

## Klassische Archäologie

Dietmar Kurapkat and Ulrike Wulf-Rheidt (†) (editors), **Werkspuren. Materialverarbeitung und handwerkliches Wissen im antiken Bauwesen.** Internationales Kolloquium in Berlin vom 13.–16. Mai 2015, veranstaltet vom Architekturreferat des DAI im Henry-Ford-Bau der Freien Universität Berlin. Diskussionen zur Archäologischen Bauforschung, volume 12. Publisher Schnell und Steiner, Regensburg 2017. XIII and 466 pages with 438 illustrations and an overview map.

This miscellaneous volume makes an important contribution to the series of studies on Ancient Construction History. This field of research has greatly benefitted from the renewed interest of architects and archaeologists in the analysis of building materials and understanding of the construction process of archaeological remains. The papers presented here are evidence of the German tradition in this field of studies (Bauforschung) and analyse a wide spectrum of »traces« that can be found on ruined buildings or on scattered architectural fragments. Most of the thirty papers are by German scholars with a few exceptions (Greece, Turkey and Belgium). Each article has a summary in English, except for one article entirely in English (with a German summary). The introduction of the two editors recalls that this book follows a previous collection of essays on Construction History promoted by the Department of Architecture of the DAI, more than twenty-five years ago (A. Hoffmann et al. [eds.], *Bautechnik der Antike. Internationales Kolloquium in Berlin vom 15.–17. Februar 1990* [Mayence 1991]).

Two aspects emerge from the reading of this book. First, the importance of graphic and photographic support to convey information and illustrate interpretation given in the articles. Most of them would have not been as effective as they are without the figures; the lavish colour printing of the volume is therefore to be commended. Second, the fact that any architecture is the result of a building process, which itself can also constitute aesthetic expression. Thus this book does not only offer an important contribution to the understanding of construction processes, but also addresses the formal values of architecture.

The focal point of the book is the construction process and the transmission of the know-how in different regional contexts of the Central and Eastern Mediterranean (with the exception of two essays regarding the South Arabian Peninsula and East Africa and one on Trier) in a span of time from the third millennium B.C. to the sixth century A. D. The volume does not aim to provide a complete and systematic regional overview. The authors have clearly been selected on the basis of the quality of their studies and their relevance to the topic of the volume.

The contents are organized starting from the making of the single element via the constructional assembly up to the organization of the building process. This approach allows the reader to consider all the fundamental stages that go from the selection of the building materials to the way they were modified and then composed in order to create edifices capable of withstanding static and dynamic stress. The construction process represents the procedure used to achieve this goal in the easiest and most effective way.

However, the importance of the publication goes beyond the technical aspects. The fragmentary reality of ancient architecture, such as discussed in these papers, makes de facto an important contribution to the understanding of the social, religious, economic, cultural, and political aspects related to building programs.

For an overview on the papers, in contrast to the order of papers in the volume, I propose a chronological approach, since it better underlines the range of information in the different periods.

To begin with contributions on Egyptian and Helladic architecture, Claudia Lacher-Raschdorff analyses the dense subterranean network of corridors and rooms in Early Dynastic architecture at Saqqara, in order to examine workmanship and the amount of work necessary to carry out the digging. The article leads the reader to an understanding of the technical and organizational capacity at this early stage of Egyptian architecture when masons used tools, which were a far cry from the much-improved later ones.

Old Kingdom construction in Egypt is a benchmark in monumental ashlar construction, since this

period yields gigantic pyramids, reaching the enormous volume of 2,8 million cubic meters of stone ashlars. To understand how the construction site was organized, Felix Arnold analyses the marks documented in the Valley Temple of the Bent Pyramid in Dahshur and proposes that they served to organize the immense amount of building material that had to be transported, stored, and then assembled to produce these constructions. Marks are in yellow, red and black colour and were written on the blocks to regulate the construction at the different working stages. According to the author the transportation of materials occurred when the Nile was in flood, with dates and numbers serving to organize the storage of material until use.

Peter Marzolff offers an interesting contribution on stone and clay roof-tiles in the third quarter of the third millennium B.C. He shows that the use of slate slabs first decreases and then disappears in Mycenaean architecture.

Contributions on Archaic Architecture are another main focus. Manolis Korres and Aenne Ohnesorg present a paper identifying the tools used for working marble. The authors trace the tools through some unfinished elements or in parts that were not exposed, thus left without the final polishing. The focus is on Archaic architecture in Greece, when the use of marble in architecture made it necessary to develop appropriate tools. The arguments developed in the article are illustrated with excellent hand drawings.

Turgut Saner and Gizem Mater discuss the quarrying and carving of the stones of Larissa Phrikonis in Aeolis, Asia Minor. The article examines the well-established process of producing stones (dressed and undressed) for dry masonry construction in the region, reflecting a tradition already well-studied in other geographical contexts.

Elisavet Siumpara's contribution on the Archaic phase of the Acropolis of Athens is a refined interweaving of the traces of the tooth-chisel (or claw-chisel) found on architectural and sculptural elements and considerations on the location of the Hekatompedon on the Acropolis of Athens. Her methodological approach shows the relevance of analysing construction techniques for architectural history.

Uta Dirschedl focuses on the Didymaion of Miletus, the last monumental dipteron built during the Archaic period. Her discussion of the different materials used in the construction of the temple highlights that they were selected according to several criteria, namely their mechanical properties, the financial constraints or the aesthetic requirements. In her analysis, the use of working tools is meticulously documented. It enables identification of the ones used for the first-phase limestone blocks, built under the influence of Samian con-

struction practices, and those employed in the marble completion of the temple – when the Ephesian Ionic base was adopted. The change of hardness of the material also required a modification of the tools used in the early phase of construction.

Alexander von Kienlin discusses the marks left on building elements to facilitate the correct assembly of architectural elements. The first examples in Greek architecture date to the 6th century B. C. The author gives possible reasons for their introduction, and to do so, he considers the evidence of terracotta, timber, and stone elements.

Considering the Classical and Hellenistic Period, Matthias Grawehr returns to the question of whether the so-called Nabataean or blocked-out capital originates from an aesthetic impulse or was it rather a technical choice, which eventually became a trend in some oriental architecture over a long period of time, as for instance in the case of the Trajanic intervention at Apollo Ylates at Kourion, where the use of the Nabataean capitals seems to result from political opportunism (T. Mavrojannis in: G. A. Xenis [ed.], *Literature, Scholarship, Philosophy, and History. Classical Studies in Memory of Iannis Taifacos* [Stuttgart 2015] 481–486). The author believes that the blocked-out capital was typically used in areas where the sandstone was very friable and prone to decay if exposed to the elements. Although Grawehr adds new and relevant observations to support his interpretation, we must keep in mind that the identification of the origin of a certain style is always challenging for historians and that sandstone elements were generally plastered to prevent damage by wind and rain. In my experience, sandstone capitals throughout Greek and Roman architecture, from Spain to Greece, were always plastered, even when finely chiseled.

Jürgen Giese moves into the field of masonry typologies. This topic has frequently led to an overestimation of the aesthetic values of wall facings, in an attempt to establish dating criteria for masonry. Giese first discusses the production process and then the decorative significance that certain techniques acquired over time. Particularly inspired is Giese's intuition that what he calls the »Kerben-dekor« – a pattern of vertical grooves made on the block surface, for instance on the Arcadian Gate at Messene – is a motive that was used to reduce the visual value of each single block – as opposed to the smoothed margin – thus achieving a »monolitization« of the wall.

Hilke Thür analyses the traces on the Heroon with water-display in Ephesus. Her work identifies the presence of two teams of masons, working simultaneously. Relevant to the understanding of the construction process is the fact that, mason's marks enable to reconstruct work at different levels of the construction.

Rudolf Känel focuses on the traces in Etrusco-Italic architectural terracotta elements to analyse how they were produced and assembled. His reconstruction is relevant to the understanding of the manufacturing process for materials that were widely used in architecture.

Günther Stanzl presents a very well-documented and detailed study on the disiecta membra and remains of the Ptolemaion of Lymira. The technical analysis allows understanding the details of the construction, which was composed of a square podium and a tholos with a conical roof, to a total height of thirty-two meters. The quality of the construction and of the architecture – with some optical refinements – is extraordinary and demonstrates that the workforce might have been the same as the one used for the construction of the Letoon at Xanthos. The building, according to the author, is part of the political propaganda of the Ptolemaean kings in early third century B.C., under Ptolemy II Euergetes, when the ideology of Theoi Adelphoi (Ptolemy and Arsinoe as Zeus and Isis) lead the way to the foundation of many sanctuaries (e. g. Samothrace, Olympia, Kos and Cnidos).

Mike Schnelle focuses his contribution on the import of limestone in the South-Arabian Peninsula mainly during the Hellenistic Period for major building projects. The use of this material implied specialised stone-work employed for the construction of palaces and religious buildings in South Arabia and Ethiopia. The technique is also found in water-management buildings, where the aesthetic value was less important, but the quality of construction was relevant to resist the destructive power of water (as can typically be seen in Roman bridges elsewhere).

Manfred Klinkott's paper on the construction of the Altar of Pergamon calls attention to the materials used for the core structure (tuff and andresite) and to the overall architectural design. Small discrepancies in the execution as well as the original metrology are examined.

Reinhard Heinz' paper addresses the construction of the Mausoleum of Belevi, in Lydia. The building had a square podium and a square peristasis of eight columns on each side with an open inner court. Its architecture reflected the models of monumental Hellenistic funeral architecture. According to the author, the way builders attempted to create strong bonds between the blocks reveals the high quality of this marble construction. One of the aspects that emerges is the use of mortar for bonding purposes – podium – and for filling the gaps at the level of the upper entablature (to increase earthquake resistance?). The use of mortar in Hellenistic masonry is a topic that deserves more investigation, since its traces are not enough considered in scholarship, as in the case of the po-

dium of the temple of the Olympieion of Salamis, Cyprus.

Contrary to the early use of construction marks discussed by Alexander von Kienlin, the paper of Martin Bachmann and Janet Lorentzen shows that the marking of stone material in Attalid Pergamon was not needed to guarantee appropriate assembly of the architectural elements, but was rather connected to the organizational needs of the different groups of stone suppliers and masons.

We now turn to the Roman Period. The use of rustication in the architecture of the Porta Nigra in Trier indicates an unfinished construction, as suggested by the observations developed by Birte Geißler on the well-known monument. Her analysis touches one of the topics frequently discussed in buildings with rustications (such as the Porta Maggiore in Rome), and concludes that the stone surface of the building in Trier was clearly meant to be smoothed and finally decorated, but the work was interrupted for some reason.

Luise Albrecht approaches a most challenging topic: how were bricks in Rome cut from square to triangular? The result of her analysis, which would have benefited our understanding of the building process, leaves without a definite answer.

Ursula Quatember and Gerhard Paul describe their experiments on connecting blocks with dowels, a technique extensively employed in Roman construction. These vertical metal connections into ashlar construction were locked into position with molten lead. The text shows that either lead could be poured after the positioning of the upper block through the pouring channel or, as supported by some scholars, it could be poured into the hole just before lowering the upper block.

Claudia Winterstein highlights the special use of so-called beachrock (Strandfels) in Western Rough Cilicia, a material easily found along the coast. Although not the only material locally available – in fact other stone building material is employed in regional architecture – it was used in a building dedicated to Trajan (present-day Şekerhane Köşkü) in Selinus. The article is dedicated to the analysis of the construction details related to this particular material.

Jens Pflung's analysis of the sunken peristyle of the Domus Augustana on the Palatine Hill contributes to the understanding of organizational issues relating to major imperial projects in Rome during the second half of the first century A. D. The lack of uniformity in the construction is interpreted as the result of three factors: the lack of a site manager (at least in the first building phase), the presence of many contractors or separate, uncoordinated building teams and changes or adaptations during the two main building phases. It is worth emphasizing that this analysis bears witness to the difficulties

(but also the creativity) of the builders as they approached new architectural styles. From Nero onwards we see that masonry is sometimes imperfect in details and uniformity, but of extremely high structural quality, thus Pflug's contribution gives new insight into the creative process and its challenges in a period when a new architectural language was developing.

Clemens Voigts addresses a topic that has remained somehow secondary in the studies of Roman construction: the use of other metal strengtheners and supports, not only clamps and dowels. Many scholars have recently turned their interest to the study of metal components in concrete and ashlar construction (cf. C. M. Amici, *Architettura romana. Dal cantiere all'architetto. Soluzioni Concrete per idee progettuali* [Rome 2016]), and Voigts' contribution relates to the evidence of boreholes which go deep into the marble entablature of the Sunken Peristyle of the Domus Augustana. His proposal – metal anchors related to tie-rods needed to reduce the thrust of the vaults built on the colonnade – remains hypothetical and will need further examination when new evidence is available. Regarding his question as to whether metal strengthening was also adopted outside Rome, I suggest, as a possible comparison, the Bath on the Lechaion road in Corinth (see P. Vitti, *Building Roman Greece* [Rome 2016] 237–242).

Thekla Schulz' reconstruction of the temple of Serapis in Ephesus is based on the analysis of its marble elements. The front of the building was made entirely of Proconnesian marble monolithic elements while the rest of the construction was built with ashlars and mortared rubble with petit-appareil facing. The plan and proportions of the temple are quite unusual, to suit the rituals of Serapis worship. Particularly interesting is her proposal for a coffered ceiling above the cella and her analysis of how water served for the religious rituals with healing and sensorial function.

The third-century fortification of Nicea (Izник) is analysed by Ayşe Dalyancı-Berns. The wall circuit of five kilometres in length is still preserved in quite good condition, making it possible to examine the building techniques and the organization of this demanding defence program. Her contribution highlights the use of bricks and the working groups that were necessarily involved in the completion of the construction in only ten years. While the overall presentation is a major contribution to the knowledge of building techniques in late third century Bithynia, her discussion of the structural details of the masonry is not compelling, especially regarding the understanding of the brick bands passing right through the thickness of the walls. This technique is adopted in many parts of the empire, sometimes using stones, on other occa-

sions bricks, to create bonding courses to reinforce concrete masonry, typically formed by a core and two facings.

Marc Waelkens, Göze Üner and Julian Richard examine the late Hadrianic nymphaeum in Sagalassos, Pisidia. From the in-depth analysis of the architectural decoration of the monumental façade emerges that many working groups had additionally been hired from other regions, due to the pressure to finish the work in a short space of time.

Finally we turn to the Late Roman period. As a part of the Ostia-Forum Project, Axel Gering has studied two thousand marble fragments in eight store places, in order to reconstruct the use of marble in the fifth and sixth century A. D. This enables greater understanding of the way these deposits were created after detaching marbles from buildings and then putting them to different use. The article provides evidence of a ›second life‹ for marble elements.

Christiane Brasse's inspired article on structural matters in late antique construction, with a strong focus in the East, particularly Syria, highlights two solutions adopted to make structurally sound masonry and arches. Regarding wall construction, she points to the use of stone ashlar in mortared masonry to create bonding courses, a well-known topic in Roman architecture, at least since the introduction of bipedalis bonding courses in Rome in the first century A. D. This addresses the structural weakness generated in walls made by two facings and a fill. Brasse's second topic is the use of toothed ashlar, interlocking horizontally, for the construction of arches and flat-arches in Syria. Her observations shed light on the development of this structural solution, often, but not only, found in Arabic architecture.

Catherine Hof focuses on the vault construction in the fortification of Resafa. The second-phase insertion of stone vaults into the towers of the fortification is analysed to show the confidence of the builders in inserting vaults, which were very shallow and quite different from the traditional half-circle barrel vaults. The comparison with the vaults of the fortifications in Zenobia is suitable to establish a possible link between expertise coming from the capital (Constantinople) and the provinces, occurring at the time of the strengthening of the fortifications of the empire, under Justinian. The article enables a better understanding of the spread of expertise throughout the empire, which I have also noted in the context of the Aurelian walls in Rome (cf. P. Vitti, *Arch. dell'Architettura* 18, 2013, 88–113). It would be interesting to establish at what level masons adapted their knowledge in the construction of brick vaults to the construction of stone vaults.

To conclude, this book makes clear that construction history should not be considered a se-

parate field of research, but undoubtedly needs to provide the foundation of any history of architecture. Starting from an analysis of the materials, construction history seeks to identify those elements that were constraints for the architects: the choice of materials, the available technologies and techniques, invented ad hoc (as demonstrated by the Mausoleum of Belevi), the evaluation of the resistance to forces and the structural layouts. This process is entirely similar to what an architect experiences when designing a building, when aesthetic and design issues are influenced not only by the context, but also by the materials, technology and workmanship available and the cost of construction.

Rome

Paolo Vitti