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PLANNING AND EXECUTING ANASTYLOSIS OF STONE BUILDINGS

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In contrast to most other archaeological finds, architecture is fundamentally and naturally destined to be preserved at the site, and to be informatively restored. There are therefore certain criteria to be considered, involving:

- technical conservation
- scientific information, and
- aesthetics

Although it is obvious that the technically best conservation should take priority, the other two viewpoints give rise to various considerations.

Special measures, beyond pure conservation interventions, are almost always necessary after the basic decision is made to keep an archaeological excavation open and accessible. (Often the most responsible solution is to backfill the excavation after scientific investigation, because it guarantees the most effective protection of the finds.) In excavations, almost always carried out with public funds and by public authority, the didactic element complements the scientific one. It depends on very diverse conditions of a cultural, ideological, political and economic nature how the two elements bear on the archaeological and architectural remains. The well-equipped and illustrated excavation site, with its urban and architectural monuments, and the museum with its display of movable finds complement each other and create an inseparable whole.

The guiding principle should be one of harmony between scientific objectivity and the didactic and, if possible, even practical role of the site (e.g., new use, such as a museum). The manner, degree and extent of the restoration should be oriented to scientific standards and at the same time make clear the degree of our scientific knowledge about the site as a whole and its monuments. Therefore one will decide between:

a) clearing and conservation of the site and its arrangement for the visitor;

b) display of examples of architecture;

c) anastylosis; or

d) reconstruction.

The measures taken should be appropriate to the significance of the find so that the values of the site will become clear to the visitor. This means as a rule interventions that go far beyond purely technical conservation. They must be consciously and responsibly defined by the archaeologist.

a) Clearing and conservation of the site and its arrangement for the visitor

For architectural monuments this means in general pure conservation, that is the simple preservation of the remains, an intervention which will involve unavoidable and significant decisions. Sometimes a ruined monument is so important, famous or expressive of its monumentality that it is in fact desirable to preserve it as a ruin without any alteration (fig. 23). But in most cases there are visible technical precautions to take, which result from the preservation of a chance state of destruction that generally exists, however, in a certain harmony with the surrounding landscape of ruins. These will become the more decisive, the more restricted the extent of the original remains, that is the less the original form of the ruin is recognizable. So by means of technically necessary interventions, one will aim for an elucidation of the monument.

At the same time, the excavator must protect himself from the illusion and seduction of being able to preserve visibly everything that has been found. Usually he must decide which situation among many (building levels, overlying levels, etc.) he will visibly preserve. Trench sections, excavation of foundations and other deep-lying deposits (groundwater problem) are, if at all, to be preserved in the long run only at considerable expense. As already mentioned, backfilling of certain areas within the excavation after being fully recorded should therefore always be considered in order better to protect and clarify the entire site. The concealed ground plan can easily be depicted schematically on the main level of the site by means of paving, planting, etc.

Obviously among the first tasks is the planning of facilities (protective fences, paths, etc.) to reduce the risk of danger to visitors as well as danger to the monuments caused by visitors. At this stage the didactic element can already be influential, for example by carefully designing pathways instead of leaving naturally beaten tracks.

b) Display of architectural examples (partial anastylosis)

For informative didactic treatment and for the effective protection of building components, architectural elements that form a unit should be correctly assembled and placed in a clear relationship to the monument to which they belong. The presentation should correspond to the extent of scientific knowledge of the monument and make this quite clear (e.g., restoration of foundation features, integration of remains of the original building preserved *in situ*, arrangement of sample sections of preserved architectural elements in the correct position, figs. 1, 2). A reduction in scale (e.g., Memmius' Monument at Ephesus, fig. 3) is not advisable, although many excavators have thought it a good method for presenting the upper part of a building where the lower part is missing. The simple arrangement of architectural fragments on the ancient foundation or on an obviously modern one is often much more satisfactory (fig. 12). Above all, an unpretentious, objective character should be maintained in the presentation of the finds. For explaining the total context to which the architectural fragments belong, the use of information panels is recommended. The extent of these examples naturally depends primarily on the preservation of the original building, but should not be determined only by it. Displays of architecture can also be used to emphasize significant features within the excavation site and to serve indirectly as a guide to visitors (for instance the sequence at Olympia: Heraion (columns) – Treasury of the Sicyonians, Stadium arch – Nike column).

c) Anastylosis

Anastylosis in the strict sense can only be the identical re-erection of a dismembered historical building or one part of it in its original position. In such anastylosis, which is only possible when most of the original building elements are preserved, every element should take up its original position and structural role. As a rule this is possible only with cut stone architecture with its characteristic technique (figs. 4-6).

Such anastylosis represents an ideal case – to be sure only seldom reached – as much in the sense of scientific research as in the actual work of anastylosis of a historical monument. In this ideal case, the knowledge and experience derived from the restoration usually provide such an important contribution to scientific research into the building that anastylosis is to be regarded as an integral part of architectural historiography (e.g., the Library of Celsus at Ephesus and the Treasury of the Athenians at Delphi).

The integrity of the monument is the first goal and its original value the highest criterion. Every modern intervention made to realise it must remain in the background.

d) Reconstruction

Reconstruction is therefore clearly to be distinguished from anastylosis. For ancient stone architecture with its inherent logic of form, it is frequently possible to make scientifically correct reconstructions on paper although comparatively little of the original building survives. But even where a surviving building element can be placed successfully in its original position, the character of the modern reconstruction always remains dominant if too few of the original elements survive. Its erection on the original foundation in a ruined excavation site is always problematical (e.g., Sardis, the Roman baths, fig. 8) and requires a serious justification (e.g., Athens, the Stoa of Attalus – new function as a museum, fig. 7).

More easily justified is reconstruction in the sense of a full-scale model. This then is not bound to the original site (e.g., the Parthenon in Nashville, Tennessee, and the Pergamum Altar in Berlin).

To sum up, one must keep in mind that every intervention represents an opinion and an interpretation which is always the expression of its own time. In the interests of the maximum objectivity, all interventions should therefore be avoided whenever possible or at least be sufficiently recognizable. In all cases, any measure beyond

simple safeguarding of the remains must always be alterable and easy to remove (the principle of reversibility) (compare fig. 22).

For every intervention there exist three criteria which must be respected:

- the relationship between the surviving elements and the modern intervention in the single building, determined by the historic significance of the building in absolute terms;
- the relationship between the restored building and the total site, determined by the significance of the building within the (urban) complex; and
- the relationship between the area of the ruins as a whole and the surrounding landscape, determined by the importance of the site in the overall context.

There can be no strict rules, however, despite the procedures recommended or prescribed by the legislation of individual countries. The decisive criterion will probably above all be the historical, that is the scientific meaning of the monument. This is what the archaeologist has the responsibility to define.

On the other hand, there are several concrete rules to follow in the practical treatment of excavated architectural monuments. These concern (1) preparatory work and (2) the actual execution.

1. Preparatory work

1.1 Excavation phase 1: documentation

The excavation succeeds according to the standard of archaeological methodology applied to it. The first duty is the comprehensive documentation of all archaeological research (section profiles, small finds, etc.). The most important basis is the complete graphic and photographic documentation of the whole find context. (This means as a rule a greater expenditure than is generally required in purely scientific research for publication purposes.) In particular:

a) a site plan must be made of the monument that includes *in situ* finds and the position of disturbed or displaced building elements. The drawings must be complemented by photographs. Polaroid photographs help complete the documentation during the clearance work (figs 9,10).

b) all building elements that are removed from their original position must be numbered individually and recorded on the site plan. The numbering should when possible be firmly secured: punched aluminium labels attached with brass screws in plugs of plastic (∅ 3 mm) on the damaged areas are useful.

1.2 Excavation phase 2: clearing of the ruins, study of the building and its elements

After clarification of the existing state of the destroyed building, the excavation enters its second phase with the clearing of the ruin. The disturbed (numbered) building elements will be clearly and visibly ordered, being placed together in proper relationship to each other and to the building from which they came (figs. 11, 12). For this purpose an adequate place must be created within the site. It is advisable first of all to remove from their excavated position only those elements that (a) must be studied in detail to understand the building or (b) may be needed for its anastylosis or restoration.

It is desirable to preserve in one part at least of the monument an example that illustrates the historical event of its destruction (fallen walls, etc.). Special protection measures (protective roof, chemical consolidation) are therefore necessary.

After clearing the building blocks, their detailed study begins with exact drawing at large scale (usually 1:5 or 1:10). In view of any planned analysis, all building elements are to be recorded, even those that are identical and repetitive. In exceptional cases of especially well-preserved monuments, a simple catalogue with measurements alone should suffice and working with the pieces themselves is the most expedient procedure.

1.3 Scientific study and reconstruction on paper. Preliminary requirements and investigations for anastylosis or restoration

1.3.1 Plans and models

With the material gained in excavation phases 1 and 2, a scientific reconstruction can be achieved. Most important will be its representation in graphic form. The evidence for reconstruction will be in the form of drawings in which all preserved fragments are depicted in their original positions (fig. 13).

These drawings (possibly also photomontages of similar-sized individual photographs) illustrate at the same time the conditions required for anastylosis, giving information on the position, state of preservation and number of preserved fragments in relation to those missing.

Scale models of the excavation site and its buildings are especially helpful:

(a) *reconstruction models* are the final results of scientific research and help to illustrate it for wider audiences. They are found both in museums and on excavation sites, and are all the more helpful, the more destroyed and invisible the monument is (e.g., the city model of Rome and models of individual buildings in the Museo della Civiltà Romana in Rome; city model of Jerusalem in Jerusalem; model of Priene in Berlin, models of Olympia at Olympia and of the Villa Adriana at Tivoli, fig. 14).

(b) *scale models of the existing situation* are recommended as decision-making aids for anastylosis projects (these are easy to construct from paper or cardboard). The models of various suggested options can be subjected to discussion (e.g., the Theatre at Metapontum, fig. 15). This is especially recommended for difficult sites, above all when different overlapping phases are to be made visible.

(c) *full-size scale models* at the site itself are very useful when the overall appearance of the excavation is at stake and when discussion by a wider public is desirable. They can be temporary constructions in light pasteboard or tubular steel (e.g., Metapontum) and can be photographically recorded (fig. 16).

1.3.2 Preliminary investigations

In many cases, special preliminary investigations of a technical nature are necessary, e.g.:

- investigation of the carrying capacity of the building foundation which often has changed since ancient times (through changes in the water table, bradyseism, earthquakes, etc.);
- investigation of the static condition of the ruin; and
- examination of the original materials and those to be used in further work, their static and physical characteristics.

These investigations should always be entrusted to experts.

2. The execution of the work

2.1 Initial protection measures

The first requirement – the protection of the finds *in situ* – involves at first purely technical considerations. Protective roofs and simple shelters, which will be replaced later by aesthetically pleasing and long-term solutions, are usually advisable for a certain time during the excavation and planning phases. Therefore it is important, during the period of excavation, to have readily available the appropriate materials (wooden laths, planks, corrugated roofing sheets) and at the same time to establish suitable transport and work systems.

2.2 Edges of excavated areas

For the long-term safeguarding of the edges of excavations, reinforcement is necessary. Chemical consolidation and reinforcement or stabilizing of embankments with plastic mesh are only practical for large dimensions. The most useful and appropriate solution is generally planting with vegetation, which must correspond to the geographical and climatic conditions and be carefully selected.

2 3 Excavated sections and profiles

Previous experience has shown that the long-term safeguarding of earth profiles is almost impossible. Excavation sections should therefore as a rule be well recorded and then backfilled. In exceptional cases chemical consolidation is advisable, sheltered by a protective roof. Attempts to protect trench sections and at the same time leave them visible by means of glass or plexiglass are to be warned against (problems of water condensation, plant growth). In general, however, sections and any voids (e.g., excavated foundations) are practically unintelligible and confusing for the non-expert.

2.4 Protecting remains of the original building

For the aesthetically and technically satisfactory protection of preserved building remains, there are scarcely any binding rules because there are so many different cases. Nevertheless the difference must be kept in mind between technically necessary

measures and additional integration for illustrative purposes. In the first case the intervention should be clearly legible in material and technology. Unequivocal and proven materials and clearly visible construction methods are recommended for this work. The modern intervention should support the ancient monument and interfere as little as possible in its substance.

2.5 Restoration anastylosis and reconstruction

When the wish to interpret and integrate arises, as in most cases, there are two basic positions to consider:

a) illustrative "reconstructions" with clearly modern material and modern technology in continuation of the techniques used for safeguarding (e.g., the Roman villa at Piazza Armerina, Sicily); or, more commonly,

b) the use of techniques and materials that are similar, or should be similar, to the ancient ones. Thus it is important to be aware of the consequences and to use ancient technology and suitable materials as faithfully as possible. That is, a comparable technique should be used both for ashlar masonry (e.g., Athens, the Acropolis; Pella in Greece; Metapontum, the Theatre, figs. 17,18,19) and for brick construction (e.g., Rome, Market of Trajan, fig. 20, but not, however, the restoration of the columns in the Forum of Trajan, fig. 21). It is important, above all, for the new intervention to take into account not only aesthetic considerations but also the static and physical characteristics of the ruin. Interventions that alter the static system (replacement of the structural system in masonry with reinforced concrete skeletal systems, as in the Temple of Hera at Selinunte and at Lindos) and those that misjudge or wrongly evaluate the physical building characteristics (integration of natural stone contexts with brick and concrete, concrete and steel skeletal systems in all cases) are often accompanied by catastrophic results (fig. 22).

The second major problem is at the same time aesthetic and scientific, namely, the degree of approximation of the new to the old material. The legislation of most countries demands clear evidence of the new interventions, if necessary an appropriate marking. But the unity of the whole picture should not be too strongly intruded upon. Judging by experience, the fear is ungrounded that the difference between old and new material could become obliterated with time to the eye of the expert, with only few exceptions (Pella; Agrigento, Temple of the Dioscuri). According to the state of the discussion today, the general principle of the priority of "continuity of form" (Hueber 1978) of ancient buildings is preferred to the one of direct and immediate visibility of modern intervention.

2.6 Stone conservation: restoration of broken and weathered pieces, casts

The most difficult questions arise in ashlar masonry, which represents the most significant monumental architecture of Antiquity. Technical problems are concerned as a rule with:

- joining of broken building blocks and the rehabilitation of badly weathered and brittle elements;

- the integration of damaged architectural elements in order to restore their static characteristics (for re-use in their building contexts) and the restoration of their architectural form; and
- the preparation of new building components needed for anastylosis.

The problems vary according to different materials (marble, limestone, sandstone), but there are some general principles:

a) for gluing broken fragments, epoxy glue has today almost completely replaced the use of cement. For all stone types there are optimal glues which can be obtained commercially. In any case the advice of an expert is necessary, including at least a laboratory analysis of the stone. In general, today, so long as the fragments have first been appropriately treated (for reinforcement), the clamps and pegs that were once required can be avoided completely. In the few cases where they are still necessary, only stainless steel should be used, but there have already been very good results with fibreglass armatures. The problems of weight and differential expansion can be solved in this way.

The rehabilitation of brittle stone, especially limestone and sandstone, is possible using injection of epoxy solutions or through treatment with silanes. This can be effective if impregnation is deep, though very expensive for large stone masses. Marble affected by air pollution can also be treated; acrylic resins have been used for this purpose. It is essential in all cases that the stones be cleaned before treatment by experts using non-damaging cleaning methods. Otherwise the best solution is still to dismantle valuable pieces and replace them with artificial stone casts.

b) the integration of missing parts in damaged building blocks is necessary at first only for static reasons. The question of how far the integration should be taken and to what extent it should reproduce the ancient form can only be decided in each individual case. But in recent years there has been general agreement that either any allusion to the original architectural form should be abandoned or that it should be imitated as faithfully as possible. Simplified, crudely reminiscent forms create a third element that is conspicuous and distracting, and generally misleading for the non-specialist.

The integration can be carried out in natural or artificial stone. Although natural stone is aesthetically satisfying, generally there are serious problems. Apart from the difficulty of procuring similar stone, this solution is difficult, costly and lengthy to execute. Since, in accordance with the antiquities legislation of Classical countries, original blocks cannot be altered for restoration purposes, integration of missing parts will require the exacting work of the best-trained stonemasons.

So today, with few and very significant exceptions (Athens, the Acropolis; Pella in Greece), artificial stone is normally used for stone integration. The advantage lies in its fast and simple working, and its application to damaged surfaces. This technique guarantees the optimal adhesion of the old material to the new, which can be chosen to match. The disadvantage consists in general in the too homogeneous and lifeless structure of the stone substitute. The other disadvantages in physical terms (differential

expansion and porosity, problems of decay, hairline fractures) that are often produced by artificial stone bonded with cement, can largely be avoided today by the expert use of suitable epoxy binders. Thus what is needed is a very exact matching of materials by means of laboratory tests. The materials can be prepared in the laboratory so that they are produced and delivered in dependable quantities for immediate use at the site (e.g., Metapontum, the Theatre). The desired surface structure will be achieved at the site through reworking by the stonemason.

c) for quite new building components required for anastylosis, the natural stone/artificial stone alternatives are also present. Again, the advantage of artificial stone is that it can often be quickly and easily reproduced in one ready-casting form. But the high cost of the material and its aesthetically lifeless surface are disadvantages. Thus natural stone is used more frequently, if it is obtainable and if suitable stonemasons are available.

2.7 Carrying out the re-erection

For the reassembly of the prepared architectural components, careful planning and building site organization are necessary. The required equipment (crane, scaffolding, etc.), trained workmen and, above all, the continuous presence of supervisory staff are essential. Because of the particular character of ancient ashlar masonry constructed without mortar, every building element has its unique position. Therefore the greatest care is required and many individual decisions must be made actually during the re-erection process. Experience has taught that for the reconstruction of buildings (e.g., Ephesus, the Library of Celsus; Athens, the Acropolis; Olympia, the Treasury of the Sicyonians; Pella; Metapontum, the Theatre) all means of assistance and any device that was used in antiquity (hoisting method, anathyrosis, caulking holes, etc.) must be repeated exactly.

2.8 Maintenance of the re-erected monument

Since in most cases the result of anastylosis retains a ruined or episodic character, the building is rarely covered and the roofing elements seldom survive. Additional protective measures are necessary, usually in the form of waterproofing with an appropriate epoxy solution which must be renewed at regular intervals. This should be part of the normal maintenance of a restored excavation site, as are the control of plant growth, drainage, the regular painting of metal support constructions, the maintenance of footpaths and the replacement of signposting.

Final remarks

From this discussion it has become clear that the responsible restoration of an ancient architectural monument, especially with whole or partial anastylosis, is a very demanding task that should only be carried out by experts, under the best possible conditions and only with the best materials. These remarks can thus serve to make archaeologists

familiar with the problems so that they can express their ideas clearly and practically to the specialist.

But if experts, equipment or materials are lacking, then it is better to suggest, in every case, more modest solutions. These solutions must not compromise on clarity, however. A clearly arranged layout, a progressively informative collection of architectural remains in a lapidarium or also at the excavation site (perhaps under a protective roof), explained by reconstruction drawings, is possible for every excavation and is worthwhile in itself.

FURTHER READING

Archäologie und Denkmalpflege. Diskussionen zur archäologischen Bauforschung, 2. 1975. Berlin.

HUEBER, F. 1978. Theorie und Praxis des Anastylose und ihre Bedeutung für die Bauforschung. Diss. T.U., Wien. Bibl.Zit.: R/ZL 2/14-1978, TU Wien.

HUEBER, F., & STROCKA, V. M. 1975. Die Bibliothek des Celsus, eine Prachtfassade in Ephesus und das Problem ihrer Wiederaufrichtung. *Antike Welt*, **4**: 3-14.

MERTENS, D., DE SIENA, A., & BELLWALD, U. 1983. Metaponto, il teatro-ekklesiasterion. *Bollettino d'Arte*, **16**: 1-60.

NOHLEN, K. 1983. Die Wiederaufrichtung des TrajanHeiligtums in Pergamon. *MannheimerForum*, **82/83**: 163-230.

ROSSI DORIA, P., TABASSO, M., & TORRACA, G. 1978. Note on conservation treatment of stone objects. UNESCO/RILEM International Symposium on Deterioration and Protection of Stone Monuments, Paris, 5-9 June, 1978.

SANPAOLESI, P. 1972. Conservation and restoration: operational techniques. pp. 149-85 in: *Preserving and Restoring Monuments and Historic Buildings*. Museums and Monuments 14. Paris: UNESCO. (existe aussi en version francaise)

TABASSO LAURENZI, M., & TORRACA, G. 1974. Marmo – materiali lapidei. pp. 48-62, in: *Problemi di conservazione* (ed. G. Urbani). Rome. (with bibliography)

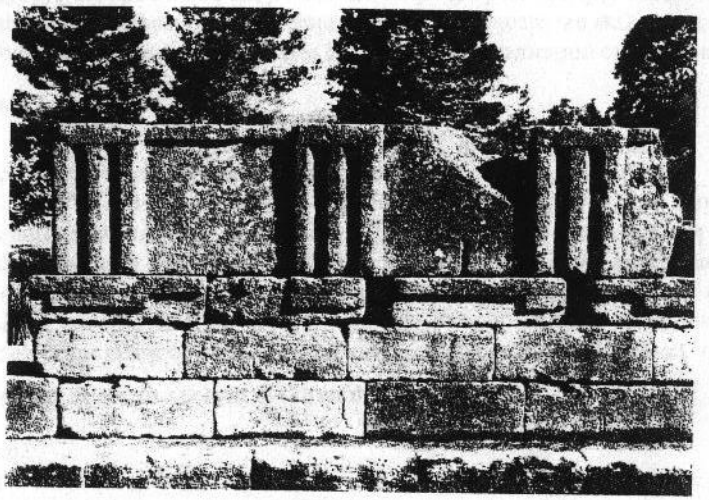

Figure 1. Olympia, Bouleuterion. Simple composition of preserved building elements as general example of the architectural order. Concentration of several preserved fragments, thus false in detail.

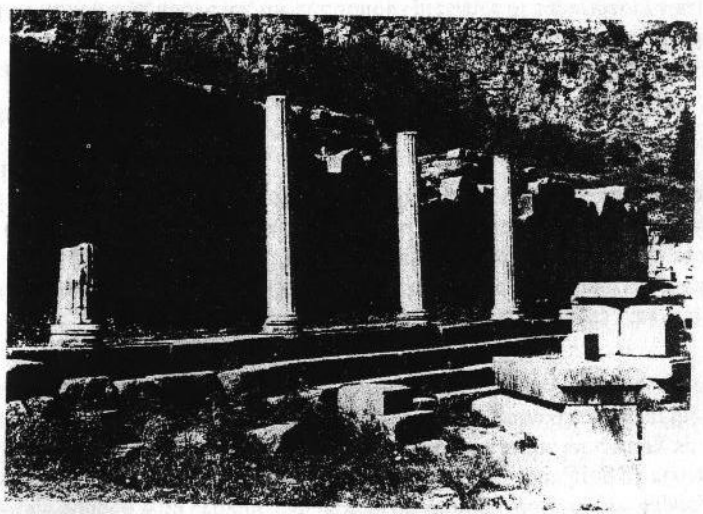

Figure 2. Delphi, Stoa of the Athenians. Columns re-erected in their positions without further restoration. Provides essential information and helps spatial presentation.

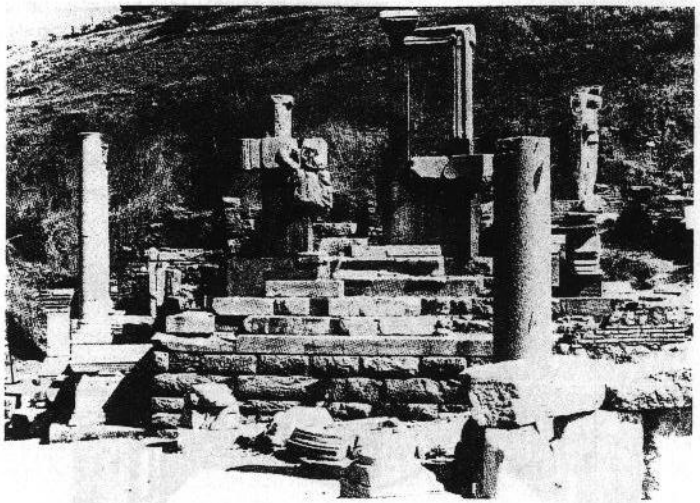

Figure 3. Ephesus, Monument of Memmius. Arrangement correct only in detail. Reduction in height and arbitrary composition of the large components impede presentation of the whole monument.

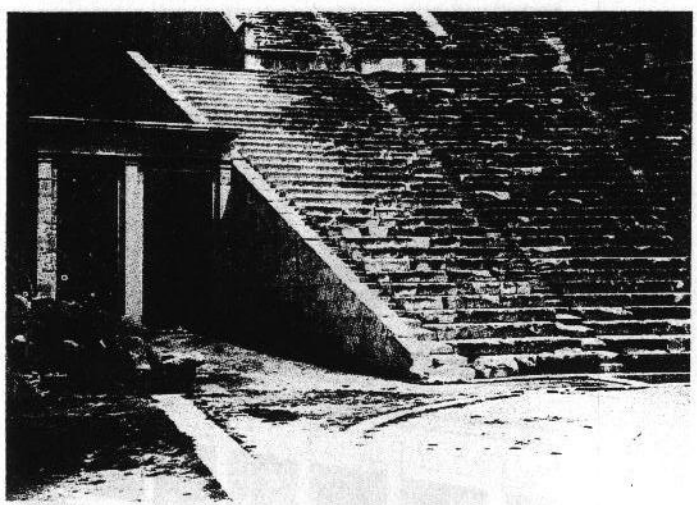

Figure 4. Epidaurus, theatre. Reconstruction of the damaged parts of a monument for the most part well-preserved.

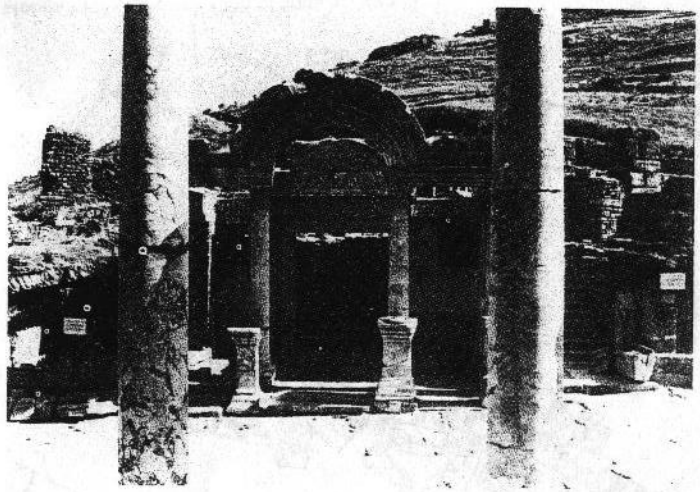

Figure 5. Ephesus, Temple of Hadrian. Anastylosis carried out almost exclusively with original building elements.

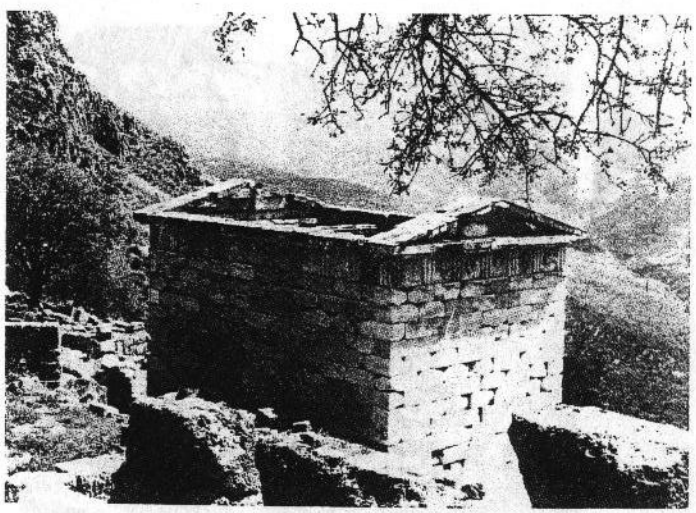

Figure 6. Delphi, Treasury of the Athenians. Anastylosis carried out almost exclusively with original building elements.

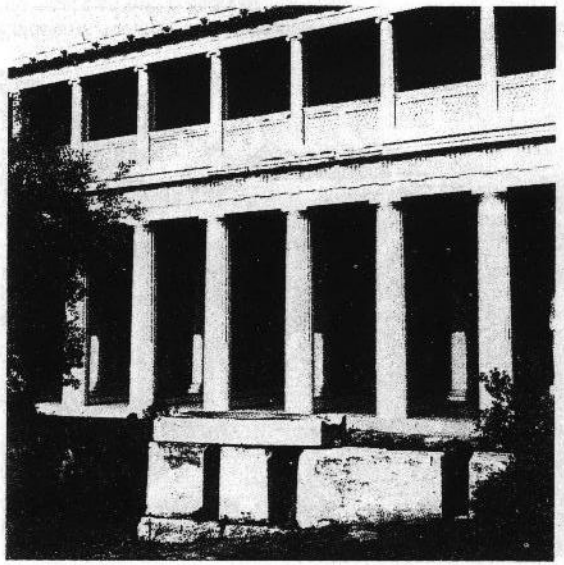

Figure 7. Athens, Stoa of Attalus. Very little original material in the reconstruction. Used as a museum.

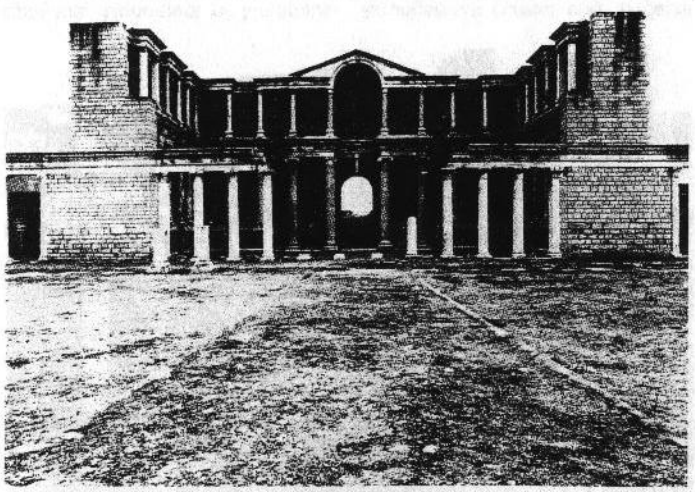

Figure 8. Sardis, Roman baths. Full-scale reconstruction of a large section of a building in an otherwise much ruined environment.

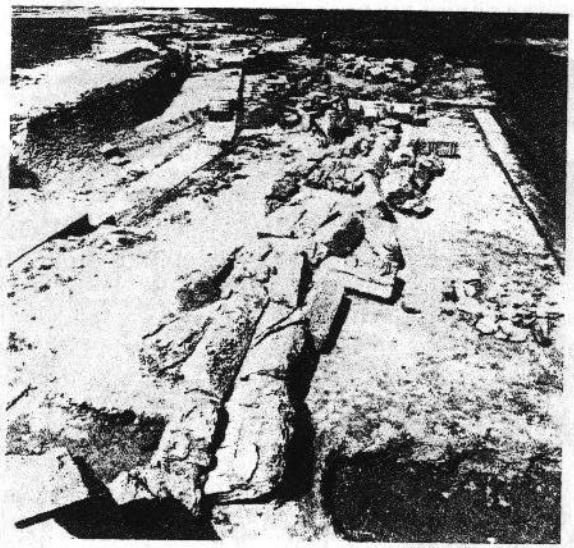

Figure 9. Metapontum, Italy, the theatre. Position of collapsed entablature in Area III.

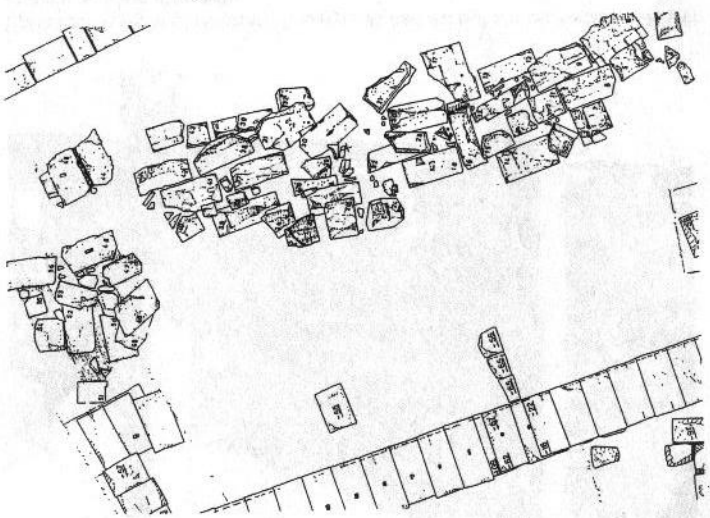

Figure 10. Metapontum, theatre. Plan of finds in Area III.

Figure 11. Metapontum, theatre. The entablature after removal.

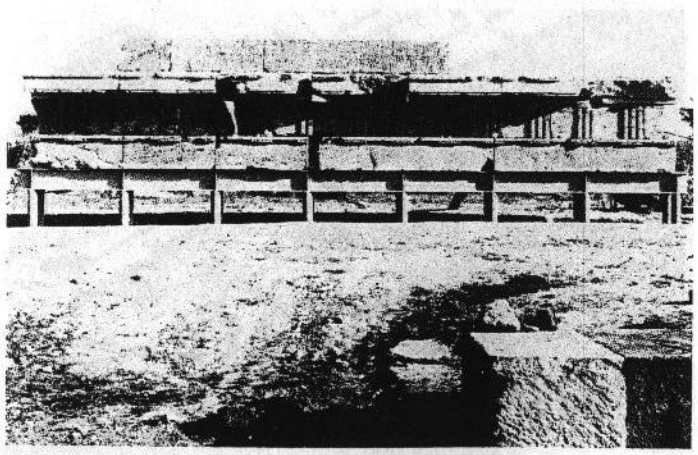

Figure 12. Metapontum, theatre. The entablature put together again as an example of the architecture.

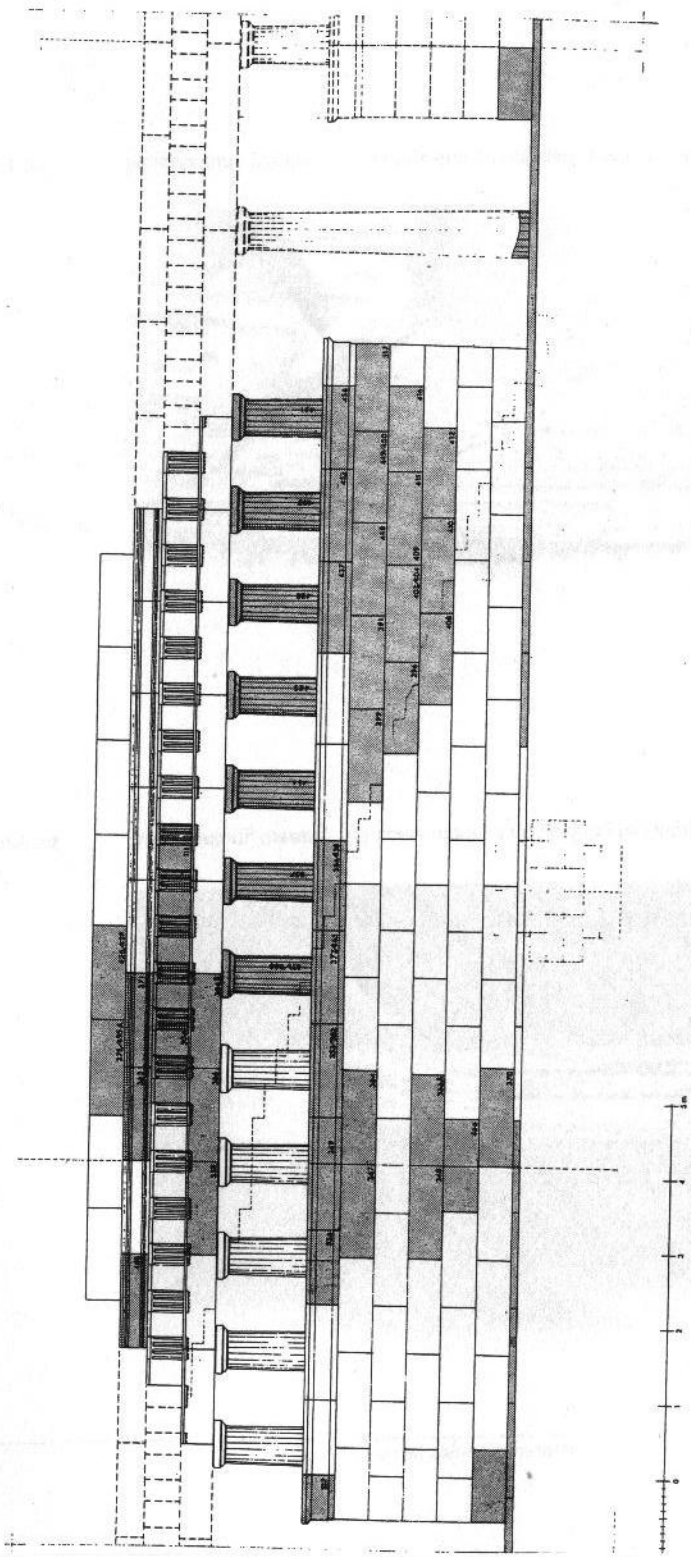

Figure 13. Metapontum, theatre. External architecture in Area XIII/IX, reconstruction drawing.

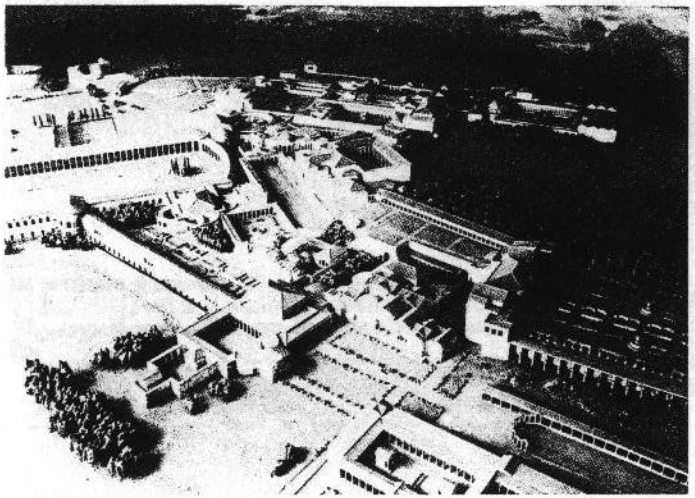

Figure 14. Tivoli, Villa Adriana. Reconstruction model.

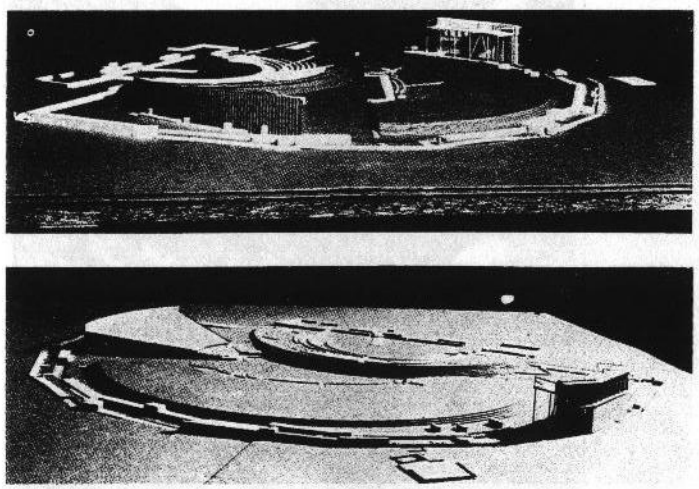

Figure 15. Metapontum, theatre. Model at 1:100 of the proposed restoration.

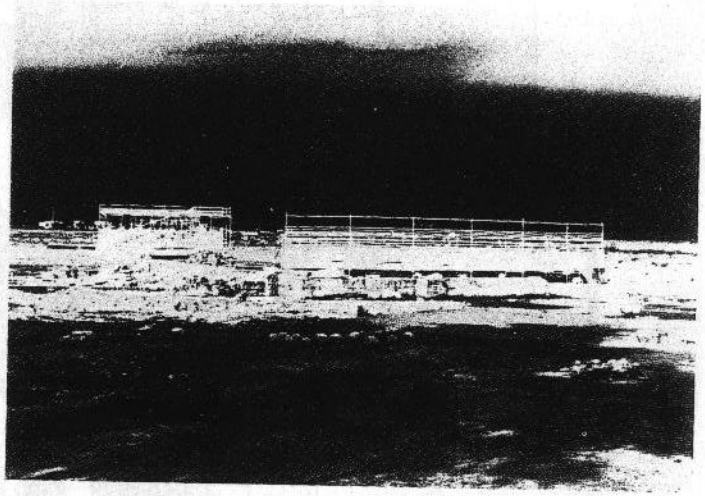

Figure 16. Metapontum, theatre. 1:1 scale model as an aid to presentation.

Figure 17. Metapontum, theatre. The completed anastylosis within its site context.

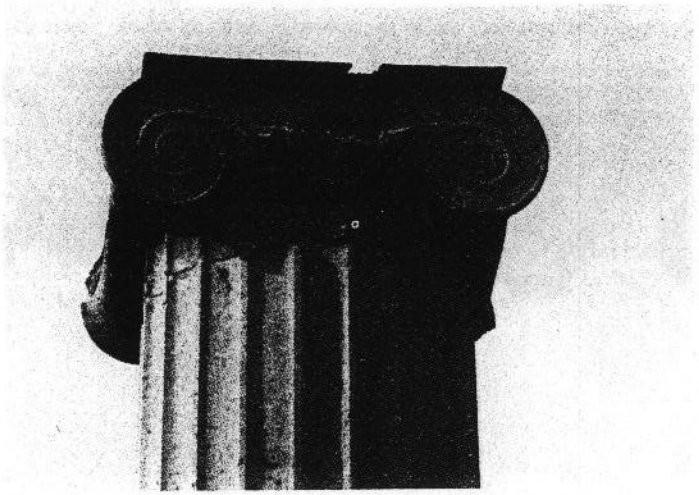

Figure 18. Pella, Greece. Completion of column with natural stone.

Figure 19. Metapontum, theatre. Natural stone used in rebuilding the outer wall, with strict adherence to ancient technique of working.

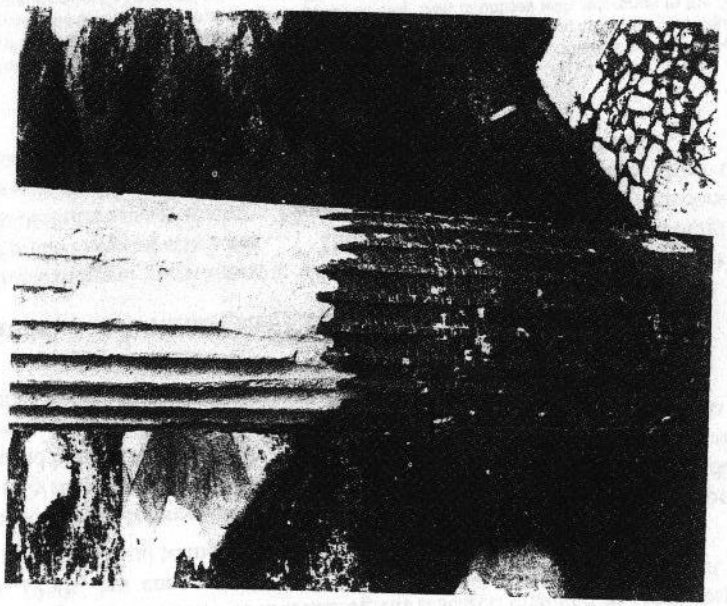

Figure 21. Rome, Market of Trajan. Completion of marble columns with bricks.

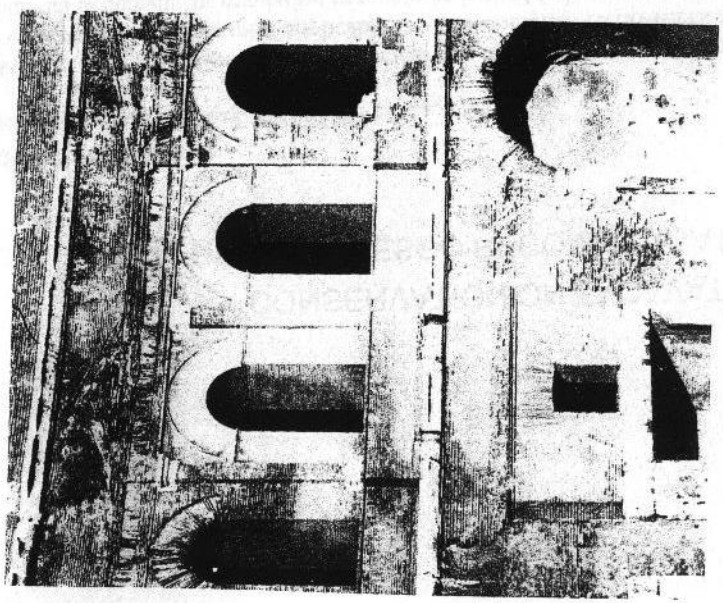

Figure 20. Rome, Market of Trajan. Completion of brickwork of wall. Marking of restored areas by using different working technique.

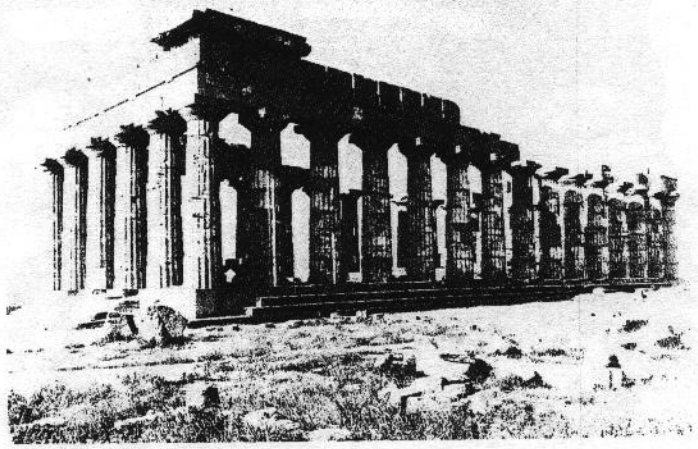

Figure 22. Selinunte, Temple of Hera. Original building elements embedded in reinforced concrete. Considerable errors, which can no longer be corrected, in the reconstruction from a scientific point of view, and dubious aesthetic decisions: an early Classical Greek temple has been partially destroyed through reconstruction.

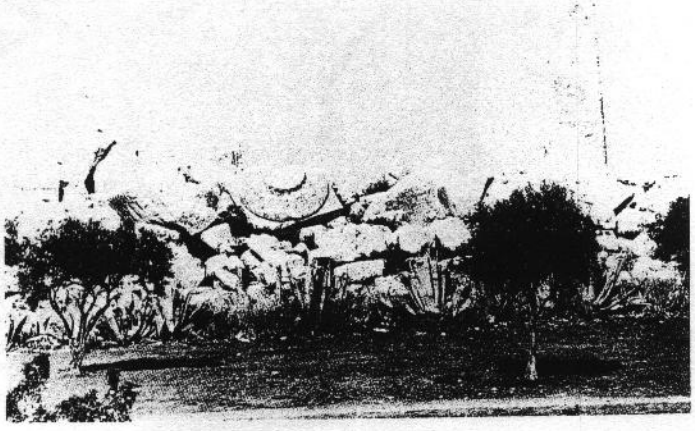

Figure 23. Selinunte, Temple of Zeus. Preservation of the monumentality of a ruin without intervention.