

WATER SUPPLY SYSTEM AT KRŠEVICA (4th century BC)

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Abstract. – Archaeological investigations of an urban settlement dated between the beginning of the 4th and first decades of the 3rd century BC have been conducted at the site Kale in Krševica since the year 2001. Below the acropolis and close to the Krševica river segment of the complex with water supply system, which could provide water for few thousand inhabitants has been discovered. The system consists of basin for water filtering and structure with barrel vault as reservoir. The chronological framework for this intricate and unique complex is possible to establish only after detailed analyses and further investigations (only around 6% of the entire site has been investigated so far).

Key words. – Kale–Krševica, urban settlement, 4th century BC, water supply, barrel vault.

The investigations at the site Kale in Krševica have started in 2001 in an attempt to establish main characteristics of the archaeological site where the remains of settlement with walls and 4th century BC Greek pottery have been recorded in 1966.¹ It became clear already after initial site surveying and test trenching that this location had been carefully chosen. The area of the settlement and its surroundings belong to two different ecosystems – wooded slopes of the Rujan mountain with Krševica river and fertile Vranje plain with Južna (South) Morava valley in the background. The plateau with acropolis is around 480 meters above sea level and structures by the river, at the foothill, are around some 80 meters lower. It turned out in the ensuing years that fortified settlement with urban structures – acropolis and large suburbium – covered around 5 hectares, so in the course of time it became clear that site is much larger and scientific problems much more complex than it appeared in the beginning (www.kale-krsevisa.com).

The settlement was established on the conical rocky massive of sandstone as the prevailing rock. At first the problem of water supply could have been most probably solved with wells at the bottom of slope in the immediate vicinity of Krševica river. This assumption is based on the fact that there is modern village at the foothill of the site where every household has the well providing drinking water throughout the year. Some new information was acquired during 2003 excavations when the drainage canal made of roof bricks has been discovered under the latest building horizon on the acropolis.² We have expected to discover also some kind of cistern but further works did not confirm that. In that very same year (2003) large hydria together with few complete vessels in the habitation horizon was found

¹ Mincyruth, Jonanonith 1968.

² Popović 2005, 150, Fig. 19.

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Fig. 1. Map (drawn by S. Tripković)
 Fig. 2. "Stone quarry" and "rampart"
 with added structure in 2003 (photo M. Jeremić)
 Сл. 1. Карта (израдио С. Трипковић)
 Сл. 2. „Каменолом“ и „бегем“ са призидањем
 трајевином 2003 (фото М. Јеремић)



on the slope.³ It could have been another confirmation of the assumption that acropolis did not have cistern and that water had been brought from the foothill. In any case if we add information provided by the local inhabitants to many chance finds and geophysical investigations⁴ then we have convincing evidence that the largest portion of the settlement was situated on the northeastern slopes, between the acropolis and the river valley. It should also be mentioned that under the humus layer there were visible remains of the walls, which local inhabitants demolished to obtain stone for house building. Even today large dressed stones incorporated in the house walls made of stone rubble and mud bricks could be noticed throughout the village.⁵

The most recent results should confirm earlier assumptions that below the acropolis and by the Krševica river is large hydro-technical system, which provided large quantities of good-quality water for the settlement. These quite unexpected discoveries of monumental structures raised the questions of time of their construction, their appearance, function and also of the origin of inhabitants of this significant settlement on the distant periphery of the Mediterranean world in the Južna Morava valley.

HYDRO-TECHNICAL COMPLEX – INVESTIGATIONS 2003–2010

The excavations in the first years of investigations were directed at exploration of the acropolis, so we

started excavations at the foothill thanks to coincidence. Namely, below the Kale hill there is a path, which following the river is the shortcut to the neighboring village Žbevac. At certain spot in the steep profile and under the shrubs we encountered a layer with pottery fragments, so we decided to explore that profile in order to complete the data about this site (trench E/2002). It soon became clear that pottery comes from the eroded layer but traces of carving activity consisting of deep vertical and horizontal grooves, circular holes and oval beddings were clearly visible in the rocky massive. At first sight everything indicated the techniques of stone exploitation so the structure at the foothill, was ascribed, with a reservation, to the remains of quarry.⁶ This assumption was based besides certain analogies also on the fact that there is no good quality stone in the immediate vicinity. It would turn out later that these were just segments of larger wooden structures with many holes for posts and beds for horizontal beams.

As the cultural layers extended deeper and deeper the excavations continued also next year (2003). In

³ Popović 2005, 152–153, Fig. 22.

⁴ Вукadinović 2005.

⁵ Jepsen 2005, 242–246, Fig. 22–26.

⁶ Jepsen 2005, 232–235, Fig. 2–4, 7–11; Popović 2005, 154–155, Fig. 23.



Fig. 3. View to the north section of the site in 2006 (photo A. Đorđević)
 Сл. 3. Поглед на северни гео локалитет 2006 (фото А. Ђорђевић)

trench 3 x 6 m in size large stone blocks, which we explained as rampart were encountered in the south profile at the depth of around 1.5 meters, and next to the profile were recorded the remains of some structure built of broken stone. Under the fourth row of stone blocks and at the depth of almost three meters the water appeared (Fig. 2).⁷ From that moment all further excavations in this section of the site were possible only with permanent use of the water pumps. In the campaigns, which ensued it became clear that rather deep under the grassland and fields in the layers with water and mud there are walls, buildings, various structures and other archaeological finds covered with thick sand deposits of Krševica river and the material washed away from the nearby slope.

The excavations continued also in 2005 following the assumed position of the rampart. The rows of stone blocks continued around 5 meters to the east while large area covered with broken stone was encountered further toward the river. The two-room building was leaning onto the north face of the "rampart" and to the south was broad stone area consisting of two platforms. Two walls made of large ashlar separated by narrow funnel-shaped passage branched from the upper platform up the steep slope (Fig. 3). We have assumed that

it was the system for regulating surplus of water from the slope and thus protecting the settlement from excessive rainfall. The permanent presence of water in the lower zone and some kind of drainage canal with walls descending along the slope made us identify this section of the site as "hydro-technical complex".

In the following year (2006) we investigated area to the north of platform where despite depth and pressure of water we reached with great effort the virgin soil for the first time. At least three building horizons have been encountered: the level of virgin soil characterized by traces of few oven floors and many postholes of different size, the horizon with remains of the walls of structures, large number of domed ovens and the horizon with already mentioned two-room building.⁸ At this moment we are particularly interested in the results of investigations in the zone toward large platform and the south sector.

Finally, in 2006 and 2007 we acquired precise data about the appearance of this monumental structure.

⁷ Jepsen 2005, *ibid.*; Popović 2005, 154–155, Fig. 24–27.

⁸ Popović 2008; 2009a, 148, Fig. 3, 7.



Fig. 4. Large platform with east wall and structure with barrel vault in 2008 (photo A. Đorđević)



Fig. 5. Building complex in 2008 (photo A. Đorđević)

Сл. 4. Велика платформа са источним зидом и грађевином са бачвастим сводом 2008 (фото А. Ђорђевић)
Сл. 5. Потлед на комплекс 2008 (фото А. Ђорђевић)

Upper platform is stone paved. It is around 4.5 m long and 5 m wide. Two previously mentioned walls of massive ashlar were gradually ascending from that platform up the slope. They were of approximately same width (2.3 m). The space separating them near the bottom is around 0.25 – 0.30 m wide. The north wall is well preserved in the lower zone, while the south wall is considerably damaged and only large blocks of inner face are preserved. On the basis of identified beds for the stone blocks and the later wall of broken stone leaning to the outer face we got the essential elements for the reconstruction of massive walls on the slope (Figs. 3–5).

Lower platform, which is around 0.50 – 0.70 m below the upper one, extends 7 meters toward the river but maintains identical 5 meter width. We should add here that there is another zone in the north (approximately 6 x 3 m) made of smaller stones and divided into many rectangular fields, which are the impressions of wooden beams used as reinforcement for the wall mass. The blocks preserved only in the lower zone suggest that the substructure was built of stone, wood and mud bricks in the upper zones. It is not impossible that these were in fact remains of the corner towers of the fortification (Figs. 3–4)?

The north face of the platform lies on large stones used as foundations. It was covered with around 3 meters high six courses of nicely dressed stone blocks. They are decorated with borders in two instances and between the ashlar are smaller or larger gaps filled with

stone rubble. The preserved length of the face is around 5.50 meters. Further to the east only two lower courses 1.5 meters long were recorded. The wall of which only few ashlar (remains of the mentioned tower substructure?) are preserved and which is orthogonal to the platform turns from there to the north (Fig. 4).

Both faces of the platform were executed in the approximately same manner but few rows of ashlar are missing near the top on the south side. South wall is almost 13 m long and socle with preserved five courses of blocks is approximately 2.5 m high because the first course is hardly visible in the water and mud (total height of the south wall could have been over 3.5 m). Slightly below the platform the eastern wall branches out at almost right angle. This wall is around 2 m high and the top surface of broken stones is 2.80 m wide (Figs. 5–6). Although it is slightly damaged near the end its length revealed during 2010 excavations is 16 m. At that time the face of south wall extending over 4 m toward the slope was discovered in the 3.5 m high profile (Fig. 15).

Thus the entire complex, which was surrounded on three sides by large platform and two walls and on the fourth side by vertical cliff carved into the sandstone rock, was one architectural entity encompassing the area of around 210 square meters (Fig. 13). In the center is completely preserved structure with barrel vault that has been investigated between 2008 and 2010.

The size of this structure of rectangular plan is 10 x 6 m. It was built of large ashlar of tuff that are exception-



Fig. 6. East wall with structure in 2010 (photo A. Đorđević)



Fig. 7. Structure interior in 2008 (photo A. Đorđević)

Сл. 6. Источни зид са грађевином 2010 (фото А. Ђорђевић)
Сл. 7. Унутрашњост грађевине 2008 (фото А. Ђорђевић)

ally precisely dressed inside the room. Two openings of approximately same size (1.77 x 0.70 m) are aligned on the top. South opening around 0.50 m high is surrounded with four stone blocks, which are fixed on one side with leaded iron clamps while the frame of north opening was carved in stone on which fence (well curb) was once resting. The building was filled with variety of material and it was investigated to the depth of 3.5 m after emptying. Its size is 5.30 x 9.20 m. Because of large amount of water, mud and stone only two to three rows of ashlar ending the vertical walls could be recorded. The top course consists of the row of symmetrical blocks on most of which are oval projections for handling and from that level starts 2.60 m high barrel vault. Rectangular openings for transversal beams are arranged at equal distance along the springing-like. They most probably supported the framing in the process of the vault construction (Figs. 6–8).⁹ The structure has not been explored to the bottom. We gave up such intention because of great depth and possibility to endanger the stability of the entire structure in such an attempt. It turned out on the basis of many testing holes that there is over 2 meters to the bottom but because of large quantity of stone these estimates are not reliable. Thus remains only the assumption that structure was over 6 m high and that walls were recessed and resting on the bedrock, which provided long-lasting stability of this imposing structure.

Whether the construction of this expensive and intricate complex could be considered a "white elephant"

was known only to the contemporaries who directly felt all the consequences. In any case, the inhabitants of settlement by the Krševica river were at a certain moment forced to fill the vaulted structure with earth, stone, animal bones and other material. At that point the complete water supply system was abandoned and covered with earth.¹⁰ After leveling the area only 0.20 – 0.30 m above the highest point (well curb) the new horizon was established with many ovens of diverse shape and size. This entire area is nowadays under water, which retains almost same level disregarding period of the year and this level varies between the upper and lower platform (ca 404 m AMSL) (Fig. 9).

HYDROGEOLOGY OF KRŠEVICA

The fringes of Vranje valley and Južna Morava valley particularly around the mouth of Krševica river are characterized by up to 20 meters thick alluvial deposits of sand and gravel containing considerable amount of underground water.¹¹ The terrain of Krševica consists of the so-called grus horizon, stage composed of small-grained decomposed rock predominantly limestone but

⁹ Popović 2009a, 147–149, Fig. 6; 2009b, 96–98, Fig. 2–6.

¹⁰ Popović 2009b, 98–102.

¹¹ Main data taken from Main Geological Map of Republic of Serbia, scale 1:100 000 (OGK)



Fig. 8. Apertures in the structure interior and water level in 2008 (photo A. Đorđević)

Fig. 9. View of the site and water level prior to the use of pumps in 2009 (photo P. Popović)

Сл. 8. Отвори у унутрашњости грађевине и ниво воде 2008 (фото А. Ђорђевић)

Сл. 9. Поглед на локалитет и ниво воде пре пада пумпи 2009 (фото П. Поповић)

also containing sandstones, conglomerates and claystones and on top of the grus rocks is the stage with underwater sliding with marl, claystones and sandstones. These layers are permeable i.e. water-bearing. The basic rocks with granites of the Bujanovac pluton are at greater depths.

The Krševica river valley as part of the same region is covered with alluvial deposits consisting of water-rich sandy and gravel layers. These water currents come partially along the valley and partially from permanent and rich springs on the slopes of the Rujan massif. In these aquifers could easily be detected descending types where water runs eastward through slanting layers of degraded sandstone and accompanying rocks. Such situation was encountered also on the slope at the site foothill where occurrence of reduction of depth (thickness) of water-bearing layers on the surface that are not under pressure and are lying on the waterproof ground, has been noticed.

The Krševica river is an example of typically torrent river, which could carry considerable amount of various material during excessive rainfall. The result was depositing of material along the river bed in particular at places where the water speed decreases, so the width of alluvial deposits could be up to 100 meters in the vicinity of the site. We know on the basis of evidence from few previous years that rising currents of Krševica river could carry everything before it, as at few instances some smaller bridges had been carried away. At times like that the river frequently changed its bed so it is today difficult even to assume how this settlement on



the bank of one of the Južna Morava tributaries had looked like two and a half thousand years ago.

In the vicinity of the site there are always water deposits at the depth of only few meters and in the drought years when there is no water in the river local inhabitants use wells and small motor pumps to water their gardens. Recent digging of trenches for the village waterworks at Krševica revealed how big river deposits and changes of the riverbed location near the foothill of Kale had been. As a rule the layers consisted only of the finest river sand and gravel.

It is not possible to identify the fossil bed of the Krševica river without detailed investigations including drilling of the ground nor to gather data about human activities in this section of the river valley what would be of exceptional importance for our investigations. It is quite possible according to certain indications that river once flew closer to the settlement and was deeper but in the course of time due to erosion it was covered more and more with gravel and sand, while the bed shifted more to the east. But, despite all changes of water level in the river the approximately identical quantity of fresh water whose temperature is around 12° reaches the place where the "hydrotechnical complex" is located. In the course of archaeological excavations and when water pumps are working around the clock the level of water in all neighboring wells falls drastically and that significantly speaks about connection between the aquifers and the water potential in this area below the acropolis.

HYDROTECHNICAL COMPLEX – WATER COLLECTION BASIN WITH WATER INTAKE FACILITY

The founders of this settlement had to solve many problems and one of unavoidable tasks was the question of water. They had to decide on the location, which is most suitable and easily defendable, also close to the fields, which provided food for the inhabitants and to provide good and continuous water supply.

The construction of this large complex was certainly preceded by careful investigations and in the beginning the wells were most probably used that not only provided water but also provided certain hydrological data necessary for realization of this project. They were not obliged to observe the Solon's law according to which the wells have to be at precise distance¹² but such "extended system" of water supply was too much vulnerable, easy to contaminate and difficult to defend.

The detailed analysis of water resources in the immediate vicinity offered the builders few possibilities for solving the water supply issue. Despite enormous quantities obtaining water from the gravel deposits on the fringes of the Vranje valley was not rational for many reasons of which the greater distance was just one. Other solution was digging of many wells to draw water from alluvial deposits along the Krševica river. In that case there would not be permanent influx of necessary amount of water because of seasonal variations and possible torrents could endanger the installations.

Therefore, the most convenient solution had been chosen – use of constant natural springs, which did not depend on water level in the gravel layers of the riverbed. These aquifers are of permanent character and in order to use them it was necessary to construct water tapping system, i.e. masonry structure, which would collect intended quantity of water and thus made possible unlimited water supply for the acropolis and suburbium.

The reasons for construction of this monumental and expensive water supply system must have been serious strategic intentions to establish relatively large and well-protected settlement organized after Greek models. We know very little about the actual reasons as we now realize that our investigations are just at the beginning. We could consider discovery of the complex as genuinely great luck because these results speak about importance of the settlement much more than, for instance, the finds of certain structures of the fortification or the dwelling structures. Therefore, it is our intention to present here the basic data about the way this

system, which was of vital importance for the entire settlement, functioned.

At the very beginning you could say that regardless of many common architectural elements similar structures of such purpose should not be expected in the Mediterranean area as analogous structures there had been generally built on the karst terrains and with different hydrotechnical characteristics.¹³

Nevertheless, we need not look far for the main analogies we are interested in. It could be concluded according to many data available nowadays from the internet that modern structures used as water collector basins and intake water facilities or captures do not differ much from the structure at Krševica (<http://www.gradri.hr-adminmax-files-slass-vodoopskrba-02.pdf>; <http://grad.hr-nastava-hidroehnika-gf-opskrbavodom-predavanja2/slide/1.5.%20vodozahvati.pdf>). Even the principle of intake of the falling spring is technically almost identical to modern water intake facilities and only difference is that electric pumps and other installations are used today as results of modern technology.

The water collector basin at Krševica covers an area of around 210 square meters and it is surrounded on three sides by stone walls and on the fourth, where the influx of water is biggest, by vertically carved cliff in the sandstone. There is first of all the imposing structure of large platform, which certainly had the most important role and was the backbone of the entire system. The walls extending up the slope could have regulated water flow and protect the settlement, while the surplus of water drained via the platform either into the basin or outside. According to certain characteristics it is only a question of time whether large platform would turn out to be also the segment of fortification system leading toward the acropolis (Fig. 13).

From the south wall extend less deeply recessed east and south wall and after recent excavations we still do not have evidence whether they are an integral part only of the water collector basin or they had some additional function. There are openings between the blocks on all three sides that could have regulated the flow of water in the basin.

Water intake facility with barrel vault was covered with earth almost to the top and, as we already said, it

¹² Grouh 1993, 244–245.

¹³ Grouh 1993; Certain parallels with water supply system at Krševica could be seen at Miletus but that system dates from the imperial period (Tutahs 2007, 118–121, Abb. 126.)

was over 6 m high. To the west of the structure we investigated the trench where we reached the greatest depth at 400 meters above sea level which means over 3.5 m below the vault with well curb. In the trench we encountered alternating layers of lighter and darker soil, i.e. the strata of diverse thickness consisting of sand and smaller and larger gravel. Large stones as foundations around the structure were lying near the bottom. On the sandy ground above the trench (ca 402.30 m above sea level) was discovered the zone with fragments of large vessels, mostly pithoi, hydriai and amphoras while stone blocks were scattered over the entire area. Whole structure ended in the row of blocks, which laid next to each other alongside the structure (Fig. 10).

These finds will be the subject of detailed analysis after conservation and restoration of pottery material but if the situation in the west does not offer clear picture we have precise data about the top level the entire water collector basin in the north and east.

On top of the structure, which is at 403.20 m above sea level on the average, were blocks and row of stones extending as far as the large block placed vertically in front of the north face of the vault (Fig. 11). This stone, which was recessed for at least twenty to thirty centimeters, was around 0.70 m high and secured in place with pieces of stone and. The purpose of this structure is not clear but sunken block could have been at 402.80 – 402.90 meters above sea level. In that case the opening,

Fig. 10. Horizon with ashlar and pottery to the west of structure in 2010 (photo P. Popović)

Fig. 11. Structure with stone block in front of north wall in 2008 (photo P. Popović)

Fig. 12. Vessels next to east rampart in 2009 (photo P. Popović)

Сл. 10. Ниво са блоковима и керамиком западно од грађевине 2010 (фото П. Поповић)

Сл. 11. Грађевина са блоком испред северног зида 2008 (фото П. Поповић)

Сл. 12. Посуде уз источни беодем 2009 (фото П. Поповић)



Fig. 13. Plan of hydrotechnical complex: A – upper platform with walls, B – lower platform, C – “tower”, D – east wall, E – south wall, F – water collection basin, G – water intake facility, H – wall of broken stone, I – stone block in front of north structure wall, 2 – bucranium, 3 – pottery (drawing A. Nikolić and A. Subotić)

Сл. 13. Ситуација хидротехничког комплекса: А – горња платформа са зидовима, В – доња платформа, С – “кула”, Д – источни зид, Е – јужни зид, F – водосабирни базен, G – водозахватна грађевина, H – зид од ломљеног камена, I – блок испред северног зида грађевине, 2 – букранион, 3 – керамика (израдили А. Николић и А. Суботић)

i.e. the well curb was protruding just ten to twenty centimeters above the ground.

The head of ox, an exceptional example of *Bos primigenius*, had been placed apparently ritually on the vault, under thin layer of earth and near the opening.¹⁴ The bucranium was at 402.80 – 402.90 m above sea level.

The third find consists of two vessels – oinochoe and hydria – placed immediately next to top course of the east wall whose average height is around 403.00 m above sea level (Fig. 12). The vessels were at 403.08 m above sea level and most probably had the cult purpose (hydria did not have bottom and could have been used for libation). Considering certain indications the walls could have been higher and built of mud bricks and covered with some kind of roof.

It could be concluded on the basis of these data that vaulted building was covered with earth almost to the level of well curb, which coincides with the level surface of water collector basin at 402.80 – 402.90 m AMSL. The basin was surrounded by walls and filled with sand and gravel used as filtering layer. The system constructed in this way (Fig. 14) could have functioned in the following way: from surrounding saturated layers the water is collected in large and deep basin of considerable capacity. Following filtration water enters the intake water facility, i.e. the reservoir where it is accumulated and later distributed as necessary. It is also

¹⁴ Popović 2009c, 125, Fig. 10–11.

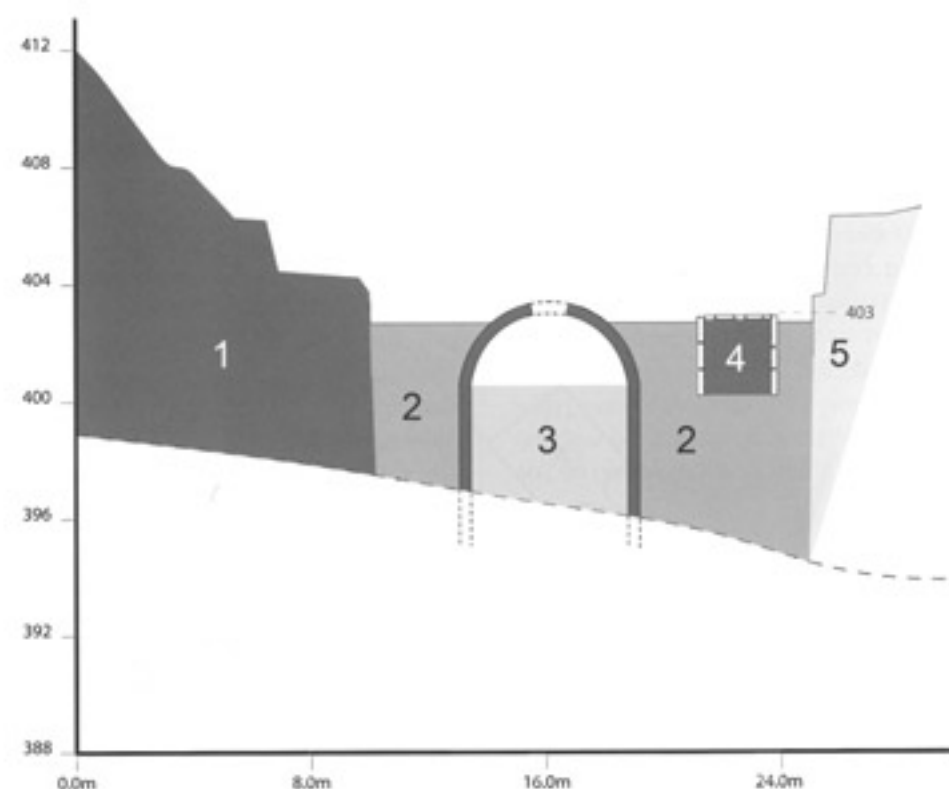


Fig. 14. Section through hydrotechnical complex: 1 – rock, 2 – water collection basin, 3 – water intake facility, 4 – east wall, 5 – sand deposits (drawing A. Nikolić and A. Subotić)

Сл. 14. Пресек хидротехничког комплекса: 1 – стена, 2 – водосабирни базен, 3 – водозахватна грађевина, 4 – источни зид, 5 – наноси песка (израдили А. Николић и А. Суботић)

possible that both well curbs had additional apparatus to facilitate drawing water from the reservoir particularly if the water level was lower. This system might look simple but it should not be disregarded that behind such an undertaking stand not only enormous resources and labor but skill and idea of these masters – architects to put into effect such a project.

CHRONOLOGY

We did not mention so far the period when this complex, which provided water for the inhabitants of Krševica had been built. The main reason is the fact that there are no finds in this section of the site that could offer reliable information about this, as we shall see, rather ambiguous question. The discovered material mainly consists of fragments of pithoi, hydriai and amphoras or wide repertoire of pottery shapes for every-

day use and produced in the local workshop.¹⁵ Also, there was hope that objects, which could provide important evidence would be found on the bottom of reservoir in the vaulted building, but as we said we could not count on that any more. In such a situation we must rely on chronology based on the pottery finds from the Attic workshops¹⁶ or the numismatic material¹⁷ recorded on the acropolis or in other sections of the site. In brief, regarding available evidence everything indicates that acropolis with suburbium at Krševica was established in the beginning of the 4th century BC and later, the settlement, which underwent

¹⁵ Асимт, Баџић 2005; Popović 2005, 157–158, Pl. II–III; 2006, 128–129, Fig. 11–12; 2007b, 132, Fig. 8.

¹⁶ Крстич 2005; Popović 2005, 156, Pl. I; 2006, 528, Fig. 8; 2007b, 131, Fig. 5–6; 2007a.

various transformations, lasted until the first decades of the 3rd century BC.

The complex with remains of public buildings from the latest horizon could be seen on the acropolis after investigations, so any parallels with situation at the foothill of the site are not of much help (Fig. 16).¹⁸ Therefore, we must rely on an attempt to determine the time of construction and existence of the complex by the Krševica river at least approximately and without any substantial argument.

We start from the assumption that settlement had been established in the beginning of the 4th century BC and it is logical that in the beginning water supply had been organized by alternative methods (wells, cisterns). In the meantime the settlement prospered, it was expanded and during first half of that century the water supply system with basin and reservoir had been constructed in order to solve that problem. Finally, from the mid 4th century there is permanent protection of the aquifer zone, system is functioning and method of

exploitation satisfies the needs of inhabitants considering the quantity as well as the quality of water.

We have somewhat more exact data concerning the time when this system was abandoned and when the barrel-vaulted building and accompanying structures were covered with earth and the entire area was leveled. Namely, one bronze coin from the time of Cassander minted in Uranopolis around 300 BC has been found together with pottery fragments in one pit from that leveling horizon.¹⁹ This pit could be dated, on the basis of stratigraphic situation, to the beginning of the 3rd century but the entire horizon could be more extensively dated – from the end of 4th to the first decades of the 3rd century BC. This roughly coincides with the period when life in this settlement came to an end.

Thus conceived chronological framework could be, however, questioned when we take into consideration some distinct and important elements. It is a question of a significant but unsolved problem related to the provenance and time of origin of the buildings with barrel vaults as distinct architectural feature. We do not doubt here the Macedonian tombs with barrel vaults as distinct contribution to the history of Greek architecture but there are discrepancies in chronological definitions and models on the basis of which many monumental structures had been built.²⁰ Most examples of this kind are tombs buried under tumuli and the structure built in 336 BC for Philip II of Macedon is considered the earliest.²¹ According to another opinion this royal tomb dates from the later period, i.e. 316 BC when Philip III Arrhidaios had been buried.²² However, disregarding different approaches to this problem, the Macedonian aristocracy had been buried in the tombs of this type from the end of the 4th century and distinguished nobles from the Thracian lands soon followed suit.²³

On the other hand, barrel vaults as architectural elements in fortifications and public buildings are not very frequent in the Greek cities.²⁴ In one study dealing

Fig. 15. View of the complex in 2011 (photo P. Popović)
Сл. 15. Поглед на комплекс 2011 (фото П. Поповић)



¹⁷ Popović 2007a; Mitrović, Popović 2009.

¹⁸ Popović 2006, 523–525.

¹⁹ Mitrović, Popović 2009, 157–158, Fig. 3.

²⁰ Tomlinson 1987, 308–312; Chlidis 2008, 83; D'Angelo 2010, 59–61.

²¹ Andronikos 1987, 3.

²² Whitley 2001, 409.

²³ Andronikos 1987, 9; Chlidis 2008, 83; D'Angelo 2010, 59–61; Archibald 1998, 302, Fig. 10.2.

²⁴ Tomlinson 1987, 308.

with this problem the mentioned examples are dated in the period starting at the end of the 4th century BC, i.e. in the time of diadochi and the beginning of the Hellenistic period. It is assumed that this architectural feature originates from the east and that it was transferred to Macedonia after the conquests of Alexander the Great.²⁵ After this study, which was published in 1978 the new discoveries followed including the royal tombs in Vergina but by all appearances there is still discussion going on whether the barrel vault is of local origin or it was brought from the east, i.e. whether it could dated in the time before Alexander.²⁶

The investigator of Vergina, Manolis Andronikos advocated the thesis that "free arch" appeared in Macedonia in the middle of the 4th century BC. Only then the masons well-experienced in such undertakings were commissioned to build the tumulus with monumental tomb for Philip II. He mentions among other things interesting information according to which only the buildings with arched roof could have sustained huge pressure of earth covering in some cases really enormous tumuli.²⁷ Observing his words there is room for assumption that that barrel vault was invented and improved in the mid 4th century by the builders of large Macedonian tombs.

If we could draw any conclusion from all mentioned above about period of construction of the complex at Krševica then it would be best to try to solve this problem by detailed analyses and further excavations, which would provide reliable chronological evidence. In other words, it results on the basis of gathered evidence that this building should be dated not later than the middle of the 4th century BC, i.e. among the earlier if not the earliest known structures of this type. This is even more surprising as the settlement in the Krševica river valley is far from the civilized areas and urban centers and especially because water supply systems are related to the cities and planned and used for the long period of time.

We have seen above that it is not impossible that "free arch" appeared in the mid 4th century BC and it is perhaps only question of time when these assumptions will be definitely confirmed. The very method of construction of the reservoir at Krševica does not differ in essence from some Macedonian tombs and considering architectural design they are more similar than the arches applied in certain urban structures.²⁸ How barrel vault was reliable structural feature is confirmed by the building at the foothill of the site that was not supposed to sustain large weight but by coincidence it re-

mained undisturbed thanks to the fact that it laid under thick layers of earth for many centuries. Just as an example we are mentioning one tomb in the vicinity of Pella in Macedonia. The tomb is under 15 meters high tumulus, which is 100 meters in diameter. The tomb made of tuff (?) is 10.30 m long, 6.70 m wide, 6.10 m high and it is dated to the end of 4th or the beginning of the 3rd century BC.²⁹ Similarities in dimensions and method of construction with our reservoir could be coincidence but it makes us think even more that builders of the Macedonian tombs had an active role at Krševica. In any case, generally speaking, we came to the conclusion that problem of Krševica could not be solved without detailed analyses of archaeological results from Macedonia.

CONCLUSION

It took us nine years of investigation to be able to identify in rough outline at least one architectural entity, which makes just small segment of this urban settlement. The excavations of hydrotechnical complex at the foothill of the site from the very first trench to the unearthing of large areas and the discovery of vaulted building progressed slowly because of great depth and permanent influx of water and only in 2010 we got clear picture about the purpose of this closed system, which could provided water for the populace of few thousands. Below the acropolis, at aquifer location was constructed water collector basin with water intake facility, which because of good state of preservation and quite distinctive hydrotechnical system represents one of few monuments of this type. The realization of this project must be understood as great undertaking and challenge as it was based on combination of Greek experience applied on a terrain with different climate conditions, topographic and geological characteristics and on different approach to the tradition of water supply. The problem imminent to every urban settlement had been solved by these pioneering undertaking but later abandoning of this system forced the inhabitants to turn to certain

²⁵ Boyd 1978, 88–89.

²⁶ Whitley 2001, 408–210; Chilidis 2008; D'Angelo 2010.

²⁷ Andronikos 1987, 12.

²⁸ Boyd 1978; Miller 1979, 103.

²⁹ Chrysostomou 2003, 145, fig. 112.

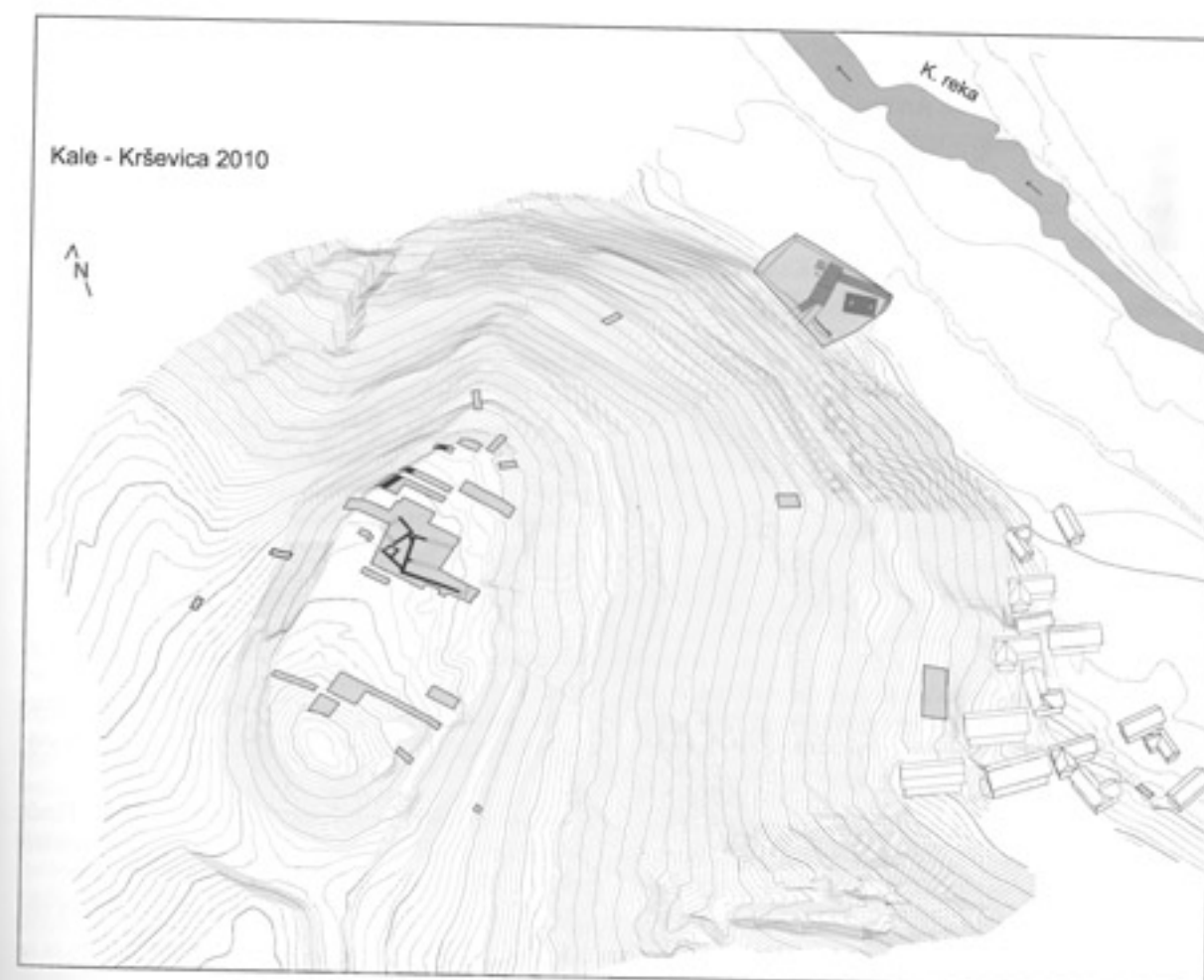


Fig. 16. Kale - Krševica, site plan in 2010 (drawing A. Nikolić and A. Subotić)

Сл. 16. Кале - Кршевца, ситуација 2010 (израдили А. Николу и А. Суботић)

alternative solutions what was considerable handicap for the entire settlement. What were the actual reasons for that we can only guess. These could have been slight climate changes, few rainy seasons or the consequences of human activities and all that could have had an impact on considerable changes of the local eco system. Unfortunately, the investigations carried out so far offer rather partial answers to some quite basic questions like whether the burying of the water supply system or later abandoning of the settlement could be explained as a result of natural phenomena, imposed leave of the inhabitants (because the settlement lost its original function) or the pressures from outside. But when we take into account that settlement covered an area of around five hectares and that only around 6% has been investigated so far, then we should not expect too much and

it is not difficult to conclude that only by further investigations the data, which could provide the answers could be acquired. This also concerns the big dilemma regarding the name of urban settlement in the Krševica river valley. It is remotely conceivable that acropolis with suburbium and monumental structures with the finds from the 4th century BC had remained anonymous and such lacuna could be filled so far only by Strabo and his words about the mining city of Damastion.³⁰

Translated by Mirjana Vukmanović

³⁰ Strabo, VII, 7.8; VIII, 6.16; Popović 2006, 530–532; 2007a, 416–417; 2007b, 133; Mitrović, Popović 2009, 156–157, 159.

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Резиме:

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СИСТЕМ ВОДОСНАБДЕВАЊА У КРШЕВИЦИ (IV век пре н.е.)

Кључне речи. – Кале–Кршевица, урбано насеље, IV век пре н.е., водоснабдевање, бачвасти свод.

Истраживања локалитета Кале у Кршевици започета су 2001. године и током ових радова откривени су делови урбаног насеља које је грађено по грчким узорима у IV и првим деценијама III века пре н.е. На површини од око пет хектара налази се плато са акрополом где су остаци бедема и јавних грађевина, а подграђе је захватало већи део падине која је гледала према Кршевичкој реци (Сл. 16). Прва рекогносцирања и ископавања показала су да је реч о пространом насељу, па се одмах поставило питање начина снабдевања водом. На почетку се претпостављало да су становници могли да користе цистерне или бунаре у подножју узвишења, али касније ће се показати да је решење овог проблема далеко сложеније, али ефикасније.

Од 2001. до 2005. године истраживања су била концентрисана на акрополу и само стипај околности дао је прве индиције које су постепено довеле до коначног решења. Наиме, 2003. године у једној пробној сонди испод арополе, у близини Кршевичке реке, откривени су остаци правоугаоне грађевине присловљене уз бедем од великих блокова. Пратећи бедем низ више редова тесаника, на дубини од скоро три метра, појавио се ниво са водом (Сл. 2). Од тог тренутка вода ће нас пратити све време, а дала ископавања на овом делу локалитета била су могућа само уз непрекидан рад пумпи. У кампањама које су уследиле видеће се да испод травнатих површина и усева, на великој дубини, у слојевима под водом и блатом, леже зидови, грађевине, разни објекти и други археолошки налази затрпани дебелим наносима песка Кршевичке реке и материјалом који је спирао са оближње падине.

Под овим условима до сада је истражена површина од преко 1000 m², до дубине која местимично износи и преко шест метара. Цео простор је подељен на два дела. У средини налази се велика камена платформа са обе стране озида на пакљито обрађеним блоковима, а даље уз падину дизала су се два рачваста зида од масивних тесаника (Сл. 3). Основна претпоставка је да се вода на падини каналисала и тако штитило насеље од већих падавина. Због специфичних објеката и сталног прилива воде у доњим зонама, 2005. године овај део локалитета с разлогом је добио назив „хидротехнички комплекс“.

За разлику од северне стране комплекса, где су констатована три грађевинска хоризонта са разним структурама, истраживања јужног сектора (2007–2010.) дала су другачије и сасвим неочекиване резултате. Тада се показало да се од платформе пружа источни зид дугачак 16 m, а према најновијим подацима завршавао се јужним зидом који је скоро под правим углом скретао према падини (Сл. 4–5, 15). У средњем делу откривена је потпуно очувана грађевина са

бачвасти сводом, изведена од великих тесаника за које је коришћен туф. Има правоугаону основу димензија 10 x 6 m, а на врху се налазе два отвора, од којих је један потпуно очуван (сантрач). Грађевина је била испуњена материјалом, тако да је због велике дубине испитана само делимично и може се претпоставити да је била висока око 6 m (Сл. 6–7, 15). На тај начин су велика платформа и два зида са једне и вертикална литица усечена у стену од пешчара са друге стране, затварали површину од око 210 m² (Сл. 13). Од почетка је било јасно да грађевина са сводом има улогу великог резервоара, али како је цео комплекс функционисао постало је јасније тек након последњих истраживања.

Присуство воде на овом делу локалитета лако се може објаснити чињеницом да се уз обод Врањске котлине са долином Јужне Мораве, посебно око ушћа Кршевичке реке, налазе алuviјални наноси песка и шљунка дебљине и до 20 m у којима се налазе знатне количине подземних вода. Оснивачи насеља у Кршевици у потрази за квалитетном водом испитивали су различите могућности и на крају се определили за следеће решење – коришћење сталних природних извора који не зависе од нивоа воде у реци. Ова изворшта су сталног карактера, а за њихово експлоатисање било је потребно саградити систем за капавање, односно грађевински објекат који би прикупљао воду у потребној количини. Према овом принципу изграђен је велики комплекс који чине резервоар и водосабирни базен испуњен песком и шљунком као филтрационим слојем. Укратко, систем који је сада пред нама могао је да функционисао на следећи начин. Из околних засићених слојева вода долази у простран базен и после филтрирања улази у резервоар, односно водозахват, знатних капацитета, где се врши акумулација, а потом дистрибуција (Сл. 13–14). Због климатских и геолошких услова, основне аналогije сада не би требало тражити на медитеранском простору са карстним теренима, већ у сличним објектима за водоснабдевање који се користе и данас, а разликују се само у томе што се сада примењују инсталације које су резултат модерне технологије.

У теорији можда овај систем делује једноставно, али треба имати на уму да су иза свега тога стајали не само огромна средства и физичка радна снага, већ идеја мајстора–архитеката и вештина да цео пројекат спроведу до краја. Градња објеката у Кршевици представљала је велики изазов, јер је у великој мери била заснована на медитеранском искуству примењеном на типично континенталне услове. У сваком случају подухват као што је овај могао је да настане само као последица озбиљних стратешких намера да се поред Кршевичке реке формира релативно пространо насеље организовано према грчким моделима. Његово име још није познато,

али ту празнину за сада може да попуни само Страбон и његов извештај о рудничком граду Дамастиону.

Најмлађи хоризонт на овом делу локалитета сведочи о великом хендикепу за цело насеље. Највероватније услед подизања нивоа воде, систем за водоснабдевање био је напуштен, грађевина са сводом затрпана, а простор нивелисан и формиран је нови хоризонт са већим бројем пећи. Ова промена намене простора није дуго трајала, па изгледа да су проблем воде, као и неки други разлози, на крају довели до напуштања насеља.

Основни хронолошки оквири живота насеља у Кршевици познати су пре свега на основу атичке керамике и нумизматичких налаза, али је време формирања система за водоснабдевање далеко теже одредити. Материјал откривен у оквиру овог комплекса не пружа сигурније ослоњце, јер то су углавном делови посуда као што су питоси, хидрије и амфоре, или је реч о широком репертоару облика свакодневне употребе које је радила локална радионица. Тако остаје само претпоставка да је после формирања насеља почетком IV века пре н.е., око средине истог века, изграђен систем који је становнике снабдевао водом. Таква хронологија, међутим, је у супротности са распрострањеним мишљењем да

су грађевине са бачвастим сводом пореклом са истока и да је ово архитектонско решење пренето у Македонију и Грчку у време освајања Александра Великог, дакле од краја IV века пре н.е. Другу претпоставку изнео је Манолис Андроникос, истраживач Вергине, који сматра да је „слободни лук“ настао у Македонији средином IV века пре н.е.

Питање тачнијег времена градње комплекса у Кршевици остаје за сада отворено, јер према досадашњим резултатима произлази да грађевину са сводом треба датовати од средине IV века пре н.е., а то би значило да спада међу најстарије, ако не и да је најстарији објекат овог типа. То изнемађује утолико више што је насеље у долини Кршевичке реке далеко од цивилизованих области и урбаних центара, посебно што су системи за водоснабдевање везани за градове који се планирају и користе на дуже периоде. За сада треба нагласити уочљиву сличност начина градње Македонских гробница са техником градње монументалног објекта из Кршевице. То је један путоказ, јер се има утисак да су искусни мајстори тог заната имали овде активну улогу. На крају, гледано у целини, долазимо до закључка да се овај проблем Кршевице не може решавати без детаљних анализа археолошких резултата из Македоније.