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Technology: Architectural Innovation in Anatolia

Introduction

A prime example of technology transfer occurring at a relatively early period is seen in the monumental structures of the Mycenaean and Hittite cultures. Cyclopean walls and corbel vaulting are obvious characteristics shared by both civilizations (fig. 1). Looking deeper at sophisticated construction techniques, such as use of the stone-saw, seems to have provided an even stronger indication for technical exchange between the two centers of the Bronze Age Mediterranean world[1].

Fig. 1 – Cyclopean walls in Boğazköy (BACHMANN 2006).

New results from experimental archaeology carried out by Jürgen Seeher at Boğazköy shows that the often-cited Hittite sawing technique is in fact based upon very simple principles[2]. Although a cultural exchange is not ruled out by this discovery, it is now likely that there could have been an independent development of the sawing technique, especially given well-understood common needs of both Empires. Here we have a good example of Dissemination Theory resting its edifice on shaky foundations. In reality, the supporting information coming from the field of building technology studies has been too self-contained, as a discipline, and scantily treated thus far, to serve as proof for any general trends. Also, the situation with ancient cultures in Asia Minor has as yet too much unexamined complexity for making generalizations. The examples from Asia Minor discussed here attempt to place building activity and innovation into a much tighter historical, cultural and scientific context.

[1] For example MARAN 2004, 270.
[2] SEEHER 2008, 27–43.

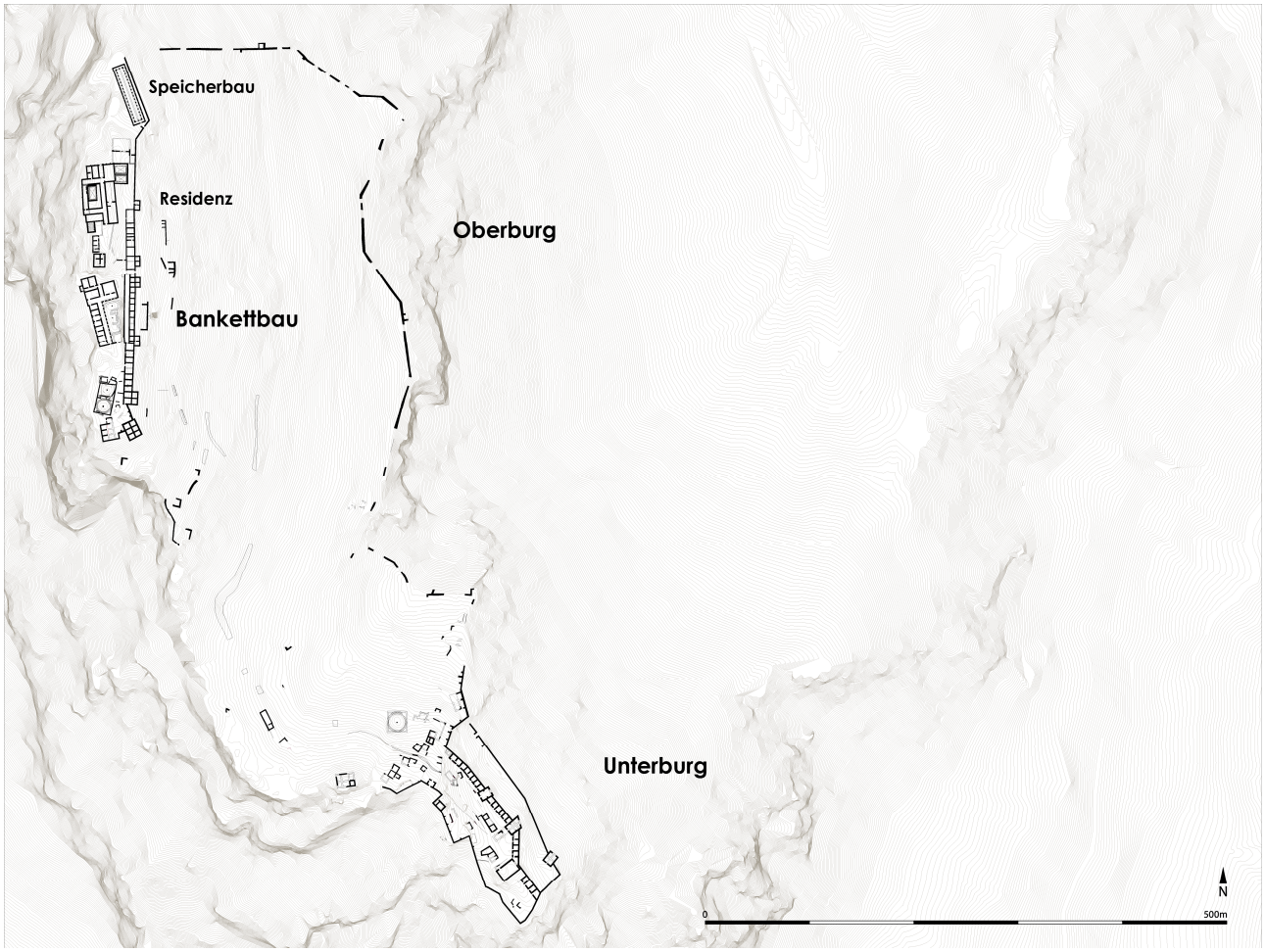


Fig. 2 – Layout plan of the Karasis fortress (Drawing D. Lorentzen).

Case studies in hellenistic architecture

The fortress on the Karasis

The Hellenistic fortress on the Karasis in Cilicia demonstrates how for a very large project indigenous building modes were productively combined with imported planning and engineering techniques. The expansive building complex lies on top of a mountain of the same name, on the edge of the fruitful Cukurova plain north of modern-day Adana. The ruin was only discovered some 10 years ago, and from 2003 to 2006 Mustafa Sayar and Adolf Hoffmann conducted a systematic examination[3]. An exact documentation of the ruins should help with clarifying the central questions about function and dating.

A look at the layout of the fortress shows, in the first instance, a skillful use of the difficult topography (fig. 2). The complex is divided into an upper citadel on the highest, elongated spur of the mountain massif, and a lower fortress which secures the southern flank with the entrance area. A long defensive wall spreading far to the east secures both parts.

The fortress is completely functional in its arrangement and absolutely unadorned, apparently by intent. For an antique building it is quite extraordinarily austere. The only decorative relief, showing a war elephant, adorns one of the towers of the lower fortress (fig. 3). This relief can be understood as a reference

[3] Preliminary report at HOFFMANN 2008, 365–468.

to Seleucid rule. Despite this lack of iconography, the walls of the Karasis are teeming with information: in addition to the relief, numerous mason's marks are visible on the tower wall.

Such mason's marks appear, in changing density, on nearly all wall sections of the Karasis. Some sections appear evenly covered with marks. Only the simple rubble walls of the fortress are free from marks, as their material was hardly worked. The marks served thus for the identification of the elaborated stones, into which some effort was invested. This pattern accords with the oldest examples of buildings with mason's marks[4].

Fig. 3 – Karasis, tower of the lower fortress (BACHMANN 2005).

It is clear that the ashlar blocks were marked early on in the process of their creation. Otherwise there is no explanation for the often-observed phenomenon of a truncated mark at the edge of a block (fig. 4). The truncation must have occurred when the prefabricated ashlars received their final preparation for setting on the site. Most likely, then, the marks were applied immediately after preparation in the quarry. This corresponds to the topography of the Karasis; the area is so steep and difficult that a transport of stones in hardly possible. The building material was quarried directly on the site, with extraction and terracing for the building resulting from the same process.

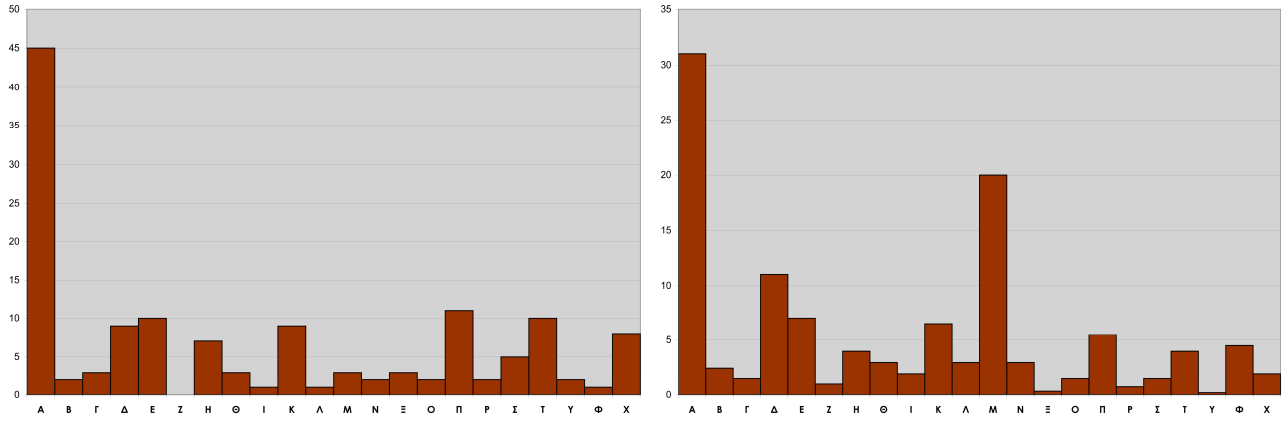
Fig. 4 – Karasis, truncated mark at the edge of a block (BACHMANN 2004).

Hellenistic mason's marks in Pergamon

This phenomenon, the distribution of mason's marks applied early in the building process, shows clear parallels to the building industry of the so-called Eumenian urban extension at Pergamon[5]. In the first half of the 2nd Century B. C. the town of the older kingdom had been extended by the addition of a considerable area. At the lower parts of the citadel numerous monumental buildings were rapidly erected: the Gymnasion, the Demeter sanctuary[6] and the lower Agora, to mention only the largest. This large-scale building site, as on the Karasis, required complex organization forms, in which the mason's marks seemed to have played an important role.

The mason's marks of the Eumenian building activity in Pergamon were systematically examined in the past years (fig. 5). The letters of the Greek alphabet predominate. Other marks, such as a swastika-like symbol, hardly appear. Amidst the letters there are also numerous ligatures. Usually two letters were connected to a characteristic symbol. Such ligatures are well-known as potter marks. Among the ligatures

[4] RICHTER 1885, 8–24. Early Investigation of mason's marks in Rome, Pompeji, Perusia-Perugia and Mons Eryx.
[5] Further investigations in Pergamon's mason's marks at BOEHRINGER *ET ALII* 1937, 78 and SCHAZMANN 1923, 17.
[6] Excavation report DOERPFELD 1919, 346–524.



Figg. 6-7 – Diagrams of the prosopografic frequency of initial letters in Pergamon and of the frequency of letters in Pergamon's mason's marks (M. Bachmann).

the letter Alpha is noticeably frequent; numerous variants of the Alpha also occur. This is a clear indication for an interpretation of the marks as abbreviations of proper names.

It is a clear indication, because the prosopografic frequency of Alpha in Pergamon (fig. 6) is just as significantly above average as its occurrence amidst the well-known mason marks of the Hellenistic city (fig. 7). This is can be seen by comparing the two diagrams shown. The building industry of the Hellenistic metropolis in the west of Asia Minor was thus determined by hierarchical organization forms, which were subdivided into individual craftsman or wage entrepreneur structures. The marks served therefore both as certificate of performance as well as organization aid – for example for the destination of the material. Thus they indicated origin and regulation at the same time.

Fig. 8 – Karasis, points as mason's marks (BACHMANN 2005).

Mason's marks and building technique on the Karasis

It is possible that the mason's marks on the Karasis served a similar function. A certain form of building organization developed in the western centers of Asia Minor seems thus to have been transferred into the Cilician province[7]. However, a closer look at the Karasis marks shows some clear differences, in contrast to the situation at Pergamon. The Karasis marks include a large number of trivial, non-alphabetic marks such as points or simple symbols (fig. 8). The simple points were at first not recognized or identified as mason's marks, so unusual was their form. With these simple marks native Cilician craftsmen could have adjusted themselves to working under an alien organizational mode. The Greek letters then stand symbolically for this innovative alien building practice, whose representatives acted as consultants.

There are variations in the masonry techniques on the Karasis, and as expected, there are correspondingly different marking systems. Certain buildings on the Karasis have elaborate ashlars with

[7] A similiar phenomenon in earlier periods was suggested for the Carian stone masons: DRESSLER 1966, 73–76; FRANKLIN 2001, 107–116; GOSLINE 1992, 43–50 and GUSMANI 1988, 27–34.

drafted margins. These drafted-margin ashlars are hardly ever signed with native Cilician symbols, such as the points. Thus this kind of masonry technique might be a more direct transfer of technology in the 2nd century B.C., which raises the question: what were the extant building practices in Cilicia before the transfer?

Fig. 9 – Hellenistic tower in Meydankale, Cilicia (courtesy ROOS 2004).

There was, first of all, a very sophisticated tradition of stonework, involving complex masonry techniques. Characteristic is the closely and carefully fitted polygonal masonry, which is transformed at the corners of the building into rectangular ashlar masonry, illustrated by a Hellenistic period tower (fig. 9) in Meydankale (Olba region). Technical details such as a hardly visible, but highly effective relief of a door lintel with a jack arch are typical of the indigenous craftsmanship.

The established masonry techniques were exploited when the fortress was erected, but for new and unusual architectural forms. Included among these new elements is a remarkable Symposia building of the upper fortress, which allowed the injection of manorial life into the purely functional fortress architecture[8].

Using the mason's marks, the development process of the Symposia building could be exactly reconstructed (fig. 10). For each step of the process the existing terrain and its stone resources were skillfully employed. Extremely similar procedures may be presumed for the Eumenian buildings of Pergamon. The question which now follows is whether the innovative building industry of the Hellenistic fortress showed direct consequences for the further architectural development in Cilicia, as it should do to be regarded as a lasting innovation process.

Fig. 10 – Karasis, development process of the Symposia building (M. Bachmann, G. Hell).

[8] HOFFMANN *ET ALII* 2007, 416–423 and 438–441.

Fig. 11 – The southern church of Akören II (courtesy ROOS 2005).

Fig. 12 – Karasis, storehouse (BACHMANN 2005).

Further development in Cilicia

It seems that there was little lasting impact of the inventions of the Karasis in Cilicia. Cilicia remained faithful to her own stonework traditions through and beyond the Roman period, apparently unaffected by their innovations, as this example of early Byzantine architecture of Akören shows (fig. 11). The masonry of this church was produced in the same, careful technology as already existed seven hundred years before[9]. General rules for the dating of masonry techniques fail here miserably because of the continuity.

Fig. 13 – Andriake, horrea hadriani (BACHMANN 2007).

The magnificent masonry of ashlars with drafted margins (Rustika), with which certain building of the Karasis fortress were emphasized, likewise remained without direct successors. Here a view of the remarkable storehouse of the fortress (fig. 12). Much later this technique appears again in Cilicia with the Roman horrea hadriani in Andriake[10]. It is a point of interest, that more than three hundred years later, for a similar building function a similar, representative ashlar masonry was used (fig. 13). Innovative advances of Roman civil engineering remained nevertheless usually limited to the large coastal centers and Cilicia experienced no further impact.

The Red Hall in Pergamon

This is actually also valid for one of the most remarkable Roman building complexes in Asia Minor, the Red Hall in Pergamon (fig. 14). The enormous building complex can be considered the main urban emphasis of Roman Pergamon which covered the plain in front of the citadel. Presumed to be a cult center, the exact interpretation of the Red Hall's function is still pending. Much points however to the fact that imperial Rome had made itself owner of this enormous building project. In various regards it could be

[9] WULF 2003, 306–307.
[10] BORCHARDT 1975, 66–71.

Fig. 14 – Red Hall in Pergamon (BACHMANN 2008).

Fig. 15 – Dome of the southern tower of the Red Hall in Pergamon (BACHMANN 2006).

described as an exposition of the Roman building industry, especially put together for the benefit of Asia Minor.

First the course of the Selinus river had to be diverted into two huge conduits, in order to create an enormous building platform, a monumental engineering achievement. On this platform the buildings of the Red Hall with their enormous courtyard were situated.

However, the most remarkable innovation is the use of bricks for the erection of the main building, the so-called Basilica. Prior to the Red Hall, building with bricks was virtually unknown in Asia Minor. In contrast to *opus testaceum*, the brick walls of the Red Hall are substantially through-bricked without using *opus caementicium* as inlay. Tremendous quantities bricks had to be manufactured for this task.

Not only the through-bricked Basilica walls but also the domes of the two flanking round towers were erected in brick (fig. 15). This seems especially significant, as elsewhere in the Red Hall *opus caementicium*, or Roman concrete, was largely used. Special consideration seems to have been implied through the use of brick, and especially regarding the precision of the execution of construction.

Special marble pieces were integrated into the brick walls, which served as the fixed part of a prefabricated wall decoration of white and coloured marble. The building would have been completely encrusted with marble; today only a few remnants can be seen.

The use of brick masonry was limited to the main architectural elements. All remaining building parts of the Red Hall were erected with natural stone. Here *opus implectum* was largely used, in a form with relatively small, easily-handled ashlars, as is often seen subsequently at Pergamon (fig. 16). In this regard,

Fig. 16 – Retaining wall of the Red Hall in Pergamon (BACHMANN 2006).

at least, the introduction of the Roman building industry in Asia Minor can be called a success story. *Opus implectum* with the characteristic, small ashlars was used in many Roman buildings. A totally different development must be noted concerning the brick technology. Here, the Red Hall in Pergamon must be considered as an investment failure to introduce a new building and construction technology. Building with bricks remained exceptional in Roman Asia Minor.

Fig. 17 – Vespasianic bath building in Oinoanda/Lycia (BACHMANN 2007).

Conclusion

The examples shown outline a rich and multi-layered diversity of features concerning innovation processes in Asia Minor. The Hellenistic epoch is characterized by strong innovation in both areas of craft technique and industry organization. These innovations built upon indigenous developments, and thus display regional peculiarities. The Roman building industry was introduced in different ways. Some innovations - like *opus implectum* - were fast

established in the urban centers; others were not generally accepted in relation to pre-existing strong traditions. Faraway from the centers of Roman display of power the strong traditions of Hellenistic construction continued for a long time. As for instance in this bath building from the Vespasianic period in Oinoanda/Lycia (fig. 17).

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