Tommaso Ismaelli

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*Schlüsselwörter*: Restaurierung, Antike Technik, Kleinasien, Hierapolis
*Keywords*: Restoration, Ancient technique, Asia Minor, Hierapolis
*Anahtar sözcükler*: Onarım, Antik teknik, Anadolu, Hierapolis

### The Question of Restoration in Antiquity

It is widely accepted that approaches to the restoration of architectural heritage are subject to dynamic evolution. Historically they are conditioned not just by the available technology but above all by cultural values and choices. For this reason, the theory of restoration has seen detailed studies of the history of the discipline. Rarely however, have experts in restoration, be

The idea for this paper was developed during the analytical study of various architectural complexes in Hierapolis, thanks to the author's participation in the excavation and restoration activities conducted by the MAIER – Italian Archaeological Mission of Hierapolis in Phrygia. For this reason, special thanks are due to Francesco D'Andria, the Mission's Director, for enabling me to study the monumental heritage of this unique city of Asia Minor.

*References for figures*: *fig. 1 box* = Maddy *et al.* 2008, fig. 1. – *fig. 3* = D'Andria *et al.* 2008, Quadro 3. – *figs. 4 i*; *23 c* = Thür 1989, pls. 9. 13. – *fig. 5 a* = IAph2007, no. 91. – *figs. 5 c*; *7 b* = Steskal 2010, pls. 60, 2; 61, 1. – *fig. 5 f* = Quatember 2011, pl. 44, 2. – *figs. 5 i*; *7 c–e*; *12 d–g*; *20 e*; *23 d. e* = Kadıoğlu 2006, figs. 34. 60 pls. 15, 6; 19, 2; 21, 5; 23, 7. 8; 27, 5; 30, 1; 32, 3. 7. – *fig. 6 a* = Köster 2004, pl. 135, 1 – *fig. 6 b* = Kästner 1992, fig. 17. – *fig. 7 a* = Korres 1999, fig. 33. – *figs. 7 f. g* = Pensabene 1998, pls. 6, 4; 8, 1. – *fig. 8 f* = Koenigs – Radt 1979, pl. 120, 1. – *figs. 9 f. r*; *10*; *11 b*; *16 d. f. l*; *17 d*; *19 e. h*; *21 d*; *22 d*; *35 a* = Massimo Limoncelli. – *figs. 11 d*; *19 c* = Campagna 2012, figs. 7. 11. – *figs. 11 e–g* = de Chaisemartin 1987, no. 7. – *fig. 11 i* = Öztürk 2009, pl. 19, 5. – *fig. 12 b* = Vandeput 1997a, pl. 86, 1. – *fig. 12 c* = Boehlau 1940, pl. 20. – *fig. 12 h* = Hoffmann 2011, fig. 21. – *fig. 12 i* = Devreker – Waelkens 1984, fig. 124. – *fig. 13 d* = Vandeput 1997b, fig. 5. – *fig. 14 b* = De Nuccio – Ungaro 2002, no. 321. – *figs. 15 a. b* = Bermúdez Cano 2009, pls. 1 d; 4 d; 5 a. – *fig. 20 a* = Waelkens 1987, pl. 3 no. 6. – *fig. 20 b* = Jeppesen 1955, fig. 18. – *fig. 20 c* = Şimşek 2007, fig. 132 a. – *fig. 20 d* = Kawerau – Rehm 1914, fig. 30. – *fig. 24 a* = Korres 1996, fig. 26. – *fig. 24 b* = des Gagniers *et al.* 1969, pl. 56, 1. – *fig. 24 c* = Theodorescu 1990, fig. 7. – *fig. 24 d* = Maischberger 2009, fig. 17. – *fig. 29 a* = Dinsmoor 1941, fig. 4. – *fig. 29 c* = Wilberg *et al.* 1923, fig. 223. – *fig. 30 a* = Tataranni 2002, fig. 1. – *fig. 30 b* = De Nuccio – Ungaro 2002, no. 263. Photos and drawings without captions belong to the author.

they architects or art historians, paid much attention to pre-medieval contexts[1]. Aside from the practice of transformation of ancient buildings and reuse of blocks as *spolia*[2], the architectural experience of the Greek and Roman worlds offers numerous points of reflection that can help us gain a deeper understanding of the history of restoration. The first step in this process is to broaden the time span of the discipline.

This paper will therefore discuss not restoration of the ancient but *restoration in ancient times*[3]. That is, it will look at the techniques, materials and practical choices that characterised restoration projects in the Greek and Roman worlds. To this end, in the absence of an explicit ancient theoretical treatment of the value and techniques of restoration, we must turn to the tools of archaeology. The specifically archaeological aspect of this paper is thus intended to complement the epigraphical and historical research, which is focused on the Roman legislation concerning the maintenance and restoration of public and private buildings[4].

It should be stated at the outset that anybody seeking to study restoration in the Greek and Roman worlds from a strictly archaeological point of view will find themselves dealing with a dearth of detailed studies, whether of individual repairs or complete reconstructions[5]. Indeed, only recently have scientific publications begun to discuss not only the technical aspects of the original building process but also the subsequent transformations affecting the buildings over time. Within this overall context, some significant exceptions provide useful indications regarding methods and points of departure for further research. By way of example we shall cite the pioneering studies by W. B. Dinsmoor of the Parthenon (1934) and the Temple of Zeus in Olympia (1941). In the latter study, the great scholar of ancient architecture perfectly illustrated the technical characteristics of Hellenistic restoration, showing the potential, in terms of a general historical reconstruction[6], of an analysis founded on the painstaking observation of architectural materials, with no ideologically driven exclusion of the post-classical phases. More recently, the theme of restoration in ancient times has been developed by M. Korres based on his direct knowledge of the monuments of the Acropolis in Athens. Gathering together the numerous traces of Roman-age work on the Parthenon and the Erechtheion, he stressed the highly ideological value that the restoration of the monuments of classical Athens already possessed in the imperial epoch, a value that can still be seen in the restoration projects active on the Acropolis today[7].

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1 On the restoration of archaeological heritage in a diachronic perspective see, among others, Melucco Vaccaro 1989; Melucco Vaccaro 2000; Vlad Borrelli 2010, all of which however are based only on ancient literary sources.

2 The bibliography on the use of *spolia* is copious, see e. g. Pensabene – Panella 1993/1994; Pensabene – Panella 1994/1995; de Lachenal 1995.

3 The modern restoration of archaeological monuments in Greece and Asia Minor is presented by Gizzi 1997.

4 Literary sources and epigraphical evidence are described by Stuart 1905; Cagiano de Azevedo 1952, 55–60; Melucco Vaccaro 1989, 18. 26–30; Pekáry – Drexhage 1992, 343. 344. 351. 352; Thomas 1992; Nolan 2006; Vlad Borrelli 2010, 21–61. For Roman laws concerning restoration see Janvier 1969; Melucco Vaccaro 1989, 65–68; Anguissola 2004; Vlad Borrelli 2010, 58–60.

5 For general observations concerning repair techniques, see Martin 1965, 302–304; Hellmann 2002, 95–100.

6 Dinsmoor 1941, esp. 415. 416. For the Parthenon, see also Dinsmoor 1934, 98–102.

7 Korres 1997. It should be mentioned that the first scientific edition of the Erechtheion by Paton – Stevens (1927, 207–214. 223–224) devoted much attention to classical and Roman construction techniques and repairs, offering detailed documentation with numerous pictures and useful drawings.

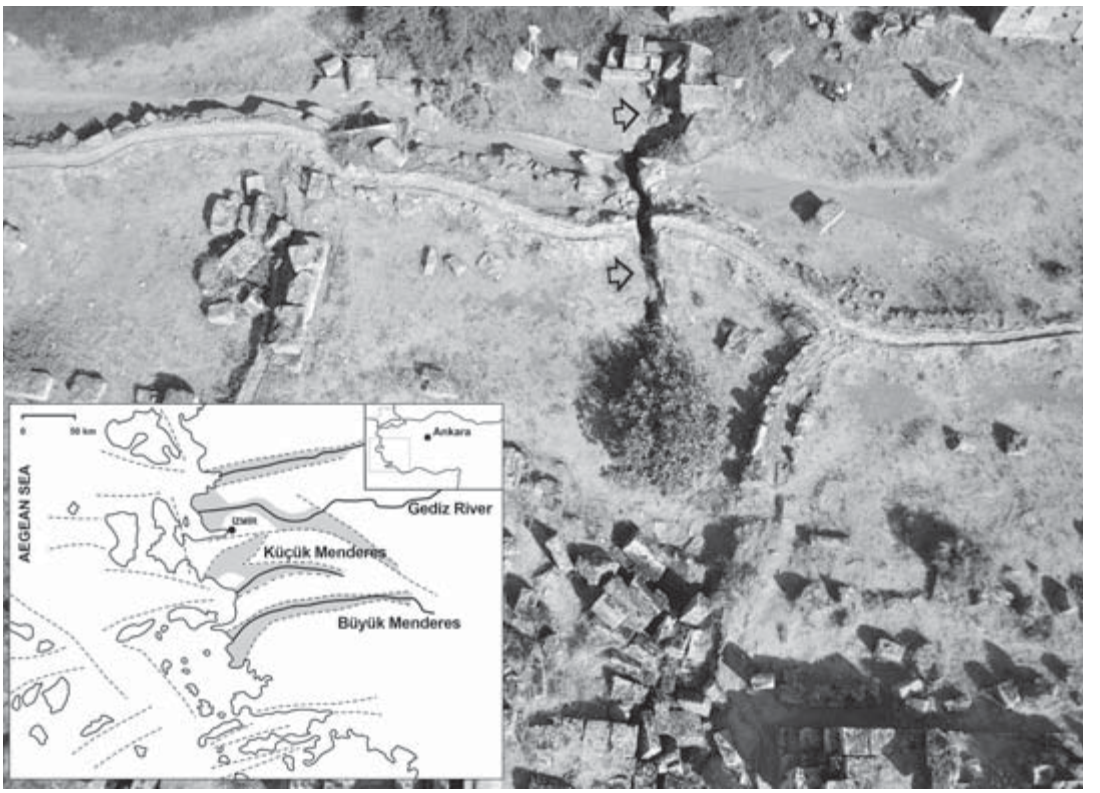


Fig. 1 Hierapolis of Phrygia. Seismic cracks in the centre of the city; in the box a map showing the main faults of western Turkey

## Restoration in Ancient Times in an *Euseistos* City, Hierapolis in Phrygia

In this general framework, this paper focuses on the evidence from Asia Minor, starting with an examination of the architecture of the city of Hierapolis in Phrygia (today Pamukkale, Turkey). The study of the evidence promises to yield much information, thanks to the exceptional state of conservation of the site and its architectural materials, but also to the advanced state of the archaeological research, conducted since 1957 by the Italian Archaeological Mission[8]. The wealth of information provided by this town constitutes an open-air database on the ancient technology of architectural restoration. This technology represents the application of locally acquired practical knowledge that evolved over the city's complex history.

Indeed, it should be stressed that for the population of Hierapolis, architectural restoration was unavoidable. The city lies in a highly seismic region, where the *Gräben* of the Maeander and Gediz rivers meet (*fig. 1*). The city itself is laid out along a fault that takes its scientific name

[8] For the monuments of Hierapolis and the historical development of the city see, among the recent publications, D'Andria 2001; D'Andria 2003; Ritti 2006; D'Andria – Caggia 2007; D'Andria *et al.* 2008; Ismaelli 2009; D'Andria – Romeo 2011; D'Andria *et al.* 2012. Annual reports are presented in KST, available online at <http://www.kulturvarliklari.gov.tr/TR,44760/kazi-sonuclari-toplantilari.html>.

Fig. 2 Hierapolis, North Necropolis. The effects of disastrous earthquakes are visible on the tomb n. 114

from the modern name of the site, Pamukkale[9]. Hierapolis and the nearby city of Laodikeia ad Lycum were struck by many earthquakes according to the literary sources[10]. The ancients were perfectly aware of this geological characteristic: in the second half of the 1st century B. C., Strabo (12, 8, 17) described the region around the river Maeander as *euseistos*, i. e. an area highly subject to earthquakes (»σχεδὸν δέ τι καὶ πᾶσα εὔσειστος . . . χώρα«)[11].

In this framework, the geological instability of the site and the periodical recurrence of disastrous events are reflected in ways that differ from building to building depending on chronology (*fig. 2*). Indeed, analysis of the architectural materials reveals both improvised repairs and expensive rebuilding, carried out by the municipality or private citizens, sometimes with the help of the provincial or imperial authorities. Without attempting to describe the vast post-

9 For archaeo-seismological evidence in the monuments of Hierapolis and descriptions of the tectonic features of the area see Hancock – Altunel 1997; Altunel 2000.

10 Literary sources referring to earthquakes are described by Ritti 1985, 23–26; Guidoboni *et al.* 1994, 174–177. 180–185. 188–190. 194. 195. 239. 254. 255; Altunel 2000, 299–314. For a short review of earthquakes in Asia Minor see Karagöz 2005. A wide-ranging discussion of the dynamic relationship between *Naturkatastrophen* and human settlements in the Greek and Roman worlds can be found in Sonnabend 1999.

11 Ritti 1985, 7 »almost the entire region around the Maeander river is subject to earthquakes and it is undermined by water and fire to the most interior areas. In fact, starting from the plains, this feature of the soil extends to the Charonia of Hierapolis, of the place called Acharaka in the territory of Nysa, and of the place near Magnesia and Mious«. During the Byzantine period John the Lydian (ostent. 53) says that »without doubt, the regions near the eruptive zones and hot springs are more often subject to earthquakes, such as the regions around Laodikeia and the nearby Hierapolis of Phrygia and, in our part, of Philadelphia, and in general that zone of Asia«.

seismic rebuilding programme of the late Flavian period and mid 2nd century A.D.[12], we shall seek to highlight the most detailed evidence of practices commonly used in the restoration of architectural materials.

## A Typological Study of Ancient Restoration Measures

In the field of ancient sculpture, efforts have been made to classify the production techniques used, with studies focusing on the methods and the tools employed not only in creation but also in the various restorations undertaken in the ancient times[13]. Regarding ancient pottery, recent analytical investigations have described the techniques and material employed to repair the broken vessels, without forgetting the social value of this common practice[14]. By contrast, analogous lines of research have not been developed in the field of architecture, despite the abundance of recognizable evidence on ancient buildings.

Thus, in the first part of this paper we propose a typology of ancient restoration measures affecting building blocks, based on the monuments of Hierapolis, which shall be compared to other examples, chosen from Asia Minor and identified during inspections conducted in the field[15]. The purpose is not to provide a complete catalogue of ancient repairs undertaken in the cities of ancient Anatolia, in reality barely feasible; rather, the advantage of this approach, focusing on Hierapolis, lies in the opportunity it provides to emphasise the value of technical knowledge originating in local workshops and to reconstruct a key aspect of the technological history[16] of this important city in ancient Asia Minor. Obviously a typological approach alone is not sufficient, and only a complete and detailed study of each monument will clarify the motivation for the recognized restoration measures. Of course, repairs due to accidental breakage of the mouldings or detection of imperfections and fissures in the stone during construction have a very different historical significance from repairs conducted on blocks that were damaged, chipped or broken as a result of deliberate human action or natural phenomena. In fact, the need for the restoration of public and private buildings could arise from various events or agents: military action, local conflicts, natural catastrophes (fires, earthquakes, storms . . .), the desire for public approval and prestige, competition between cities and religious interests are all repeatedly cited in the epigraphical texts as reasons to undertake building reconstruction[17].

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12 After the earthquake of 60 A.D. (Tac. ann. 14, 27, 1), a large-scale project for the enlargement of the urban area was planned and executed during the Flavian (see Ismaelli 2009, 171–346. 445–454; Ismaelli 2010) and Hadrianic-Antonine eras (see Rossignani – Sacchi 2007; Rossignani – Sacchi 2011).

13 Different materials and expedients are discussed in Dickins 1912, 37. 38; Adam 1966, 80–82; Frel 1972; Frel 1982; Claridge 1990, 135 note 3; Harrison 1990; Frel 1994, 11. 47–67; Leka 2003.

14 Bakry 1962; Bakry 1969; Elston 1990; Charters *et al.* 1993; Dági 2003; Dooijes – Nieuwenhuyse 2007; Nadalini 2007; Schöne-Denkinger 2007; Rotroff 2011; Slane 2011.

15 For restoration projects financed by emperors or public authorities in Asia Minor see Winter 1996, esp. 188–192. Few publications on the monuments of this region include a careful description of ancient repairs; exceptions are the Gate of Hadrian in Ephesos (Thür 1989, 121–124) and the Theatre in Nysa (Kadıoğlu 2006, 139). References to repairs and restoration programs affecting Greek monuments can be found in the online ›Bibliographie de l'architecture grecque‹ (<http://www.mae.u-paris10.fr/bullarchi/>), *s. v. réparation* and *restauration*.

16 Important data on the technological features of Hierapolis were acquired thanks to the discovery of a hydraulic saw for blocks, see Ritti *et al.* 2007; Grewe 2009; Grewe 2010; Kessener 2010.

17 Winter 1996, 338–359 lists inscriptions in Asia Minor regarding public building activity: together with donors and sources of funding, the specific reasons for new constructions or restoration projects are recorded. See also Halfmann


Fig. 3 General plan of Hierapolis

The second part of the paper is devoted to the Gymnasium of Hierapolis, a building stratigraphically excavated and carefully studied, which enables us to develop a contextual and diachronic analysis of the evidence in order to highlight the social and cultural changes reflected in the different restoration measures.

### *Short Premise to the Typology*

The monuments presented in the paper are associated with architectural complexes that have been the object of investigations performed by the author in recent years. Specifically, detailed studies have been conducted on the Augustan-Tiberian portico (*Temenos*) enclosing the middle terrace of the Sanctuary of Apollo, which has a lower Doric and an upper Corinthian storey. The blocks of the *Temenos* Portico will be indicated with the abbreviation SA. Numerous cases were also selected for this study from the blocks of the Marble Portico, a 62 m-long Doric *stoa*, built in the Julio-Claudian period around the middle of the 1st century A.D. along the main street of Hierapolis. The related blocks are labelled HSTM. Lastly, a separate chapter will focus on the transformation and restoration of the Gymnasium, a large peristyle courtyard with Doric columns from the same period, whose architectural elements are indicated with the abbreviation HG[18] (*fig. 3*).

In the typology described here, the evidence gathered is organized in growing order of complexity of the restoration measures undertaken; every type is presented starting with the evidence from Hierapolis and is then compared with similar cases recognized in other ancient cities of Asia Minor. The examples from Hierapolis and other cities concern columns and entablatures of large-scale stone constructions that are generally extensively described in the literature. Repairs to walls, mosaics, *opus sectile* and other floor coverings and roofing elements, such as tiles or timbers, are deliberately excluded.

### *Type A Restoration Measures: Joining of Broken Blocks Without Acting on the Surfaces Exposed as a Result of the Fracture (figs. 4–7)*

***Definition*:** The two parts of the broken block present butt surfaces that are still compatible with each other, which are simply reattached by means of metal elements and adhesives. Sub-type **A-1** uses dowel-rods and sub-type **A-2** uses Π-shaped iron cramps. Both sub-types are used for blocks broken both horizontally and vertically.

***Examples*:** A clear example of sub-type **A-1** is provided by two blocks of the lower drum of one of the Doric columns of the Gymnasium (HG10+HG28). The two contact surfaces are not altered: the horizontal join is under pressure, and the two pieces are joined with a central metal rod[19]. A second dowel-rod was not inserted, since the alternation of concave and convex parts on the contact surfaces was judged to be sufficient to prevent a dangerous rotation of the shaft (*fig. 4 a–c*). In contrast, capital HG17 of the Gymnasium has a vertical joint, in which the corner of

2001, 93–106; Barresi 2003, 109–128.

18 For the *Temenos* Portico see Ismaelli 2009, 1–118. For the Marble Portico, see Ismaelli 2009, 119–163. For the Gymnasium see below 301–310.

19 The lower hollow is 7.5 × 8 cm and the upper one 3 × 4 cm, providing the dimensions of the missing metal rod. Wooden rods (*empolion* and *polos*) were found still in place in the Erechtheion, see Paton – Stevens 1927, 196. 226. 227 figs. 124–126.

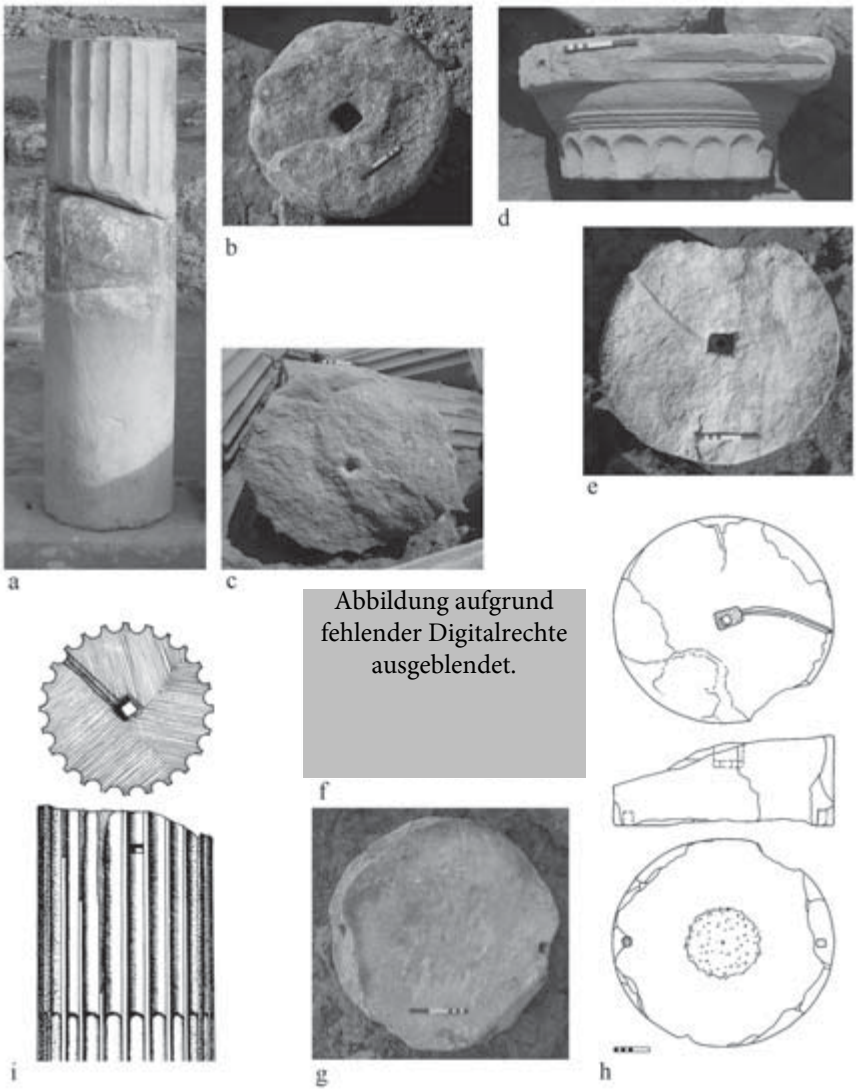


Fig. 4
Type A restoration measure, sub-type A-1. a–c: Hierapolis, Gymnasium, drums HG10+HG28; d: Gymnasium, capital HG17; e–h: Marble Portico, drum HSTM182; i: Ephesos, Hadrian's Gate, drum

the abacus, now missing, had been reattached with a metal rod that was square in cross-section (2 × 2 cm, *fig. 4 d*). A similar repair is found in a fragment of a drum of the Marble Portico (HSTM182), only 29 cm high, that was secured to the original block with a central dowel-rod, fitting into a recess carved in the irregular upper surface, which remained untouched[20] (*fig. 4 e–h*). Parallels can be found in the Hadrian's Gate in Ephesos (*fig. 4 i*) and in the Theatre of Perge[21].

[20] In contrast the bottom surface of the same block underwent small alterations, receiving an *anathyrosis* (sub-type B-2) but remaining convex; two rods were inserted near the outer edge to connect the bottom to the lower fragment of the original drum, see Ismaelli 2009, 146 fig. 159 no. HSTM182=STM25.

[21] For Hadrian's Gate, see Thür 1989, 123 pl. 39 no. HT106, cornice. In the Theatre of Perge, during the late-ancient restoration of the *scaenae frons* a marble capital was replaced by a limestone capital; in this case, the damaged part of the abacus and calathus of the re-employed capital were fixed with two horizontal rods fitting into hollows carved in a rough surface, see Öztürk 2009, 93. 148 pl. 9, 2 no. 241.

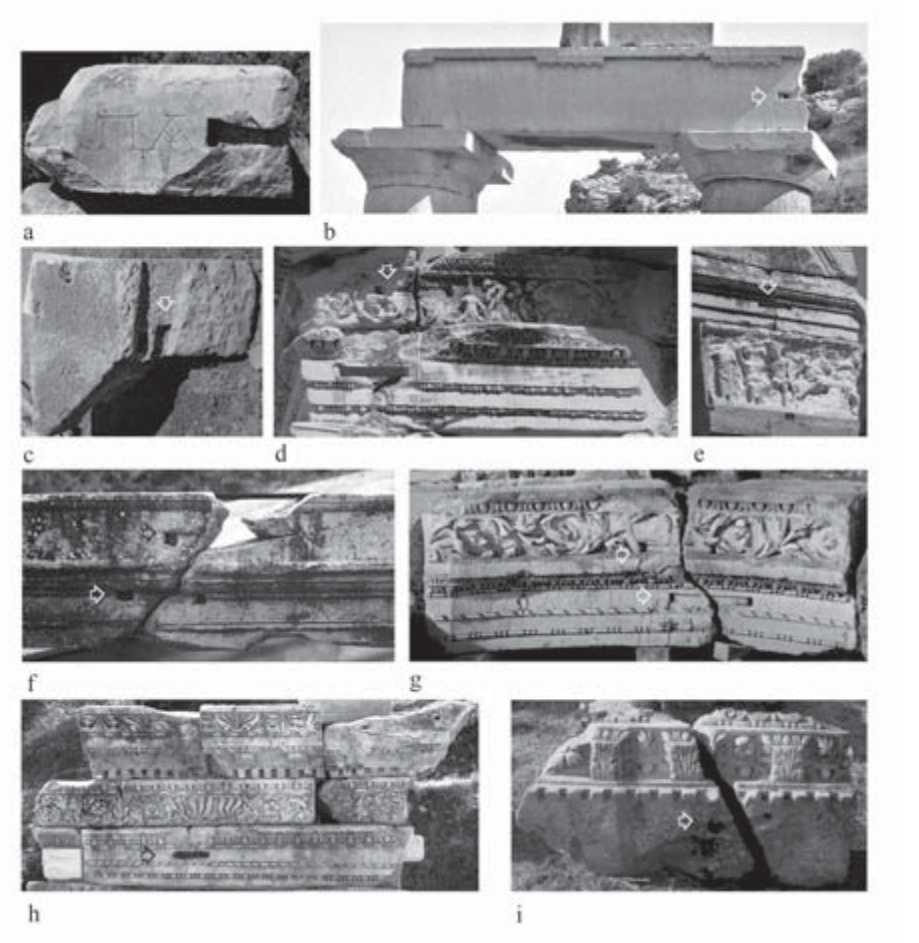


Fig. 5
Type A restoration measure, sub-type A-2. a: Aphrodisias, *Sebasteion*, architrave of the northern portico; b. c: Ephesos, *Prytaneion*, architrave and cornice of the Doric portico; d. e: Ephesos, Temple of Hadrian, entablature; f: Ephesos, Nymphaeum of Trajan, frieze-architrave; g: Hierapolis, Theatre, frieze-architrave of the second storey; h. i: Nysa, Theatre, entablature and cornice of the first order

Sub-type **A-2** is exemplified by the frieze-architrave of the Theatre's *frons scaenae* (second order), restored between 350 and 352 A. D.[22]: a large Π-shaped cramp is inserted into a horizontal hollow, carved in the front-facing side of the block, to hold the irregular butt surfaces together (*fig. 5 g*). This is a common kind of repair in Asia Minor, especially – but non exclusively[23] – in architraves, in both gravity-assisted situations (above capitals or walls) and above the intercolumniations. This repair in the Theatre may be directly compared with many other cases in Aphrodisias, Ephesos, Nysa, Miletos, Perge, Sardis and Smyrna[24] (*figs. 5. 6*). Because of the

[22] Ritti 2007, 416 fig. 16. For the *frons scaenae* see De Bernardi Ferrero *et al.* 2007; Sobrà – Masino 2010.

[23] Repairs with visible iron cramps have been documented in an Ionic capital from Pergamon with the lead coating still in place (Kästner 1992, fig. 17; Hellmann 2002, 97 note 64) and in a column of the Roman Gate of the Stadion in Miletos (von Gerkan 1921, 33 fig. 41).

[24] Aphrodisias, *Sebasteion*, see *IAph2007*, no. 91, architrave. Ephesos, *Brunnen an der Straße zum Magnesischen Tor* (Quatember 2008, 232 fig. 19 no. 4–3), Nymphaeum of Trajan (Quatember 2011, 23. 85 pl. 44 no. 5–44, frieze-architrave, cramps on front face), *Prytaneion* (Steskal 2010, 49 pl. 60, 1. 2, cornice, cramps on upper face; 49 pl. 58, 3 no. A7 architrave, cramp on front face) and *Südliches Hafentor* (Wilberg *et al.* 1923 fig. 179, frieze-architrave, cramp on the front face); many examples of this sub-type A-2 in the Temple of Hadrian, in gravity-assisted situations, can be attributed to the restoration of the façade carried out in the Tetrarchic Age (for this restoration, see Fleischer 1967;

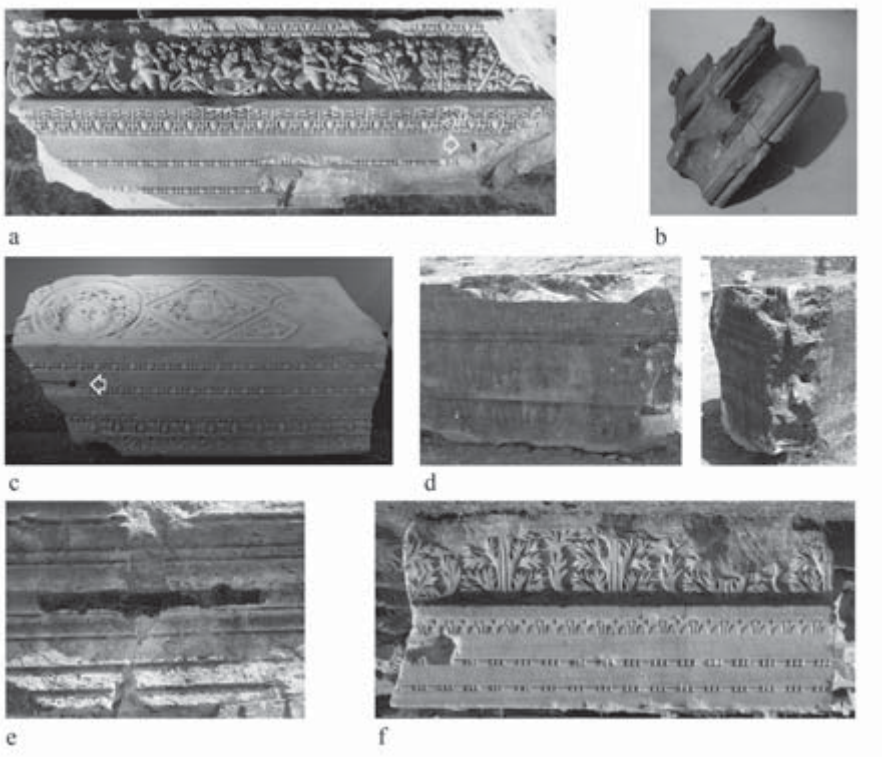


Fig. 6
Type A restoration measure, sub-type A-2. a: Perge, Theatre, frieze-architrave from the *scaenae frons*; b: Pergamon, Ionic capital; c: Perge, South Baths, architrave of the Propylon; d: Sardis, *Artemision*, architrave; e: Perge, *Agora*, door architrave of a *taberna*; f: Smyrna, *Agora*, frieze-architrave of the porticoes

position of the cramps, this type of restoration measure has a strong visual impact and is impossible not to notice. In order to hide the iron element or its lead coating, plaster may have been applied, at least in the most finely executed cases, but no trace of this solution has been found.

Two more remarks need to be made about sub-type **A-2**. First, it should be noted that iron cramps were used not only with architectural blocks that were definitely broken but also with blocks that were simply damaged, i. e. affected by fissures before being laid. The use of anti-cracking cramps is attested for freshly quarried blocks, as with various imperial-age columns found in the quarries[25], and for blocks that were reinforced at the building site after the workmen had noticed the potentially dangerous cracks, as is the case with some examples in Klaros,

Brenk 1968; for the building, see Miltner 1959, 264–273 figs. 125. 128); the same technique was used in the modern restoration. Nysa, Theatre, see Kadıoğlu 2006, 139. 208 fig. 42 pl. 15, 4 no. 156 (cramps on front and rear faces of architrave); 139. 177 pl. 10, 1 no. 29 (frieze-architrave, cramps on rear and front faces); 139. 217 pl. 17, 10 no. 175 (front, upper and bottom faces of *Seitenarchitravbekrönung*); 139. 214 no. 164 (*Seitenarchitrave*, rear face); 139. 237 pl. 23, 7 no. 262 (*Konsolengeison*, bottom); 139. 302 fig. 102 pl. 35, 7 no. 536 (*Tympanonblock*). Miletos, *Serapeion*, see Knackfuss 1924, 195 fig. 201, frieze-architrave. Perge, *Agora*, unedited architrave of a shop (for the monument, see Mansel 1975, 76–83), Propylon of South Baths (Abbasoğlu 1994, 91 pl. 38, 1–5), Theatre, architraves (Öztürk 2009, 93. 148 no. 242; 93. 148 no. 245; 93. 149 no. 249; 93. 150 no. 265; 93. 172. 173 no. 583; 93. 192 no. 865; 93. 170 no. 556 pl. 14, 1; 93. 195 no. 903; also Köster 2004, pl. 135, 1). Sardis, *Artemision* (not illustrated by Butler 1925, 49–51 and Gruben 1961).

[25] Some examples are listed by Wurch-Kozelj 1988, 55; Pensabene 1995, 73 no. 17; 99 figs. 121–123 no. 37; 264 figs. 295–297. 304. 305; Pensabene 1998, 313. 315 fig. 1 pls. 6, 3. 4; 8, 1; 10, 1. 2.

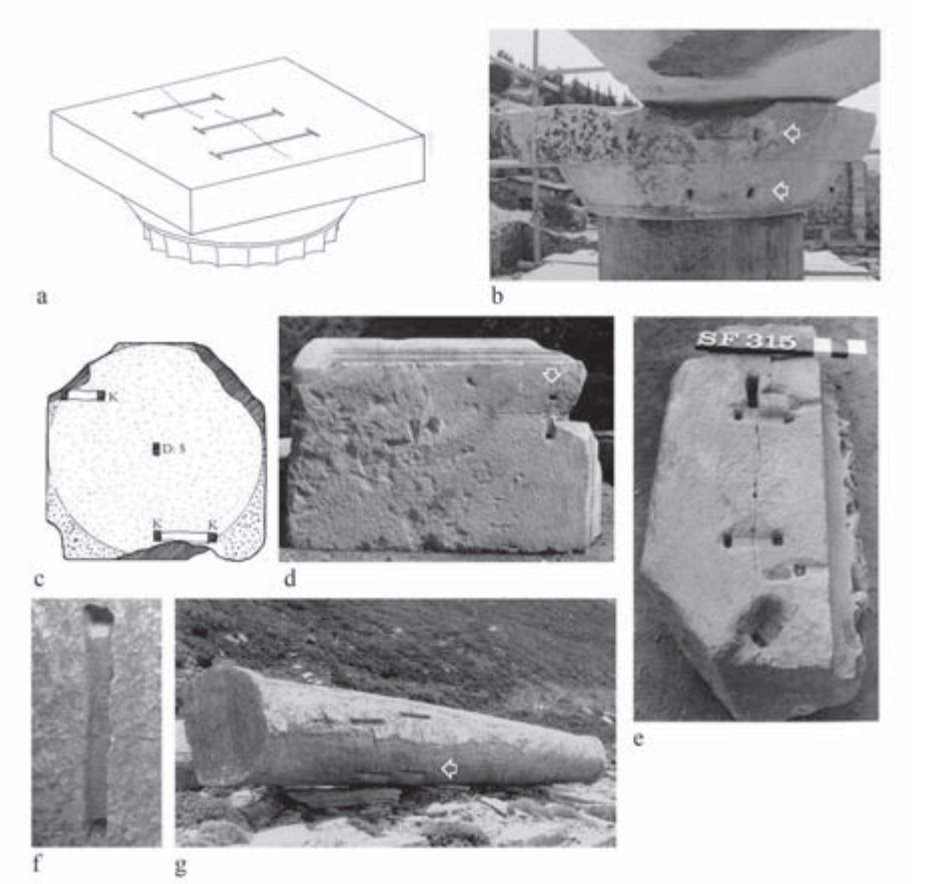


Fig. 7
Type A restoration measure, sub-type A-2, anti-cracking cramps. a: Athens, Parthenon, capital; b: Ephesos, *Prytaneion*, Doric capital; c: Nysa, Theatre, Ionic base of the first order; d. e: Nysa, Theatre, *Sockelprofil* and *Seitenarchitrav* of the second storey; f. g: unfinished column shaft in the quarry at Kylindroi, Karystos

Ephesos and Nysa[26] (*fig. 7*). Secondly, sub-types **A-1** and **A-2** can be observed together, for example to secure the broken parts of column shafts in the Hadrian's Gate in Ephesos: a central rod inserted into the broken surface was reinforced by a Π-shaped iron cramp inserted along one of the flutes (*fig. 4 i*)[27].

The solution found in the so-called Great Exedra of the *Apollonion* in Klaros can be considered a variant of the type A restoration measures: the broken part of the seat was repositioned and the empty space between the main fragment and the bench was filled in with molten lead, with no rod or cramp[28].

The above-described use of metal elements to strengthen the joins is in contrast with the prescriptions of modern restoration theory. Indeed, ancient restoration did not entail the use of

[26] Klaros, *Apollonion*, see Martin 1965, 304 note 1, stylobate. Ephesos, *prytaneion*, see Steskal 2010, 49 pl. 61, 1 no. A6, Doric capital. Nysa, Theatre, see Kadıoğlu, 196 fig. 34 no. 94 (base with cramps on bottom surface); 196. 279 pl. 30, 1 no. 443 (*Sockelprofil* with cramps on upper and bottom surfaces); 139. 291 fig. 91 pl. 32, 7 no. 494 (frieze-architrave with cramp on upper face). In Greece see e. g. the portico of Philip in Delos (Vallois 1923, 70. 71 figs. 90. 91) and the Parthenon (Korres 1999, 110 fig. 33; Hellmann 2002, 97 note 64).

[27] Thür 1989, 37. 122 fig. 25 pls. 13. 14 nos. HT5, HT8, HT107.

[28] Étienne – Varène 2004, 81 figs. 48. 124, 2.

inert and compatible materials. Iron was generally chosen for dowel-rods and cramps, although it was well known that this metal was subject to oxidation, especially when exposed to atmospheric elements[29]. Where possible, however, the decay of the metal was mitigated by the use of lead coatings and by grouting the joins. The conservation in the original position of a replacement part secured by an iron cramp in a block (SA37) corresponding to type **D-2** described below indicates the extraordinary durability of these restorations[30].

### *Type B Restoration Measures: Joining of Broken Blocks with Small Alterations to the Butt Surfaces (fig. 8)*

***Definition*:** The two contact surfaces are modified purely in order to ensure better adhesion, without the addition of newly worked material; this type of restoration is not always clearly distinguishable from the previous one in the published documentation. In sub-type **B-1** the durability of the restoration depends only on the conformation of the new contact surfaces and the use of adhesives, whereas sub-type **B-2** also includes the use of metal elements.

***Examples*:** A specimen of a sub-type **B-1** repair is seen in a column in the Sanctuary of Apollo (SA38)[31], in which the contact surfaces were cut so as to form a series of small steps. In this way, since the join is no longer diagonal with respect to the ground, the upper piece discharges its weight vertically and does not risk slippage. Column SA38 also provides an example of sub-type **B-2**, with the insertion of Π-shaped iron cramps in the flutes to strengthen the join (*fig. 8 a–d*). Parallels are attested in Ephesos[32]; the architrave of a round funerary monument is similar to the previous case, with its butt surfaces carved into a two-stepped-shape[33] (*fig. 8 e. f*).

The restorations corresponding to the subsequent types are characterised by more invasive measures. The greater part of the block is conserved, while the damaged, chipped or fractured portions are mechanically removed, in accordance with a technique common when working with wood[34]. Thus, the restoration entails two successive operations: the creation of a new contact surface, deliberately modified to facilitate the joining of the pieces, and the production of a new element to replace what was removed, which in Greek is called *emblema* (ἔμβλημα), ›what is inserted/integrated‹[35].

In the simplest restoration measure (type C, see below), the *emblema* is attached by means of a specially cut joint and binders, while in type D, iron dowel-rods or cramps are used. Various sub-types have been recognised, determined by the shape of the metal elements, which in turn depends on whether the joint is vertical (and therefore gravity-defying) or horizontal (and there-

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29 The reason for the well preserved iron cramps and rods from the Acropolis are set out in Varoufakis 1992 (*non vidi*).

30 In other cases, such as the tympanum of Temple A (see below), the iron rods of the restoration, having been left exposed, caused further fractures.

31 Ismaelli 2009, 43. 71 fig. 60.

32 See an unedited cornice of the Terrace of Domitian; for the Doric façade see Bammer 1978–1980, 81–86; Steskal 2010, 195. 196. In a frieze-architrave from Smyrna, *Agora* (Vandeput 1997b, fig. 14 = Vandeput 1997a, pl. 119, 1), it is not clear if the repair belongs to sub-type B-2 or D-2.

33 Koenigs – Radt 1979, 324 pl. 120, 1; the use of cramps or rods is not visible in the photograph.

34 The link with the carpentry technique is highlighted by Korres 1999, 110 and also by Claridge 1990, 137, especially for the solutions of the Archaic age when it is the shape of the joint – not the use of rods or adhesives – that strengthens the *emblema*. Many cases of this technique are recognizable in statuary, see Frel 1972; Harrison 1990, esp. 165–170.

35 The use of replacement parts (ἔμβλημα ἐβαλεῖν) was imposed on the contractors in case of broken blocks, but it was punished with fines, see Hellmann 1992, 124.

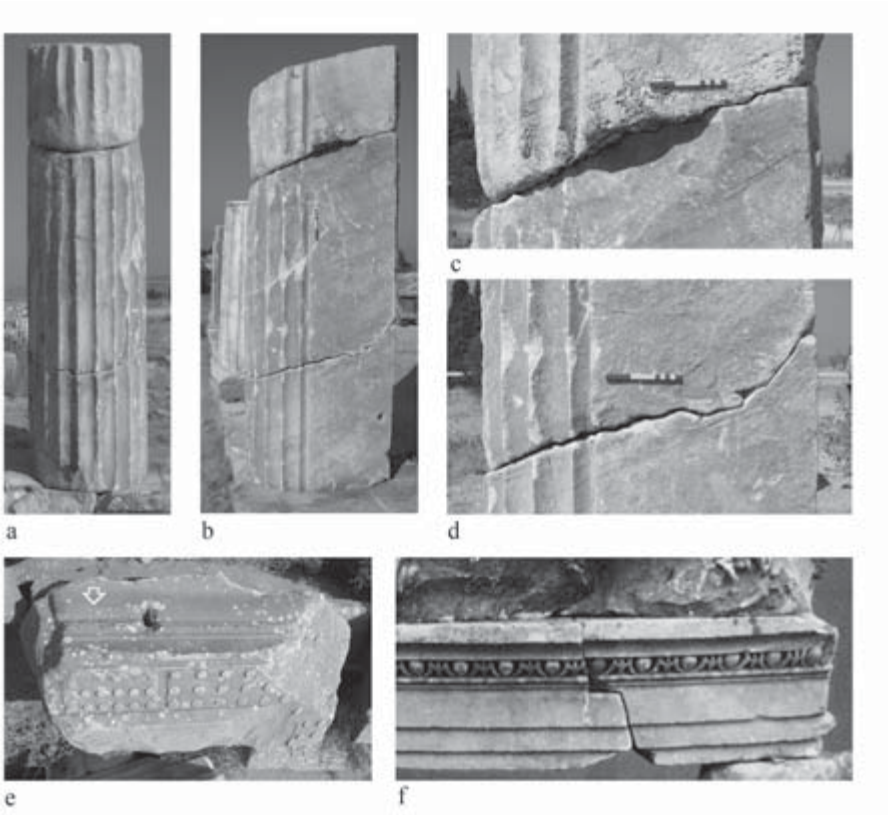


Fig. 8
Type B restoration measures. a–d: Hierapolis, *Temenos* Portico, drum SA38 with repairs of sub-type B1 and B-2; e: Ephesos, Terrace of Domitian, cornice with type B-2 repair; f: Ephesos, *Rundbau*, architrave with repair of type B

fore gravity-assisted), the latter requiring fewer additional measures. It should not be forgotten that these various types of repairs are sometimes seen together on the same block.

The binders were mortars and plasters, materials that are well documented in both architectural and sculptural restoration and are also alluded to by Theophrastus[36]. Unfortunately the physical properties of the mortars used in ancient restorations are hard to assess, due to the low level of interest shown in the studies[37] and the difficulty of obtaining good samples from blocks that have remained exposed to atmospheric agents.

As well as mortar, other mixtures based on animal and plant products may have been used: the ancients called them κόλλα or *glutinum*[38], with different adjectives, depending on their specific purpose. Examples of these fixatives include τεκτονικὴ κόλλα, for carpentry, and ἀγαλματίτης

[36] Theophrastus (lap. 65) describes the use of plaster (*gypsos*), produced in the region of Tympaia, as being useful to bind stones: χρῶνται γὰρ πρός τε τὰ οἰκοδομήματα αὐτῷ τῷ λίθῳ περιχέοντες κἄν τι ἄλλο βούλωνται τοιοῦτο κολλῆσαι; see Adam 1966, 82. Mortar was observed in the classical and Roman repairs to the Erechtheion, see Paton – Stevens 1927, 213.

[37] Claridge 1990, 136 complains of this problem; in contrast, see the modern approach of Paton – Stevens 1927, 225. 226 and the analysis of the cement around the rods used on the plinth of a Caryatid; see also Farnsworth – Simmons 1960.

[38] See Ginouvès – Martin 1985, 90 note 63; Hellmann 1992, 226. 227. Unfortunately, Plinius nat. 13, 81–82 gives us only the recipe of the glue for papyrus (*glutinum vulgare*, see Sider 1976; Puglia 1993, 29–32) but not the one used in the workmen' activities (*glutinum fabrile*). For adhesives used in pottery repair, see Charters *et al.* 1993.

κόλλα, used especially for statues, noted by Hesychius[39]. Even in the Hellenistic period, contract specifications regarding building procedures forbade the use of wax or glue to hide imperfections and damage, showing the recourse to these expedients[40].

In some cases, chemical analyses of the residues have confirmed the existence of these mixtures, including one made of beeswax and powdered lime[41], which had been used by the Egyptians and indeed was used until modern times[42]. Alternatives to beeswax that were more resistant to the summer heat included mixtures with plant resins, also used for sculpture[43]: significantly, Pliny mentions resin as a binder for lead and marble[44]. This use of resins has been archaeologically documented in the Egypt of the Pharaohs, in mixtures with powdered limestone[45]; while in the 17th and 18th centuries, resins and products derived from resin such as Greek pitch (rosin) were listed in sculptors' manuals[46]. Also of ancient origin is the recipe for glue based on casein and lime, used in the ancient restoration of the famous sculpture of Laocoön and His Sons[47], and still appreciated by sculptors in modern times, since it is insoluble in water[48].

### *Type C Restoration Measures: Joining of Broken Blocks with Replacement of Damaged Parts and Use of Binders (figs. 9–15)*

***Definition*:** The butt surface is re-carved and the damaged parts are fixed without metal parts. The reworking of the fracture, the tool used and the features of the new surface that is formed as a result may depend both on the dimension and form of the replacement part, and the substances to be used as binders. Often, although we have no evidence of their presence based on chemical analyses, the shape and position of the replacement material clearly suggest that adhesives must have been used.

In sub-type **C-1**, the replacement material is made up of a cuboid element that is simply positioned in the suitable space, carved in the main block, and is maintained in place by gravity or binders alone, or more rarely thanks to a particular shape of the join[49]. In sub-type **C-2**, the

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39 Hesychius, sv. ἀγαλματίτης· λίθου κόλλα. Glue was commonly used to assemble the parts of pseudoacrolithic statues (see Pollini 1988; Jockey 1999) together with rods (see Ashmole 1951, 19 note 40; Adam 1966, 80–82; Bol 1972, 93–96; Stewart 1997, 41. 44; Claridge 1990; Ridgway 1990, 185. 186; Hermary 1998; Hermary 2003; Jacob 2003). Pausanias (8, 37, 3) denies that glue or iron had been used to connect the parts of the statuary group of Damophon in Lykosura.

40 Hellmann 1992, 34. 35 ἀκόλλητος, ἀκήρωτος; Hellmann 2002, 97.

41 Farnsworth – Simmons 1960; Claridge 1990, 153.

42 The recipe recorded in the handbook of Nicholas Stone Jr. (see Spiers 1918/1919, 196) requires beeswax, rosin and powdered bricks or marble. Egyptian examples are cited by Lucas 1926, 8.

43 Adam 1966, 82; Claridge 1990, 153. 154.

44 Plin. nat. 33, 30, *resina plumbo et marmori*.

45 Lucas 1926, 13. 116; Adam 1966, 82.

46 See the handbooks of Orfeo Boselli (Dent Weil 1967, 90. 91. 97. 98 notes 18. 19) and Nicholas Stone Jr. (Spiers 1918/1919, 196).

47 Recorded by Magi 1960, 16; see also Claridge 1990, 154.

48 Powdered lime and casein from cheese were recommended by Nicholas Stone Jr., see Spiers 1918/1919, 196; Dent Weil 1967, 98 note 1; Claridge 1990, 154.

49 Among the blocks of Asia Minor the author found no case more complicated than the repairs to a column in Tegea: in this case the *emblema* is divided into three pieces, of which the outer ones have grooves to make them fit in the recess carved in the drum, while the central one is wedge-shaped (Pakkanen 1998, 28 figs. 9. 10; Hellmann 2002, 97 fig. 114).

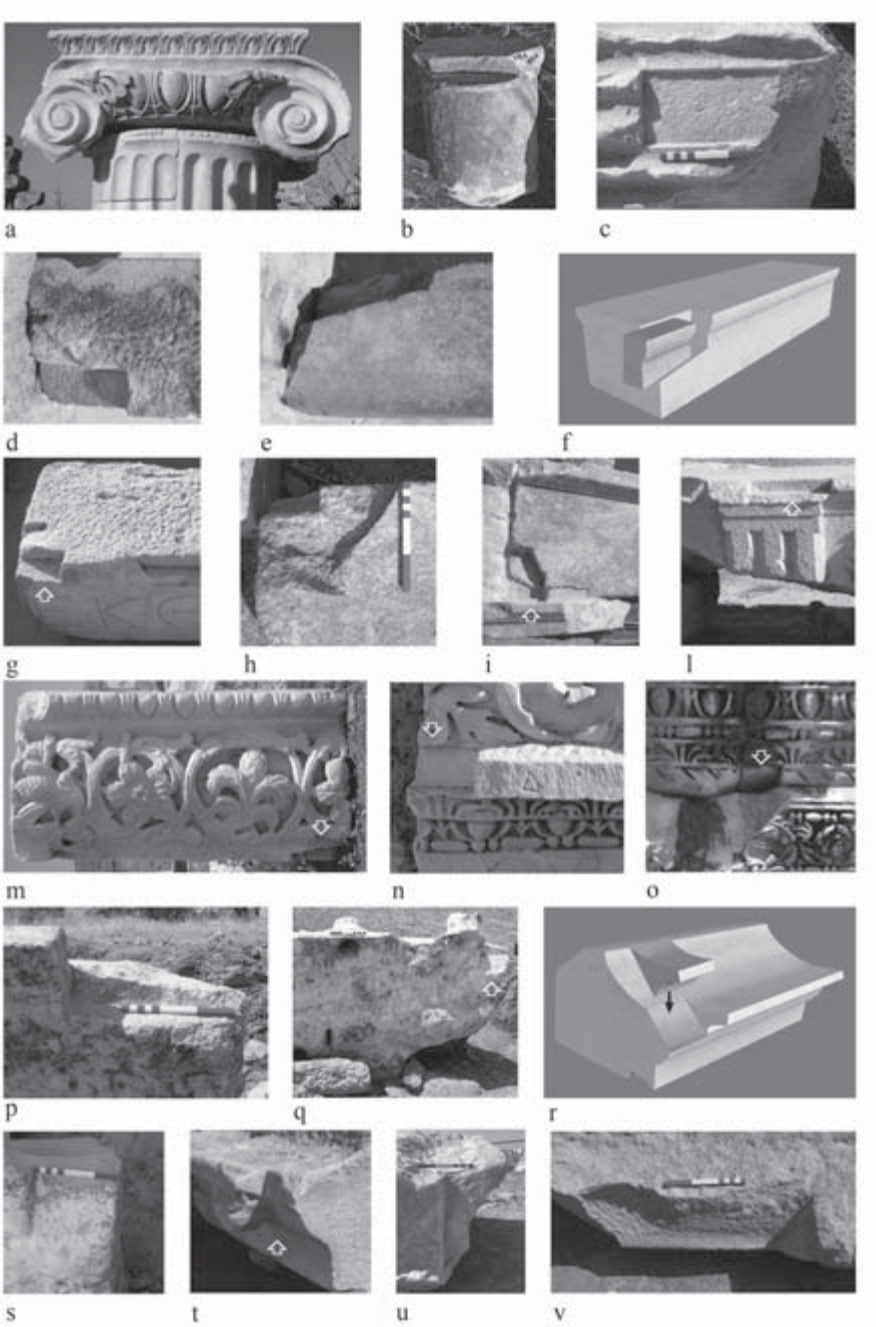


Fig. 9
Type C restoration measure, sub-type C-1 in Hierapolis. a: Temple of Apollo, capital; b: Nymphaeum of Apollo, column shaft; c: Sanctuary of Apollo, sporadic column; d–f: Gymnasium, architrave HG2; g: Gymnasium, architrave HG20; h. i: Gymnasium, architrave HG13; l: *Temenos* Portico, frieze SA93; m: Temple of Apollo, frieze; n: Theatre, frieze-architrave of the second order; o: Theatre, southern door of the *scaenae frons*; p: Marble Portico, cornice HSTM107; q–s: Marble Portico, cornice HSTM67; t: *Temenos* Portico, cornice SA135; u: *Temenos* Portico, cornice SA165; v: *Temenos* Portico, cornice SA162

replacement part and the piece that will hold it have wavy edges, so as to form a special joint between them that prevents the added part from moving around and rotating. In sub-type **C-3** the two parts are joined with the socket-and-tenon technique, in which only a small section of the *emblema* is inserted into the larger block.

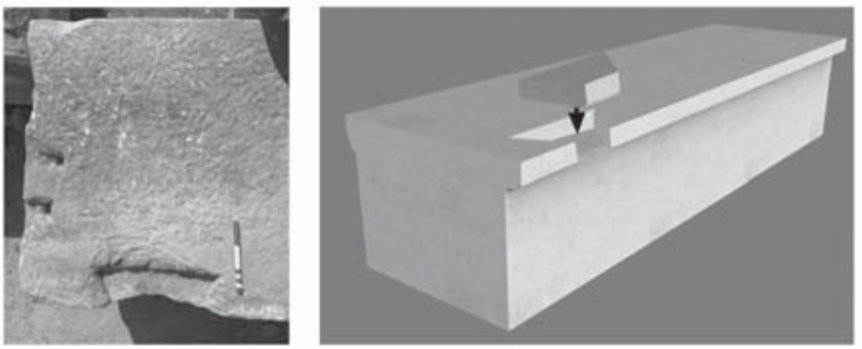

Fig. 10
Type C restoration measure, sub-type C-1. Hierapolis, Gymnasium, architrave HG15

***Examples*:** In Hierapolis sub-type **C-1** is a very common solution and includes repairs to column shafts and capitals[50], the restoration of the doorjamb of the Theatre[51] and repairs to the upper corners of architraves, friezes, and cornices[52]; in the restoration of the *taenia* of an architrave in the Gymnaisum (HG15) for example, the *emblema* is inserted into a trapezoidal recess that leaves only the moulded part exposed, preventing the replacement part from moving horizontally[53] (*fig. 10*). In all these cases the main joint is horizontal and each replacement part is supported by its own block, while in others the *emblemata* are maintained by the architectural elements beneath them[54] (*fig. 9 a–o*). Otherwise, where the contact surface between the pieces is oblique or vertical, the replacement material could only remain in place thanks to the use of a binder[55] (*fig. 9 q–v*).

Sometimes the *emblemata* are placed above the intercolumniations, in a gravity-defying situation: these included simple cuboid elements, held only by binders (SA82, SA135)[56], or, thanks to their tapering shape, the replacement parts were held in place by gravity alone (HSTM118

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50 Sanctuary of Apollo, Ionic Temple (Sacchi – Bonzano 2012, 343. 344 nos. TRS23, TRS33, TRS35, TRS39, TRS41, TRS43, TRS49, TRS-50, KG-14, figs. 6. 15. 16, drums; nos. HTA12, HTA13, HTA116, HTA126, fig. 6, capitals), *Temenos* Portico (Ismaelli 2009, 72 no. SA42, shaft; 43. 96 figs. 39. 119 no. SA125, pseudocorinthian capital) and Nymphaeum (unedited, no. HNA-F6,6.2). In an unattributed column from the same Sanctuary, the replacement part fits into a corresponding socket, in which the raw carving of the surface is clearly designed to increase the hold of the glue (*fig. 9 c*).

51 Northern *porta hospitalis*, see Pensabene 2007, 283 fig. 91.

52 Architraves HG2, HG20, frieze-architraves (Ismaelli 2009, 43. 85. 86 figs. 35. 400 no. SA92; 43. 86 figs. 36. 108 no. SA93; 43. 87. 88 figs. 51. 110 no. SA98), cornices (Ismaelli 2009, 44. 105 no. SA162; 44. 106 fig. 46 no. SA165; 44. 106 no. SA167; 44. 107. 108 no. SA169; and the unedited HSTM107).

53 This may be compared with a repair in the Erechtheion, see Paton – Stevens 1927, 208 fig. 11; see also Martin 1965, 303 note 1.

54 Examples are architrave HG13 in the Gymnasium, frieze HTA33 of the Apollo Temple (Sacchi – Bonzano 2012, fig. 11), a cornice of the southern door of the Theatre (Pensabene 2007, 281 fig. 72), and some blocks of the frieze-architrave of the first (Pensabene 2007, 263 figs. 39. 40) and second orders of the same building (Pensabene 2007, 263 fig. 43; Kadıoğlu 2006, pl. 49, 6).

55 Cornices HSTM67, SA161 and SA169.

56 See Ismaelli 2009, 83 fig. 105 no. SA82; 99 no. SA135. This may be compared with the repairs to the scribe statue from the Acropolis (Acr.629, Leka 2003, 23. 24 fig. 4) and to a female head in Thessaloniki (Claridge 1990, 148. 150 fig. 23): their replacement parts, with vertical joins, were held in place only by binders.


Fig. 11
Type C restoration measure, sub-type C-1. a–c: Hierapolis, Marble Portico, architrave HSTM118; d: Hierapolis, Nymphaeum of Tritons, frieze-architrave; e–g: Soussa, statue of Saturnus; h: Aphrodisias, Sanctuary of Aphrodite, architrave of the *temenos*; i: Perge, Theatre, frieze-architrave of the third order

and a frieze-architrave of the Nymphaeum of Tritons[57]), a solution that was also sporadically used in ancient statuary[58] (*fig. 11*).

Simple examples of sub-type **C-1** elsewhere in Asia Minor include column bases and shafts in Aizanoi, Didyma, Ephesos, Nysa, Pergamon and Sardis[59], capitals in Pisidian Antioch, Ephe-

[57] Campagna 2012, 540 fig. 11.

[58] Examples include the Saturnus from Soussa (de Chaisemartin 1987, 18–20 no. 7; Claridge 1990, 146 fig. 14) and, probably, the Despoina of Lykosoura (Dickins – Koirouniotis 1906/1907, 387 fig. 9; Claridge 1990, 146 »wedge-shaped socket-and-tenon arrangement«).

[59] Aizanoi, Corinthian portico of the Temple of Zeus, see Naumann 1979, 42 pl. 30b, column. Ephesos, *Prytanion*, see Steskal 2010, 48 no. A4 pl. 57, 3, column shaft. *Didymaion*, see Pontremoli – Haussoullier 1904, 136 fig. p. 136, base. Nysa, Theatre, see Kadıoğlu 2006, 139. 196 pl. 13, 7 no. 94 corner of plinth; 139. 195. 196 no. 91 torus of the base; 197 no. 95 pl. 13, 6 torus and trochilus of a base; 310 fig. 110 pl. 37, 4 no. 570 *Pilasterbasis*; 139. 203 no. 137 shaft. Pergamon, *Athenaion*, see Bohn 1885, 12. 13 fig. p. 13, shafts. Sardis, *Artemision*, see Butler 1925, fig. 65, base no. 6, lower corner of plinth; fig. 58, base no. 10, corner of plinth; figs. 60. 130 base no. 16, upper edge of plinth; fig. 72, column no. 7, shaft.

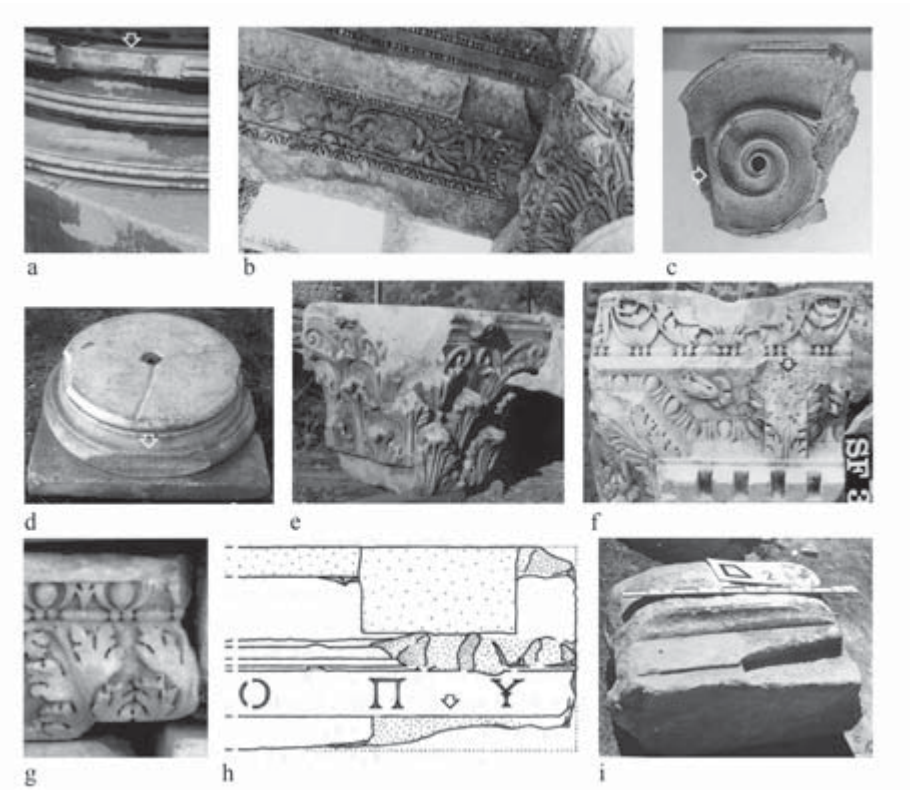

Fig. 12
Type C restoration measure, sub-type C-1. a: Didyma, *Apollonion*, Ephesian base; b: Ephesos, Library of Celsus, architrave; c: Larisa, Ionic capital; d–g: Nysa, Theatre, Ionic base, Corinthian capital, *Konsolengeison* and frieze of the first order; h: Pergamon, *Asklepieion*, architrave-frieze of the Ionic portico; i: Pessinus, architrave-frieze from the arch along the Gallos river

sos, Larisa, Nysa and Smyrna[60], numerous architraves, friezes and cornices from Aphrodisias, Aspendos, Ephesos, Klaros, Miletos, Nysa, Pergamon, Sagalassos, Side and Sardis[61] (*figs. 12.*

[60] Antioch, Augustan Temple (Mitchell – Waelkens 1998, 127 fig. 87, Corinthian pilaster capital) and an unedited Doric capital of a double half-column of the same sanctuary. Ephesos, limestone Doric capital, see Alzinger 1974, 69 fig. 68 no. CVa4. Larisa, Ionic capital, see Boehlau 1940, 125. 126 pls. 20. 21. Nysa, Theatre, see Kadıoğlu 2006, 139. 264 no. 374 pl. 27, 5, Corinthian capital. Smyrna, *Agora*, Corinthian capital described by Naumann – Kantar 1950, pl. 28d. Examples of sub-type C-1 are to be found in Athens, Erechtheion (Paton – Stevens 1927, 207, stylobate), Delos, portico of Philip (Vallois 1923, 70 figs. 44. 45. 78. 89. 145), Delphi, Athena Pronaia (Demangel 1923, 21 fig. 27, stylobate; 21 fig. 28, column shaft), Aigina, Temple of Apollo (Hoffelner 1999, 24 fig. 9 pl. 33, 1, cornice with a zigzagged *emblema*), Paestum, *Athenaion*, Ionic capital (Krauss 1959, 46. 47 fig. 27 no. II), Tegea, *Athenaion* (Pakkanen 1998, 29, shaft); in the Temple of Zeus in Olympia (Dinsmoor 1941, 410. 411 figs. 9. 10) new abaci, composed of one or two blocks, were not attached to the echinus with dowel-rods but simply rested on it.

[61] Aphrodisias, north portico of the *Agora* (Chaniotis 2004, fig. 10), *Tetrapylon* (Outschar 1996, fig. 22, upper edge of frieze). Aspendos, Theatre, see Vandeput 1997a, pl. 77, 2, cornice, sub-type C-1 or D-1(?). Klaros, Doric Propylon, see Étienne – Varène 2004, 74 figs. 23. 26. 27, respectively architrave, frieze and cornice. Ephesos, *Celsusbibliothek*, see Wegner 1978–1980, fig. 8, bottom of architrave over the capital = Vandeput 1997a, pl. 86, 1. Miletos, South *Agora* (Knackfuss 1924, 28. fig. 25, upper mouldings of architraves), *Serapeion* (Knackfuss 1924, 195 fig. 203 upper moulding of frieze-architrave) and frieze from Hagia Paraskevi (Köster 2004, 188 pl. 73, 4 no. 22F9). Nysa, Theatre, see Kadıoğlu 2006, 139. 227 pl. 19, 2 no. 222, bottom of frieze; 139. 290 fig. 90 pl. 32, 3 no. 493, upper mouldings of frieze; 139. 292 pl. 33, 1 no. 496, upper mouldings of architrave; 139. 239 no. 269 pl. 21, 5. 6, part of console; 139. 309 pl. 37, 2 no. 566, part for palmetta on *Pfeifengesims*. Pergamon, Ionic portico of *Asklepieion*, see Hoffmann 2011, pl. 8, 12 fig. 21 no. 43 on frieze and bottom of architrave in gravity-defying position. Sagalassos, Antonine Nymphaeum, see Vandeput 1997b, fig. 5, upper moulding of frieze. Side, *Grabbau*, see Mansel 1956, 8 fig. 36, architrave of door, string with beads and reels. Sardis, angle-antefix, see Butler 1925, 74 figs. 86. 87.

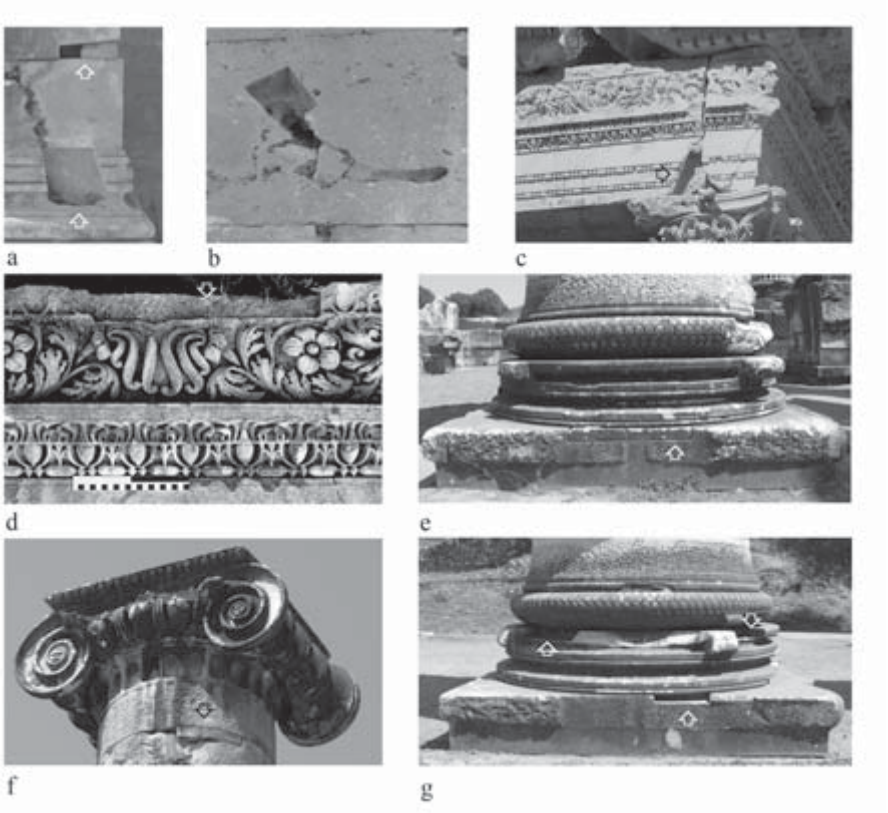


Fig. 13
Type C restoration measure, sub-type C-1. a. b: Patara, Corinthian Temple; c. d: Sagalassos, Antonine Nymphaeum, entablature; e–g: Sardis, *Artemision*, Ionic bases and column shaft

*13*). In these cases the *emblema* varies in size, replacing only a small section of a moulding or a substantial part of the main block. Obviously intended to replace the limestone where it was characterized by small and irregular natural cavities are the *emblemata* used in the ashlars of the Corinthian Temple in Patara[62] (*fig. 13 a. b*).

As in some examples from Hierapolis, the repairs of various architraves from Nysa, Pergamon and Pessinus were in a gravity-defying position and simply secured by glue[63]. In contrast, the tapering shape of the *emblema* used in HSTM118 is echoed by other blocks from Aphrodisias and Perge[64].

A common version of sub-type **C-2** is seen in the so-called »tessellate« columns, in which the replacement parts and their corresponding recesses have matching wavy edges that prevent them from sliding around or rotating. These are sometimes strengthened by dowel-rods or cramps, inserted before and under the replacement parts, thus combining sub-type C-2 with sub-type D-1 or D-2. Few cases of this technique have been identified in other sites in Asia Minor[65] (*fig. 14*

62 For the building, see Işık 1999, 160. 161 fig. 3; Işık 2000, 117–121.

63 Pessinus, frieze-architrave belonging to the arch along the Gallos river, see Devreker – Waelkens 1984, 84 fig. 124. Nysa, Theatre, see Kadıoğlu 2006, 139. 289. 290 no. 492 fig. 89 (the *emblema* was fixed to the bottom of the architrave). Pergamon *Asklepieion*, see above, note 61.

64 Aphrodisias, unedited architrave from the *Temenos* (Doruk 1990, 70 cites the restoration of some blocks). Perge, Theatre, see Öztürk 2009, 192 pl. 19, 5 no. 864, frieze-architrave.

65 Some examples have been identified in Hierapolis, Temple A, and in shafts of the North-South Colonnaded Street in Side; for the monument see Mansel 1963, 17.

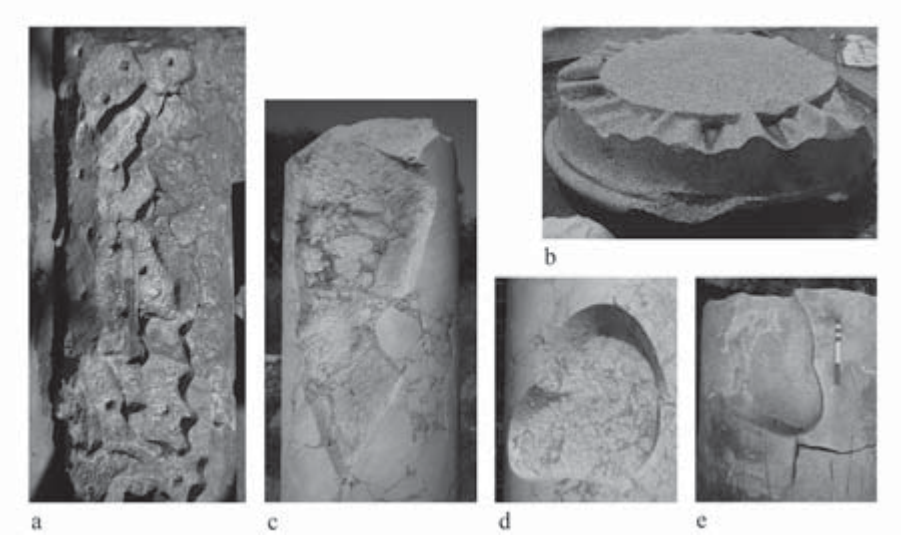


Fig. 14
Type C restoration measure, sub type C-2. a: Ostia, *Africano* column with inserts of *Bigio Africano*; b: Rome, Forum of Trajan, granite column shaft; c. d: Side, North-South Colonnaded Street, column shafts; e. Hierapolis, column shaft of Temple A

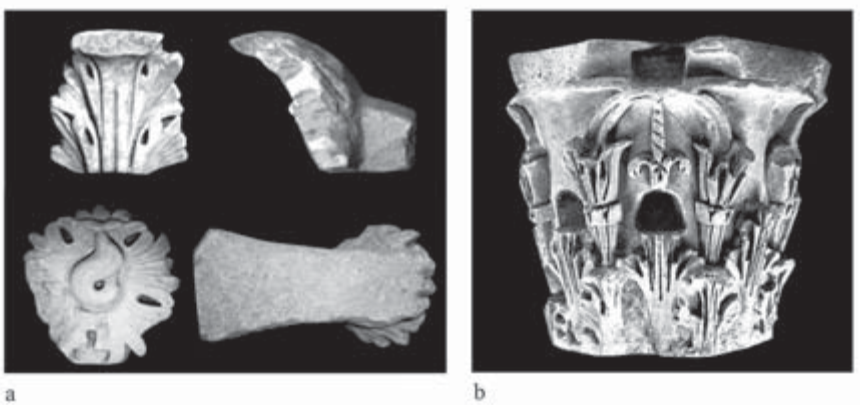


Fig. 15
Type C restoration measure, sub type C-3. a: Italica, *Trajaneum*, replacement parts with tenons for Corinthian capitals; b: Rome, Museo Gregoriano Profano, Corinthian capital

*c–e*), while it has been recognized in columns in Rome and Ostia, suggesting an Italic or even an Urban solution, sometimes exported to the Western cities of the Empire by itinerant Italic workmen[66] (*fig. 14 a. b*).

Sub-type **C-3** entails the use of small tenons to connect protruding *emblemata* to the block. The tenons are quadrangular, trapezoidal or D-shaped, so as to prevent them from rotating within the hollows[67]. As with sub-type C-2, the socket-and-tenon technique is unusual in Asia

[66] Examples from Rome and Ostia are listed by Pensabene 1995, 53. 54 nos. 3–6 figs. 59–64. 66–72; 239. 240 nos. 42. 43. 46 figs. 268–271. 274–279; 249 nos. 48–50 figs. 280–284; De Nuccio – Ungaro 2002, 528. 530 no. 288; 532. 533. 549 nos. 293. 295. 320, the marbles used are *Africano*, *Bigio Africano*, *Alabastro Fiorito*. Examples include granite columns in the Forum of Trajan, Temple of Rome and Venus and Pantheon, see De Nuccio – Ungaro 2002, 549 no. 321; Hoffmann 2007/2008; Hoffmann 2009. In Spain some cases are listed by Rodríguez Gutiérrez 2001 among the columns of the Theatre of Italica.

[67] Bermúdez Cano 2009, 147. 148. 150. 152. 154–156. Quadrangular tenons and opposing concave-convex joints are used in statuary to prevent the elements from rotating, see Claridge 1990, 139. 140.

Minor although it was extensively adopted in the marble workshops of Rome[68], especially to insert the acanthus leaves of Corinthian capitals (*fig. 15*).

*Type D Restoration Measures: Joining of Broken Blocks with Replacement of Damaged Parts and Use of Metal Parts (figs. 16–23)*

***Definition*:** Considering the weight, function and position of the replacement part, the use of specially shaped recesses and binders may be considered insufficient. In this case the join is strengthened with metal elements, which can be classified into various types depending on their shape.

In **D-1** the replacement part is held in place by one or more metal dowel-rods, in general made of iron and normally without a lead coating[69]. In sub-type **D-2**, L-shaped or Π-shaped iron cramps are used. The exposed position of these metal elements led the craftsman to cover them with lead to protect them from oxidation. In both cases the number, dimensions and shape of these rods and cramps may vary, as does the position of the joins, which can be either vertical or horizontal.

***Examples*:** Sub-type **D-1** includes various restorations with vertical joins, in shafts, capitals, architraves, friezes and cornices in Hierapolis[70] (*figs. 16. 17*). In the tympanum of Temple A of the Sanctuary of Apollo (Fr18), the iron dowel-rods are still in place[71] and are only 5–7 mm in diameter (*fig. 18*). The same technique is used with horizontal joins, as in the end of the drip moulding of a cornice in the Marble Portico (HSTM67), clearly to reinforce the hold of the binder that was considered not sufficient[72]. In a column of the Severan Nymphaeum of the Apollo Sanctuary, a large vertical rod prevents the two restored parts from moving around while minor horizontal rods secured the thin external *emblemata* bearing the flutes (*fig. 16 e*).

This restoration technique, common in sculpture[73], is documented in Aphrodisias, Miletos, Magnesia ad Maeandrum and Pergamon[74]. Comparable examples that are geographically closer to Hierapolis are to be found in Laodikeia on the Lycus in the form of leaves with iron dowel-rods that were destined to be inserted in Corinthian capitals, as is demonstrated by a piece from

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68 Examples from Ostia, Villa Adriana and Rome can be found in Bermúdez Cano 2009, 164. 166 notes 8–11. 18–28 pls. 6–8 who highlights that the socket-and-tenon technique was in use between the late Flavian and the Severan periods, among the *marmorarii* working in Roma and occasionally in the western provinces.

69 The use of *emblemata* made of plasters as in the Parthenon (Dinsmoor 1934, 99; Korres 1994, 145; Korres 1997, 207 fig. 7) and in the Temple of Apollo at Delphi (Korres 1997, 207, with wooden and metal rods) is not attested in Asia Minor.

70 Examples are shaft SA39 (Ismaelli 2009, 43. 71. 72 fig. 90), capitals HG17 and HSTM187, architraves HSTM3 (Ismaelli 2009, 140 fig. 156 no. HSTM3=STM52) and HSTM122, frieze HSTM148 and the rain spout of cornice HG95.

71 Of larger dimensions (2 × 3 cm) is the dowel-rod in the front face of the *Konsolengeison* SA159, see Ismaelli 2009, 44. 104 fig. 124.

72 Ismaelli 2009, 140. 158 fig. 156 no. HSTM67=STM81.

73 A chrono-typological sequence of dowel-rods used for sculptures is proposed by Claridge 1990, 147. Examples in Frel 1972, 80. 81 no. 9 figs. 10–12.

74 Aphrodisias, North *Agora*, Ionic capital of the south portico, see Waelkens 1987, pl. 3 no. 6; Smith – Ratté 2000, 235. 236 fig. 15. Miletos, dentils of a cornice in the *Faustinathermen*, see Vandeput 1997a, pl. 97, 2. Magnesia, corner block of altar in the *Artemision*, see Humann 1904, 97 fig. 96. Outside Asia Minor, examples of sub-type D-1 are to be found in the Athenian Erechtheion (Paton – Stevens 1927, 207. 208. 210. 211. 214 figs. 133–137) and in the Doric Temple of Segesta (Mertens 1984, 38 pl. 36, 4–6).

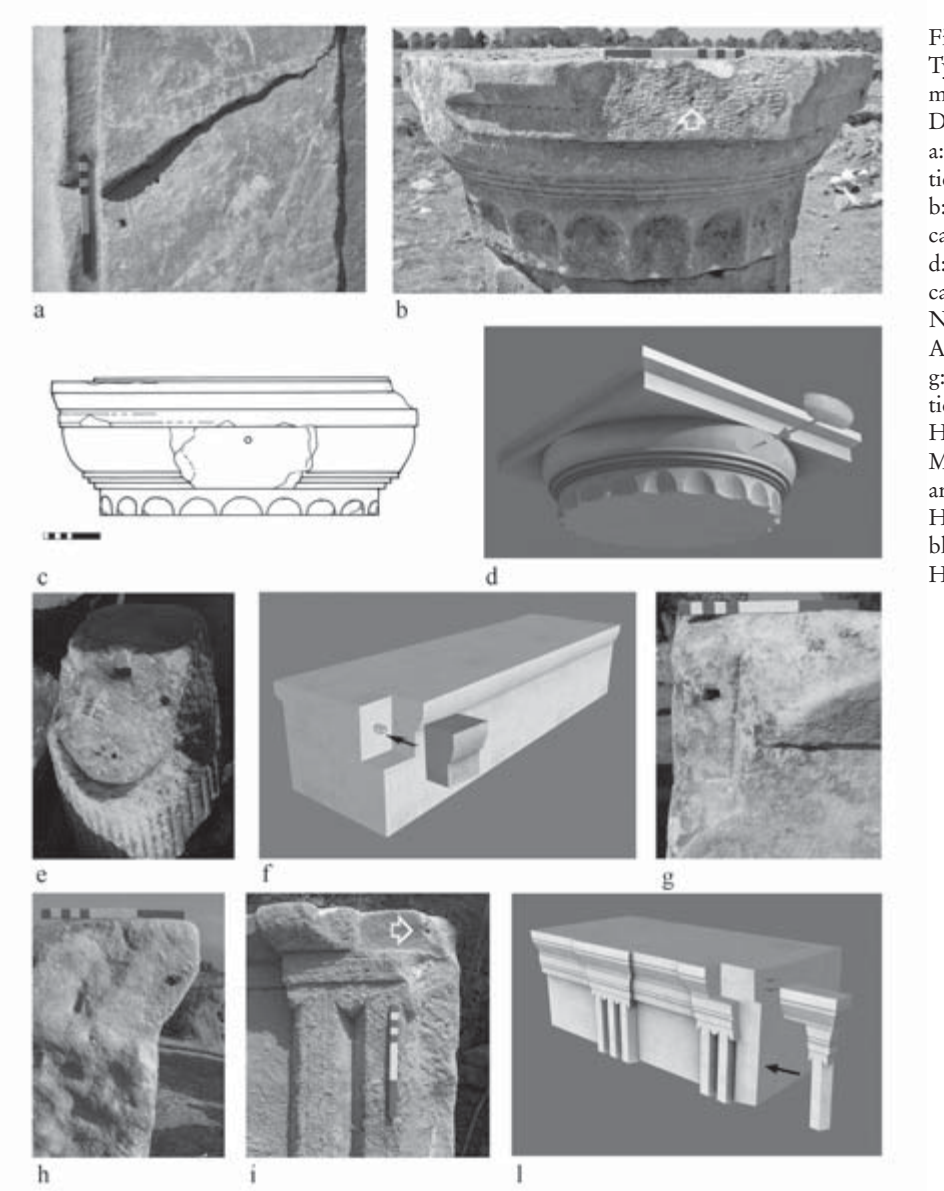


Fig. 16
Type D restoration measure, sub-type D-1 in Hierapolis. a: *Temenos* Portico, drum SA39; b: Gymnasium, capital HG17; c. d: Marble Portico, capital HG187; e: Nymphaeum of Apollo, drum; f. g: Marble Portico, architrave HSTM122; h: Marble Portico, architrave HSTM3; i. l: Marble Portico, frieze HSTM148

Miletos[75] (*fig. 20 c. d*). Particularly accurate are the repairs employing dowel-rods, inserted into the vertical joins of blocks in the Propylon in Labraunda and the Theatre of Nysa: unusually, the rods were supplied with a lead coating, the molten metal being poured in through narrow channels after the blocks were re-laid[76] (*fig. 20 b. e*).

[75] Laodikeia, see Şimşek 2007, 335 fig. 132 a; Miletos, *Delphinion*, Corinthian portico, see Kawerau – Rehm 1914, 145 fig. 30.

[76] Architrave of Propylon in Jeppesen 1955, 26. 27 fig. 18 pl. 10, 7. For the cornices of the Theatre in Nysa see Kadıoğlu 2006, 235. 236 fig. 60 no. 257; 236. 237 no. 261 pl. 22, 1. 2; 239 no. 269 pl. 21, 6.

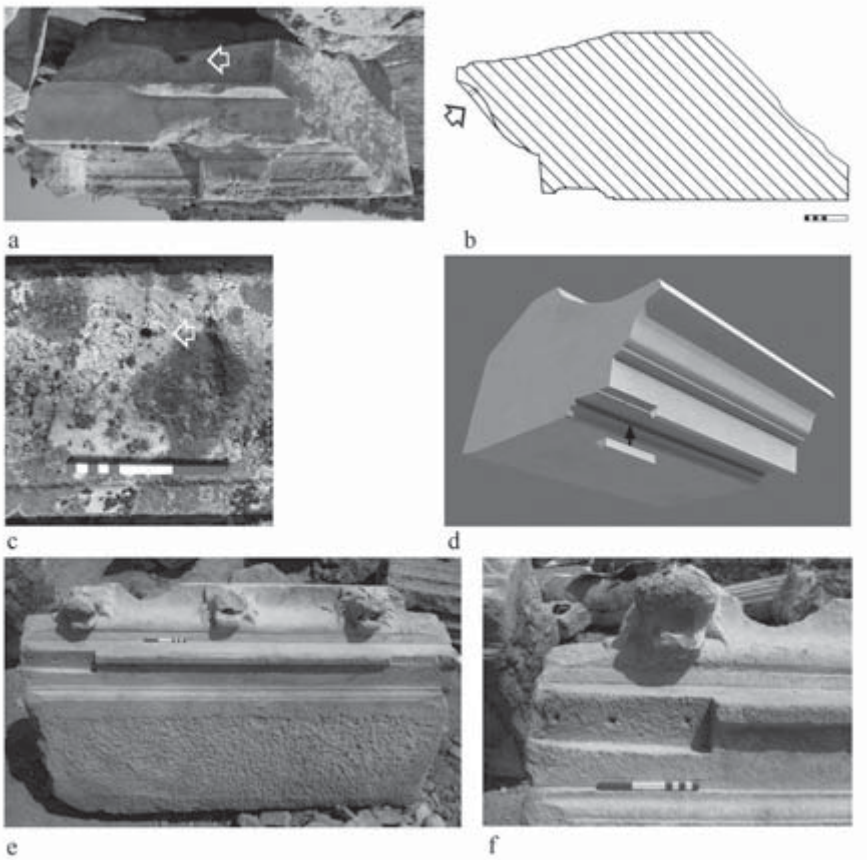


Fig. 17
Type D restoration measure, sub-type D-1 in Hierapolis. a: *Temenos* Portico, cornice SA159; b. c: Gymnasium, cornice HG95; d–f: Marble Portico, cornice HSTM67

Sub-type **D-2** includes restorations of column shafts, capitals, architraves, friezes and cornices[77] (*figs. 19. 21*). In these cases the replacement part rests entirely or partly on a larger block and the iron cramps serve only to prevent horizontal movement. In contrast, in cornice HSTM64 the Π-shaped iron cramps

Fig. 18 Type D restoration measure, sub-type D-1 in Hierapolis. Ranking cornice of Temple A with iron dowel-rods still in place

[77] Column shaft SA37 (Ismaelli 2009, 43. 71 figs. 61. 89), capitals (Campagna 2012, 540 fig. 7, Corinthian capital from Nymphaeum of Tritons), architraves (HG15, HG20, SA83 in Ismaelli 2009, 43. 84 fig. 106), friezes (HSTM111) and cornices (HSTM67, HG42).

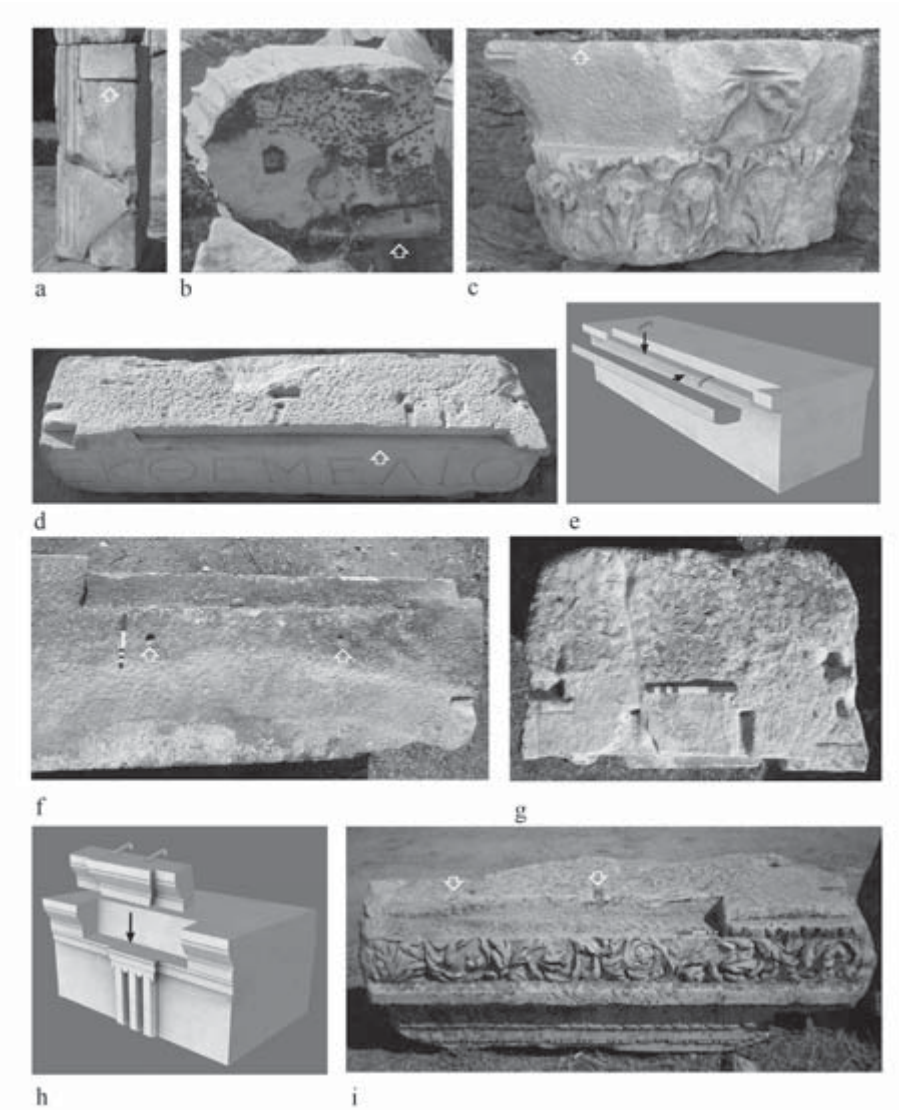

Fig. 19
Type D restoration measure, sub-type D-2 in Hierapolis. a. b: *Temenos* Portico, drum SA37; c: Nymphaeum of Tritons, Corinthian capital; d. e: Gymnasium, architrave HG20; f: Gymnasium, architrave HG15; g. h: Marble Portico, frieze HSTM111; i: Theatre, architrave-frieze of the second storey

supported a replacement part that was completely free and thus also had to be held in place with binders[78] (*fig. 21 c. d*). Both solutions, rods and iron cramps, are found in capital HG47, which has a horizontal join, and in capital HSTM187, which shows a vertical join (*fig. 22*).

An exemplary case of an *emblema*, intended to replace a damaged part, was discovered in Hierapolis belonging to the second order of the *Temonos* portico (SA161). This is the front-facing part of a *sima*, with two false rainspouts, which was held in place by two Π-shaped iron cramps on the upper surface. A modillion of the same portico (SA173) was carved to fill in a gap in a

[78] Cornice SA158 (Ismaelli 2009, 44. 104 fig. 43), only partially visible, may represent a similar case.

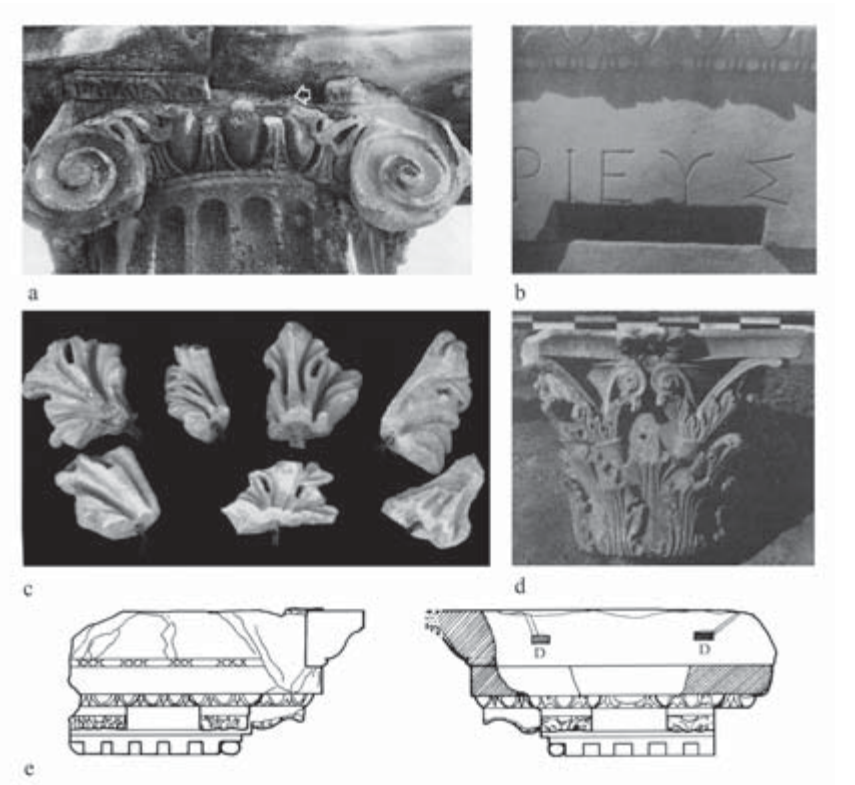

Fig. 20 Type D restoration measure, sub-type D-1. a: Aphrodisias, North *Agora*, Ionic capital of the south portico; b: Labraunda, Sanctuary of Zeus, architrave of the Propylon; c: Laodikeia, leaves for Corinthian capitals; d: Miletos, *Delphinion*, capital of the Corinthian portico; e: Nysa, Theatre, cornice of the first order

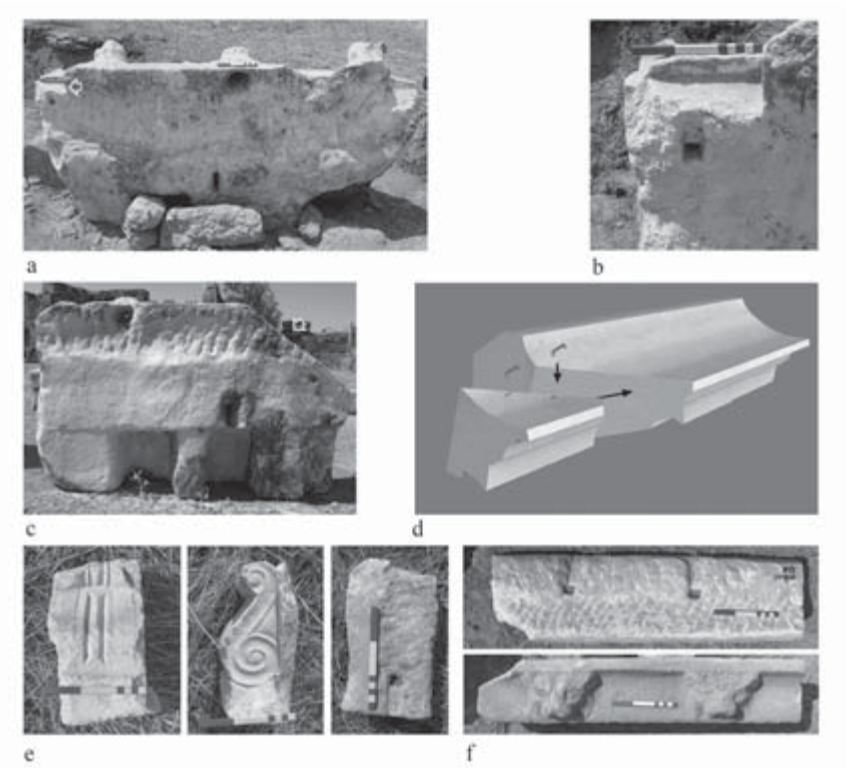

Fig. 21 Type D restoration measure, subtype D-2 in Hierapolis. a. b: Marble Portico, cornice HSTM67; c. d: Marble Portico, cornice HSTM64; e: *Temenos* Portico, *emblema* SA161 for a cornice of the second order; f: *Temenos* Portico, *emblema* SA173 with a modillion for a cornice belonging to the second order

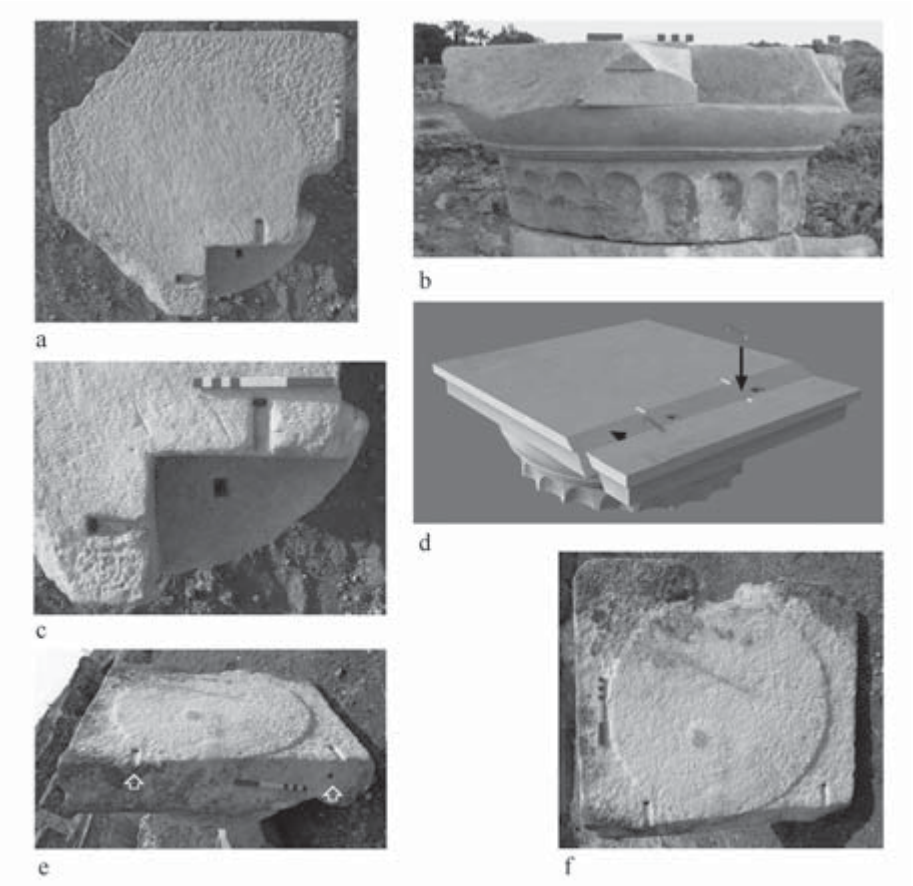


Fig. 22
Type D restoration measure, sub-type D-1 and D-2 in Hierapolis. a–c: Gymnasium, capital HG47; d–f: Marble Portico, capital HSTM187

cornice, being inserted as an *emblema* and fixed both with a binder, perhaps indicated by the yellowish surface patina, and an L-shaped iron cramp[79] (*fig. 21 e. f*).

The use of iron cramps to hold the replacement parts is also widely documented elsewhere in Asia Minor, for example in Aphrodisias, Ephesos, Nysa, Pergamon[80]. Less common is the solution used in the repair of the Doric façade of Blaundos, in which cramps secured an oblong

[79] Ismaelli 2009, 44. 108 fig. 62 no. SA173 (modillion); 44. 105 fig. 125 no. SA161 (*sima*). Further *emblemata* are recorded in Paton – Stevens 1927, 211 fig. 139.

[80] Aphrodisias, *Sebasteion*, Propylon, unedited frieze-architrave with cramp on upper face; for the building see de Chaisemartin 2006. Ephesos, *Arkadiane* (Schneider 1999, 469 pl. 101, 4 no. 92, capital, cramps on upper face), *Hadrianstor* (Thür 1989, 35. 121 figs. 18. 20 pl. 9 no. HT2, pedestal, cramps on visible sides); *Vediusgymnasium* (Steskal 2008, 13 pl. 52, frieze-architrave with cramps on rear and bottom faces); Nysa, Theatre (Kadıoğlu 2006, 139, 203 no. 135, column shaft; 139. 291. fig. 91 pl. 32, 4. 7 no. 494, frieze, cramps on upper mouldings). Pergamon, Dionysos Temple (Bohn 1896, 46 pl. 39; Vandeput 1997a, pl. 102, 2; Köster 2004, pl. 131, 4, doorjamb), Portico of *Trajaneum* (Stiller 1895, 46 fig. p. 45, architrave, cramps on bottom and upper face). In Greece, see the ante architrave of the Temple of Zeus in Olympia (Dinsmoor 1941, 417), the cornice of the Great Temple at Delos (see Courby 1931, 32–34 figs. 43–48; Hellmann 2002, 97 note 64 fig. 62) and many *emblemata* of the Erechtheion (Paton – Stevens 1927, 208 fig. 11 pls. 16–18; 213 fig. 48).

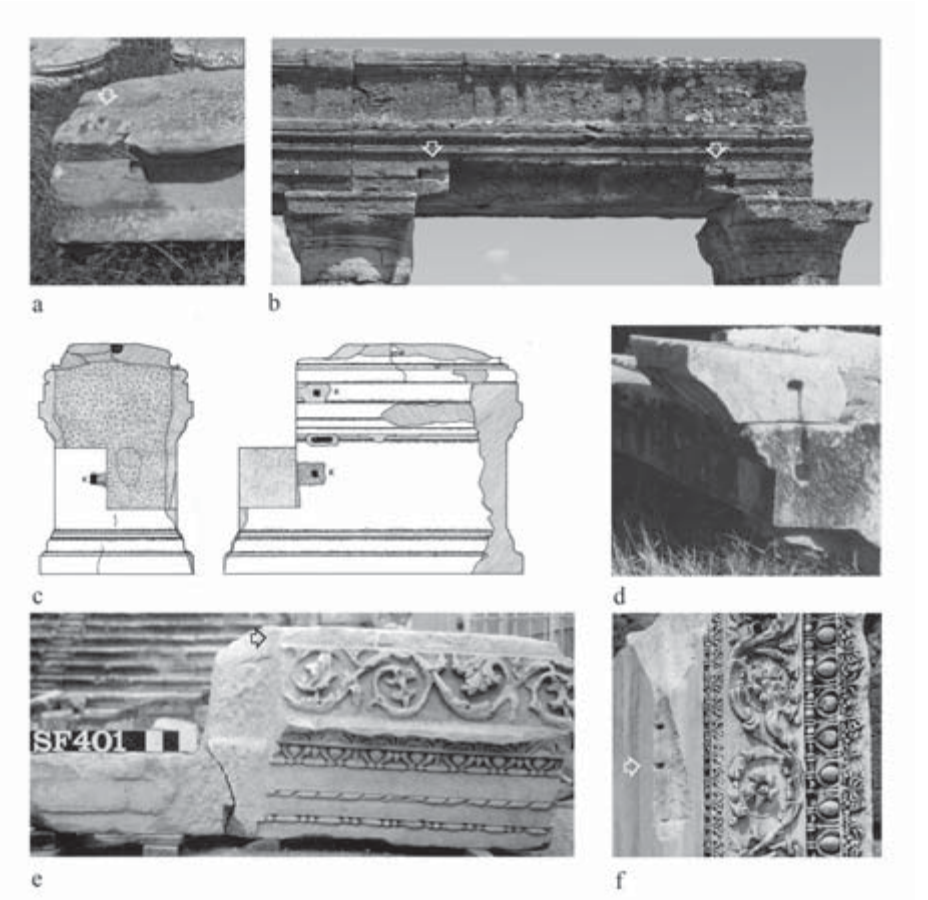


Fig. 23
Type D restoration measure, sub-type D-2. a: Aphrodisias, *Sebasteion*, architrave-frieze of the Propylon; b: Blaundos, architrave-frieze of the Doric façade; c: Ephesos, pedestal of the *Hadrianstor*; d: Nysa, Theatre, cornice of the first order; e: Nysa, Theatre, *Seitenarchitrav* of the second order; f: Pergamon, Temple of Dionysos, doorjamb

replacement part inserted in the middle of the architrave over the intercolumniation[81] (*fig. 23*).

Sub-types D-1 and D-2 are sometimes used together, as in many of the *Konsolengeisa* of the Theatre of Nysa, where the cornice blocks of a *Tabernakel* include a series of *sima* elements that were worked separately and then secured to the cornices by means of dowels and cramps[82].

*Type E Restoration Measures: Recarving of Original Blocks (fig. 24 a)*

***Definition*:** The damaged block is maintained and partially or completely recarved, removing a layer from the previous surface to obtain a new surface or a new moulding, in a way that has often been noted in statuary[83]. In this type of repair, the original function of the architectural element is not altered.

81 Filges 2006, 201 figs. 195. 198.

82 Kadıoğlu 2006, 149. 239. 241–243 nos. 271. 281–284 pls. 22, 6; 23, 1–5; for replacement parts see Kadıoğlu 2006, 245–248 nos. 295–308 pls. 22, 6; 23, 8–10. In Greece, for instance, the Erechtheion, see Paton – Stevens 1927, 210 fig. 138.

83 For example Frel 1972, 74. 75 nos. 2–4; Frel 1994, 47–67.

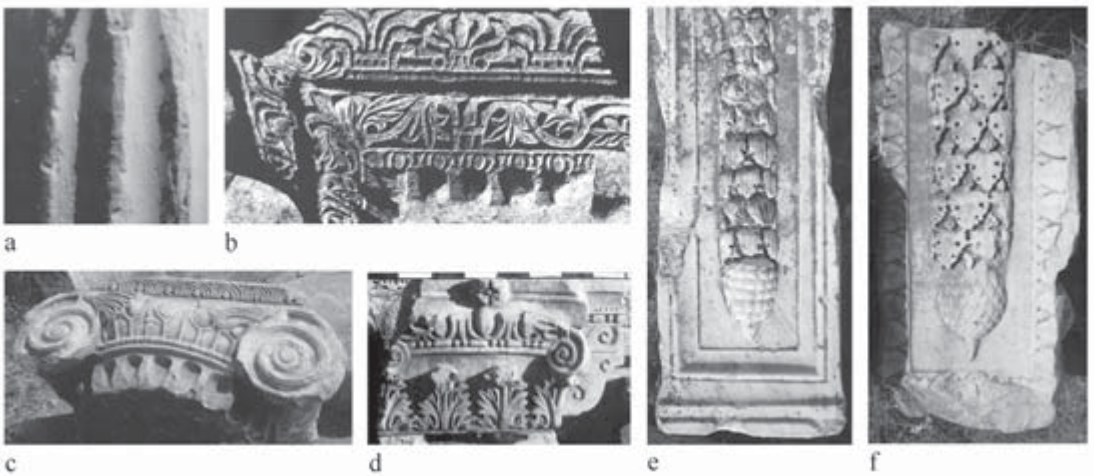


Fig. 24 Type E restoration measure. a: Athens, column of the Ionic temple at Ampelokepoi. Type F restoration measure. b: Laodikeia, Nymphaeum, early Byzantine cornice; c: Aphrodisias, late Roman capital of the Aphrodite temple; d: Miletos, late 2nd or 3rd century capital of the *Markttor*; e: Hierapolis, Theatre, original pillar of Severan age; f: Hierapolis, Theatre, pillar belonging to the mid 4th century restoration

***Examples*:** No certain cases of this type of restoration have yet been identified in Hierapolis, but a specimen can be recognised in nearby Laodikeia, where a frieze-architrave of the Severan Nymphaeum was vertically cut and the mouldings of the previous long sides were extended on the new short face[84]. In Greece, the literature refers to the columns of the Ionic Temple of Ampelokepoi in Athens (*fig. 24 a*) and the columns of the Temple of Ares in the same city, whose flutes were recarved[85].

*Type F Restoration Measures: Replacement of Damaged Blocks with Freshly Executed Materials (fig. 24 b–e)*

***Definition*:** This type of restoration is characterised by the preparation from scratch of new blocks to replace the damaged ones. Obviously, it applies to original architectural elements that can no longer remain in place due to their poor state of conservation. This is the most extensively described type of measure in the literature, partly because it genuinely seems to have been a rather common practice[86], given the low cast of labour and the possibility of reusing older and discarded blocks. However, the phenomenon does appear to have been overestimated, as a result of the specific focus on decorative aspects that characterises the studies of art history. Indeed, it is the style, together with the use of different tools and techniques of execution, that allows this type of restoration to be identified by scholars.

84 See des Gagniers *et al.* 1969, 99. 100 fig. 34 pl. 48, 1.

85 For Ampelokepoi see Korres 1996, 106–108 figs. 25. 26; Korres 1997, 204. In the Temple of Ares, the column shafts were recarved after the transfer of the building to the *Agora*, see Korres 1997, 205.

86 Korres 1997, 203.

***Examples*:** In Hierapolis, restoration by substitution has been recognised in the Theatre, where some elements of the *frons scaenae* of the Severan epoch appear to have been replaced by blocks carved in a later period, plausibly in the middle of the 4th century A. D. under Constantius II, in a completely different style but imitating the original moulding types and sequences[87] (*fig. 24 e. f*).

The more famous examples of restoration by substitution are from Athens and Rome[88] but other specimens are found in Asia Minor among the blocks of the *Aphrodision* at Aphrodisias, the Hadrianic Gate in Ephesos, the *Markttor* of Miletos, the Nymphaeum of Laodikeia, the Theatre of Perge and the Baths-Gymnasium in Sardis (*fig. 24 b–d*)[89].

## Looking for Ancient Restorations

The examples described above refer to measures limited to individual blocks but obviously these repairs were often part of ambitious restoration programmes that entailed the more or less extensive reconstruction of the original monuments. Dismantling and subsequent reconstruction are performed when there is a need to replace many damaged blocks or parts that are no longer saveable, or when it is necessary to work on the structure's foundations.

These large-scale restoration measures are sometimes mentioned in the inscriptions[90], as in the case of the Theatre in Hierapolis, which was subject to significant restoration during the reign of Constantius II (337–361 A. D.)[91]. The inscription carved on the architrave of the second order of the *scaenae frons* records the consolidation and restoration of the building that was carried out between 350 and 352 A. D., with financial contributions from local donors. Associated with this restoration are the markings discovered on the blocks of the *scaenae frons* that helped ensure they were put back in the correct position when they were reassembled (*fig. 9 n*). On this occasion, various architectural elements that could not be repositioned were replaced with new pieces, imitating those that were part of the original construction phase, as noted above[92] (*fig. 24 e. f*).

Apart from cases that are mentioned in epigraphical documents, we are obliged to rely on archaeological evidence and the examination of details for recognising the presence and the extent of ancient reconstruction. In this process, the various types of restoration measure de-

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87 Milella 1996, 70 fig. 10; Pensabene 2007, 292–294 figs. 116–123.

88 In Athens, examples include Buildings E, F and I (Korres 1997, 204. 205), the Erechtheion and the altar of Athena on the Acropolis (Korres 1997, 207); in Olympia, the *sima* blocks of the Temple of Zeus (Dinsmoor 1941, 402 fig. 2; Willemsen 1959, 42–124; Korres 1997, 207; Hellmann 2002); other examples in Hellmann 2002, 98. 99. In Rome, the Temple of Saturnus (Pensabene 1984, 53, 93. 94. 98 figs. 48. 52. 55 nos. 23. 25. 27–29).

89 Aphrodisias, Temple of Aphrodite, Ionic capital (Theodorescu 1990, 64 fig. 7 no. 20, 2nd century A. D. or later); Ephesos, Hadrianic Gate (Thür 1989, 36. 37. 122 pl. 14 no. H7, column shaft; 123 figs. 96–98 pl. 44 no. HT44 pedestal); Laodikeia, Nymphaeum, Ionic capitals (des Gagniers *et al.* 1969, 76. 135 pls. 35, 2–4; 36, 1 nos. 1628. 1628bis. 564+985, first half 5th cent. A. D.); Ionic cornices (des Gagniers *et al.* 1969, 108–110 fig. 43 pls. 55, 3; 56, 1–4 nos. 643. 648. 1739; Milella 1996, 71. 72 figs. 11. 13), *Konsolengeisa* (des Gagniers *et al.* 1969, 113. 114 pls. 59, 4; 60, 1 nos. 1743B. 1790bis); Miletos, *Markttor* (Knackfuss 1924, 152 figs. 167–169; Strocka 1981, 22 fig. 61, Severan; Maischberger 2009, 117 figs. 17. 18, Antonine or Severan date), Perge, Theatre, ranking cornices (Öztürk 2009, 93. 155 nos. 325–328, A. D. 450/475–525); Sardis, Ionic capital of south-eastern corner of the palaestra (Yegül 1974, figs. 4–15; Yegül 1986, 35. 36 figs. 61–63, second half of 5th century A. D.).

90 See above notes 4. 15. 17.

91 Ritti 2006, 124–126; Ritti 2007, 415–417.

92 For the markings, see Ritti 2006, 124. 125; for other repairs, see above.

Fig. 25
Markings of different series on the column shaft. a: Marble Portico, drum HSTM140; b: Gymnasium, drum HG38

scribed above constitute the main clues, but further evidence is provided by the mason's marks, the sockets for dowel-rods and cramps and the shape, position and number of the lewis holes[93].

*Markings Used in Positioning the Blocks (figs. 25–27)*

Mason's marks are alphabetic letters that are used to indicate the position of the blocks with respect to each other in a sequence. Many variables have been detected in the logic used for this lettering[94], but the notion that these letters do not belong to the original construction phase is rarely discussed. In fact, in many cases, these markings were carved in the context of restorations, when it was important to record the correct position of individual elements, apparently very similar to each other but actually unique and not interchangeable. Indeed, the chronological difference between the style of the architectural materials and the *ductus* of the markings indicates that the latter do not belong to the original phase of construction[95].

One form of evidence that the markings used in positioning the blocks should be attributed to ancient restorations is the presence of letters belonging to distinct sequences on the same block, for example on some columns of the Marble Portico and the Gymnasium in Hierapolis (*fig. 25*)[96]. In other cases, evidence that the markings were used in restorations is provided by their position, carved on exposed faces that were already finished, as in some very clear examples found on architraves, friezes and cornices in the Marble Portico[97] (*fig. 26 a. b*).

An interesting case is that of the markings carved on the visible parts of the columns, on the smooth portion of the lower part of the shaft and along the flutes. Since we know that the flutes

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93 Further evidence is the repeated series of pry-holes, see Thür 1989, 122 pl. 17 no. HT9.

94 See Martin 1965, 221–231; Orlandos 1968, 84–87; Guarducci 1974, 381–389; Herrmann 1991; Hellmann 2002, 88. 90.

95 Erechtheion, see Paton – Stevens 1927, 186 fig. 11; Metapontum, Theatre seats, see Magnolo 1995. Marking letters of the Roman period can also be found in the so-called itinerant temples (recent discussion in Hellmann 2009, 278–282), dismantled and transferred to Athens during the imperial period (such as the temple of Ares in the *Agora*, see Dinsmoor 1940, 2. 42. 49 fig. 1; McAllister 1959, 47–54), or in the Ionic Temple rebuilt in Thessaloniki (see Tasia *et al.* 2000; Karadedos 2006).

96 Marble Portico, block no. HSTM140 (O+E); Gymnasium, blocks HG10+HG28 (KϘ+N+BΘ), HG11 (KZ+A), HG8 (E+KZ), HG37 (ΛA+ΛC+EI ?), HG38 (KΘ+Z).

97 Ismaelli 2009, 136 fig. 152.

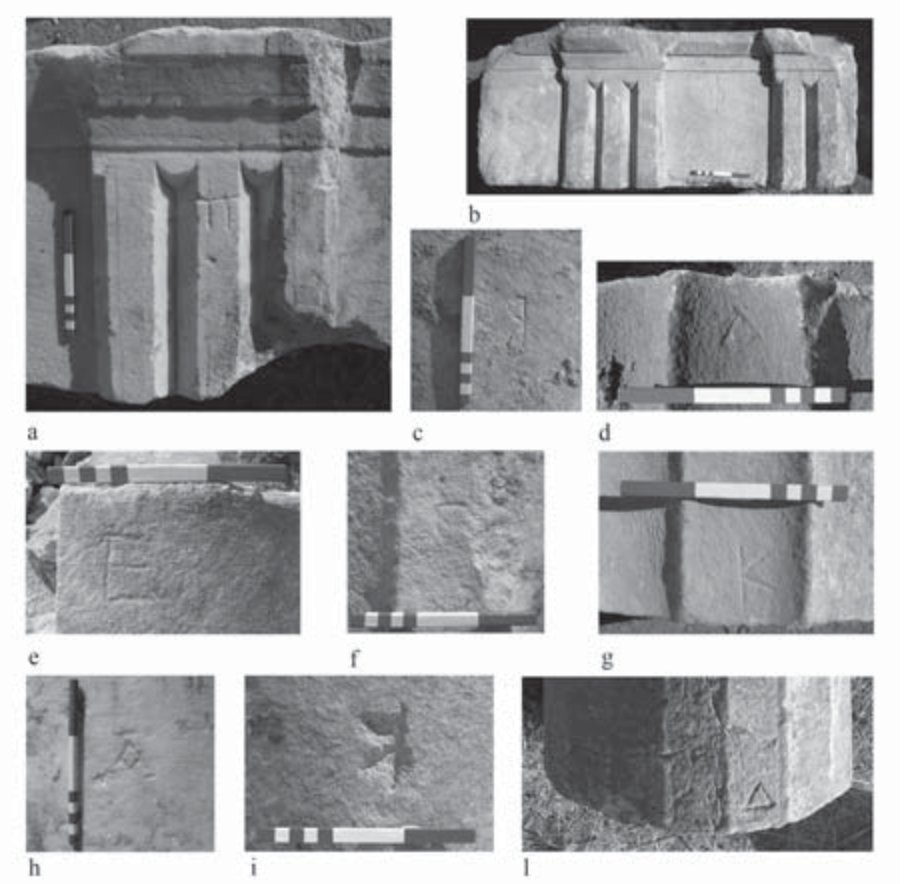


Fig. 26
Markings carved on exposed faces in order to facilitate reconstruction. a: Marble Portico, frieze HSTM62; b: Marble Portico, frieze HSTM148; c: Marble Portico, drum HSTM15; d: Marble Portico, drum HSTM7; e: Marble Portico, drum HSTM189; f: Marble Portico, drum HSTM117; g: Marble Portico, drum HSTM181; h: Gymnasium, drum HG39; i: Gymnasium, drum HG36; l: Teos, Sanctuary of Dionysus, column of the Doric portico

were carved only after the drums and the capital had been assembled, the markings inside the flutes cannot belong to the original phase of construction but must have been engraved on the occasion of some dismantling, in order to facilitate the subsequent reconstruction. Examples of this are seen on some columns of the Gymnasium and Marble Portico of Hierapolis[98] (*fig. 26 c–i*). Similar examples in Asia Minor can be found in the so-called *Prophethaus* in Didyma[99] and in the Doric portico enclosing the sanctuary of Dionysus in Teos[100], which is known to have undergone extensive restoration in the early imperial epoch (*fig. 26* l). Specifically, two drums of the Marble Portico in Hierapolis (HSTM113 and HSTM114) constitute an interesting case, in which the mason's marks used during the restoration, namely a *theta*, are carved both on the upper contact surfaces of the blocks and the external face, showing not only that the drums belonged to the same column but also indicating the angle of rotation necessary to line up the holes for the internal dowel-rods (*fig. 27*).

98 See Gymnasium, HG35 (A), HG36 (K), HG39 (A) and Marble Portico, HSTM10 (A), HSTM15 (B), HSTM7 (Δ), HSTM189 (E), HSTM117 (H) and HSTM181 (K).

99 Knackfuss 1941, 150.

100 Uz 1986, 230 fig. 16; also Uz 1990, 53.

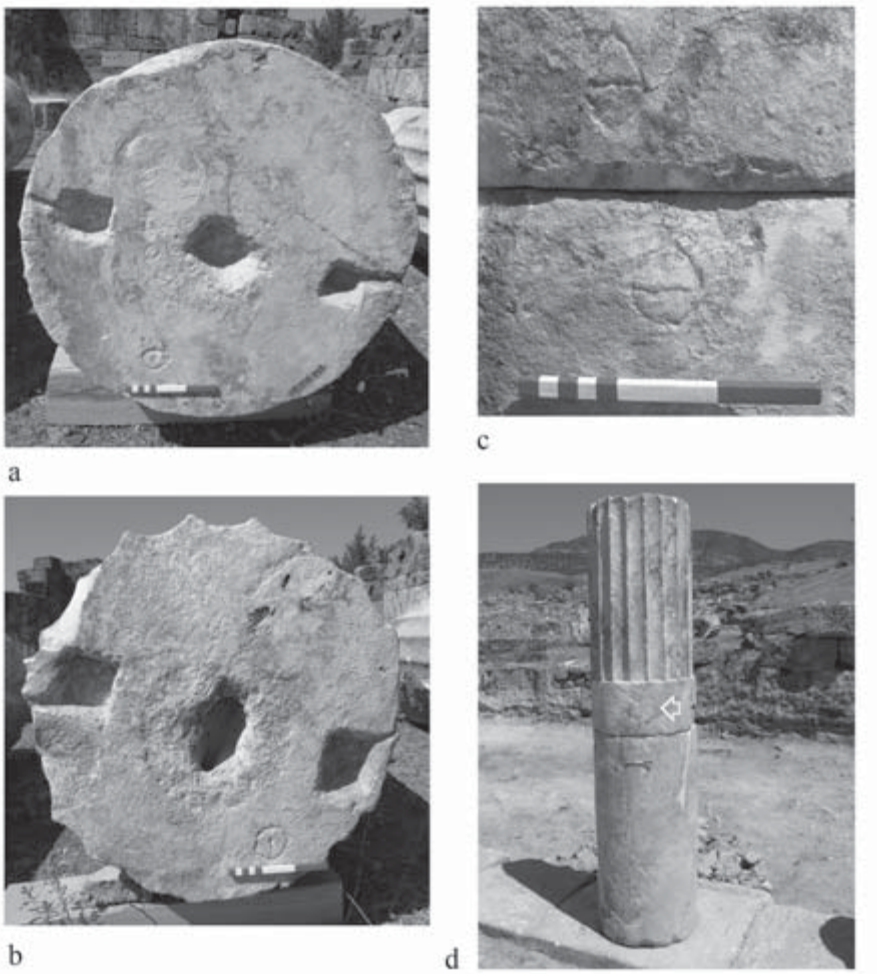


Fig. 27
Markings carved both on the two upper surfaces of the drums HSTM113+ HSTM114 (a. b) and the external face (c. d) in order to indicate the angle of rotation necessary to line up the holes for the internal dowel-rod

*Repeated Sockets for Iron Dowel-rods and Cramps (figs. 28. 29)*

Dowel rods and iron cramps are metal elements that increase the solidity of construction[101]; the presence of a higher number of recesses than is usually the case for the specific type of block may suggest the occurrence of reconstruction. Thus for example, the presence of additional recesses in pieces from the Gymnasium, the Marble Portico and *Temenos* Portico, with more than one cramp on the short side of the frieze and architrave, or more than two dowel-rods in the column drums and capitals, is attributed to the dismantling and reassembly of the pieces in a period subsequent to the original construction (*fig. 28*)[102]. Further evidence is provided by the enlargement of the cramp and rod recesses, to permit the careful extraction of the metal

101 Orlandos 1968, 99–122.

102 Ismaelli 2009, 140. Similar case in the Hadrianic Gate of Ephesos (Thür 1989, 122 pls. 21. 22 nos. HT40-42-89, HT45; 122 fig. 52 pl. 24 no. HT17; 122. 123 fig. 78 pl. 34 no. HT33) and in the *Vediusgymnasium* (Steskal 2008, 23 pl. 76, 7, altar in *Marmorsaal*).

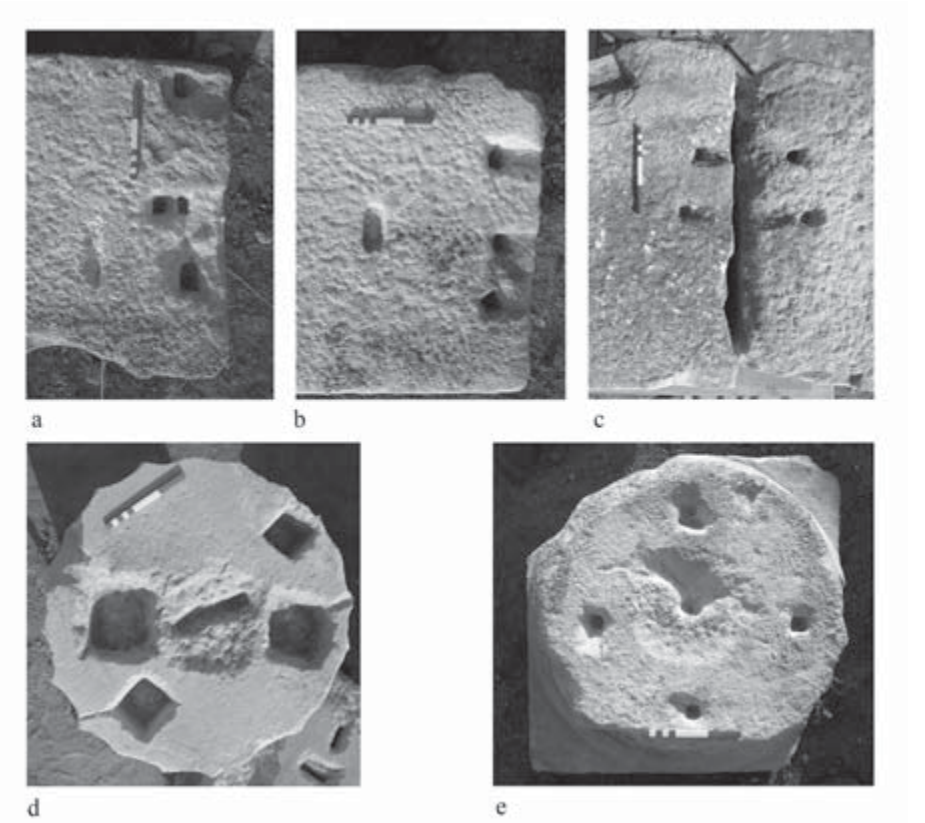


Fig. 28
Repeated sockets for dowel-rods and cramps, attributed to the dismantling and reassembly of the architectural blocks. a: Marble Portico, architrave HSTM61; b: Marble Portico, architrave HSTM81; c: Gymnasium, architraves HG13+HG15; d: Gymnasium, drum HG22; e: Gymnasium, capital HG123

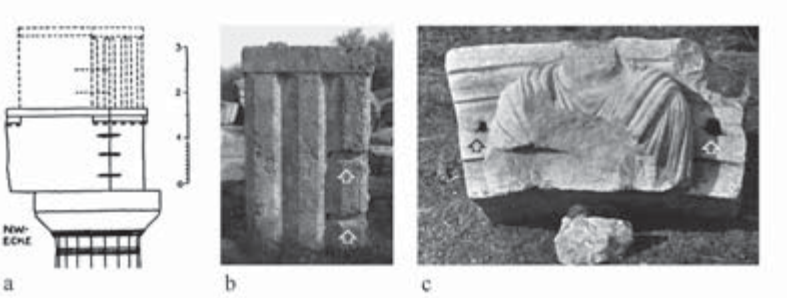


Fig. 29 Cramps strengthening the original join between two contiguous blocks. a: Olympia, Temple of Zeus, north-western corner; b: Olympia, Temple of Zeus, triglyphs of the south-western corner, c: Ephesos, *Nördlicher Torbau*, key-wedge of the arch

elements and their new positioning[103], or by the different shape of the metal elements used in the later reconstruction[104].

In this framework, we may also cite the cases of cramps used in non-conventional positions, as in the frieze and architrave in the north-western corner of the Temple of Zeus in Olympia, discussed by W. B. Dinsmoor[105]. Here, the metal elements were fixed horizontally on the visible face, also chiselling part of the triglyphs (*fig. 29 a. b*). The cramps strengthen the original join

103 For the Temple of Ares, see Dinsmoor 1940, 49. For the *Temenos* Portico in Hierapolis, see Ismaelli 2009, 43 fig. 59 (SA18).

104 Erechtheion, see Paton – Stevens 1927, 196. 199.

105 Dörpfeld 1892, 5 pl. 13 fig. 3b and pl. 16; Dinsmoor 1941, 404. 405. 409 figs. 4. 7; Korres 1997, 207.

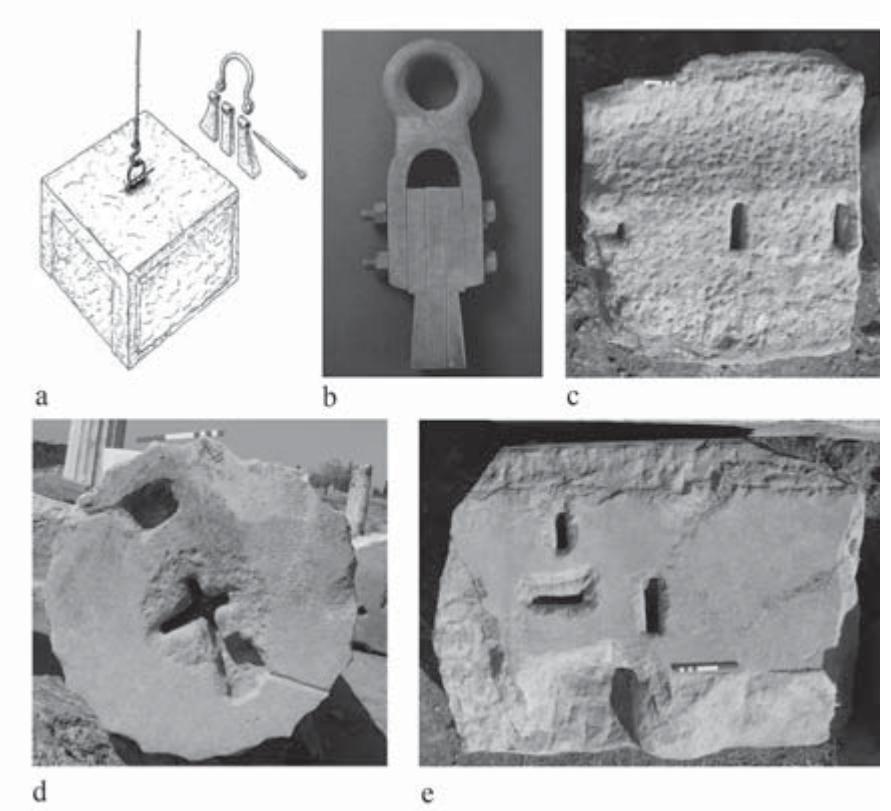


Fig. 30
Repeated lewis holes on the blocks indicating restoration activities. a: the Roman-period lewis system; b: small-size lewis in Museo della Cività Romana; c: Gymnasium, cornice HG42 with two lewis holes; d: Gymnasium, overlapping lewis holes of the drum HG27; e: Gymnasium, cornice HG19 showing three recesses on the upper surface but only one associated with the block in its current dimensions

between two contiguous blocks that were considered critical for the statics of the construction; therefore they cannot be listed as **A-2** or **D-2** restoration measures, because the join was not produced by the splitting of a single element nor by the reworking of the fracture to host an *emblema*. An example of this expedient in Asia Minor is seen in a keystone of the Ephesian *nördlicher Torbau* with two cramps inserted to ensure better cohesion of the wedges forming the arch[106] (*fig. 29 c*).

### *Repeated Lewis Holes (fig. 30)*

As is well known, in ancient times various systems were used for lifting architectural blocks. Some, such as the simple harness with ropes, leave no trace on the blocks. In contrast, lifting by lewis is easily recognisable. In the Roman-era system, the lewis consists of three iron pieces (or legs) with eye-holes at the top. The outer legs are thinner at the top, flaring towards the bottom to match the trapezoidal profile of the hole carved in the block[107] (*fig. 30 a. b*). There may be more than one lewis hole on the same element, often because the block has been moved twice

106 Wilberg *et al.* 1923, 217 figs. 221. 223.

107 Orlandos 1968, 96–98; Martin 1965, 216–219; Coulton 1974, 7. 8. 16 (for the origin); Ginouvès – Martin 1985, 122. 123; Hueber 1989, 220–225; Hellmann 2002, 88; Aylward 2009. Well preserved specimens are described in De Nuccio – Ungaro 2002, 513 no. 263 and Aylward 2009, 310–311 fig. 1.

or more times on the building site and even in the quarry[108]. There are however circumstances in which the lewis holes are a sure sign of restoration activities.

Of the blocks in Hierapolis, various column drums and cornices have more than one lewis hole on their upper surfaces. In some cases these are clearly due to successive dismantlings and reassemblies. For example a cornice in the Gymnasium (HG19) shows three recesses on the upper surface but only one can be associated with the block in its current dimensions while the other two, closer to one of the sides and thus not above its centre of mass, are from an older phase, when the element must have been of greater length. It is therefore possible that the cornice has undergone at least three successive movements and was broken at some point before the last reconstruction[109] (*fig. 30 e*).

Further evidence for reconstruction is the presence of lewis holes with different shapes and dimensions. A special case is seen in the Temple of Zeus in Olympia: the classical-era building site (about 471–456 B.C.) used only ropes, but on various blocks, especially those of the east and west short sides, W. Dörpfeld and W. B. Dinsmoor noted the presence of lewis holes in column drums, capitals, friezes, architraves and elements of the horizontal and ranking cornices. These were quite rightly attributed to a large-scale restoration of the building, which entailed the removal and reassembly of various pieces using different technology from the original construction, since the bosses that were used in the 5th century B.C. to lift them were no longer present and usable[110].

## The Example of the Gymnasium

The Gymnasium of Hierapolis, of which architectural elements have already been cited, contains many examples of the restoration techniques used in Asia Minor during the imperial age. In addition, due to the subsequent reconstructions performed on the structure up until its definitive destruction, the monument allows for a diachronic study, supported by a clear stratigraphic sequence. The analysis of the individual architectural blocks in their archaeological context complements the previously described typological approach, enabling us to get a clear picture of the historically determined sensitivities which guided successive restoration measures between the 1st and 7th centuries A.D., against the backdrop of the social and economic evolution of Hierapolis.

On the southern edge of the city, the building is composed of a vast peristyle courtyard, at least 80 m long, around which there are believed to have been rooms for reading, recitations and musical performances. Of the portico, much of the southern side has been excavated[111]. This is characterised by a Doric colonnade, 4.40 m high, a frieze with flat metopes and cornices with rain spouts terminating in human or lion heads. The early phase of the structure dates back to the Julio-Claudian era, about the middle of the 1st century A.D., as may be deduced from a stylistic analysis of the mouldings of the portico (*fig. 31*).

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108 Aphrodisias, *Sebasteion*, see Smith 1987, 101. 102. 107. 113. 115. 117. 120 fig. 4 and Rose 2003, 44 fig. 12; Aylward 2005, 161 note 179. Pergamon, *Asklepieion*, see Ziegneaus – De Luca 1975, 14 pl. 89, *Eckgesims* of the Ionic Temple.

109 Further examples can be found in Ismaelli 2009, 43. 99 no. SA135. See von Gerkan 1921, 27 fig. 30 for a broken and restored cornice from the Hellenistic *Stadiontor* of Miletos.

110 Dörpfeld 1892, 8. 18 fig. 2; 5 pl. 13 fig. 2 c; Dinsmoor 1941, 405–415 figs. 5–8. 10. 11. The use of lewis in the Temple of Nemesis at Rhamnous indicates restoration, see Miles 1989, 181. 200.

111 D'Andria 2009, 399. 400; Ismaelli 2009, 165–169; D'Andria 2010, 222. 223; D'Andria 2011, 81. 82.

Fig. 31 Hierapolis, Gymnasium, the south colonnade of the palaestra after the recent anastylosis (2010)

The building, which was the object of excavations between 2007 and 2010, was discovered in a collapsed state: the ceramic materials indicate that the colonnade was destroyed by the earthquake of the second half of the 7th century A.D., archaeologically attested in other points of the city[112] (*fig. 32*).

As previously mentioned, between the 1st and 7th centuries A.D. the building underwent various restoration measures. It is not easy to determine the relative and absolute chronology of these repairs. Two macro-groups of activities can however be recognised: those of the Roman imperial age (1st century – mid 4th century A.D.) and those of the early Byzantine period, subsequent to the disastrous earthquake that took place in the second half of the 4th century A.D.[113].

### *Restorations of the Imperial Age*

To the imperial age may be dated numerous restoration measures recognisable on the blocks of the Doric south colonnade of the palaestra:

1 Firstly we should mention all those measures that entailed the partial substitution of the damaged mouldings, as illustrated above.

2 The numerous recesses for dowel-rods recognisable on the blocks of the stylobate should be attributed to reconstructions carried out before the 4th century A.D. These indicate that the lower parts of the column shafts were removed and restored to their positions many times before the final reconstruction, often moving the columns just a few centimetres. In some cases, it has even been possible to recognise a sequence of three successive reassemblies on a single block of the stylobate (*fig. 33*).

112 Arthur 2002, 218; Arthur 2006, 33. 34.

113 Guidoboni *et al.* 1994, 254. 255; Arthur 2006, 33.

Fig. 32 Hierapolis, Gymnasium, the blocks of the south colonnade found in a collapsed position after the earthquake of the second half of the 7th century A. D. (2007)

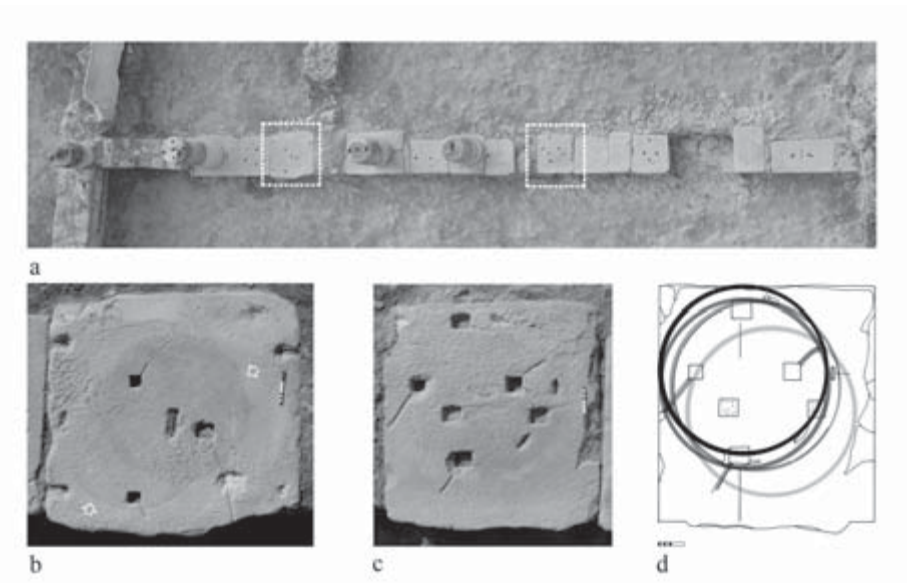


Fig. 33 Numerous recesses for dowel-rods recognisable on the blocks of the stylobate, attributed to reconstructions carried out before the 4th century A. D. a: aerial view of the stylobate; b: stylobate block HG52; c. d: stylobate block HG58 showing multiple and overlapping traces of the column positions

3 Also to the imperial age are attributed the assembly markings on the drums of the colonnade, consisting of a double series of letters: BΘ, KϹ, KZ, KΘ, ΛA etc. Given the large number of columns in the huge courtyard of the peristyle, it is assumed that they proceeded section by section, which was indicated by the first letter while the second specified the individual column. On the basis of the *ductus*, particularly regarding the squared Ϲ[114], this sequence can

[114] The shape can be compared to the squared *sigma* on the Severan base of the statue of Apollo Kareios from the Theatre, see Ritti 2006, 172. 173 fig. 71; see also Tod 1979, 135 on IG II², no. 3620, l. 17, from the Acropolis, dated to 177–180 A. D.

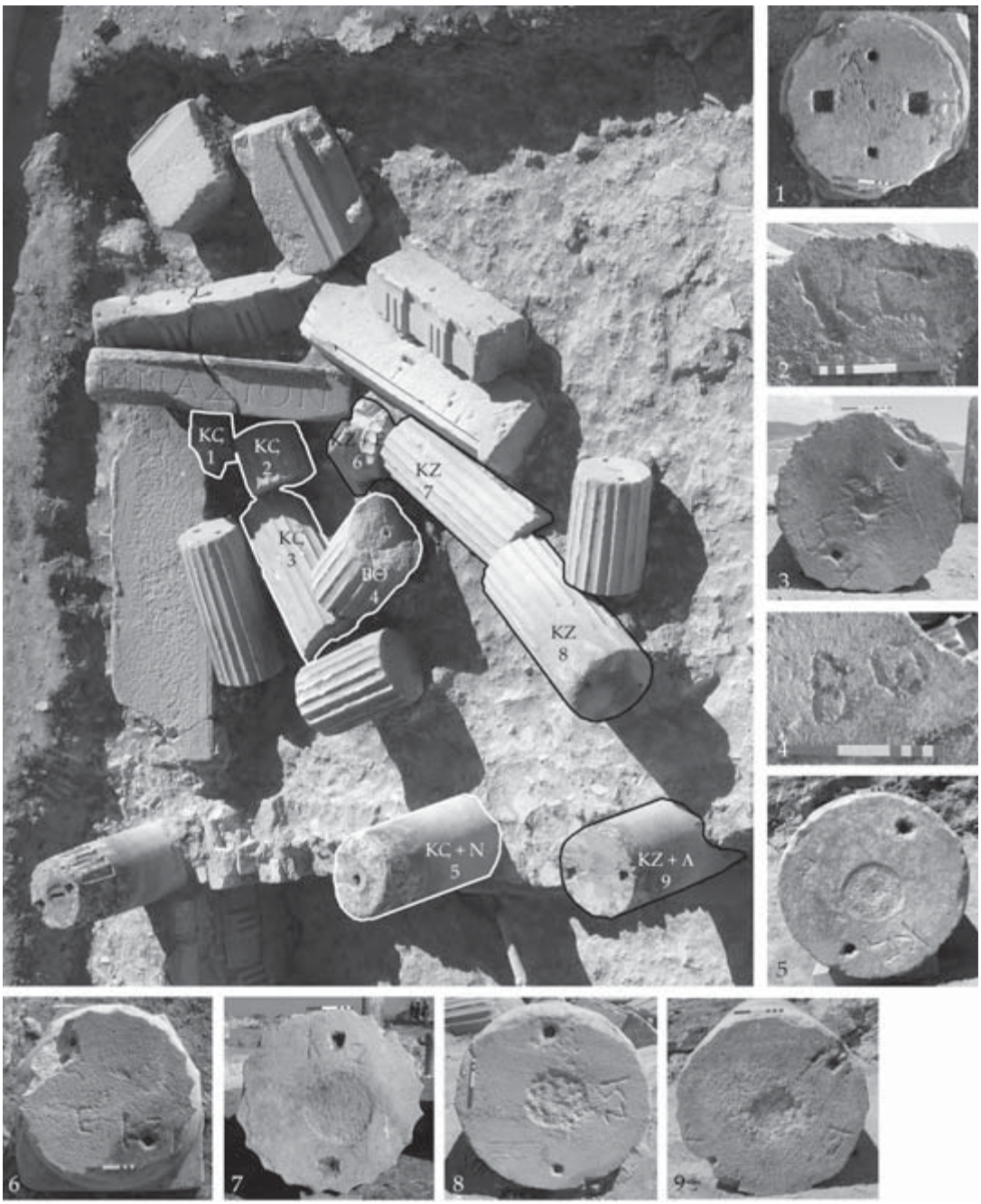


Fig. 34 Hierapolis, Gymnasium, Roman-period marking letters on the columns of the south portico

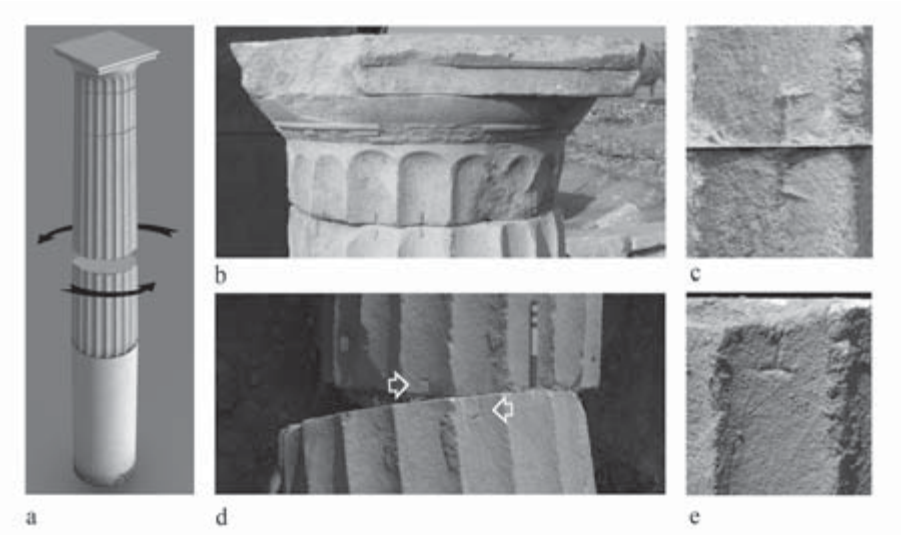


Fig. 35
Hierapolis, Gymnasium. a: short lines carved in the flutes of the columns to set the drums in the correct position in terms of their rotation; b: capital HG8; c: drums HG24+HG27; d: drums HG6+HG22; e: drum HG27L

be attributed to a restoration performed between the second half of the 2nd and the 3rd century A. D.[115] (*fig. 34*).

4 The most significant expedient introduced in one of the imperial-age restorations was an ingenious system for setting the drums of the columns in their correct position in terms of their rotation. Indeed, at the moment of the excavation, short lines carved in the flutes near the top and bottom of each drum were recognised. These incisions consist of simple vertical or L- or T-shaped lines (*fig. 35*). In each column these run in sequence, drum by drum, along the same flute. Whereas the letters used in positioning the blocks clearly explained to the site foreman the relationship between the various blocks once dismantled, these lines showed the workers performing the reconstruction how to rotate the drums so as to match up both the recesses for the rods on the contact surfaces and the vertical flutes, which – despite the attentive craftsmanship – were never of exactly the same dimensions[116].

Briefly, it may be noted how the restorations of the imperial age were distinguished by their great care and precision in cutting the damaged blocks, inserting the metal parts, and attempting to replicate the original order and sequences of the blocks. It is clear that the restoration aimed to provide a faithful restitution of the image of the monument and sought a reaffirmation of the original aesthetic and cultural values[117]. On a structural level too, there appear to have been no changes, with the same technical expedients and static methods as before.

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115 An earthquake during the reign of Antoninus Pius is cited by Oracula Sibillina 3, 470–473.

116 This expedient does not belong to the Byzantine phase because it was also used in some drums of the Marble Portico (HSTM141), a building destroyed and abandoned after the earthquake of the 4th cent. A. D., see Ismaelli 2012, 393–397.

117 The same conclusions were expressed by Cagiano de Azevedo 1952, 60, after examination of the restorations described by the literary sources. In the Roman repairs to the Acropolis, Korres 1997, 199 highlights the accuracy of the restoration, imitating the extraordinary quality of the original blocks.

Fig. 36
Hierapolis, Gymnasium, the Byzantine foundations of the portico made of blocks of varying dimensions, reused materials and layers of bricks

*Restorations of the Byzantine Era*

Following the disastrous earthquake of the second half of the 4th century, the southern area of the city of Hierapolis underwent a profound transformation, in which the building of the Theodosian-era city walls played a key role[118]. Indeed, the construction of the fortifications entailed the dismantling of many nearby buildings, including part of the Gymnasium. Since the route of the walls cut across the western end of the peristyle, parts of the building could thus be transformed into new construction materials. In contrast, the eastern section of the south side of the Gymnasium was spared and, in an operation that must have entailed no small expense, was completely rebuilt. The function of this new structure, within which various rooms were built in the area of the ambulacrum of the portico, is not clear, but the educational and training purposes were hardly maintained.

The Byzantine restoration entailed the complete removal of all the blocks, even those which would have still been in place, such as the stylobate of the colonnade. The movement of the seismic fault caused some subsidence, which seems to have brought about not only the collapse of the building but also the partial sinking of the structure, a phenomenon described by Pausanias for the most destructive earthquakes[119]. To restore the original height, new foundations

[118] For the city wall, see D'Andria 2003, 115. 116; Arthur 2006, 129–131; Scardozzi 2007, 119–122; Scardozzi 2008, 40. 42.

[119] Paus. 7, 24, 11 κατὰ ταὐτὰ οὖν καὶ τὸν σεισμὸν εἴτ' εὐθὺ ὑποδύεσθαι τῶν οἰκοδομημάτων καὶ θεμέλια ἀναπάλλειν φασὶν αὐτόν, καθότι καὶ τὰ ἔργα τῶν σφαλάκων ἐκ μυχοῦ τῆς γῆς ἀναπέμπεται: μόνη τε ἡ

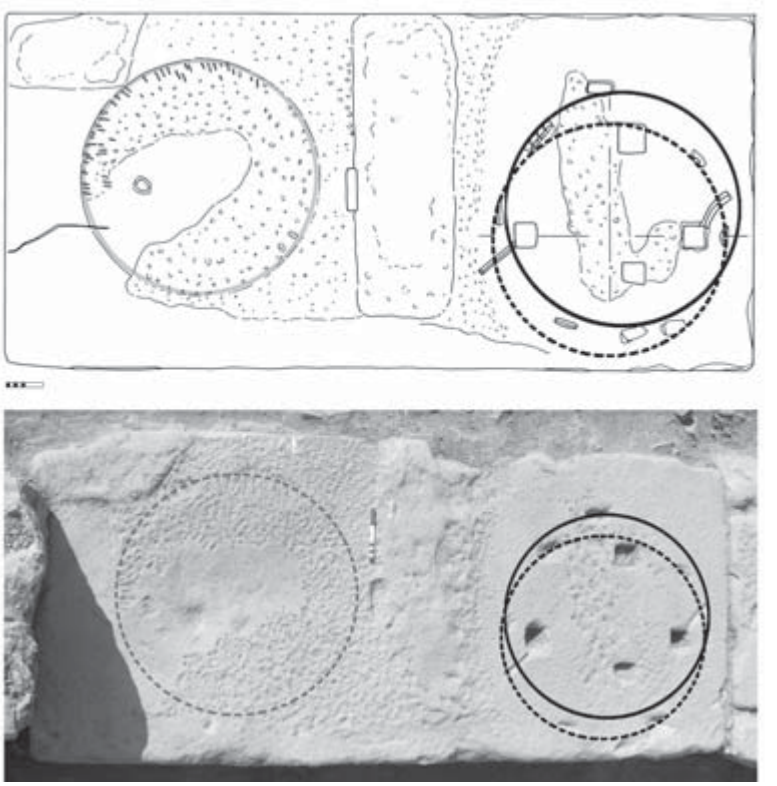

Fig. 37
Hierapolis, Gymnasium, stylobate HG51: the grey circle indicates the 4th century position of a column, set up without dowel-rods on the stylobate; the black circles show two subsequent imperial-age positions of a column, held by pairs of rods

were built, after the dismantling of the damaged ones. The excavation has shown that the new foundations were made of blocks of varying dimensions and reused materials (breccia column shafts, limestone blocks . . .), with layers of brick laid in such a way as to compensate for the differing levels of the stones (*fig. 36*). Above these foundations, which were quite different from the solid bases of large blocks used in the Roman phase, were laid the slabs of the stylobate, using elements of the original building. However the deployment of the blocks only partially replicated their original orientation: many of them appear to be rotated 90° or 180° with respect to their previous position.

The Byzantine reconstruction did not involve cutting new holes for the dowel-rods that held the blocks together. Indeed, rods were not used to attach the drums of the colonnade to each other, nor even to the stylobate, as was discovered in 2009 when the lower parts of the column shafts still *in situ* were removed (*fig. 37*). Even the drums discovered in a collapsed position, not moved in subsequent epochs and thus still lying next to each other, were found to be completely without rods. The decision not to use rods to secure the joins between the blocks, which is seen in some restorations of the 3rd century A. D.[120], meant that the work was performed more rapidly

τοιαύτη κίνησις οὐδὲ τοῦ οἰκισθῆναί ποτε ὑπολείπει σημεῖα ἐν τῇ γῇ. (trans. »In the same way, they say, the earthquake dives directly under buildings and shakes up their foundations, just as molehills come up from the bowels of the earth. It is this sort of shock alone that leaves no trace on the ground that men ever dwelt there«).

120 After the fire of A. D. 217, in the Severan restoration of the Colosseum, the wedges belonging to the arches of the radial ambulatories of the 2nd level did not receive iron cramps, unlike those of the Flavian period, see Lancaster 1998, 153. 157 figs. 6–8. 11.

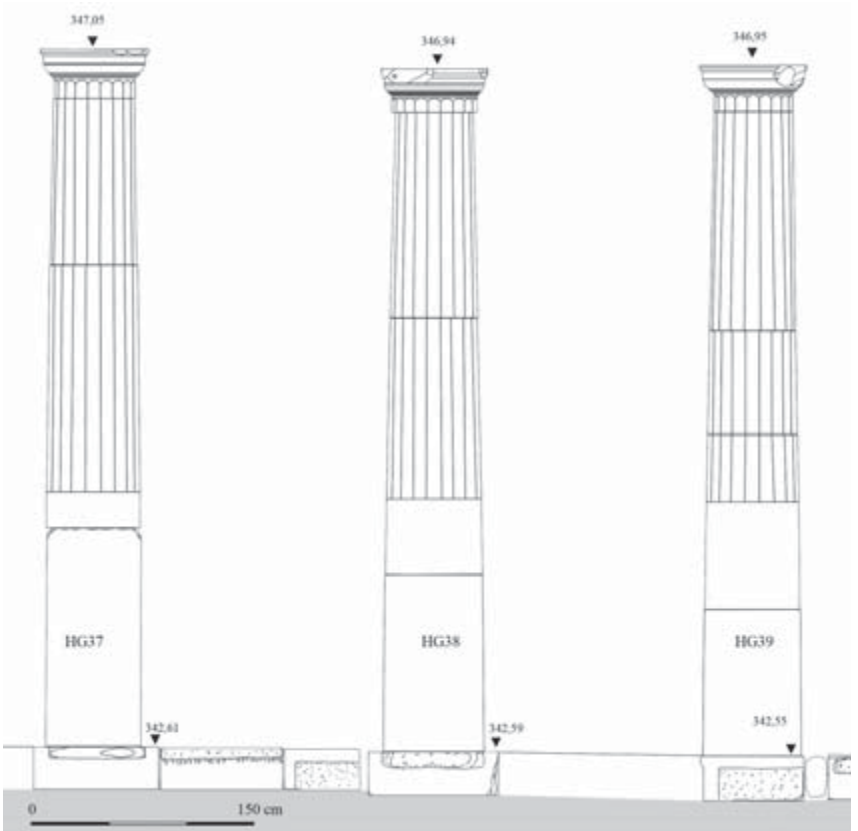


Fig. 38
Hierapolis, Gymnasium, three column shaft as restored in the middle of the 4th century A. D.

and more cheaply but it also showed that the sensitivity towards questions of statics, which had always characterised the prestigious architecture of the Greek and Roman world[121], was by then much diminished.

In order to ensure the effective execution of the building work, the reconstruction of the Gymnasium sought as far as possible to maintain the original relations between the architectural elements: the architraves were restored to their order (HG1+HG20, HG13+HG15), respecting the text of the inscription on the front face. To reconstruct the individual columns, the markings used to position the blocks in the imperial age were followed. The excavation of the drums lying in a collapsed position showed that the lines previously carved in the flutes were also followed by the Byzantine workers when reassembling the columns. However, the order of the shafts with respect to each other was changed, because the workers were obliged to select from the various parts of the monument those columns that were still intact. In some cases, not all the drums of the same column were in a good enough condition to be reused. Examples include column KΘ, which was fitted with the capital of column KH, which was wider than the original and not high enough to support the entablature at the right height (*figs. 38. 39*). This did not prevent them from placing the entablature complete with frieze and cornice on these columns of unequal heights.

121 See Hellmann 2002, 100. 101.


Fig. 39 Hierapolis, Gymnasium, the blocks of the south colonnade found in a collapsed position after the earthquake of the second half of the 7th century A.D. (2007) and details of the marking letters showing the use of originally not belonging blocks

The restoration of the Gymnasium in the mid 4th century shows the social and economic transformations affecting the city of Hierapolis and its inhabitants during the late 3rd and 4th centuries A.D. At the same time, it gives us a very clear picture of the tension – reflected even in architecture – between loyalty to Roman traditions and the introduction of new values that characterised the dawn of the Byzantine epoch. On the one hand, we see the continuity of technical knowledge and a considerable effort to restore, as far as possible, the original monumental character of the imperial-age architectural forms. On the other hand, we cannot fail to notice a new freedom, which translates into the reassembly of mutilated and fractured blocks, with no attempt to repair them, and the incoherent combination of elements. Such choices are anything but canonical from the formal point of view, and in the final analysis constitute structurally unsound solutions. With this new approach, the practice of restoration becomes closer and closer to the use of *spolia*, building the new with the pieces of the old.

*Abstract*: This paper discusses the phenomenon of architectural restoration in Hellenistic and imperial times. In the absence of an explicit ancient theoretical treatment of the objectives and techniques of restoration, the topic is analysed using the tools of archaeology, in order to complement the existing historical and epigraphical research. In this framework, the paper focuses on the evidence from Asia Minor, starting with an examination of the well-preserved architectures of Hierapolis in Phrygia (Pamukkale, Turkey), a city lying in a highly seismic region. In the first part of this paper ancient restoration measures are discussed and a typology of repairs is proposed: the evidence gathered from the monuments of Hierapolis is compared to other examples, chosen from Asia Minor, in order to emphasise the value of the technical knowledge originating in the local workshops. The second part presents a contextual analysis of restoration measures affecting the Gymnasium of Hierapolis, which underwent numerous reconstructions between the 1st and the 7th centuries A.D. The systematic study of the south colonnade of the palaestra makes it possible to view the various restoration measures (materials, assembly techniques, etc.) from a diachronic perspective, showing the historically determined sensitivities which guided successive reconstructions of the building.

## Antike Architekturrestaurierung in Kleinasien

### Eine Diskussion der Typologie, Techniken und Bedeutung mit Bezugnahme auf Beispiele von grossflächigen öffentlichen Bauten in Hierapolis in Phrygien, einer erdbebengefährdeten Stadt im Westen der Türkei

*Zusammenfassung*: Dieser Artikel beschäftigt sich mit dem Phänomen der Architekturrestaurierung im Hellenismus und der Kaiserzeit. Aufgrund des Fehlens expliziter antiker theoretischer Betrachtungen der Ziele und Techniken der Restaurierung wird das Thema mithilfe der Archäologie analysiert, um die existierenden historischen und epigraphischen Forschungen zu ergänzen. In diesem Rahmen konzentriert sich der Text auf die Zeugnisse aus Kleinasien, beginnend mit einer Untersuchung der gut erhaltenen Bauten von Hierapolis in Phrygien (Pamukkale, Türkei), einer Stadt, die in einer stark erdbebengefährdeten Region liegt. Im ersten Teil des Artikels werden die antiken Restaurierungsmaßnahmen diskutiert und eine Typologie der Reparaturen vorgeschlagen; die von den Monumenten Hierapolis' gewonnenen Erkenntnisse

werden mit anderen Beispielen aus Kleinasien verglichen, um den Wert des technischen Wissens, das sich in den lokalen Werkstätten entwickelt hatte, hervorzuheben. Der zweite Teil legt eine kontextuelle Analyse der Restaurierungsmaßnahmen vor, die das Gymnasion von Hierapolis betreffen, das zwischen dem 1. und 7. Jh. n. Chr. mehrere Umbauphasen durchlaufen hatte. Die systematische Studie der Südkolonnade der Palästra ermöglicht es, die verschiedenen Restaurierungsmaßnahmen (Materialien, Herstellungstechniken usw.) aus einer diachronen Perspektive zu betrachten und die historisch bedingten Empfindlichkeiten zu zeigen, die die fortlaufenden Rekonstruktionen des Gebäudes bestimmten.

## Anadolu'da Antik Dönemde Mimari Onarım

## Batı Anadolu'da Deprem Bölgesinde Yeralan Frigya Hierapolis'inde Büyük Boyutlu Kamu Yapılarından Yola Çıkılarak, Tipoloji, Teknik ve Önemi Üzerine Bir Tartışma

*Özet*: Bu makale Hellenistik ve İmparatorluk dönemlerinde yapılmış mimari onarım üzerinedir. Restorasyon'un amaç ve tekniklerini ele alan teorik Antik Dönem incelemeleri olmadığından, tarihsel ve epigrafik araştırmalara ek olarak konu arkeolojik açıdan ele alınmaktadır. Metin bu çerçevede, büyük bir deprem tehlikesi gösteren Frigya Hierapolis'inde (Pamukkale) iyi korunagelen yapıların incelenmesiyle başlayarak Anadolu delillerine yoğunlaşmaktadır. Makalenin ilk bölümünde Antik onarım önlemleri tartışılmakta ve uygulanmış olan onarımların bir tipolojisi önerilmektedir. Hierapolis anıtlarından kazanılan gözlemler yerel işliklerde geliştirilen teknik bilgilerin değerinin vurgulanması için Anadolu'daki diğer örneklerle karşılaştırılmaktadır. İkinci bölümde, MS 1. yy ile 7. yy arasında çeşitli yapı değişikliklerine uğramış olan Hierapolis gymnasiumuna ilişkin onarım önlemlerinin bağlamsal analizleri irdelenmektedir. Palaestranın güney sütun sırasının sistemli incelenmesi sonucunda restorasyon önlemlerini (malzeme, üretim tekniği vs) diyakronik perspektifle gözlemleme mümkün olmuş ve yapının sürekli olarak rekonstrüksiyonunu belirleyen tarihten kaynaklanan hassas noktalar gösterilebilmiştir.

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