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## THE ARCHITECTURE OF TETRACONCH CHURCHES: BOSRA AND THE SYRIAN EXAMPLES OF APAMEA AND SELEUCIA OF PIÈRÍA, WITH SOME REFLECTIONS ON MILAN. PLANS AND IDEAL SCHEMES

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**Keywords:** Byzantine architecture, tetraconch churches, architectural design, stone structures; Hauran, Neoplatonism

**Parole chiave:** architettura bizantina, chiese tetraconche, disegno architettonico, strutture in pietra, Hauran, neoplatonismo

### Abstract:

*This study examines examples of 'centralised plan' churches, which are characterised by a symmetrical layout derived from a central point, in the particular design commonly known as 'aisled tetraconch' due to their distinctive shape, featuring four semicircles along the four main axes. The church of Saints Sergius, Bacchus and Leontius in Bosra, Hauran region, southern Syria, is examined in detail. Using documentation produced by European scholars between the 19<sup>th</sup> and 20<sup>th</sup> centuries, as well as examining the preserved remains, a hypothesis has been proposed for reconstructing the church's elevation. The plans of other Syrian tetraconch churches enables to define their design methods and propose a relationship with the Milanese church of San Lorenzo.*

*Lo studio esamina alcuni esempi di chiese con planimetria complessa, conosciute comunemente come chiese a 'pianta centrale', ovvero con una simmetria che deriva da un punto centrale, nella particolare forma a tetraconco, che prevede nella zona centrale quattro colonnati disposti a semicerchio realizzati lungo quattro assi principali. Viene esaminata in dettaglio la chiesa dei Santi Sergio Baccho e Leonzio di Bosra, nella regione dell'Hauran, a Sud della attuale Siria. Attraverso la documentazione prodotta dagli studiosi europei fra il XIX e il XX secolo e l'esame dei resti conservati si è arrivati a proporre una ipotesi di ricostruzione dell'elevato della chiesa. Le piante degli altri tetraconchi siriani consentono di definirne le modalità di disegno e di proporre una relazione la chiesa milanese di San Lorenzo.*

Because of their shape, tetraconch churches are a particularly interesting field of study for the history of architecture. They are buildings characterised by a centralised plan and a symmetrical interior, with colonnades arranged in four semicircles on the main axes, with four pillars at the meeting points of the colonnades. The outer wall sometimes follows the course of the semicircular colonnades, so forming a continuous four-lobed ambulatory, but it can also be a circle within which the semicircular colonnades are placed, as in the case of the church of Bosra. To one side of the nave are the presbytery rooms, which are more traditional in form. The architectural type has previously been examined by Peter Grossmann and W. Eugene Kleinbauer in several articles dealing with various aspects of the theme discussed here<sup>1</sup>. Although presented in a somewhat synthetic form, I bring out some new elements and present a revised interpretation of the architectural layout of the eastern tetraconch in the Syrian region.

One of the more complex matters to be studied is how the roofs of the central space and the ambulatory were constructed. At present, most of the buildings studied are in ruins, with only a few metres height of wall remaining. Even San Lorenzo in Milan, where the elevation does seem to have been preserved and which has been studied for its likeness to the Syrian models, does not offer elements that allow us to fully understand the shape of the vaults, due to the great changes they have undergone over time<sup>2</sup>.

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<sup>1</sup> See GROSSMAN 1983, pp. 169-173; and in our bibliography the various references to W.E. Kleinbauer. For a recent study also SANNAZARO 2015.

<sup>2</sup> On San Lorenzo in Milan: KLEINBAUER 1967; KLEINBAUER 1968; *San Lorenzo* 1985 (R. Cecchi), pp. 80-88; *ibidem* (L. Giordano), pp. 118-128; ROCCHI 1991; *San Lorenzo* 2004 (L. Fieni), pp. 97-113; *ibidem* (A. Scotti Tosini), pp. 167-182. For San Lorenzo and 4<sup>th</sup>-century architecture in Milan, KRAUTHHEIMER 1986, pp. 88-94.

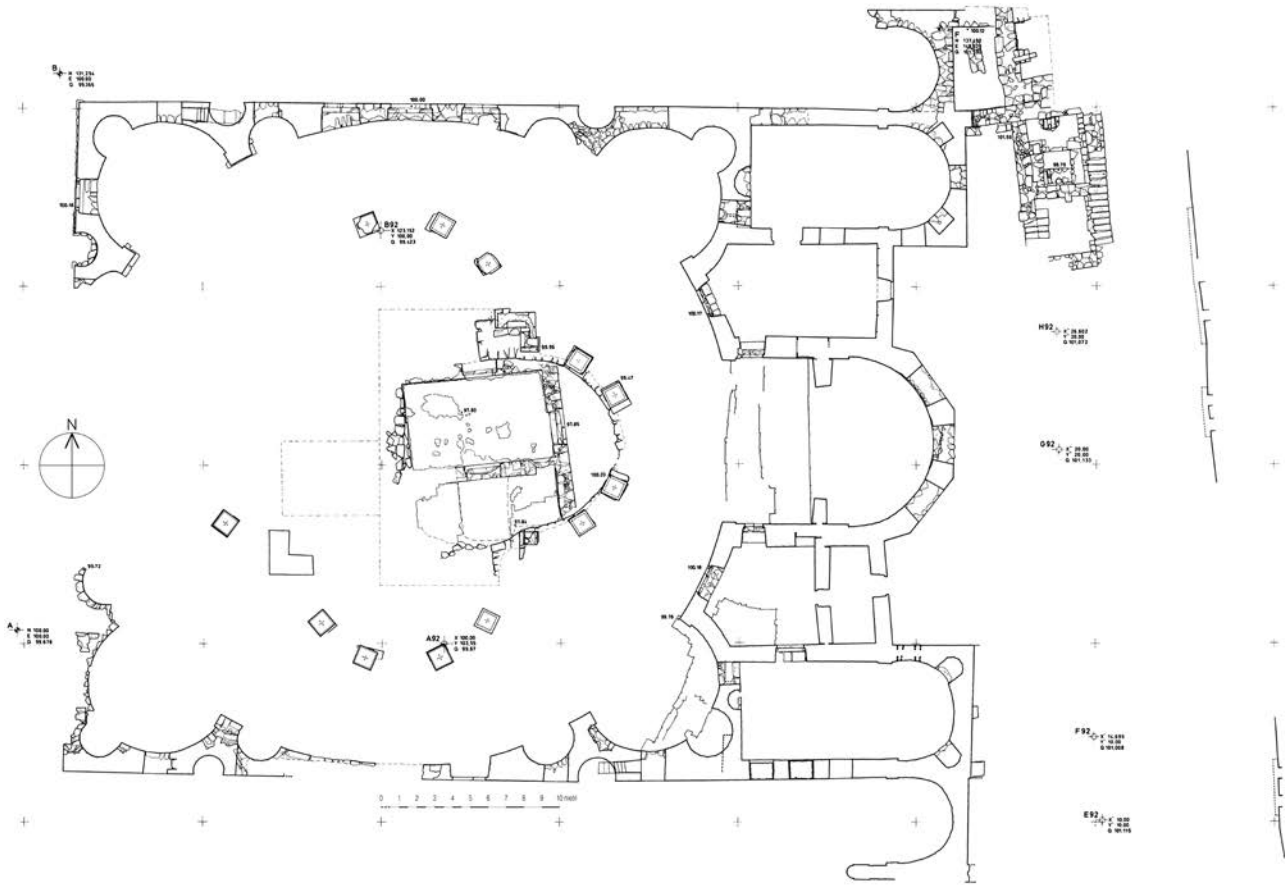


Fig. 1. Bosra, plan of the church of SS. Sergius, Bacchus and Leontius In the centre, several older structures are visible in a broad trench (surveys from 1996 and later by the author).

Compared to the nave churches, which derive from a more ancient architectural tradition and do not present any particular difficulties in the elaboration of their plans<sup>3</sup>, the tetraconch buildings require a more articulated geometric elaboration, both in the design of their layout and in the actual laying out of the plan on the ground. This is the most interesting and complex aspect of this type of building, as it demands a certain relationship to exist between geometry, architectural form and representative function that is difficult to fully comprehend. It could be said that the design of the tetraconch churches, thanks to the necessary coordination of architectural forms, exercises a dialectical *reductio ad unum* of the multiplicity of parts. This does not necessarily imply a direct relationship between architecture and the philosophical texts of the Neoplatonic school, except that both belong to the same *Zeitgeist* or, more simply, to the same cultural context<sup>4</sup>.

The focus here will be on buildings that allow a hypothetical reconstruction (and so study) in plan, as in Seleucia in Pièria, in Apamea and in Milan, and even in part of the elevation, as in Bosra. As we shall see, the status of the city is a primary factor in the construction of this particular type of religious building, since the cases studied are found in urban contexts of particular importance. However, buildings with a centralised plan had already achieved considerable success in Palatine architecture in the mid-Imperial period, before spreading their influence to the architecture of large aristocratic houses in Late Antiquity and being widely adopted also in early Byzantine ecclesiastical architecture<sup>5</sup>. After reaching a peak of popularity between the 5<sup>th</sup> and 6<sup>th</sup> centuries, the centralised plan – a ‘double envelope’ or ‘double shell’ building structures of various layouts, such as circular, octagonal or tetraconch, with a single or double roof of varying height – seems to have been largely abandoned in the West in favour of the nave layout<sup>6</sup>. Only in the case of the free-standing baptistery, which was not included into the basilica church, was the centralised plan used<sup>7</sup>.

<sup>3</sup> On the transmission of the basilica model, recently, KINNEY 2001.

<sup>4</sup> See below.

<sup>5</sup> See for example the Hadrian’s Villa in Tivoli or the palaces of Constantinople in the 4<sup>th</sup> and 5<sup>th</sup> centuries. KRAUTHEIMER 1986, pp. 77-78 and 259-260.

<sup>6</sup> These types of buildings with a centralised plan were later only oc-

asionally replicated. The most famous example is the Palatine Chapel in Aachen. See, RANALDI, NOVARA 2014, pp. 118-120.

<sup>7</sup> For early Christian baptisteries built in Italy and their connections with the eastern area, see, FALLA CASTELFRANCHI 2001; also, BRANDT 2013.



Fig. 2. Bosra, the church of SS. Sergius, Bacchus and Leontius at the beginning of the 20th century, seen from the west. Note the high accumulation of debris and the semi-dome of the north-east exedra that is still preserved (after BRÜNNOW, DOMASZEWSKI 1909, fig. 908. Also in the Princeton Archive, Research Photographs).



Fig. 3. Bosra, the southern side of the church of SS. Sergius, Bacchus and Leontius at the beginning of the 20th century, from the south-west (after BRÜNNOW, DOMASZEWSKI 1909, fig. 913. Also in Princeton Archive, Research Photographs).

The study of the tetraconch churches built in the Syrian area begins with one of the most interesting examples, namely the Church of Saints Sergius, Bacchus and Leontius in Bosra (*Buṣṣā*), which has been thoroughly investigated since the mid-1970s thanks to a joint Italian-Syrian programme<sup>8</sup>. The research involved intensive excavations, but the occasional work carried out by the Syrians without the presence of the Italian team sometimes led to a lack of documentation. The need for conservation and limited reconstruction of the remains also made it necessary to refine the drawings made over the years. A new survey was therefore carried out, based on precise instrumental measurements, supplemented by a detailed drawing of the remains (fig. 1)<sup>9</sup>.

While in modern times Bosra ranks as a secondary centre of the Hauran, in ancient times it was one of the capitals of the Nabataeans and under Trajan became the capital of the province of Arabia<sup>10</sup>. Its monumental layout, con-

<sup>8</sup> Studies on the so-called Bosra Cathedral by Giorgio Gualandi of the University of Bologna in collaboration with Souleiman Muqdad of the General Directorate of Antiquities and Museums in Damascus began in 1974 (GUALANDI 1975). In the 1980s, the direction of the research on the Italian side passed to Raffaella Farioli Campanati, who unfortunately passed away in the last days of 2021: she conducted work with some interruptions until the first decade of this century. I would like to recall here with esteem her passionate scholarship and her commitment to the Institute of Ravennate and Byzantine Antiquities. On her investigations, see the various references to FARIOLI CAMPANATI in the bibliography. Also: CERULLI 1975; CERULLI 1978; GUIDONI GUIDI 1988; BLASI, LULLI, MASTURZO 2007. For paintings and mosaics: FARIOLI CAMPANATI *et alii* 1988; ZANARDI 1988. Finally,

FARIOLI CAMPANATI 2008, pp. 185-189, with extensive bibliography.

<sup>9</sup> Despite the surveys by Sergio Cerulli and later by Gigi Altomare and Serafino Busceti, there was a need for a more detailed one to which the recent excavation investigations could be linked. The new survey was carried out by the author, starting in 1992. Instrumental measurements were taken with a precision theodolite (with an accuracy of 2"), and were later verified with a total station (with an accuracy of 3" and a mirrorless feature). The final drawings were a 1:50 scale plan and cross sections. Everything was later redrawn using CAD software.

<sup>10</sup> On Bosra, see the valuable study by Maurice Sartre (SARTRE 1985, in part. pp. 103-139 for the Christian-Byzantine phase). On the city and its monuments: FREYBERGHER 1989; now also DENTZER-FEYDY, MAQDISSI 2007.

sisting of a series of buildings from the Nabataean, Roman-Byzantine and Islamic periods, although largely obscured by more recent constructions, was a point of attraction for Western travellers. Sited in the central area of the city, the remains of the church had long been known: since the 19<sup>th</sup> century, various Europeans had been able to appreciate its original architecture<sup>11</sup>, although the building was largely collapsed and occupied by some modern constructions and accumulations of debris<sup>12</sup>.

Recent research has also identified various structural elements that can be attributed to the elevation and roofing of the central space of the church. However, the poor condition of the remains suggests that the old hypotheses describing the elevation of the main body of the church, now unfortunately largely collapsed, should also be re-examined in light of the new research.

### *Previous reconstructions*

The uniqueness of the building and the fact that part of its elevation has somehow been preserved until modern times has led to various attempts to reconstruct the architectural form of the central body of the church (figs. 2-3). However, the first reconstructions suffered from the fact that the existence of the central colonnade was not recognised, and therefore they were designed to reflect the form of the church of St George in Ezra, consecrated in 515, where the central pillars and a large part of the dome were preserved<sup>13</sup>.

Towards the end of 1857, Emmanuel-Guillaume Rey visited Bosra and drew the first known plan of the church. This plan is quite reliable, but the textual description of the remains is very hasty, mentioning only the inscription of Bishop Julian engraved on the main door, and that in passing. Moreover, only the martyrs Sergius and Leontius are mentioned, and the name of the third martyr – Bacchus – is omitted<sup>14</sup>.

Ch. Melchior Mqs. de Vogüé visited Bosra in 1862, when a considerable part of the perimeter of the central body of the church was still standing. He offers a rather detailed description of the remains, a plan and a perspective view, which we will examine later, and formulates also a proposal for the reconstruction of the central supports of the dome, based on the example of the church of Ezra. He saw that the small nave church built inside was still standing after the collapse of the central dome and the colonnades, of which no trace remains. One can only admire de Vogüé's attempt to understand the geometric plan of the building: he gives the diameter of the large interior space as 120 feet, in a square of 125 feet. This is a measure calculated in feet, one of which he considers to be equal to 0.307-0.312 metres, according to the table containing the measurements of the rooms of the presbytery<sup>15</sup>. The comparison with the church of Ezra, however, leads him astray, as he formulates the hypothesis of a hemispherical dome 66 feet in diameter, approximately 20.26 metres, supported by eight pillars<sup>16</sup>.

De Vogüé is not very certain about the height measurements, stating that scaffolding would have been necessary to obtain them accurately. He states that the height of the top of the cylindrical drum is that of the presbytery, of which the round arch of the semi-dome at the rear has been preserved, supported by pilasters which he estimates to be about 8 metres high. The total height, given the width of the presbytery of 9.20 metres, was therefore calculated at 45 feet to the outer cornice of the apse. Finally, he attributed a height of 30 feet to the large cubic volume that formed the base and 15 feet to the upper drum of the main body of the church<sup>17</sup>. We will see later on whether some of the considerations made by de Vogüé can still be considered to be valid (fig. 10a).

The next hypothesis, put forward by Howard Crosby Butler in his 1914 Princeton University publication, *Expedition to Syria*, does not differ much from the previous one. It depicts a large central octagon with pillars at the corners and two columns on each side. However, the identification of the north-eastern pillar on site was incorrect. The reconstruction suggests a dome of an ogival shape, which, at first glance, seems unusual given the period in which the church is dated<sup>18</sup>.

The first plausible reconstruction of the central body's structure of the church, albeit hypothetical, comes from K. Archibald Cameron Creswell's insightful study. Rather than relying on objective data, Creswell partly followed Herzfeld's hypothesis of a sequence of octagons and squares inscribed in the outer circle, drawing an analogy with the Dome of the Rock. However, he believed that the supports of the dome were spaced at roughly the same width as the presbytery<sup>19</sup>.

<sup>11</sup> Cf: REY 1860, p. 179, pl. 15; DE VOGÜÉ 1865, pp. 63-67, plates 22-23; BUTLER 1914, pp. 281-286, ill. 248-249, plates 16-17; CROWFOOT 1937, pp. 1-23, plates 1-9.

<sup>12</sup> BRÜNNOW, DOMASZEWSKI 1909, pp. 30-33, figs. 906-913.

<sup>13</sup> DE VOGÜÉ 1865, pp. 61-62, pl. 21.

<sup>14</sup> REY 1860, p. 179.

<sup>15</sup> DE VOGÜÉ 1865, p. 63.

<sup>16</sup> DE VOGÜÉ 1865, p. 64, fig. 18.

<sup>17</sup> DE VOGÜÉ 1865, pp. 63-64.

<sup>18</sup> BUTLER 1914, pp. 281-286, ill. 248, plates 16-17

<sup>19</sup> CRESWELL 1924, pp. 21-25, fig. 6. There remained the erroneous figure concerning the pillars offered by Butler (see footnote 18).

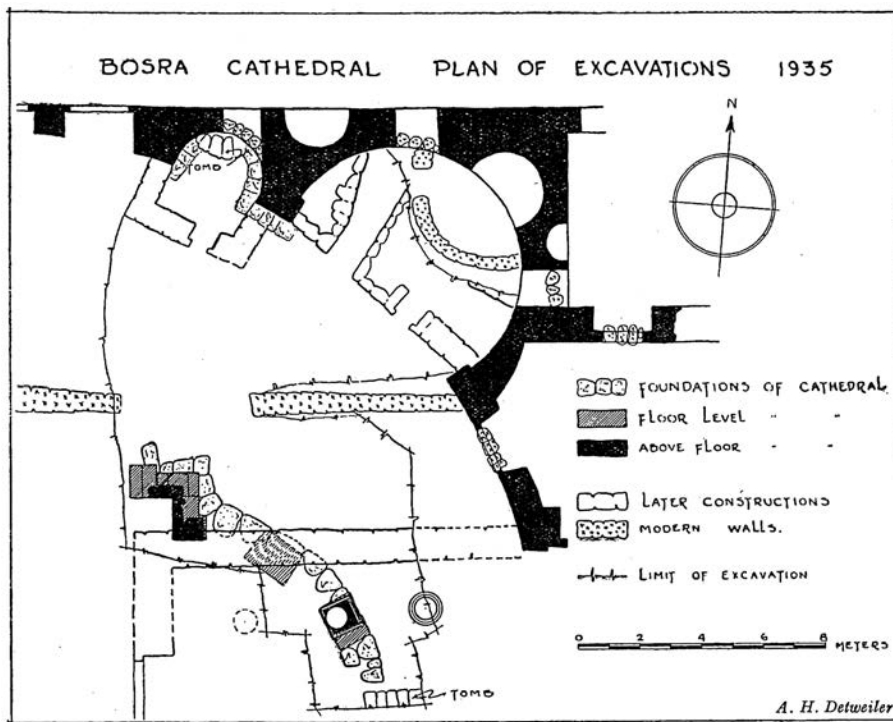
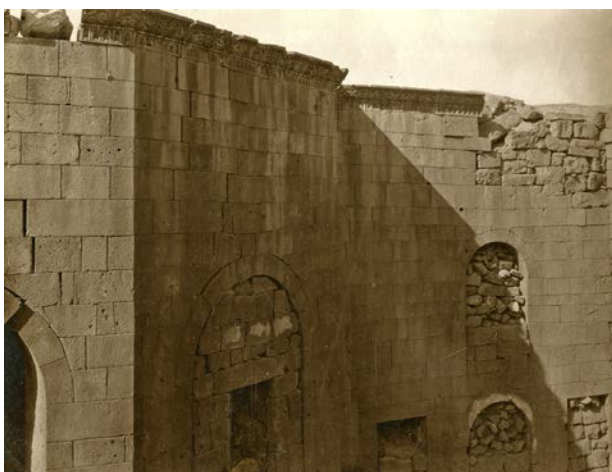


Fig. 4. Plan of the excavation carried out in 1935 at the north-east exedra of the church of SS. Sergio, Bacco e Leonzio (after CROWFOOT 1935, fig. 1, A.H. Detweiler).

Fig. 5. Bosra, the apse of the church of SS. Sergio, Bacco e Leonzio in 1904 (after BUTLER 1914, ill. 249. Also in Princeton Archive, Research Photographs).

Fig. 6. Bosra, Church of SS. Sergius, Bacchus and Leontius. The position of the nave towards the apse after the latest conservation work in 2004 (photo by the Author).



John Winter Crowfoot's investigation of the churches of Bosra and Samaria-Sebaste, published in 1937, was a turning point in our knowledge of the Church of Saints Sergius, Bacchus and Leontius. This was the first well-documented archaeological study and decisively ruled out earlier reconstructions such as those of de Vogüé and Butler. In fact, the 1935 Crowfoot excavation has eliminated any possibility of comparison with the Church of Ezra. In the trench in the central area of the church, the remains of the north-eastern part of the inner tetraconch and the foundations of the small church built after the collapse of the central colonnade were brought to light (fig. 4)<sup>20</sup>. This enabled the course of the colonnade to be reconstructed with some precision: it consisted of four semicircles arranged on the main axes and joined by L-shaped pillars.

### *The remains*

Before proposing a new hypothesis for the reconstruction of the edifice, it is appropriate to examine the data on its remains acquired from the most recent Italian-Syrian investigations.

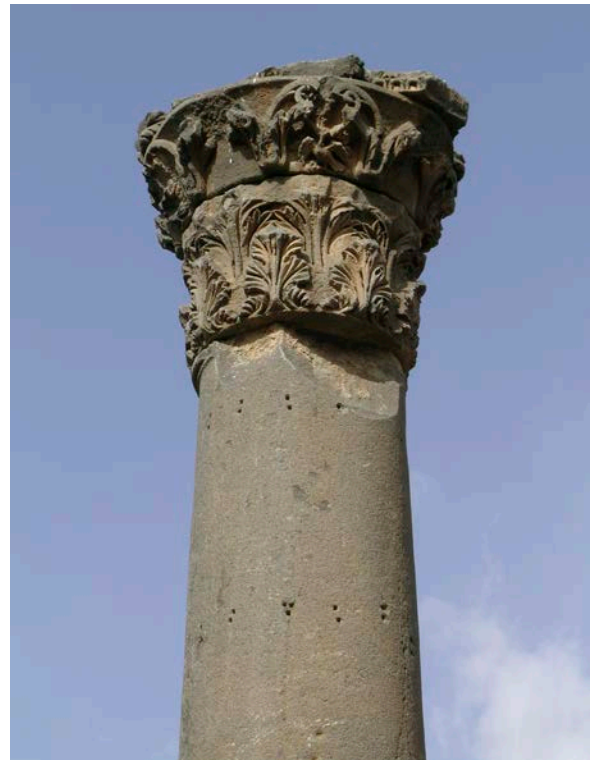
Well-squared stone blocks of basalt are used for the church walls (figs. 5-6). These come from the natural bedrock of the volcanic plateau of Hauran. Between the two faces of the wall there is a filling, or *'emplecton'*, formed of rubble and basalt chippings, all held together with lime mortar. Some of the blocks form cross-pieces that are occasion-

<sup>20</sup> DE VOGÜÉ 1865, pl. 22.



Fig. 7. Bosra, Church of SS. Sergius, Bacchus and Leontius. The position of the nave after the latest conservation work in 2004 (photo by the Author).

Fig. 8. Bosra, church of SS. Sergius, Bacchus and Leontius. A raised column of the tetraconch with the oldest capital from the time of Hadrian or the early period of Antoninus Pius; on the shaft the holes for fixing the various slabs of marble cladding (photo by the Author).



ally and irregularly spaced and anchor the faces to the core of the wall. Today, the bonding mortar between the stone blocks and inside the *emplecton* has largely degraded and dissolved, resulting in much weaker structures and dangerous localised instability. In addition to the original lime probably being of poor quality, the stone type, which is not very porous, hindered the carbonation of the lime mortar, thereby facilitating its subsequent dissolution<sup>21</sup>.

Much of the building material used for the church may have come from older public buildings that were originally intended for polytheistic worship. Indeed, the marks left by the masons who built the older structures can be seen on several squared blocks. These marks are not related to the Greek alphabet in use at the time of the church's construction, but seem to originate from the Aramaic alphabet instead<sup>22</sup>. It is also clear that the Corinthian columns and some decorative elements used in the church came from public buildings dating back to the middle of the Antonine period<sup>23</sup>. The two columns reassembled by the Italo-Syrian team feature a peculiar hanging festoon motif at the upper end of the two bottom drums that make up the shafts. However, this motif was chiselled on at the time of reuse in the church to allow the application of the marble slab covering the column. The recesses for the metal clamp retaining the marble slabs are visible (figs. 7-8)<sup>24</sup>. On the outer sides of the church, the stone blocks are mostly arranged in regular courses, but they vary in height from 0.20 to 0.47 metres. This indicates that efforts were made to standardise the working of the stones, and that a consistent supply of older material was available. It can be concluded that the stones did not come from another building on the same site as the church, as investigations conducted under its floor levels revealed only a private dwelling built from materials of lesser architectural quality<sup>25</sup>.

Only sporadic traces of the original interior decoration of the church remain. Large marble panels once adorned the walls of the ambulatories and presbytery, and the columns were also covered with slim marble slabs<sup>26</sup>. Higher up, large swathes of glass-paste mosaics covered the walls and vaults<sup>27</sup>.

<sup>21</sup> Also, MASTURZO 1994, pp. 375-376. On the last consolidation works on the monument, which were not completed also due to Syrian political events, BLASI, LULLI, MASTURZO 2007.

<sup>22</sup> On the stone rows outside the apse one can see some markings to assist their positioning, evidently derived from North-Arabian-Nabataean signs: FARIOLI CAMPANATI 1999, p. 105, fig. 7.

<sup>23</sup> This is decoration from the late Hadrianic or early Antonine Pius period. For the decoration in basalt or limestone, see FREYBERGER 1988. The capitals date to a time before the construction of the temple-hexedra (*pseudo-nymphée*), attributed to the Severan age, FREYBERGER 1989, p. 55, or to the late Antonine age, DENTZER-FEYDY, MAQDISSI 2007 (Blanc *et al.*), pp. 235-238. For the Severan-age dec-

oration reused in the so-called Kalybé and Central Baths, see again FREYBERGER 1989, pp. 54-56; also, DENTZER-FEYDY, MAQDISSI 2007 (Blanc *et al.*), pp. 230-234.

<sup>24</sup> MASTURZO 1994, pp. 379-382, fig. 5.

<sup>25</sup> GUALANDI 1975, pp. 76-88, figs. 20-21.

<sup>26</sup> MASTURZO 1994, pp. 376-379, fig. 4. This way of covering the column shafts is found both in the cult exedra at the corner of the Central Baths (*pseudo-nymphée*), DENTZER, BLANC, FOURNET 2002, p. 124, and in the large, centrally planned church at Bosra, *ibid.*, pp. 90-92; and below, note 39.. I rule out the possibility that these holes for clamps are recesses for some metal decorations.

<sup>27</sup> FARIOLI CAMPANATI 1988, pp. 89-92. EAD. *et alii* 1988.



Fig. 9. Bosra, church of SS. Sergius, Bacchus and Leontius. Chamber 'b' from above, showing the remains of the vault, set on the cornice of the central body and on the recess of the northern wall. The chamber is divided by partitions built in the late medieval or modern period (photo by the Author).

The presence of a cycle of Christian wall paintings in the presbytery, executed after the removal of the previous decorations and the closure of the apse's large windows, suggests a period of post-Byzantine abandonment and despoliation of the church, followed by its revival in the Middle Ages. In fact, this fresco cycle can be dated to the 12<sup>th</sup>-13<sup>th</sup> centuries<sup>28</sup>.

The vaults were built on ribs, with small blocks of spongy lava stone arranged in fairly regular rows and bound with lime and pumice mortar. They are preserved only in two rooms annexed to the presbytery and only partially in the two semi-domes at the corners of the central area. The vault in room B has two rows of bricks intended to level the vault, which are absent in room D despite being made of similar material. The rooms adjacent to the presbytery are covered with rather rough lime plaster with simple geometric decorations.

In the two passage rooms flanking the presbytery, there is a protruding cornice marking the impost of the vaults in the central body of the church wall, approximately 6.3 metres above floor level. Similar cornices do not exist on the western sides of the two external annexed rooms (fig. 9). However, in connection with Creswell's published plan, this absence cannot be attributed to two different construction phases, as the various walls join in a regular manner<sup>29</sup>.

### *Height measurements*

Some data on the elevation of the central body can be obtained from the two documents illustrating the state of the church prior to its collapse at the end of the 19<sup>th</sup> century. One can attempt to calculate the true height using perspective methods based on the view published by de Vogüé and the 1875 photograph published by Crowfoot (fig. 10a-b)<sup>30</sup>.

In de Vogüé's case, it can be assumed that a sketch of the drawing was made on site using a camera obscura, thus achieving a theoretically correct perspective<sup>31</sup>. The construction of the vanishing point of the lines makes it possible to determine the proportions between the square plinth and the circular upper drum with reasonable accuracy – approximately 2:1.

<sup>28</sup> FARIOLI CAMPANATI 1988, pp. 72-77; most recently EAD. 2009, p. 118. On the technique ZANARDI 1988, BLASI, LULLI, MASTURZO 2007 (Lulli), pp. 414-416.

<sup>29</sup> In Creswell's published plan, the two outermost presbytery rooms are omitted. I think this is due to a misunderstanding of the role of the cornice (CRESWELL 1924, fig. 6). He partly follows Butler in this respect (see BUTLER 1914, fig. 248).

<sup>30</sup> The position of the camera relative to the object determines the inclination of the picture plane. However, this is irrelevant for con-

structing the vanishing point of the lines in our case.

<sup>31</sup> Fortunately, there is a certain consistency in the representation of the church in the two images. By comparing the engraving (DE VOGÜÉ 1865, pl. 23) with a photograph taken in 1875, it is clear that the building was in a similar condition in 1862. For the situation after the collapse, see BRUNOW, DOMAZEWSKI 1909, p. 30, figs. 908-909, 913. The engraving also prompted a fairly plausible reconstruction, but this is not discussed in the last text (*ibid.*, figs. 911-912).

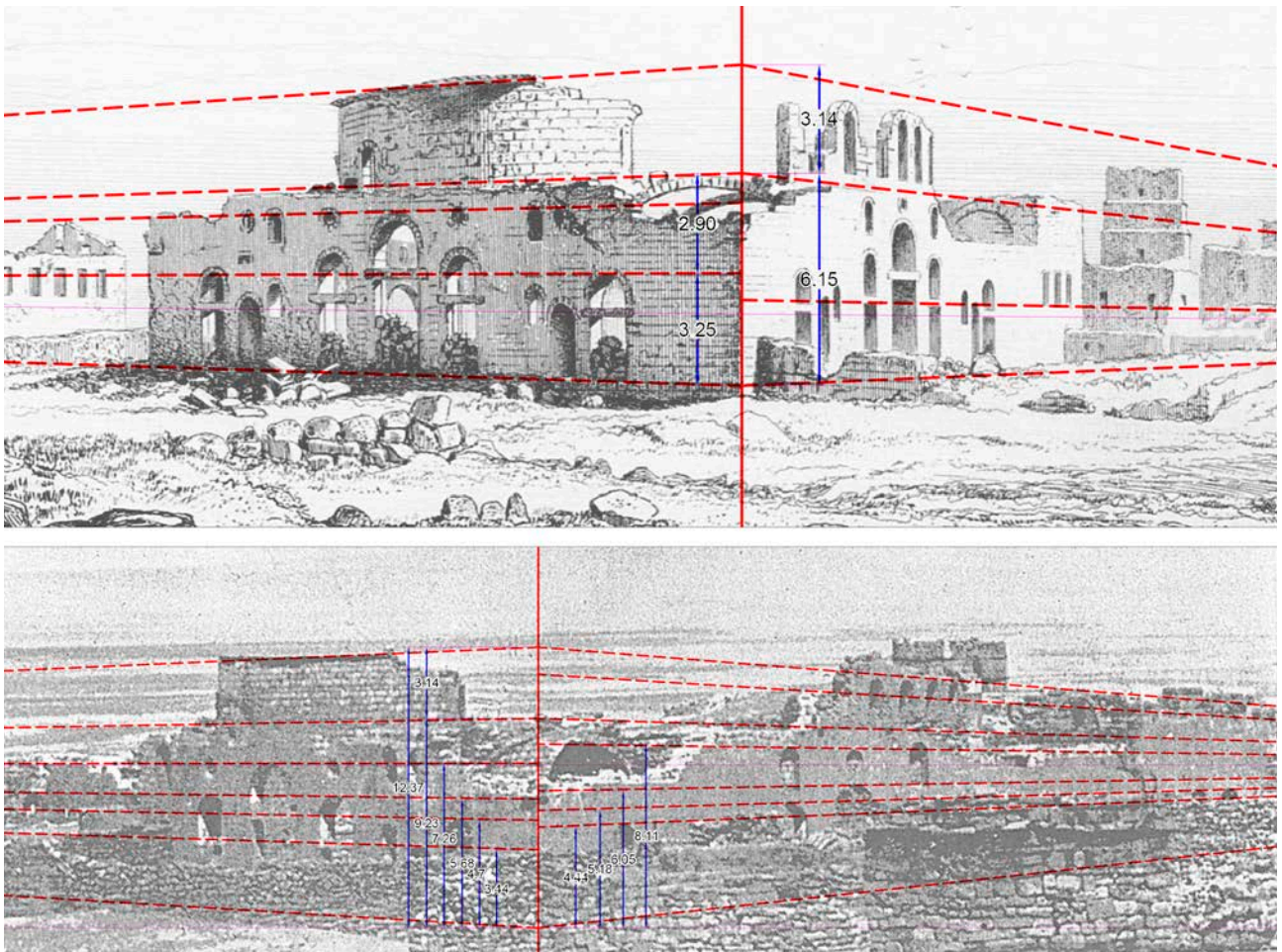


Fig. 10a,b. The perspective reconstruction of the measurements of the church's elevations (elaborated by the author after an engraving of DE VOGÜÉ 1865 and a photograph of CROWFOOT 1937).

Crowfoot's photograph clearly shows that only a few sections of the upper part of the church remain and that they were preserved until at least the second last decade of the 19<sup>th</sup> century<sup>32</sup>. However, the elevations of four of the five presbytery rooms have survived, most likely because they were reused as dwellings or storage rooms in modern times. Thanks to the vanishing point of the lines in the south-west corner of the church, the photograph provides a perspective view that enables an accurate measurement of the proportions between the heights of the front and southern sides. If elements of known height at the edge of the south-west corner of the church are reduced to scale as indicated by the vanishing point of the lines, the approximate heights of the other elements on the two façades can be obtained. In this case, however, the level of precision cannot be that high and must be estimated at around ten centimetres, given the quality of the reproduction. Thus, we can estimate the height of the square base of the church to be around 9.20 metres and the height of the circular drum frame to be around 12.37 metres, both from ground level. Compared to de Vogüé, the drum-to-base height ratio is significantly lower, at around 1:3.

The arches of the corner exedras can also be seen to be approximately the same height as the square perimeter.

### *Structural aspects and the proposed reconstruction*

It is worthwhile making a few quick remarks about the large construction sites in Bosra, and considering how structural problems, and above all the risk of collapse, might have been understood in antiquity. Deformation of a structure was a clear sign of potential collapse; see, for example, Procopius's (*De aedificiis*) passages concerning the construction of Hagia Sophia<sup>33</sup>. The same can be assumed in the case of wooden beam floors or trusses. This was an empirical appreciation and understanding that was only surpassed in the modern age thanks to studies in structural

<sup>32</sup> CROWFOOT 1937, pl. I a.

<sup>33</sup> Proc. *De aedificiis*, I.1.68-78. Cf. BRANDT 2018, pp. 19-30.

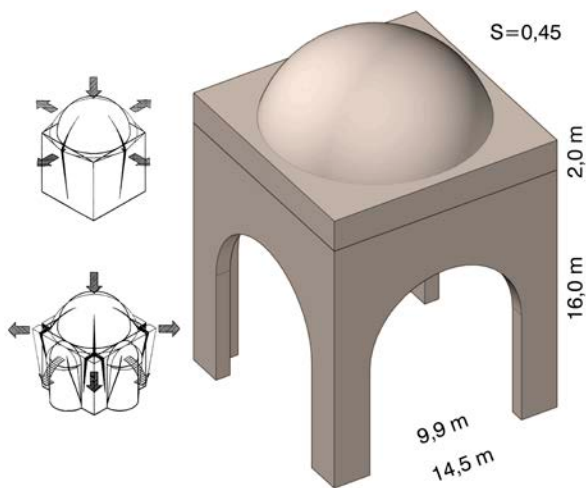
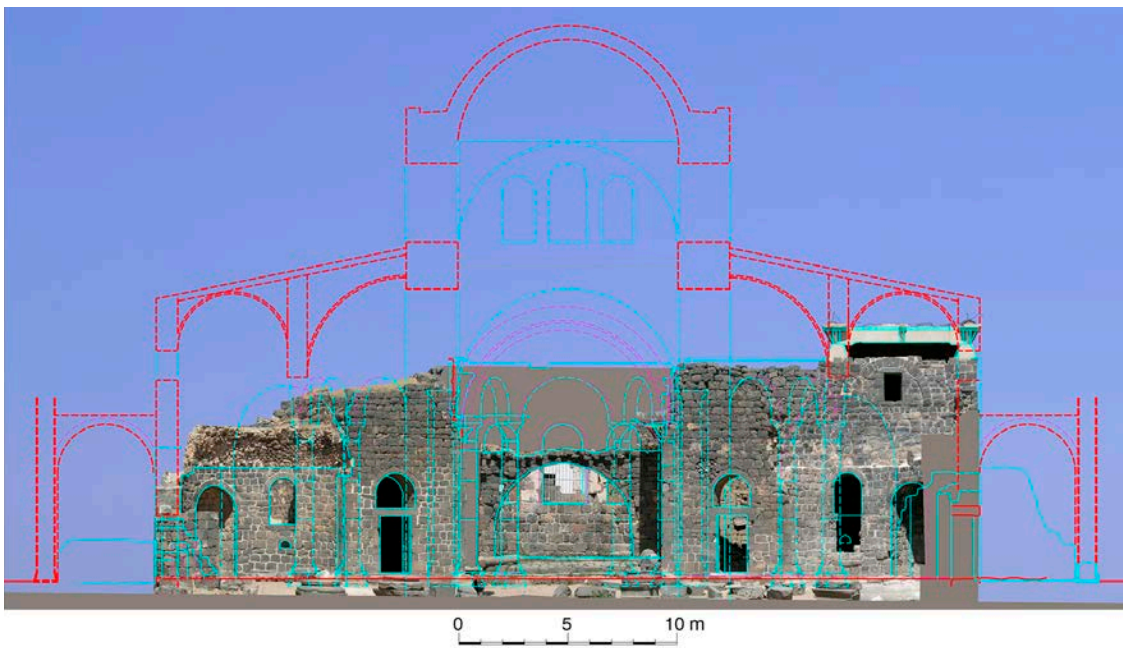


Fig. 11. The axonometric diagram of the possible vaulted roof of the central space of the church of SS. Sergius, Bacchus and Leontius; on the side, the forces and cracks relating to a dome set on a square-plan environment, with and without apses (drawing by the author; the two side diagrams are by C. Blasi).

Fig. 12. Hypothetical reconstruction of the elevation of the church of Saints Sergius, Bacchus and Leontius. Cross section towards the apse (drawing by the author).



analysis<sup>34</sup>. Therefore, it can be assumed that the proportion of spaces to be covered and the nature of the roofing structures governed the structural approach in antiquity. In the Central Baths of Bosra, for example, the thickness of the frigidarium vault's base is approximately one tenth of the room's span. While the width of the outer supporting wall is a full one-quarter of the span, the opposite internal wall, which supports the two adjacent vaults, is only approximately one-eighth of the span. Therefore, it can be assumed that the builders had at least an empirical understanding of the thrusts exerted by the vaults depending on their static configuration, as we would say today. Another example is the apsidal semi-dome of the 2<sup>nd</sup> century AD basilica known as the Bahira building, which is partly preserved and has a semi-elliptical layout<sup>35</sup>. As in the baths of Bosra and the other vaulted or domed structures in the region, a special construction technique involving small blocks of spongy basalt bonded with lime mortar and pozzolanic sand was developed. The weight of such a vault can be estimated at around 1200 kg/m<sup>3</sup>.

Returning to the problem posed by the roofs of the Church of Saints Sergius, Bacchus and Leontius, it should be noted that the five presbytery rooms were covered with light masonry vaults of a semicircular cross-section, and also that the four corner exedras were covered with half-domes built using the same type of masonry. This suggests that a similar solution was used for the rest of the covering (see fig. 11). A simplified calculation shows that it is plausible

<sup>34</sup> It was not until the work of Galileo Galilei that the concept of rational mechanics began to emerge, and Construction Science as we know it today was developed from the mid-19<sup>th</sup> century onwards, partly thanks to advances in mathematical calculation. However, Jean-Baptiste Rondelet's treatise, based on a geometric-proportional

theory, influenced construction practice for a long time at the turn of the 19<sup>th</sup> century.

<sup>35</sup> This name is based on local tradition, which considered it to be the seat of the monastery of Baḥīra, the (possibly Nestorian) monk who inspired Muhammad.

that the central space of the tetraconch was covered by this type of structure, which would have had a total weight of 1,276,500 kg: see Table 1. Even if the dome were supported only by the tetraconch's slender L-shaped pillars, this would result in a unit compression load of 0.97 N/mm<sup>2</sup>, which is very close to the current practical limit to avoid the danger of structural failure ( $\sigma < 1-2 \text{ N/mm}^2$ ): see Table 2. Actually, the structure was naturally much more complex: the calculation model eliminated the horizontal thrusts at the base of the dome and did not consider the slenderness of the pillars. It must also be remembered that the pillars were stiffened by the masonry half-cylinders supported by the central colonnades. However, the foundation of the tetraconch corner pillars occupies much of the space between the two L-shaped wings; one might therefore postulate that a larger column was positioned here. In any case, if the pillars were to be strengthened, a good option would be to insert a column in the inner corner. This option also helps to reduce the diameter of the central dome. This would result in a 20 per cent increase in the resistant section of the corner's support and, consequently, a similar increase in the resistance of the pillars to normal loads. Based on these assumptions, the cross-section shown in fig. 12 was created. But, strictly speaking, it cannot be ruled out that the central part of the church had a wooden dome, which would have been significantly lighter. This solution could also be compared to the large central dome hypothesised for the East Church<sup>36</sup>.

The roofing of the ambulatory naturally encumbered both on the outer perimeter of the church and on the four semicircles of the colonnades, but without affecting the corner pillars. However, the ambulatory's particular layout, with its circular outer perimeter and the four lobes perimeter of the tetraconch, meant that the space to be covered was very irregular. Due to this irregularity and the presence of curved blocks with recesses for wooden beam insertion among the sporadic blocks found during archaeological excavations of the interior space, it is more likely that the ambulatory roof had a wooden structure with complex, curved internal vaults, perhaps made with smaller wooden frames and plaster corbels.

When reconstructing the architectural layout of the church, it is necessary to consider the possibility that it may have had an external colonnade. This is based on certain structures that were uncovered during archaeological investigations. These are sections of walling that run parallel to the sides and are aligned with the wings of the external exedras. They are made of carefully squared blocks and form a sort of 'stylobate'<sup>37</sup>. The hypothetical presence of a colonnade should be reflected in the church's wall, where the rafters of this hypothetical portico's roof were presumably once engaged. In the case of the outer wall of room 'd', i.e. the southern annexe, which is preserved to a greater height than the others, there are currently no visible signs of support or attachment of beams. The situation was the same at the beginning of the 20<sup>th</sup> century, when the wall was apparently in much better condition (fig. 3)<sup>38</sup>. Regarding the areas around the southern entrances and the main façade, the same uncertainty remains even after examining the 1875 photograph, as no clear traces of where beams were inserted can be seen. Therefore, it is more likely that the church had a kind of perimeter pavement bordered by a crepidoma on three sides only.

structural part	volume	unit weight	weight	material
dome	123	1.200	147,600	spongy basalt and lime mortar masonry
backfill and sides of the dome	175.5	1.500	263,250	mixed basalt masonry
piers and arches	393.5	2.200	865,700	basalt masonry
			<b>1.276.500</b>	<b>total weight kg</b>
	m3	kg/m3	kg	

Table 1

surface	unit load		
128,480	9.94	97.44	0.97
cm2	kg/cm2	N/cm2	N/mm2

Table 2

<sup>36</sup> See below.

<sup>37</sup> Cf. BUCCI 2010. Unfortunately, the removal of medieval and modern structures around the remains of the church, carried out in recent decades by the local authorities, prevents any further inspection.

<sup>38</sup> See BRUNOW, DOMAZEWSKY 1909, fig. 913. It should be noted that the construction of a cistern on annexe 'd' around 1930 resulted in a partial alteration of the upper part of the wall.

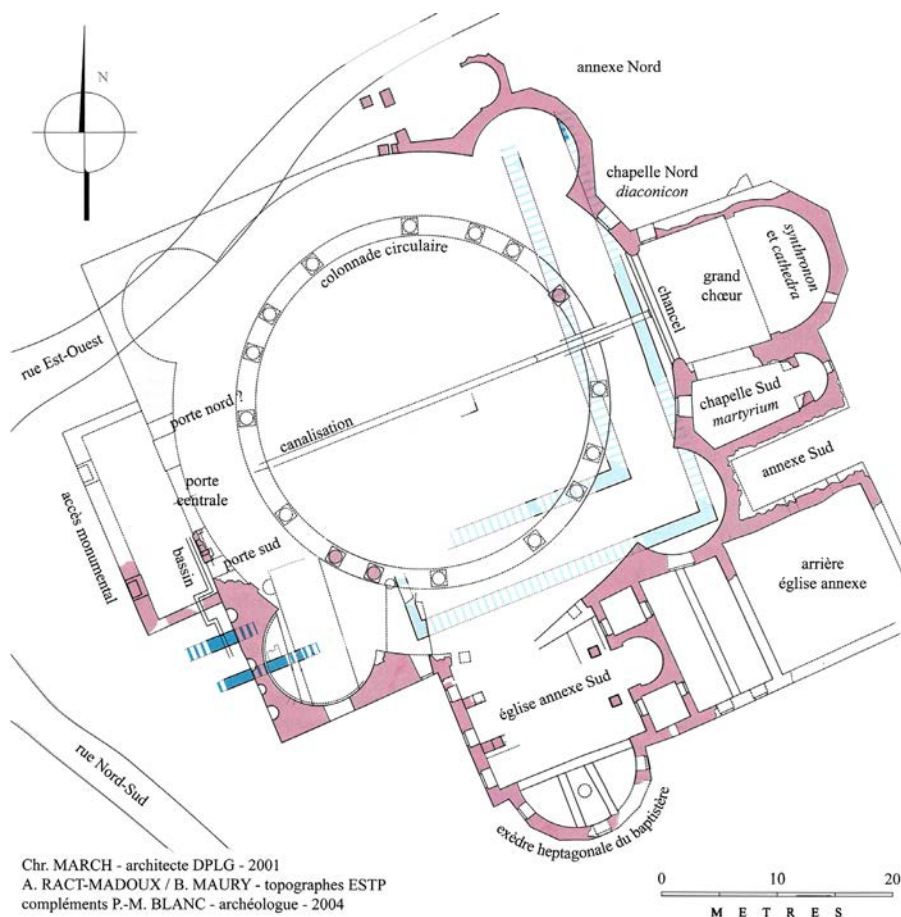


Fig. 13. Bosra. The Eastern Church or the 'grande église à plan centré' built in the area of the public square in the pre-provincial age, superimposed on a building that shows the characteristics of a civil basilica (after DENTZER-FEYDY, MAQDISSI 2007, figs. at pp. 140 and 144).

### The 'Grande église à plan centré', or East Church and its dome

When it comes to religious architecture from this period, the other main church in Bosra must be included in any discussion. This church is also known as the 'Grande église à plan centré' by the excavators. It is a very large building dating back to the end of the 5<sup>th</sup> century. Here, we will refer to it as the East Church (fig. 13)<sup>39</sup>.

In addition to its impressive size, the location of the church in the eastern ancient core of the Nabataean city<sup>40</sup> indicates that it was probably the most prestigious Christian building. It is also assumed to have stood on the site of the earlier Agora. This is where the cult of Augustus and Rome was celebrated during the first centuries of the Empire, probably on a monumental scale. This cult was likely established as early as the Nabataean period in the 1<sup>st</sup> century AD, alongside the local deities<sup>41</sup>.

The plan reveals the church's grandeur and layout, which partly anticipates that of the Church of Saints Sergius, Bacchus and Leontius. This is evident in its square external perimeter, wide central area, and semicircular exedras at the corners. However, the central colonnade is handled quite differently here: it is circular and has wider intercolumniation on the main axes. The type of structure required for the roof is quite problematic, as the central space has a diameter of about 29 metres. Known examples of domes built in the region in *opus caementicium*, composed of spongy volcanic stone and lime mortar, do not exceed 10-14 metres in diameter, as seen in the Ezra, in the praetorium of Mismyieh, and in the Kalibé of Shaqqa<sup>42</sup>. This technique was also used to construct the half-domes of the corner exedras of the Church of Saints Sergius, Bacchus and Leontius, which are approximately 8 metres wide, and the half-dome of the apse of the so-called Bahira Basilica, which has a chord of 9.14 metres<sup>43</sup>.

<sup>39</sup> For the church: DENTZER-FEYDY, MAQDISSI 2007 (Blanc, Dentzer), pp. 137-146; BLANC, PIRAUD-FOURNET 2010.

<sup>40</sup> MASTURZO 1992, pp. 241-248, fig. 7; MASTURZO 2002, p. 292, fig. 1.

<sup>41</sup> Of Julio-Claudian age (I think it was probably during the reign of Tiberius) is the dedication engraved on a tall epistyle, ...]

ΑΣΡΩΜΗΣΚ[ΑΙ ... , supplemented as follows: θεᾶς Ρώμης καὶ θεοῦ Σεβαστοῦ (IGLSyr 13.1, 9143). The block should still be kept near the Nabataean Arch.

<sup>42</sup> See DE VOGÜÉ 1865, pp. 41-46 and 61-62, pl. 6-7, 21.

<sup>43</sup> Surveys of the author. See BRÜNNOW, DOMASZEWSKI 1909, pp. 36-38.

In the case of the East Church, it has reasonably been assumed that there was a wooden dome supported by the central colonnade. A comparison with the Church of St. Simeon, which has similar dimensions to the East Church colonnade (about 29 metres at the corners of the central octagon), remains uncertain. The hagiographic sources and cult-related motifs themselves certainly do not suggest the existence of a covering for the octagon<sup>44</sup>. However, various hypotheses regarding the roof have been put forward<sup>45</sup>. This wood construction method was not seen again until approximately two centuries later in the Dome of the Rock in Jerusalem, where the diameter is only, so to speak, 20.40 metres<sup>46</sup>.

### *Historical profile*

In the case of the Church of Saints Sergius Bacchus and Leontius, there are no particular problems in identifying the date of construction, since in the first decades of the 19<sup>th</sup> century, as William Henry Waddington describes, the dedicatory inscription was kept “*au-dessus de la porte de la cathédrale, à sa place originare*”<sup>47</sup>. The text is now lost, but it was copied directly on the spot at the time<sup>48</sup>:

✠ ἐπὶ τοῦ θεοφιλεστάτου καὶ ὀσιωτάτου Ιουλιανοῦ ἀρχιεπισκο(ύπου) ᾠκοδομήθη καὶ ἐτελιώθη ὁ ἅγιος ναὸς Σεργίου,| Βάχχου καὶ Λεοντίου, τῶν ἀθλοφόρων καὶ καλλι|νίκιων μαρτύρων, ἐν ἔτι υἴ', ινδ(ικτιῶνος) ς'. ✠

Its translation reads: *Under God's loving and most devout Archbishop Julian, the holy temple of Sergius, Bacchus and Leontius, victorious and gloriously triumphant martyrs, was built and completed in the year 407, the 6<sup>th</sup> of the indiction*<sup>49</sup>.

The date of consecration is thus the year 407 of Bosra, the sixth of the indiction, i.e. from 1 September 512 to 21 March 513 of the Vulgar Era<sup>50</sup>. The events surrounding Bishop Julian, who was ousted from his see in 513, seem to suggest that the previous year is a more likely candidate. Construction of the church presumably began at the start of the century and was completed within a few years. It is believed that Sergius and Bacchus bore witness to their faith under Galerius (305-311) and their celebration was placed in the martyrology on 7 October, while Leontius would have been killed under a governor of Phoenicia named Hadrian<sup>51</sup>.

A few considerations can now be offered to help place the two largest churches with a centralised plan into the religious climate of the period. Maurice Sartre has carefully examined the situation in Bosra in his valuable historical study of the city<sup>52</sup>. From the letters of Julian (*Ep.* 114, ed. Bidez) and Libanius (*Ep.* 763), we know that the 4<sup>th</sup> century was characterised by conflict between the polytheistic ('pagan') and Christian communities<sup>53</sup>. In Bosra, material evidence of this conflict can be seen in the repaving of the temple on the Decumanus. I believe this was done under the *dux* Flavius Procopius during the period in which he was given responsibility for the province by Emperor Julian, during the campaign against the Parthians in 363 A.D.<sup>54</sup>.

By the middle of the 4<sup>th</sup> century, the city's population was divided roughly in halves between polytheists and Christians. However, it is likely that the polytheist community had almost completely disappeared by the end of the century<sup>55</sup>. The first epigraphic evidence of Christianity in Bosra dates back only to the 5<sup>th</sup> century. However, no remains of ecclesiastical buildings can currently be definitively linked to this period<sup>56</sup>. Perhaps the so-called 'Church 3' on the Decumanus, which was built over the temple I mentioned earlier, dates back to that century. The same could be said for the transformation of a large 2<sup>nd</sup>- or 3<sup>rd</sup> century AD building into the so-called 'Church of Bahira'<sup>57</sup>. It is only at the end of the 5<sup>th</sup> and beginning of the 6<sup>th</sup> centuries that the two largest, centrally planned ecclesiastical buildings of Bosra were constructed.

So, shortly before he was expelled from Bosra, Bishop Julian dedicated the great tetraconch church to the martyrs Sergius, Bacchus, and Leontius. As a convinced Chalcedonian, he was replaced by Cassian, a Monophysite who was linked to Severus. Thanks to imperial favour, Severus had been Patriarch of Antioch since 6 November 512. And indeed, Julian did not return to Bosra until 518, after the death of Emperor Anastasius<sup>58</sup>.

<sup>44</sup> Cf. Evagrius, *Ecclesiastical History*, I.14-15.

<sup>45</sup> While de Vogüé (1865) and Butler (1903) believed that the octagon must have been uncovered, more recent hypotheses have suggested that it may have had a pyramidal or domed roof (D. Krencker). Compare BUTLER 1903, p. 185, with BISCOP 2010, p. 879.

<sup>46</sup> For the building of the 72 AH (year 691 AD) and its architectural scheme, see CRESWELL 1924, pp. 1-16.

<sup>47</sup> LE BAS, WADDINGTON 1847, VI.III.1, no. 1915, pp. 462-463.

<sup>48</sup> For the text: LE BAS, WADDINGTON 1847, *ibidem*; WADDINGTON 1870, no. 1915, pp. 462-463; IGLSyR 13.1, no. 9125.

<sup>49</sup> I thank Massimo Nafissi for checking the text.

<sup>50</sup> SARTRE 1985, p. 109.

<sup>51</sup> WADDINGTON 1870, no. 1915, pp. 462-463.

<sup>52</sup> SARTRE 1985.

<sup>53</sup> See SARTRE 1985, pp. 104-106.

<sup>54</sup> On the mosaic, FARIOLI CAMPANATI 1989. See MASTURZO 1997, pp. 469-472.

<sup>55</sup> Cf. SARTRE 1985, p. 108.

<sup>56</sup> *Ibid.*

<sup>57</sup> On the Church 3, MASTURZO 1997. On Bahira, DENTZER-FEYDY, MAQDISSI 2007 (Farioli-Campanati), pp. 295-296.

<sup>58</sup> Cf. SARTRE 1985, p. 109.

This was not just an abstract theological dispute between clerics: disputes over the nature of Christ had serious consequences for city life. For example, the monk Theodosius and his disciple Julian, who would become a bishop, were insulted and branded as heretics by a 'great lady of Bosra' because they were of Chalcedonian sympathies. They also clashed with some monks. Furthermore, Julian, who became a bishop, narrowly avoided being poisoned by 'enemies of Christ', who were certainly Monophysites<sup>59</sup>.

While we do not know what concrete repercussions the rivalry between the followers of the two Christian denominations might have had, it is plausible that it also affected the construction of religious buildings. In this regard, one might consider the East Church, the large building with a centralised plan located in the eastern part of the city. Archaeological evidence suggests that its construction began no earlier than the last quarter of the 5<sup>th</sup> century, probably between the end of that century and the beginning of the next<sup>60</sup>. As Maurice Sartre has pointed out, the Monophysite community of Bosra retained considerable importance at least until the advent of Islam, so, it can be assumed that there were places of worship in the city distinct from those of the Chalcedonians, and probably also characterised by different physical forms<sup>61</sup>. As far as we currently know, attributing different architectural forms to different theological aspects can only be a highly hypothetical exercise. However, I would not exclude a priori that the Chalcedonian church dedicated to the three martyred saints might have been a counterpart to the Eastern Church, and that the latter might have been that of the Monophysite creed, apparently predominant in Bosra in the late 5<sup>th</sup> and early 6<sup>th</sup> centuries. In that case, the different shape of the interior space may simply have had the function of emphasising the building's belonging to a different confession.

### *The churches of Bosra, Seleucia, Apamea and Milan: the drawing*

We may now consider the formal aspects suggested by the remains of the tetraconch churches of Bosra, Seleucia of Pièria, Apamea and finally Milan. In this regard, one must recall what the practice of *drawing* means in architecture. This is not just the drawing on paper or such, by means of geometry, and in a generally elementary manner, a scheme of the construction that is to be undertaken. It also involves the strict necessity of tracing on the ground the cuts for the foundations and with greater precision the beginning of the walls in elevation.

#### **Bosra**

Having said that, we previously observed the only apparent complexity in the planimetric design of the Church of Saints Sergius, Bacchus and Leontius, and noted that de Vogüé had assumed an internal diameter of 120 feet. In fact, constructing the planimetric scheme of the church is not particularly difficult (see fig. 14a): starting from the intersection of the two perpendicular axes, one opens the compass to a radius of 60 feet at whatever scale one is working to, and at the intersection of the circumference with the axes, draw lines perpendicular to the axes. The square thus formed is then divided into thirds in both directions; the central third (40 feet square) also determines the diameter of the colonnades. Thus, the square inscribed in the circle along the diagonals includes the tetraconch. The centre of the four lobes is obtained by starting with the same square inscribed in the circle and opening the compass to a radius of 20 feet at its intersection with the main axes. This results in a centre of the semi-circular colonnades shifted towards the outside.

The eastern rooms are built on the basis of one thirds of the circumscribed square of 120 feet. The presbytery is 40 feet wide, including the walls. The smaller rooms are 17 and 20 feet wide, and the party walls, which are 3 feet wide, accounts for this difference. Finally, the perimeter walls are drawn, with a width of three feet.

#### **Seleucia of Pièria**

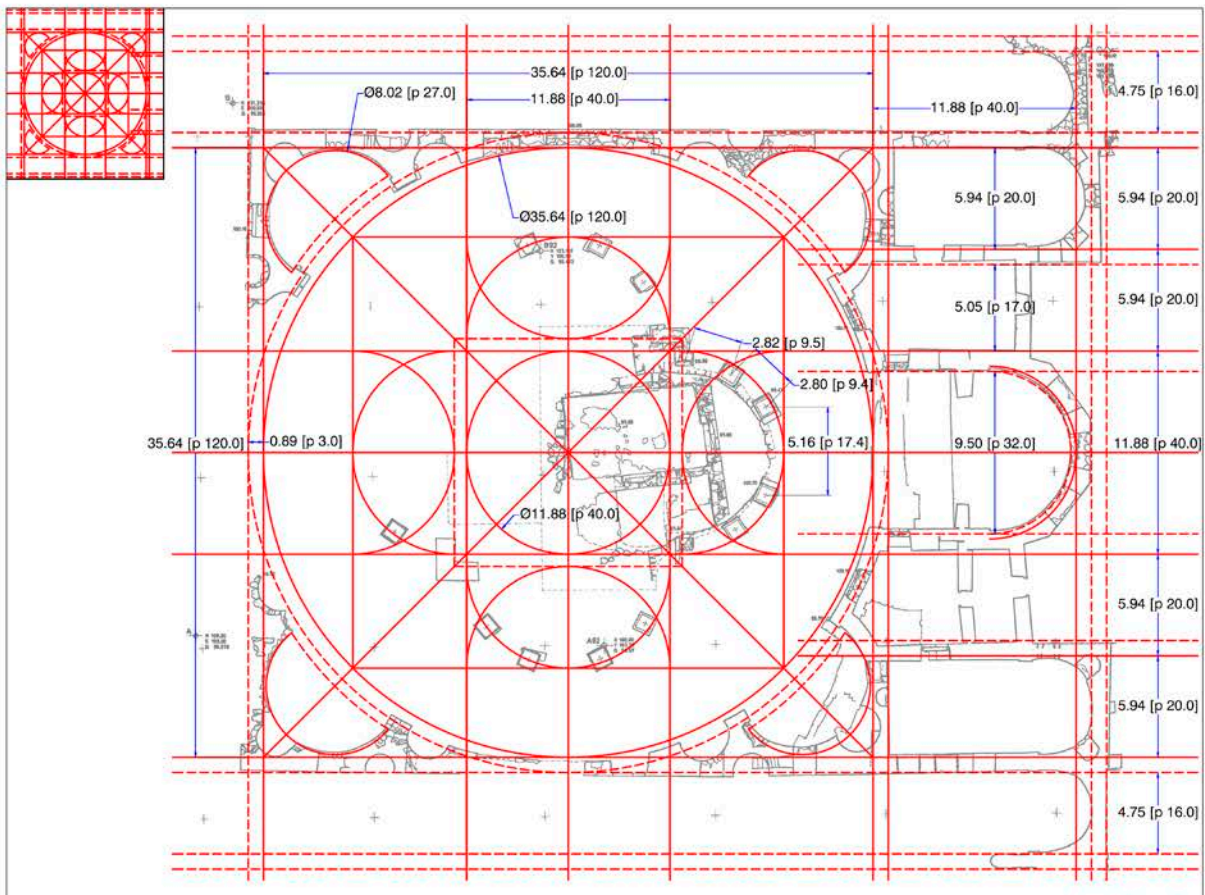
Concerning the Church in Seleucia of Pièria, reference is made to the accurate plan attached to the initial publication<sup>62</sup>. The investigations began in 1938 and the excavation was resumed and completed in the following year. The plan is based on a central square with columnar 'exedras' arranged in a 'four-leaf clover' around the four sides. A wide ambulatory followed the tetraconch shape of the inner colonnades along the external perimeter's profile. A presbytery extended to the north-east. At the four corners of the outer perimeter were placed the entrances.

<sup>59</sup> See SARTRE 1985, p. 111.

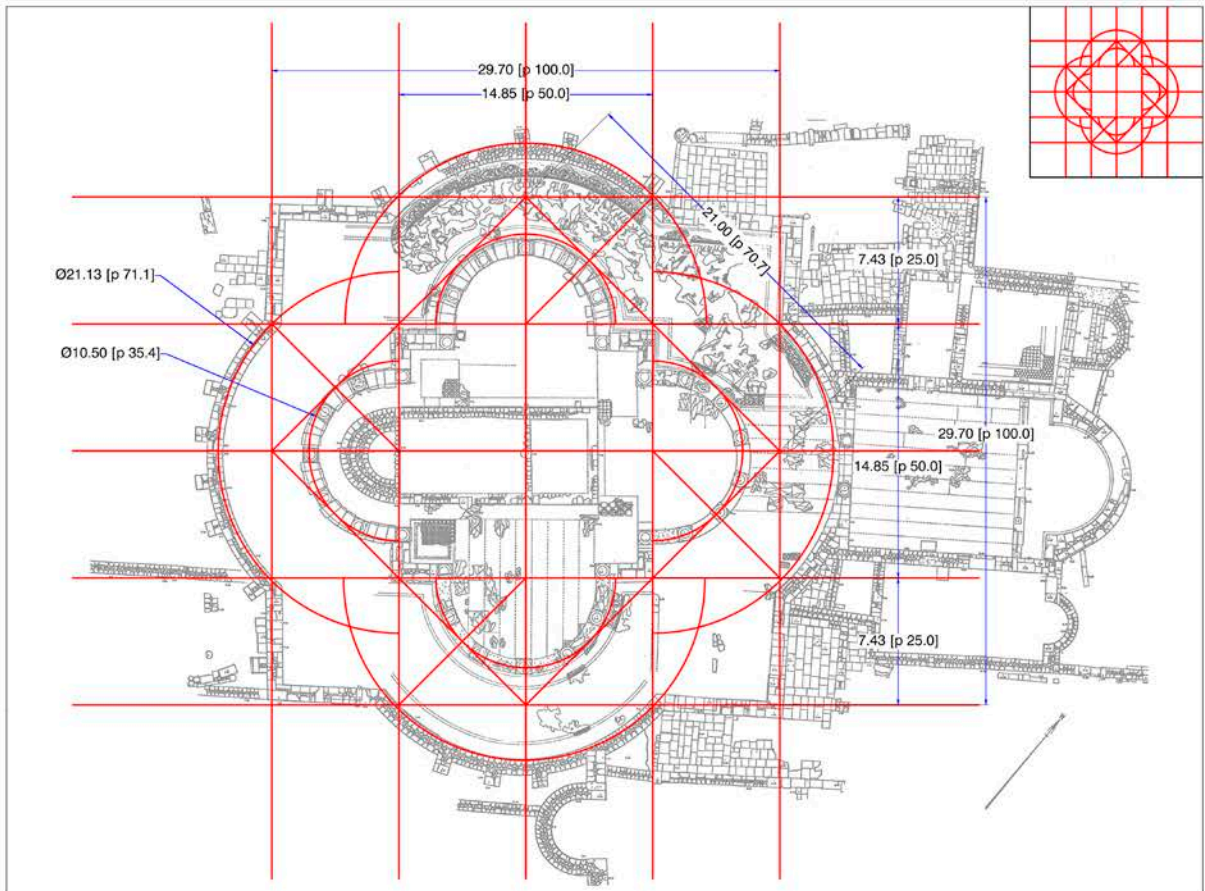
<sup>60</sup> BLANC, PIRAUD-FOURNET 2010, p. 280. The church also underwent extensive restoration in the second half of the 6<sup>th</sup> century, possibly following the earthquake of 551.

<sup>61</sup> See SARTRE 1985, pp.117-118.

<sup>62</sup> CAMPBELL 1941, pp. 36-38, pl. 10. On the church see also the texts by W.E. Kleinbauer, C. Kondoleon and S. Boyd, in *Antioch* 2000, pp. 217-223.

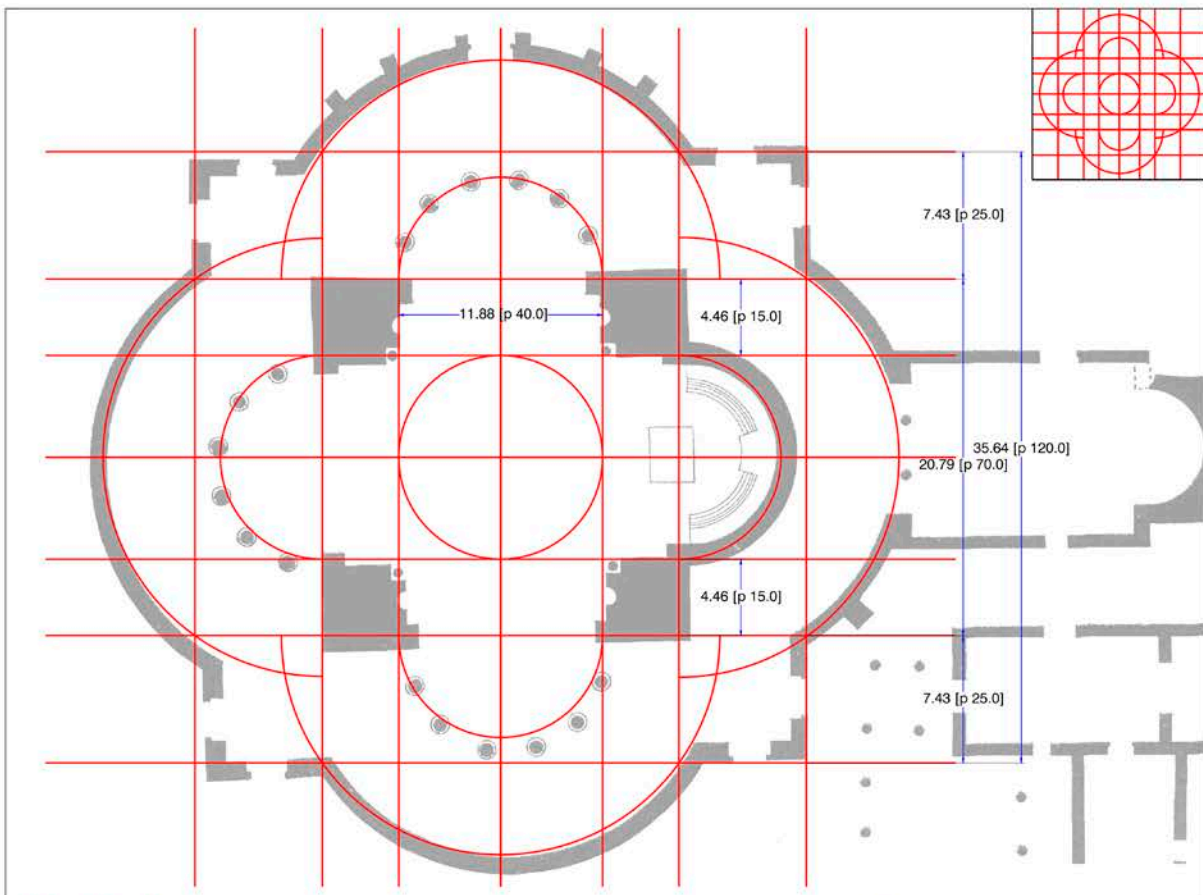


a

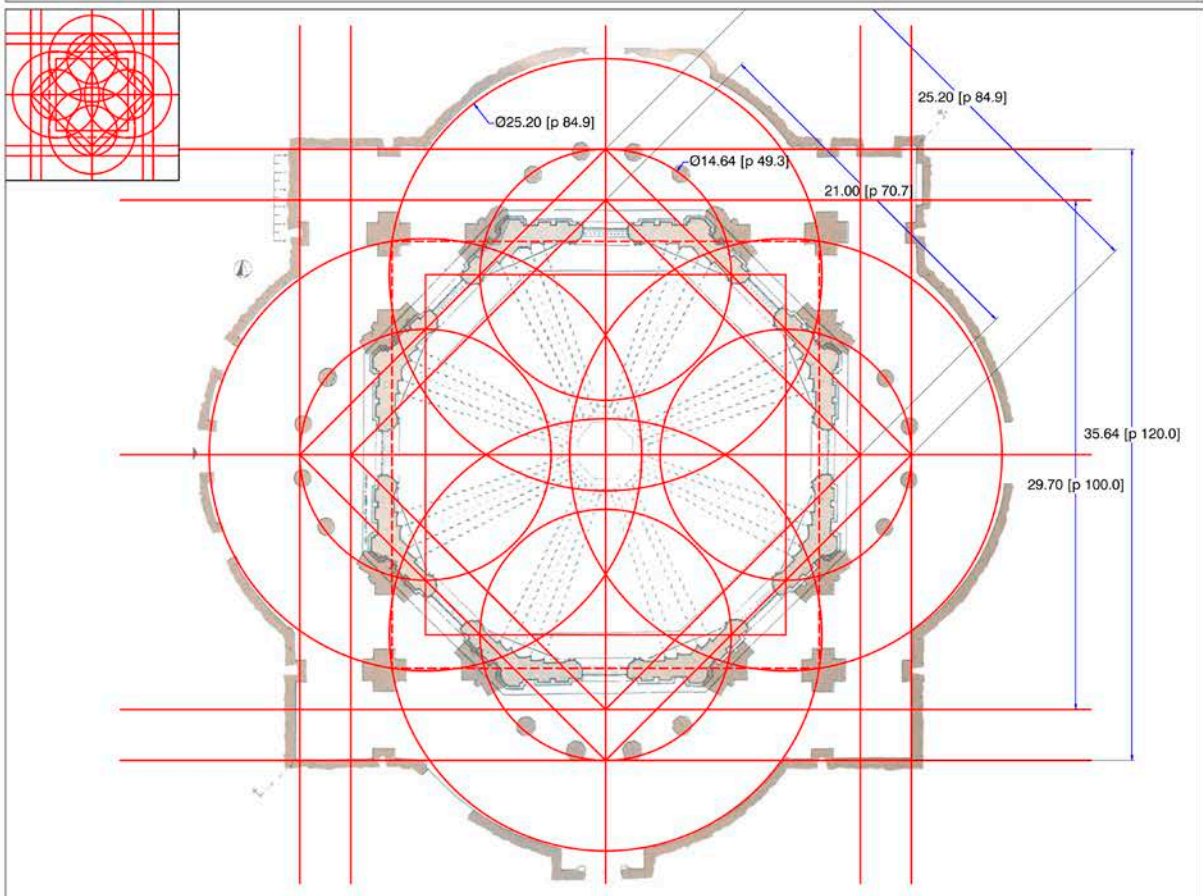


b

Fig. 14. Hypothetical reconstruction of the planimetric scheme of the church of Saints Sergius, Bacchus and Leontius in Bosra (a), and of the church of Seleucia of Piëria (b) (elaboration by the author).



a



b

Fig. 15. Hypothetical reconstruction of the planimetric diagram of the church of Apamea (a), and of the church of San Lorenzo in Milan (b) (elaboration by the author).

According to excavators, an early phase of the building had columns arranged close to the outer façades. The resulting almost total destruction was attributed to the effects of an earthquake reported in 526. After a first partial reconstruction, which was possibly interrupted by the earthquake of 528, the church was finally completed<sup>63</sup>. The church's attribution is uncertain: fragments of a figurative frieze do not provide conclusive evidence, although figures of apostles and scenes from the New Testament can be identified. According to Richard Krautheimer, if the excavations had not accurately clarified the construction date, the building would have been dated to a rather earlier period and would probably be seen as slightly later than the church of San Lorenzo in Milan<sup>64</sup>. However, a date around the end of the 5<sup>th</sup> century, as initially proposed, seems more plausible<sup>65</sup>.

The construction of the plan layout of the church of Seleucia does not require too much explanation (fig. 14b): it starts with a 100-foot-square subdivided according to a 25-foot grid. The centre of the semi-circular colonnades is formed by the intersection of the 50-foot central square with the axes. The entire central tetraconch thus results placed entirely within the inscribed diagonal square. The external curved walls share the same centre as the interior colonnades and have a radius equal to the diagonal of the 25-foot square.

## Apamea

The tetraconch of Apamea can be accurately dated thanks to four dedicatory inscriptions made during the seat of Bishop Paul<sup>66</sup>, who was active between 533 and 540. However, it is assumed that Paul's interventions were part of a restoration involving several changes to a pre-existing building, including closing the eastern lobe and creating the corresponding *synthronon*. Thanks to the considerable size of the pillars of the tetraconch, it is certain that there was a domed roof over the central space of the church.

Of particular interest is the relationship between the patron and the work, testified by the dedication of the polychrome figured mosaic: τὴν ποικίλην ψηφίδα | Παῦλος εἰσάγει | ὁ ποικιλόφρων | τῶν ἀνωθεν | δογμάτων (SEG 26: 1628)<sup>67</sup>; in which mention is made of both the mosaic, referred to as *poikile psephis* (ποικίλην ψηφίδα) and the very quality of Paul, defined as *o poikilophron* (ὁ ποικιλόφρων), a clear reference to the qualities attributed to Odysseus, including the *poikilometis*, those of a man capable of many skills<sup>68</sup>. As has already been highlighted, the vocabulary (ποικιλόφρων: one who understands and interprets in every possible way the heavenly doctrines, the Divine Truths) and wordplay (ποικίλη ψηφίδα – ποικιλόφρων) involve specialized language skills that required a solid training in the Classics<sup>69</sup>. There are few doubts that Bishop Paul was the author of the text. There is also a reference to the multiform (as a positive value) in Paul's other inscription: πολλῶν μετ' ἄλλων κ(αί) τόπον τὸν | ἐνθάδ' ἐκόσμησε | Παῦλος τῇ πολυμύρῳ συνθέσει (SEG 26: 1629)<sup>70</sup>. Despite the difficulties posed by textual exegesis, the general meaning of the first text can be understood by comparing the humble, earthly art of the mosaic with an appeal to higher truths<sup>71</sup>. By playing with the concepts of variety (*poikilia*) and decoration (*kosmos*), artists and patrons created programmes of integrated text and images that promoted Christian ideas about the right order of the universe, as well as notions with more classical connections. This allowed patrons to portray themselves as both cultivated individuals and devout Christians<sup>72</sup>. This appears to be a trait of Neoplatonic culture, where the single divine essence appears multifaceted because the human soul perceives the variety emanating from its power<sup>73</sup>.

The construction procedure at Apamea is similar to that seen at Seleucia (fig. 15a). However, the grid here has variable widths ranging from 20 to 25 feet from the centre outwards. The spacing of the 15-foot grid determines the sizes of the central pillars. To draw the outer lobes, the centre of the compass is positioned at the intersection of the main axes where the 15-foot and 25-foot grids meet, and its opening is determined by the intersection of the penultimate and last lines of the grid.

## Milan

Finally, we come to what appears to be the progenitor of this type of layout. Based only on a formal comparison with previous examples, we would probably place the Church of San Lorenzo in Milan at the beginning of the series.

<sup>63</sup> CAMPBELL 1941, pp. 47-53.

<sup>64</sup> KRAUTHEIMER 1986, p. 166.

<sup>65</sup> CAMPBELL 1941, p. 53.

<sup>66</sup> SEG 26:1627-1630. On the building, of which a detailed architectural edition is lacking, BALTŲ 1972, pp. 188-205, esp. pp. 192-193 for the paving (SEG 26:1627); BALTŲ 1976; for the church also BALTŲ 1981, pp. 105-115.

<sup>67</sup> BALTŲ 1981, pp. 106, figs. 115-116. On the texts and *poikilia*, AGOSTI 1997; his translation: "It is Paul who is introducing this variegated mosaic, since he has variegated knowledge of the doctrines from

on high". Also, ASSIMAKOPOULOU-ATZAKA 2019, pp. 106-108.

<sup>68</sup> On Odysseus and the *poikilometis* in Homer, see *Poikilia* 2009 (M. Rinaudo), pp. 49-51. Cf. AGOSTI 1997, pp. 33-34.

<sup>69</sup> ASSIMAKOPOULOU-ATZAKA 2019, pp. 106-108.

<sup>70</sup> "Along with many other places, Paul also decorated this one with the multiform composition".

<sup>71</sup> Cf. AGOSTI 1997, p. 38.

<sup>72</sup> LEATHERBURY 2020, pp. 60-63.

<sup>73</sup> See *Poikilia* 2009 (F. I. Lisi), pp. 353-354.

The question is how long before the Syrian examples it was built, a problem that has engaged numerous scholars over time<sup>74</sup>. Recent studies suggest that the building may date from an earlier period than its architecture itself suggests<sup>75</sup>. Setting aside this issue we will propose a possible planimetric geometric scheme.

As is well known, the church has undergone considerable modifications over time, making it difficult to determine the exact shape of the original building. However, large parts were retained or reimagined in subsequent transformations, particularly with regard to the overall design<sup>76</sup>. The church testifies to the considerable experience that the builders of San Lorenzo must have had in constructing large buildings, as well as their great confidence in the quality of the materials used. Indeed, the central space was originally very large, with a span of around 80 feet, more or less double that of Syrian examples.

In its general outline, the planimetric scheme is based on the outer squares measuring 120 and 100 feet, as well as on the ratio of the two inscribed diagonal squares to the two previous ones. The diameter of the outer exedras depends on the measurement of the side of the more external inscribed square, i.e. the ratio determined by multiplying half the side of the 120-foot square by the square root of two (fig. 15b).

From a practical point of view, once the main axes have been drawn, their parallels are drawn at distances of 60 and 50 feet. Then, the two inscribed diagonal squares are drawn, and the smaller one rotated by a right angle. The diameter of the outer exedras coincides with the side of the larger inscribed square, and the centre of the four circles of the colonnade is determined by where the principal axes intersect with the rotated smaller inscribed square. The radius of the colonnades is measured from the same centre to the intersection of the axes with the greater square. The various geometric measurements would have been rounded up to 85, 49, 50, 70, or 71 feet, respectively. In favour of consistency and clarity, and above all the need to draw on the ground at the construction site, there would have been a sort of normalisation of irrational numbers, which were probably problematic.

Assuming this hypothesis is well-founded, a cross vault should be excluded as a cover for the central space, whereas a dome built on an octagonal base appears to be consistent with the overall design<sup>77</sup>.

The study of the geometric schemes used to define the plans of the tetraconch demonstrates that, overall, they were quite homogeneous in their method of design, although they were less complex in Seleucia and Apamea. This suggests that architectural forms were widely disseminated through drawings. The simple level of geometric knowledge required to create the architectural diagrams meant that they could be also understood beyond a small circle of specialists. This meant that cultivated people with a non-technical background could appreciate and understand aspects of the building's shape and appearance. In addition to architects, patrons or clients (ecclesiastical and civil authorities) could also assess the general design of the building more easily if it was standardised and similar to famous examples.

The issue of concrete training methods and the transmission of technical culture in relation to centres of imperial or religious power – i.e. patrons of architectural works – remains a subject for further study. However, the previous examples clearly indicate that regional factors and locally developed skills played an important role in practical building methods within the Christian *oikoumene*.

<sup>74</sup> See also footnote 2.

<sup>75</sup> On chronology, placed between the late 4<sup>th</sup> century and early 5<sup>th</sup> century, see *San Lorenzo* 2004 (L. Fieni), pp. 71-73 and 84-85; however, a comprehensive review of the issue suggests the first half of the 5<sup>th</sup> century: NERI, LUSUARDI SIENA, GREPPI 2015, pp. 31-37. For some interesting considerations, see also RANALDI 2021, pp. 77-79.

<sup>76</sup> Most of the transformations took place in the upper parts of the building, which were also due to the fires of 1071 and 1084 (1075 according to KLEINBAUER 1967, p. 1), the collapse of 1103, and the collapse of 1573, which finally led to the complete reconstruction of the central space and dome; ROCCHI 1991.

<sup>77</sup> Cf. KLEINBAUER 1976, pp. 4-6; most recently *San Lorenzo* 2004 (L. Fieni), p. 81.

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