Specificity of research and reconstructions of ancient wall constructions in Syria, the area of Palmyra
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1. The range of survey conducted
The Polish Centre of Mediterranean Archaeology of the University of Warsaw (PCMA) has been conducting archaeological studies in the territory of contemporary Syria, in Palmyra for over fifty years. In 1999 - 2009 Palmyra was the site of excavation works of two early Christian basilicas, (basilica III, basilica IV), performed by a team of Polish specialists, supervised by prof. Michał Gawlikowski [Gawlikowski M., 2002, 2009, 2010] and Grzegorz Majcherek, PhD [Majcherek G., 2012]. The researchers also continued the exploration of the sites where the works started in 1974 - 1980, in the area of Athena-Allat temple, as well as the location of dwelling houses quarter. The author of the elaboration above has been participating in the research since 1999 and his duty was to analyze architectonic - construction arrangement, restoration and reconstruction of the wall structures.

All the studies of ancient wall constructions had interdisciplinary character and besides archaeological works consisted of: historical studies on the base of literature, comparative research including iconography, drawings, walls geodetic-inventory measurements - type of masonry, construction, technology used, technical and material condition estimation, studies and reconstructions - both real and virtual. Conservation and reconstruction of the structure elements were performed in accordance with international decisions concerning conservation and reconstruction of architectonic heritage relics, i.e. the Athens and Venice Charters, and in case of virtual reconstruction also London Charter. The studies and analysis of architectonic - construction arrangement and their documentation matches clearly particular development stages, their dismantling or rearranging in a studied object. Conservation and reconstruction works included various types of antique construction - early mediaeval basilicas, temple walls, house fragments and city walls.

2. Characteristics and specificity of wall constructions in studied objects
Specificity of studies of late antique wall constructions occurring in Palmyra results from original technology of their erection, various means of wall elements joining, and static wall work connected with this fact, different technical conditions of wall elements subjected to destruction as a result of environmental activities in semi-desert area and last but not least, the necessity of their protection from further environmental degradation. Wall constructions from Palmyra are made of lime elements, which depending on their make technology and mortar used for joining have varied forms. In accordance with the research conducted, their various types can be distinguished as they were introduced in reference with the building destination, date of erecting and making [Barański M., 1996]. Technological diversity is confirmed by the fact that in 2nd century B.C., common dwelling houses used constructions made of
mud brick, while until the end of 1st c B.C. basic building material used for tombs, temples and habitable buildings consisted of lime stones creating natural walls combined frequently with mud brick. Wall constructions appeared since 1st century A.D. in parallel with arch constructions made of cubicoid lime cut blocks. Monumental buildings of Palmyra owe their development to highly qualified builders and architects, but first and foremost to very good properties of lime rocks appearing in nearby quarries. During 1st c A.D. they served for producing cubicoid blocks for tower grave walls, more important temples and other buildings. This wall type was called „opus quadratum” [Adam J.P.,1999]. Since the half of 2nd c A.D., there was a breakthrough in external walls of those monumental buildings’ erection technology. Flat stone boards came into use, which although of the same weight as stone cubes were much more thinner, which gave them bigger elevation surface (Fig.1). They were laid parallel, in two, from outside and inside of the wall. Flat boards conveyed vertical load being the proper support structure. Space between boards was filled with rubble mixed with lime mortar. Welds between boards were filled with mortar. Wall stiffening elements in basilicas structures consisted of flat boards of identical width as the walls, placed in horizontal surface, which joined vertical elements creating a kind of a cap, laid on them. Constructions of that type had been known earlier in Greece and Asia Minor [Barański M.,1991, 1996; Vitruvius Pollio M.,1960]. Techniques of their erection resemble walls of enplecton type („opus emplectum”), mentioned by Vitruvius [Vitruvius Pollio M.,’1960], caps are a kind of diatonoi - elements joining the wall thickness and providing its durability. Since various heights of particular layers appear in the wall, it resembles “opus pseudiodomum”.

Due to its sizes and rules described above, this type of Palmyra wall structure was called „opus palmyrenum” [Barański M.,1991,1996]. In reference to classical version of „opus emplectum” - „opus palmyrenum” possesses bigger visual and aesthetic values, because the elevation displays compositions of big stone boards. The discussed technique was commonly applied for monumental buildings since 2nd century A.D. although it still coexisted with other techniques described above.

Palmyra early Christian constructions are characterized by secondary usage of their building material and elements originating from other older or destroyed and dismantled structures. It is particularly depicted in case of basilica IV. Various building techniques applied in different periods and for different purposes (sometimes combined in one building - walls of „opus quadratum” in the apse construction, „opus palmyrenum” in external walls construction of basilicas) influenced to various extent on the durability of particular construction fragments. Therefore, various constructions present varied destruction level (side walls of basilicas have preserved to the level of 1-1,5 m) and can be subjected to diversified conservation treatments or reconstructions. Walls of classical stone blocks turned out to have been more resistant due to their construction features and are easy to reconstruct, although their building elements could have been used secondarily to other structures erecting. In case of „opus palmyrenum” possibility of secondary usage, taking into account gradual wall elements degradation taking place with age, including wind erosion,
was much smaller. Separate issue was the problem arising in studied objects, concerning secondary wall constructions made within original ones and changes made by new users, transforming the buildings according to new purposes and functions. It refers mainly to buildings’ constructive changes in the period of early Islamism. Wall constructions of this type are characterized most often by primitive building techniques, making natural and semi-natural walls, with small sized stones, on mortar with lime component.

3. Research on ancient wall construction in Palmyra
3.1. Research on early Christian basilicas

3.1.1. Basilica III

Basilica III (Fig. 2) is smaller of the two known objects - churches of Palmyra, known for long and appearing in all recognized plans, together with basilica IV as “Byzantine basilicas” [Gawlikowski M., 2002]. The beginnings of the basilica date back to the early years of 5th c, however, it was rebuilt during Justinian period after 527. At the end of 9th c it was already ruined and was used as a household building for Islamic family. The basilica’s III sizes amount as follows: width about 21m, length with an apse about 23m. It is a three-nave basilica with analogue projection to the one situated in Qalb Lozeh in Syria, preserved in much better condition, which served as a point of reference during real (partial) and virtual reconstructions (Fig.3). The nave and aisles are closed with platforms, north of which had a role of a sacristy and the south one served as a martyrion. The nave roofed the presbytery, separated from the church side with a balustrade made of stone boards. The presbytery started with an arch, supported by pilasters projecting from the walls of an apse, on which a semi-dome reaching the arch rested.

The basilica had been completely covered with earth and the stones configuration did not give in the beginning any clear picture of architectonic-construction composition. The basilica’s support structure is built of lime-stone blocks, huge in size with walls of the aisles and the front one created a layer construction, where external layers of the facade blocks were filled with rubble. Particular layers were covered with caps in form of stone blocks, thick as the whole wall (about 80 cm). The wall construction called “opus palmyrenum” is characteristic for Palmyra public buildings, particularly for basilicas. The walls have partly preserved up to the height of 1-2 m. From the front side, the wall has partially been reconstructed.

The apse walls, about 80 cm thick, are made of homogenous material - lime-stone blocks. They were supported in the period of Justinian reigning with stone boards, which squared towards the apse walls, increased their rigidity and enabled to convey higher horizontal forces. Within the range of construction-restoration works, partial reconstruction of internal apse fragment was performed, using the method of anastylosis (Fig.4.). A fragmentary reconstruction was also made of the supporting pilasters at the main arch of the apse. Anastylosis was introduced for partial reconstruction of the atrium with a portico. Inside the church no traces of a bema were spotted.
Fig. 1 - Layer wall "opus palmyrenum" in basilica III (W. Terlikowski); Fig. 2 - Basilica III (M. Gawlikowski)

Fig. 3 - Virtual reconstruction of basilica III (D. Tarara); Fig. 4 - Reconstructed apse walls of basilica III (Fot. W. Terlikowski)

Fig. 5 - Basilica IV (W. Terlikowski); Fig. 6 - Islamic structures in basilica IV (W. Terlikowski)
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3.1.2. Basilica IV

The study [Gawlikowski M., 2010; Majcherek G., 2012] proved that the basilica IV (Fig.5) comes presumably from the beginning of 6th century, from the emperor Justinian, the great builder of Christian temples, period. It is a typical three-nave church, in erecting of which, constructive elements of pre-Christian structures had been used. On the grounds of geodetic measurements, analyses of the walls preserved and the artifacts found, it was stated that the church had been abandoned by the Christians in 8th c. In 9th c the temple was redecorated in Islamic style and served as urban residence (Fig.6). The aisles were divided into smaller rooms and a kitchen and the nave, deprived of a roof, served as a yard with two wells and terracotta water supply system. The construction has a rectangular base with sizes of 47 x 27 m. Its surface is extended of 11 m by a columned porch. It is a typical three-nave basilica. While erecting it, the elements of earlier pre-Christain buildings had been reused. Within the range of construction-conservation research the survey was performed which served for documentation of the two church phases and the study of virtual reconstruction, basing on comparative analysis, was made (Fig.7). The central basilica part reported signs of a bema, which is exceptional in case of early Christian basilicas situated in central part of Syria. It might have been connected with the remains of a pagan temple, which traces were excavated under the bema.

3.1.3. The analyses of architectonic-constructive compositions in Palmyra basilicas

Subjecting to analysis the other known examples of early Christian basilicas in Syria territory, one can state that they belong to early Christian church forms, appearing first of all in the area of northern and central Syria and they are the most often three-nave temples. Churches on central plan dominate in the South of Syria. Palmyra churches represent features of Syrian basilicas, however, they possess their individual characteristics. The walls of the naves were higher than side walls, raised to the height which enabled to place there windows giving light to the interior, above the roofs covering the aisles. The nave was covered with a two sloped pitched roof of wooden construction with ceramic tiles. The aisles had wooden one sloping surface roofs resting on outside elongated walls and higher walls of the nave situated on internal arcades. The nave was closed with an apse on which a stone semi-dome was resting. The apse was
separated from the nave by a transverse arch with the diameter in accordance with the apse width.

All Syrian basilicas had been designed following a strictly regulated canon, introduced probably by Antioch Church hierarchy. Palmyra basilicas represent features of that canon, preserving simultaneously their individual character.

- apse with the presbytery is oriented towards the East,
- internal arcades, consisting of arches on columns or pilasters separating the aisles,
- additional entrances from the South, sometimes from the North as well,
- aisles finished with pastoforia, north of which served as a sacristy, while the south one was a martyrion (In basilica III it is to the contrary, which shows difference between the northern and southern Syria. Palmyra is on the border of the two influences).
- frequent completing (closing) the apses with flat walls from the outside,
- bema situated in the basilica central part, in the nave - a built up platform in form of a horseshoe with the entrance from the apse side, 1,5 m high over the floor level (basilica IV),
- external narthex, from the western side, being a relic of an atrium, (there is atrium in basilica III)
- wooden two - sloped roof over the nave and one sloping roof above the aisles with the construction opened from below,
- frequent articulation of external naves and apses' walls with windows placed in them, by the means of columns ( not present in Palmyra),
- western double-towered elevation with internal narthex (not present in Palmyra),
- plain walls, without excessive ornaments.

Basilica IV in Palmyra is, apart from the other one situated in Rasafa, the biggest preserved single basilica in Syrian territory. Most of other examples in northern Syria are much smaller, than those two. The length of basilica IV in Palmyra is measured without external, columned narthex' width. The lenght of Rasafa temple is estimated together with the internal narthex, between two frontal towers. It can be stated, therefore, that both basilicas are of similar sizes. Comparing plans of these two churches, it is depicted that spaces between the columns along the longitudinal axis in the nave are different. Intercolumniation in Rasafa basilica is about 3,75 m, and in basilica IV in Palmyra - about 7,5 m. This doubled distance between the columns must have influenced the varied height of both churches. The height of Palmyra basilica is estimated for about 23 m.

All typical Syrian basilicas are wall constructions, in longitudinal composition. Supporting walls are 60 cm - 90 cm thick, depending on situating, material used, technology implemented and a basilica sizes. In Northern Syria, limestone formed into big blocks is a material used for wall erecting. They were usually put without any mortar. In the South of Syria basalt blocks were used instead.

In Palmyra, as it was mentioned above, another building technologies – layer walls „opus palmyrenum” were used.

This construction was introduced in walls of the aisles and the front of basilica
Ill, making a spectacular façade of huge blocks. Thickness of external longitudinal walls, transverse ones and the apses amounts about 80 cm. Apses’ walls were made of homogenous limestone blocks in technology - „opus quadratum”.

The longitudinal walls were stiffened by the walls closing the naves - western one, the facade, frequently joined with the tower constructions, which do not appear in Palmyra, and the eastern one closing the aisles, perforated by entrances to pastoforia, together with an arch resting on pilaster and the apse walls, was combined with the apse walls with a stone semi-dome and the walls closing pastoforia. Side winds’ pressure was concentrated on external walls and the raised walls of internal nave, party cooperating with each other by roofs construction, which timber framings were anchored in wall nests.

Elements of earlier pagan constructions were frequently used as supporting columns for raised walls of the nave (basilica IV in Palmyra). Roofs were covered with ceramic tiles.

3.1.4. Allat - Athena temple

Excavation works in this region were initiated in 1959 by prof. Kazimierz Michałowski. They were continued under supervision of prof. Michał Gawlikowski [Gawlikowski M., 2009] in the area of a military camp, built at the turn of 3rd c A.D., being an element of defensive system of the Emperor Diocletian. The works concentrated within the area of Allat-Athena temple – pre-Islamic goddess, and were the continuation of explorations carried out between 1974 - 1980. Allat’s symbol was a lion protecting a gazelle (a relief with such an image excavated by Polish archaeologists years ago is placed at present in front of the entrance to the Museum in Palmyra, and originally it had been a relief projected out of the temple wall and that was the way of Polish archaeologists’ reconstruction). Allat’s shrine is built imitating Greek temples, but it also combines the elements of Eastern and Western art in a unique and interesting mode. Its existence is particularly interesting, because it confirms the fact that Allat was still worshipped even when Christianity became officially accepted religion. As it results from Polish research, the permission for redecorating the temple was issued, after its demolition during Roman invasion. The temple, however, must have been built much earlier, probably in the beginning of 1st c and was rebuilt at the end of 3rd or the beginning of 4th c. During the excavations, a hole in the ground was found, which turned out to have been a tank, situated nearby ruined northern portico. The tank filled with rubble contained a column with the bottom and the capital. It delivers the evidence that after the construction disaster for the first three centuries there had not been any northern portico. The research proved the existence of two stages of the temple development. Within the works on real partial temple reconstruction, anastylosis of three columns in northern portico (Fig.8) and virtual reconstruction (Fig.9) were performed.

4. Summary and conclusions

Treasures of Palmyra architecture are unique in its kind. The idea of the wall construction specificity is to combine skillfully classical building techniques,
originating from Greece and Asia Minor with local solutions, taking into account favorable strength properties of lime rock present in local quarries and innovative technical solutions. Many of constructive elements creating the historical objects under research originate from older buildings and were reused. Ancient building techniques coming from different or the same periods, including early Islamic period coexist in these cases equally. This feature is a research and restoration problem because of varied level of material and particular construction components’ destruction. Studies on early Christian basilicas proved the originality of architectonic-constructive solutions. Palmyra historic transformations, time, environmental changes, destructive human activity, wind erosion, all these factors influenced on durability of Palmyra architecture. Unfortunately, war activity in Syria has stopped the explorations of Polish archaeological mission in Palmyra. This year, due to the growing threat of losing forever those unique treasures, historic heritage of Palmyra has been proclaimed as threatened on the UNESCO World Cultural Heritage List. We do hope that this action will serve well in its protection and as soon as the warfare is over, the research will be continued for future generations’ sake.

References