

## Drafting and Designing. Roman Architectural Drawings and their Meaning for the Construction of Heliopolis/Baalbek, Lebanon

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**ABSTRACT:** For the monumental Roman temples of Baalbek, although preserved exceptionally well, many questions about the construction methods remain unanswered. With the discovery of numerous architectural drawings etched into stone surfaces in the course of the excavation works of the 1940s until 1975, and now recently in the last years, some of these questions can be answered. For the first time, these scarcely published drawings are compiled and identified entirely now.

A recently discovered and documented reduced scale partial floor plan drawing suggests new theories about the construction of the hexagonal forecourt to the Jupiter sanctuary. This case shows the degree of abstraction in designing as a first theoretical step before practical construction starts. Details of this outstanding etching show an alternative design, and appear in an unsuitable scale for execution. On the other hand, several discovered full scale drawings of construction details explain the practical construction process used to dimension and assemble the giant ashlar used for the construction of the Baalbek temples.

In combination with the rooms and wall surfaces that were used to etch the lines into, the drawings help to progress our understanding of the former appearance as well as the construction process of Baalbek's temples substantially.

### INTRODUCTION

The field of Roman architectural construction drawings is far from being well known, and only little research has dealt with this subject. The technical difficulties of the master builders responsible for Roman temples and sanctuaries were challenging. Especially in Baalbek, where techniques were used that caused enormous logistic and practical efforts, Roman construction drawings help to get a better comprehension of the antique construction process today.

The town of Baalbek in the elevated Bekaa plain in today's Lebanon occupies the spot of the antique city of Heliopolis, where construction of monumental Roman temples and sanctuaries began in the first century before Christ, and lasted until the third century A.D.

Drawings from Italy, Asia Minor and the Maghreb underline the purpose and characteristics of Roman drawings. Three main purposes of representation, design and construction preparation give insight to aspects of the work of the architects of Roman architecture. While representation purposes are only found in examples elsewhere in the Roman Empire, the other two technical characteristics of drafting and designing can be explained by the etchings of Baalbek. Notation characteristics of architectural drawings correspond to Vitruvius's distinction between the Species (architectural drawings) called Ichnographia and Orthographia (Vitruvius Pollio 2001, pp.25). The first describes the reduced scale plan of a structure, intended to display the Dispositio, the arrangement of the building, mostly intended to design a building beforehand. This is opposed to the second, which is a breakdown of a building or a part in its vertical projection or elevation, in order to plan its Symmetria, the regularity and harmony of details with the whole.

We can assume that the designing process was carried out by the architects on drawings in smaller size, usually on paper. The practical preparatory sketches however were later drawn by the foremen on site, close to the spot they were intended for. While the use of preparatory score lines and scratch axes on the building are commonly known throughout the field of Roman Architecture research, discoveries and research of entire drawings are few and far between. This especially applies to Baalbek, where score lines are to be found on all of the antique monuments, and with outstanding precision on the fragments and remains of the Jupiter temple and sanctuary. All of Baalbek's preserved drawings shown in this paper are etchings into the vertical and horizontal surfaces of the architecture (see Fig. 1), and are composed of lines of different strengths, forming thick and thin descriptive lines and geometrical construction axes and outlines.

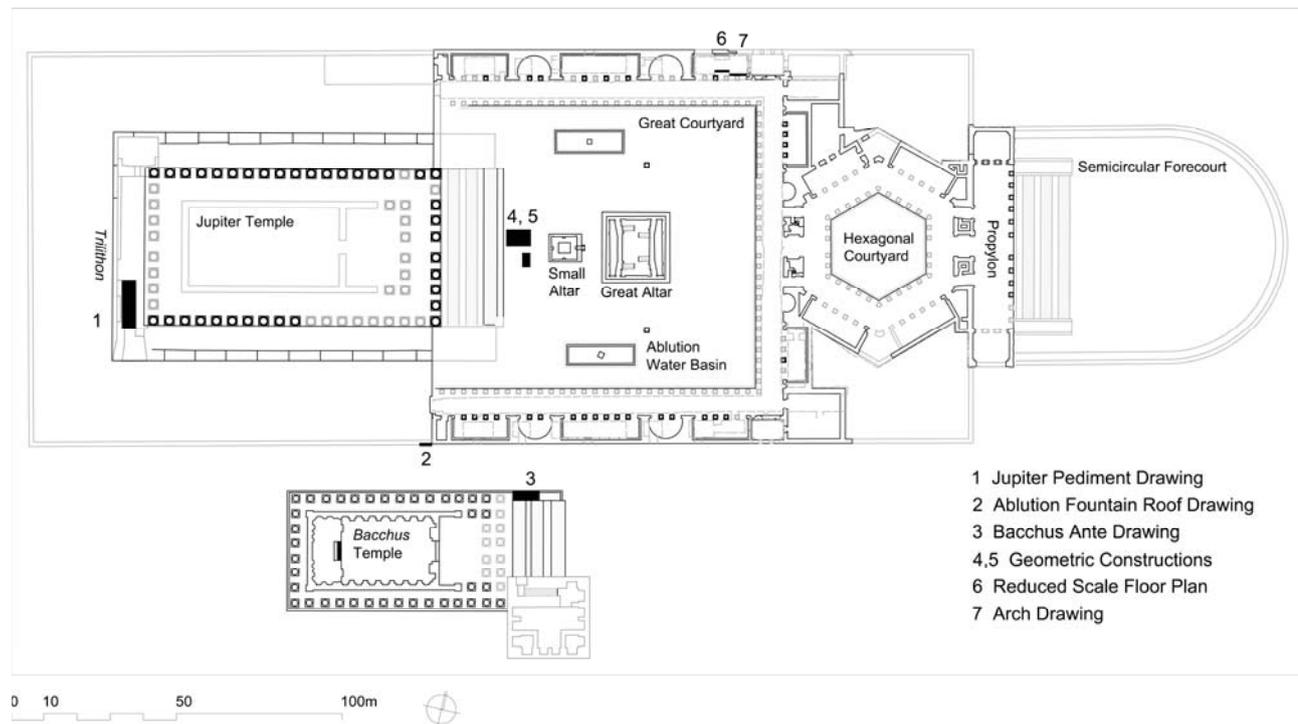


Figure 1: The Baalbek Sanctuary with the Drawing locations; (Drawing: Lohmann)

### Research Programme

The research history of Baalbek/ Heliopolis is long. In over 100 years of research projects in Baalbek since the first German excavations in 1900-1904 until today, more and more researchers became interested in the Roman architecture of Baalbek and its construction and technology.

In recent years, the research of the German Archaeological Institute, the University of Cottbus and the Lebanese Antiquities Department focused on the scientific rehabilitation of work that was carried out before the outbreak of the Lebanese civil war in 1975 (van Ess 2008). Within this programme, the architectural morphology and planning phases of the Jupiter sanctuary is a fundamental subproject carried out by the author of this paper. Most of the Roman drawings of Baalbek give substantial information about these phases and the Reconstruction of the architecture.

While new excavations in Baalbek are not planned within the current programme, other projects in the future will clearly discover more architectural drawings in Baalbek.

### PUBLISHED DRAWINGS

The first scientific publication showing Roman architectural drawings from Baalbek, but neither describing nor mentioning them, are the issues of the first German excavations in the ruins in the years 1900-1904 (Wiegand 1921). The floor plan of the Jupiter temple shows two drawings etched into the Roman courtyard floor on the right of the drawing, at the foot of the stairs (Wiegand 1921, plate 19).

During the extensive restoration works of the Lebanese Antiquities department in the years 1942-1975, numerous drawings and even some architectural models started appearing. Haroutune Kalayan, the engineer in charge of the excavations, published his ideas and documentation about a few of them.

### Jupiter temple Pediment

As the most famous example, he documented an enormous drawing on the surface of the southern one of the three trilithon blocks. Built up of three monumental monoliths of 4 x 4 x 20 meters, the trilithon is the second of three masonry courses of the western side of the Roman temple podium. The drawing shows part of the equally large pediment of the Jupiter temple (Kalayan 1969). It is composed of diagonal parallels, small rhythmic partitions between two of them, as well as arcs and a symmetry axis to the left. Almost the whole surface of the giant trilithon block is covered with lines, making up a drawing of over 4 x 13 meters size.

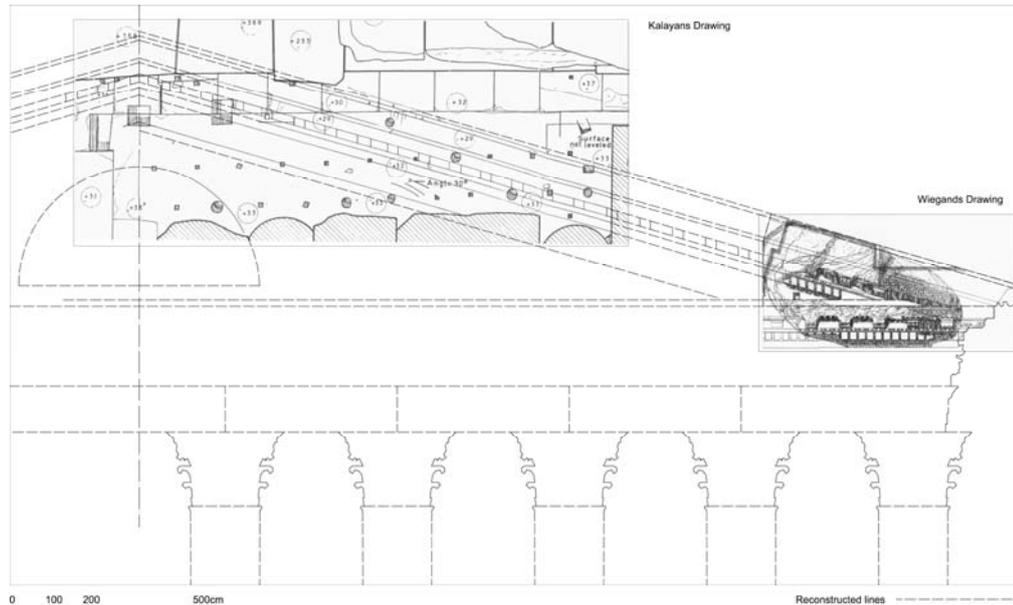


Figure 2: Natural scale drawing of the rear Jupiter temple pediment; (Drawing: Lohmann, based on: Kalayan 1969, Fig. 1 (top) and Wiegand 1921, p.58 (right))

The perfectly matching overlay of Kalayans documentation (Kalayan 1969, Fig. 1) with the fragment survey of the Germans (Wiegand 1921, Issue I, p.58) proves the drawing to be a natural scale outline of the southern half of the rear pediment of the Jupiter temple, drawn in direct proximity to its final position. The diagonal parallels show the entablature, with the small partitions marking the modillions under the cornice. To the left, a symmetry axis and the section of an arc allow a positioning of the drawing onto the reconstructed back facade of the Jupiter temple, as it is shown in Fig. 2. If the arc marks part of the Jupiter temple tympanum, the facade reconstructions must be redrawn and a central arch added: a rather unusual feature.

Kalayan suggested that this drawing proves the trilitheon to be older and already in place when the temple was built. Today, new indications show that this assumption is outdated, and that the trilitheon and the temple were built synchronous (Lohmann 2009). The upper surface of this block was practically used for the preparation of a simultaneous construction, later simply to be covered by the next stone course.

### Ablution fountain house

The second published drawing is a detail of a smaller architectural feature of the Baalbek sanctuary. It displays a sketch profile of a feature strikingly similar to the roof of the fountain house in the centre of the water basins in the Great Courtyard (Kalayan 1971). The basins are visible as horizontal rectangles in the Great Courtyard in Fig. 1. Kalayan assumed that the drawing is a layout for the fountain in the Great Courtyard, drawn to half scale. However, a simple comparison to the preserved building fragment of the fountain house and its published fragment (Wiegand 1921, p. 95), shows strongly differing dimensions (see Fig. 3). The well preserved fragment neither matches the natural scale of the drawing nor its double size, but shows a relation of 1:1,6.

Looking at the common practice in Baalbek of preparatory sketches close to the destined place, it appears to be a sketch for a different fountain house. Since the drawing is facing the Bacchus temple on its ground level, it is presumable that this temple also had ablution basins, which would be another one of many parallels to the Jupiter temple. They remain yet to be excavated.

In 1993, Joachim Heisel gave an overview of the state of research on antique construction drawings (Heisel, 1993), republishing the hardly accessible Kalayan publications about Baalbek and other examples from Lebanon. He gave a full and comprehensive overview of antique architectural drawings, as well as giving some new observations about the Baalbek drawings.

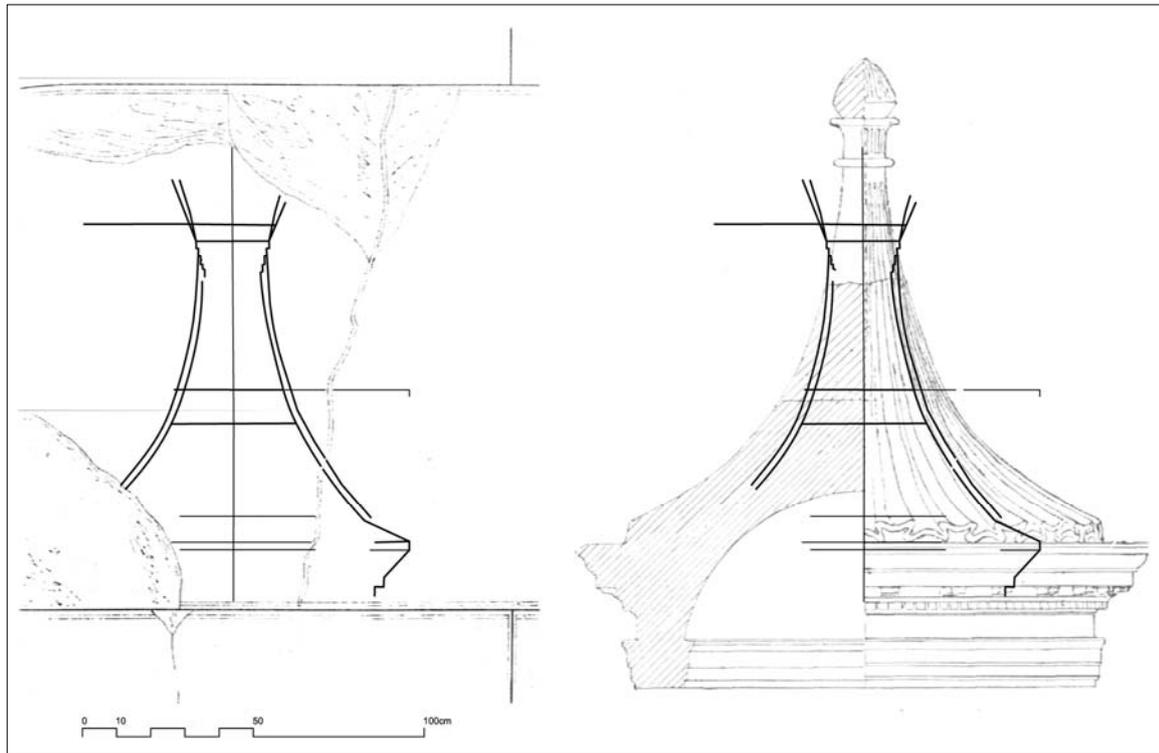


Figure 3: Natural scale drawing of an abluion fountain roof;  
(based on: Kalayan 1971, Fig. 7(1) (left, with additions by Lohmann) and Wiegand 1921, p. 95 (right))

Kalayan himself mentions further Roman drawings on the northern ante of the *Bacchus* temple stairs, and in-between the *Jupiter* temple stairs and the small altar (Kalayan 1969, p.152). They are the same drawings roughly shown by the Germans at the beginning of the century, and were surveyed in detail by the author now, to be presented amongst the following.

## NEW DISCOVERIES

### Construction drawings on the *Bacchus* Temple ante

The drawing Kalayan mentions on the north ante of the stair case leading to the *Bacchus* temple south of the *Jupiter* sanctuary (see Fig. 1) can be barely noticed. Exposed to weathering, the engraved lines are extremely altered and can be identified only in oblique lighting during sunset or sunrise.

The engraving covers two stone blocks measuring about 4 x 4 meters each, as shown on Fig. 4. The blocks were slightly displaced during the earthquake of 1759. An Arab fortification wall in front of the *Bacchus* temple, dismantled during the French and Lebanese excavations and restorations in Baalbek in the 1940s as well as the 1960s/70s, was covering part of the podium including the architectural drawing. The drawing displays a triangular shape extended on both eastern and western blocks, and an arch on the eastern block. Two engraved lines of a distance between 59.2cm (29.6 x 2) and 59.9cm (29.95 x 2) create an angle of 21° from horizontal.

The inner and outer radiuses of the arches are simultaneously 312.2cm and 221.1cm. The distance between the two curves is 118.1cm (118.1 / 4 = 29.52cm). Part of the arch is divided into 3 equally traced segments measuring 17.4° and forming three similar wedge shapes. Although one cannot relate the drawing to any existing architectural form, the shape seems to be etched at full scale. The different delineations of a pediment and a segmented arch, and their slightly shifted geometry suggest two superimposed etchings with different purposes. Possibly the surface of the ante was used for the drawings of different constructions nearby.

The Roman foot *Pes* of about 29.4 – 29.6cm was widespread throughout Empire during imperial times (Hoepfner 1984: 1). Smaller variations can be found on all monuments. This may be the result of different rulers in use by different masons and architects, as well as slight changes over time. In this drawing, the *Pes* varies from 29.5 to 29.6cm, and underline the Roman origin of this etching.

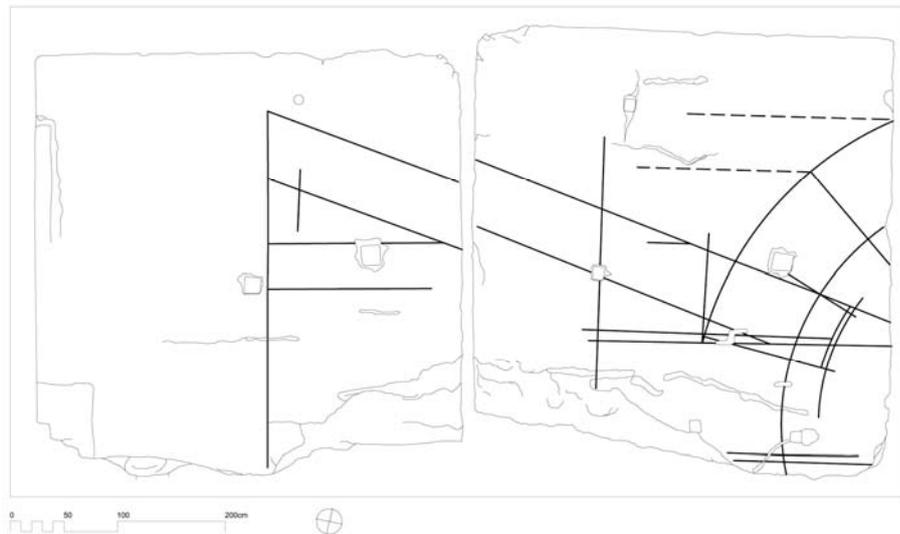


Figure 4: Natural scale arch/ pediment drawing; (Drawing: Falah Wakim)

**Geometric constructions on the Great Courtyard floor**

Both of the two drawings visible in the floor plan in Wiegands publication have recently been documented on-site in detail by the author. They are large etchings into the floor of the Great Courtyard, inbetween the older Small Altar and the staircase of the Jupiter Temple. They are drawn onto a flooring surface that was the result of a courtyard floor lowering by 52cm in a later construction phase of the sanctuary. This fact suggests that the drawing contains information about building structures from that later construction period when the Jupiter temple was already finished. There is evidence that the small altar was changed in this phase (Collart; Coupel 1977). Unfortunately its poor state of preservation makes the identification of the drawing purpose difficult.



Figure 5: Geometric constructions on the western Great Courtyard floor surface; (Drawing: Lohmann)

Fig. 5 and 6 show detailed surveys of both the drawings, added with reconstructed lines that complement the construction. Both cases are compass and straightedge constructions with arcs of giant diameters. While the drawing in Fig. 5 is a mixture of straight lines and circular compass strokes for the means of geometric construction, the drawing in Fig. 6 shows arcs as the primary drawing content. The differing distances between the long arcs suggest a giant entablature arch. However, the distances could not be paralleled to any of the surrounding construction. The *Pes* and its 16<sup>th</sup> fraction *Digitus* were used in both drawings on several places.

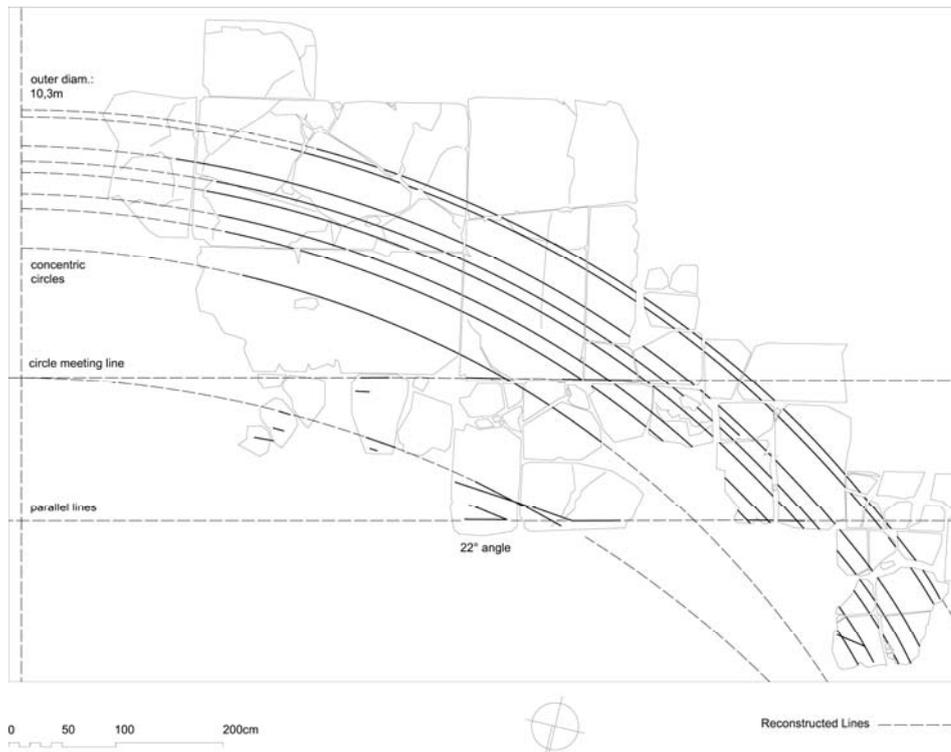


Figure 6: Geometric arc constructions on the western Great Courtyard floor surface; (Drawing: Lohmann)

### Two drawings in a vaulted substruction room

On the northern side of the sanctuary, an exterior exedra and its eastern and western side room collapsed over the centuries. The rooms were inaccessible and full of rubble, obstructed by their own collapsed vaults. Initially cleared by the German excavations at the beginning of the 20<sup>th</sup> century, the western room was made accessible only during the works of the French and Lebanese excavations and restorations in Baalbek in the 1940s and 1960s/70s. After a full reconstruction and anastylosis, their inner structure and architectural details could be investigated. On the southern wall of this room, two Roman architectural drawings are etched into the smoothed stone surface (see Fig. 1). (Lohmann; Wakim 2008)

### Reduced Scale Floor Plan

The drawing on the right displays the northwestern quarter of the floor plan of the Hexagonal Courtyard (Fig. 7). It is drawn in a reduced scale of approximately 1:12.6 and well preserved due to the protection from weathering. Outlines of the most prominent architectural features are shown, including the outer limitation of the wall construction, the exedrae and the column bases in the form of squares. In its large scale, the drawing covers a wall area of approx. 4.25m width by 2.60m in height. The orientation of the drawing on the wall, as well as the wall area available for the remaining parts indicate that it would have been possible to mirror one quarter in order to get one half for the display and construction of the whole courtyard. The main horizontal and vertical symmetry axes were already prepared, at least by smoothed areas on the stone surface. The intersection of the two axes, the central point of the courtyard is marked. However, we can hardly find traces of the southwestern part. It is obvious that the builders consciously chose this wall in this specific room of the sanctuary, as the wall surfaces had been properly smoothed beforehand. Most other rooms are built of ashlar that still show boss, a feature typical for the substructures of Baalbek.

Aside from the outline of rising walls, the drawing contains thin preparatory lines and axes. These are etched into the stone with more shallow lines, and are often times difficult to distinguish. Wall smoothing as a preparation for further drawing details show clearly, how the overall etching was intended to be continued.

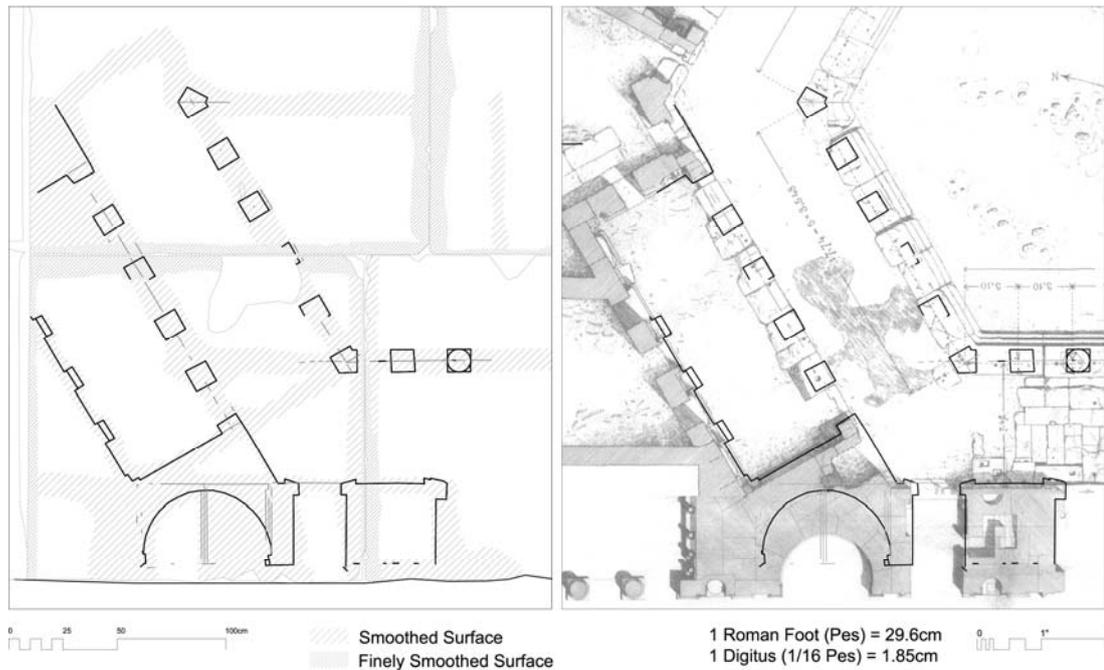


Figure 7: Reduced scale partial floor plan of the Hexagonal Courtyard; (Drawing: Lohmann (left), based on: Wiegand 1921, plates 28; 36 (right))

Fig. 7 shows an overlay of the drawing with the detailed floor plan of the first German excavations (Wiegand 1921: plates 28; 36). Because of the high precision of the German survey, many congruencies but also two major deviations from the actually constructed architecture of the courtyard can be observed: The dividing wall between the Hexagonal Courtyard and the Great Courtyard is drawn at a thickness of 38.5cm ( $38.5 \times 12.6 = 485\text{cm}$ ), being 599cm thick in its actual state and resulting in a difference of 114cm. Secondly, the semicircular niche facing the Great Courtyard has a larger diameter than in its present state. The amount of construction lines used to draw the wall and especially the niche show that the Hexagonal Courtyard and this niche were not yet executed, and are products of one single planning process. Secondly, a small but important difference in the exedra decoration of the rectangular exedra facing the Hexagonal courtyard can be seen. The wall is subdivided with four pilasters, opposing the four columns along the exedra opening. This type of decoration is never found throughout the exedra architecture of the Courtyards, and can even be considered an alternative design before work started on the entire upper floor architecture. The style later executed is a row of two-column *aediculae* in two storeys along the wall, each *aedicula* corresponding with the intercolumnium of the hall and shallow niches instead of the planned pilasters.

In consideration of these details, it can be assumed that this drawing has the character of a design drawing, rather than a reduced scale working drawing. The scale of 1:12.6 also would have caused difficulties for the executing workmen regarding the dimensions and cutting of stones. Finally, construction lines and symmetry axes show a certain 'searching', a process of thinking and designing.

The Roman foot can be found on several details of the drawing. The depth of the rectangular exedra measures 58.8cm, ( $2 \times 29.4$ ), and the radius of the circular niche towards the Great Courtyard spans 29.6cm. Wiegand indicates the precise axial length of 60 feet for the 5 bays ( $5 \times 354.8\text{cm} = 5 \times 12 \times 29.56\text{cm}$ ) of the Peristyle Hall. However, in the drawing one bay is only 28.2cm, not enough to consider it as a *Pes*.

Aside from proving the authenticity of these drawings, this shows that the drawing can be considered nothing but a design sketch, hardly intended as a working drawing in its unusual scale of 1:12.6, and scratched into the surface of a room on another floor level, far away from the designed structure. Therefore, this drawing is an outstanding example, a rare find of a reduced scale design drawing, not only for Baalbek, but for the entire Roman Empire.

### Arch drawing

Directly to the left of this floor plan, another drawing of a different character was discovered. On another part of a nicely smoothed wall, a full scale elevation or section of an arch gives us an impressive contrast to the design described above. Here, we receive specific information about the construction of the room itself. The displayed arch consists of five segments of  $36^\circ$  each, with a circular inner arch of 1.60m radius, and a horizontal upper surface. During the full survey and analysis of the drawing and the room, the drawing could be determined as a proper rendering for an arch in this very room. The depicted arch corresponds exactly with the barrel vault above the central, narrower part of the room. Only its diameter differs slightly, a deviation that is easily understood, for the arch was displaced horizontally by the vertical force of the ceiling above. Only half a drawing was necessary to prepare all the arch segments, and once more this drawing shows that the building blocks were laid out and cut in immediate vicinity of their destined position. (see Fig. 8)

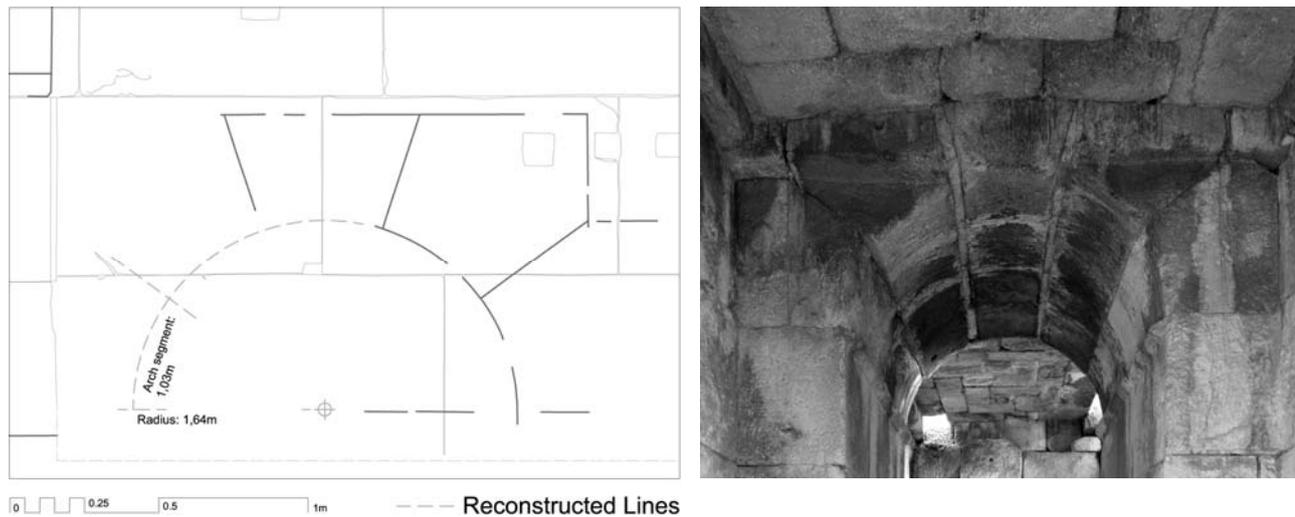


Figure 8: Natural scale arch/ vault preparatory drawing and executed arch in the same room; (Drawing: Lohmann)

## CONCLUSIONS

Enlarging the scope onto the entire Roman Empire and the scarce amount of preserved architectural drawings, Baalbek seems a stroke of luck in several ways.

The architectural development of Baalbek is a complex history of monumental designs, plan changes, and incompleteness. By considering the historicity of the surfaces that the drawings are scratched into, they give information about the historic layers by providing a terminus post quem for the drawings. All the drawing bases in Baalbek are architectural surfaces that were in their proper place when the drawing was etched, and therefore give reference to building activity that was executed concurrently or later. Results from other architectural research help to give a better precision dating of the depicted construction.

Amongst its contrast between enormous monumentality and delicate detailing, Baalbek is famous for its architectural incompleteness. Surfaces that were used to draw onto, such as the wall surfaces of the ground floor, were later to be covered by the next course of masonry, or smoothed and polished. Construction drawings were usually scratched into surfaces that were meant to be smoothed later (Heisel 1993). In most cases of Roman architecture, this polishing was finished, and the drawings lost. But since Baalbek was never finished in any of its planning phases, it is a lucky coincidence to have so many construction drawings preserved.

Grouping the drawings into three characters, the preparatory outline, the design drawing and the geometric construction, Baalbek provides a great overview of the practice of Roman architects and master builders, as it is shown in the examples. The most outstanding find however is the discovery of a reduced scale design drawing with no direct reference throughout the Roman Empire.

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