building meet. From the architectural evidence, it is clear that work on these two projects did not progress at the same pace: the construction of the Propylon was much further advanced than that of the South Building. Because of the irregular shape of the site, the W end of the South Building meets the S end of the Propylon at an obtuse angle that made a proper architectural connection between the two difficult to establish. Due, it would seem, to lack of communication, this connection was poorly executed, and the result was an improvised, *ad hoc* solution. The physical connection between the two buildings was at the Ionic level of the South Building's second storey. While the base of the Ionic column was carefully worked to accommodate the obtuse angle, the column and the capital were carved as if the two buildings were to meet at a right angle. The masons had to make makeshift cuttings in the South Building's blocks to establish a connection (fig. 17.14). The quality of the blocks used in this

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14 Ibid. 1-54.

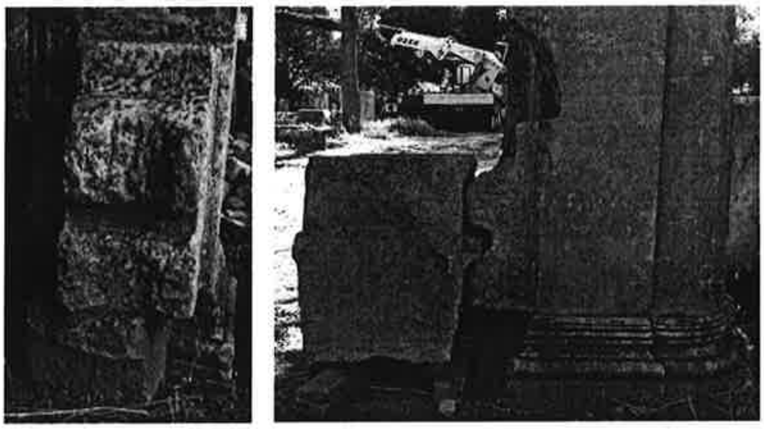

Fig. 17.14. Sebasteion. South building and Propylon. Connecting pier between Propylon and South Building.

part of the South Building also varies from piece to piece: the Ionic base was carefully carved, but the column and the capital were poorly finished. Clearly different workmen with various levels of skills were responsible for individual architectural pieces.

Repairs on the building

Ancient repairs range from patching damage caused in transport to major restoration work following earthquakes. Minor damage, such as broken profiles, tended to occur during the building process, and small patches were added to correct the problem. They were usually performed to a good quality, comparable to that of the original blocks. By contrast, major repairs were often carried out when the finished structure had suffered from a disaster, such as an earthquake, and this repair work was often of poorer quality than that of the original elements, taking less notice of the original architectural concept and its details.

At the Tetrapylon the Syrian arch of the E façade was dismantled and rebuilt in late antiquity.[15] The rebuilding work involved a difficult centering process and re-setting the voussoirs from both sides. The original keystones of the arch no longer fitted due to inaccuracies introduced during the re-installation, and new keystones were carved to accommodate the different angles of the voussoirs on both sides of the re-erected arch (fig. 17.15). The original keystones were discarded (one of the two was found in the vicinity of the Tetrapylon during excavations). Another major repair can also be seen in the *logeion* of the Theater (figs. 17.16-17.17). The central architrave and frieze were repaired without considering the sequence of triglyphs and metopes:

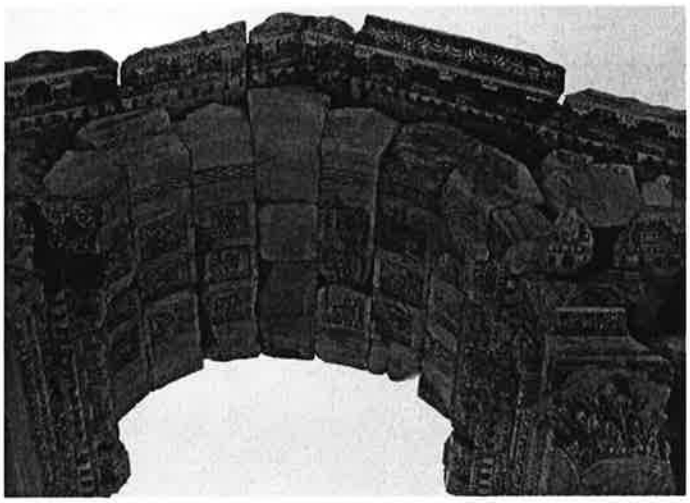

Fig. 17.15a. Tetrapylon. Late-antique replacement keystones in vault.

15 The re-erection can also be seen in secondary clamp holes in the tops of the voussoirs: Paul 1996, 212-13.

Fig. 17.15b. Tetrapylon. Late-antique replacement keystones in vault.

an existing block was cut down to the necessary length and fitted to the neighbouring block, but with an ill-fitting, partly-cut triglyph.

Conclusion

The anastylosis and conservation work has given us a rare glimpse into the inner workings of Roman architecture. Our hands-on work and careful study of ancient assembly procedures have brought insights into different aspects of architectural process and technique. Anastylosis is not simply about restoring an ancient monument or a ruin; it also helps us to understand a long-vanished architectural tradition.

Fig. 17.16. Theatre *logeion*, after anastylosis (2013).

Fig. 17.17. Theatre, *logeion*. Repair disrupting triglyph.

Acknowledgements

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