UDC: 904:711.42"652/653"(497.11)
902.3:528.8.044.6(497.11)"2011/2015"
https://doi.org/10.2298/STA1969297I
Original research article

VUJADIN IVANIŠEVIĆ, Institute of Archaeology, Belgrade
IVAN BUGARSKI, Institute of Archaeology, Belgrade
ALEKSANDAR STAMENKOVIĆ, Republic Institute for the Protection of Cultural Monuments of Serbia, Belgrade

# THE OUTER FORTS OF CARIČIN GRAD: VISUALISATION OF DIGITAL TERRAIN MODELS AND INTERPRETATION

e-mail: vujadin.ivanisevic@gmail.com

*Abstract* – The erection of a new polis, Justiniana Prima, on the site of Caričin Grad, was part of a larger engineering project in a rural hilly setting of the western areas of Dacia Mediterranea, which had also included the construction of nearby fortlets. The article presents LiDAR data which has provided new information related to their ground-plan and dimensions. Located in a 12 km² area around the metropolis, St Elias, Kulište–Jezero and Gornje Gradište in Svinjarica were LiDAR scanned in 2011, while the Sekicol fort, with its 4 km² surroundings, was subjected to the same technology in 2015. Our analysis of the outer fortifications of Justiniana Prima is based on a visualisation of the obtained digital terrain models and field observations; in the case of the St Elias fort, we also used the results of the 1976 excavations. These fortlets had manifold functions. On the one hand, they overlooked the approaches to the city and its infrastructure – Kulište–Jezero was a watchtower – and on the other, they also served as shelters for the local population – refugia. In the middle of the St Elias fort there was a large three-nave church; this may well have been a fortified monastery. Future research of these forts should provide more detailed information on their chronology and function, complement the outstanding results of the LiDAR and geophysical surveys, and contribute to a better understanding of Justiniana Prima itself.

*Key words* – Justiniana Prima, outer fortifiations, refugia, watchtower, monastery, LiDAR, digital terrrain models

LiDAR technology was introduced to Serbian archaeology in 2011, as a major benefit from the involvement of the Institute of Archaeology, Belgrade, in the ArchaeoLandscapes Europe project. Following wide-area scanning of Caričin Grad and Margum/Morava,[1] within the scope of the same project, other important localities in Serbia have also been LiDAR surveyed – Krševica, Romuliana, and the Ras Fortress – along with fortifications from the surroundings of Caričin Grad, Sekicol and Rujkovac/Radinovac. While several other projects have just been completed or are near completion, the outcomes are studied together with other data obtained from different prospection methods, such as UAV[2] and geophysical surveys. Entered into the GIS, they are not only used for the detection of new structures, but for different space and urban-planning analyses as well.[3]

So far, only the results of the LiDAR survey of the Velika Morava and Danube confluence have been published in a more elaborate fashion.[4] Remarkable

[1] Иванишевић, Бугарски 2013.
[2] Иванишевић, Бугарски 2015.
[3] Иванишевић *et al*. 2016.
[4] Иванишевић, Бугарски 2012.

This article results from the project *Urbanisation Processes and Development of Mediaeval Society* (no. 177021), supported by the Ministry of Education, Science, and Technological Development of the Republic of Serbia.


Manuscript received 31st December 2018, accepted 10th May 2019

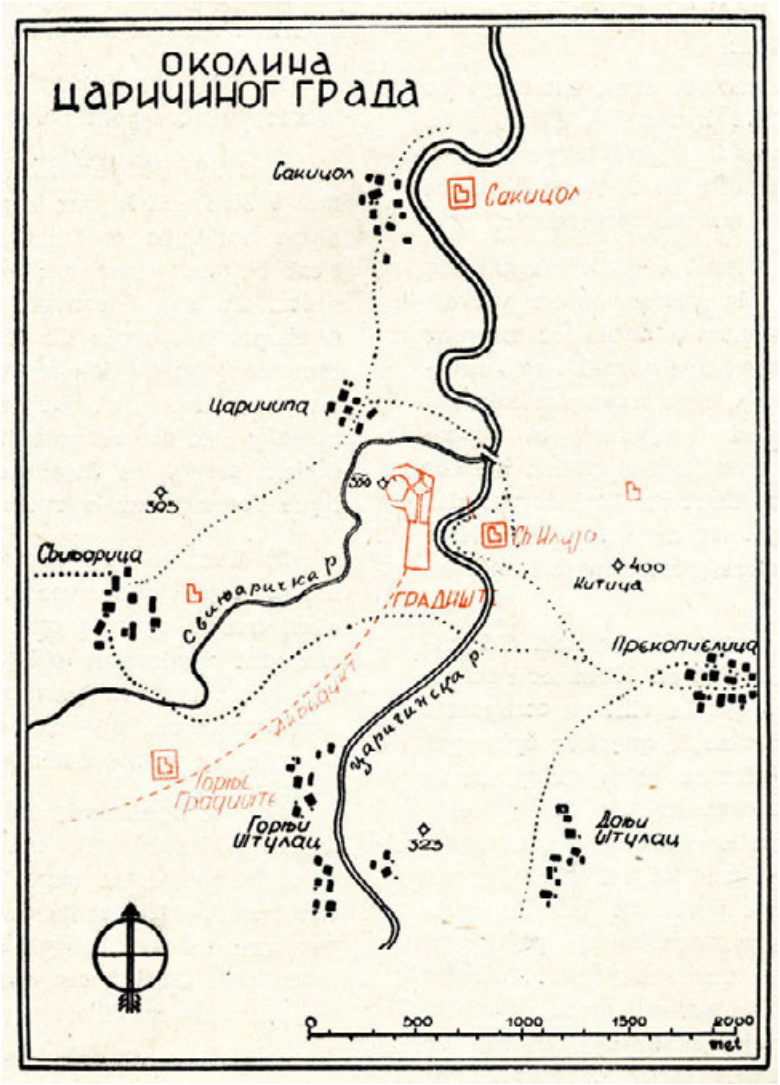


*Fig. 1. Ground-plan of Caričin Grad and nearby fortlets and localities (Дероко, Радојчић 1950а, сл. 50)*

*Сл. 1. План околине Царичиног града са утврђењима и локалитетима (Дероко, Радојчић 1950а, сл. 50)*

scans of Caričin Grad and its vicinity were mentioned in the introductory article on the application of LiDAR in Serbian archaeology, notably those indicating the existence of a rampart enclosing the north-eastern outer town.[5] After the excavations which followed, we concluded that this was the fourth line of fortifications built in opus mixtum there.[6] In addition, part of the LiDAR data was presented in the publication of the settlement at the Upper Town's northern plateau.[7] The same LiDAR survey provided useful information on subsurface structures in the city's vicinity. Covering part of the aqueduct route, it led us to resolve the question of the Caričin Grad water-supply system; after performing the analysis of satellite imagery and field surveys, we were able to find its source on the Radan Mountain,[8] which enabled a significant revision of the earlier conclusions.[9]

**Earlier Knowledge of Fortifications around Caričin Grad**

The construction programme of a new polis, Justiniana Prima, at the site of Caričin Grad, executed during the first decade of Justinian's reign (527–565), also envisaged the establishment of an outer fortification system. For many decades, researchers have justifiably focused on numerous monuments within the city limits, but the nearby fortifications were somewhat neglected.[10] Although described as early as 1950, their

[5] Иванишевић, Бугарски 2013, 82–84.
[6] cf. Бугарски, Иванишевић 2014, 255–256.
[7] Иванишевић *et al*. 2016, 148, 151–155.
[8] Иванишевић 2012.
[9] Петровић 1970.
[10] Кондић, Поповић 1977; Иванишевић 2011.

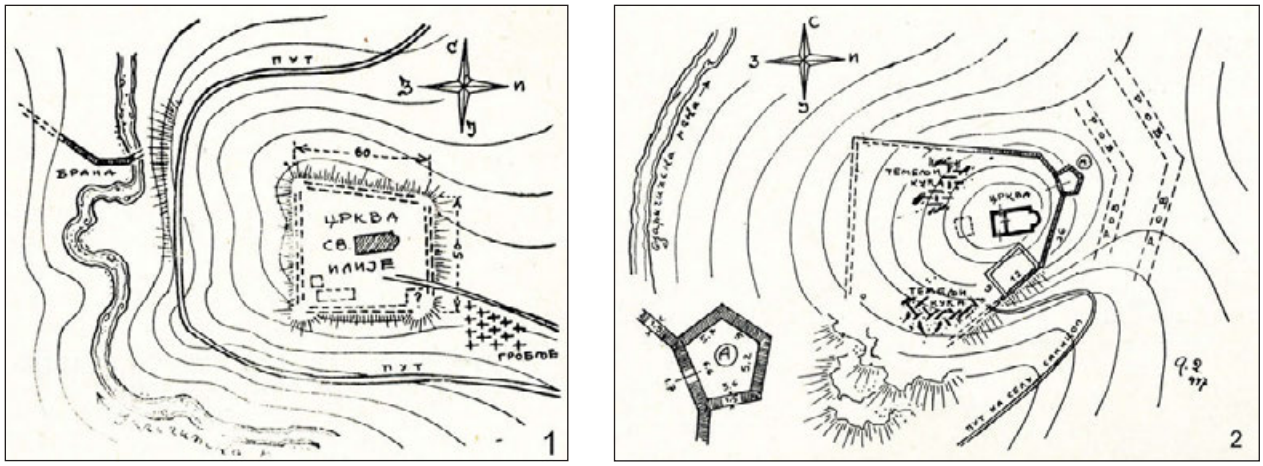


*Fig. 2. 1) Ground-plan of St Elias; 2) Ground-plan of Gradište in Sekicol (Дероко, Радојчић 1950b, сл. 2, 4)*

*Сл. 2. 1) План утврђења на Св. Илији; 2) План Градишта у Секицолу (Дероко, Радојчић 1950b, сл. 2, 4)*

ground-plan, chronology and function have so far not been discussed in more detail; it has only been suggested that they probably served as outposts.[11]

Aleksandar Deroko and Svetozar Radojčić briefly commented on the fortifications at St Elias, Gornje Gradište in the village of Svinjarica and in Sekicol. Another fort was mentioned as well – Kulište, situated on the stretch called Jezero (Fig. 1). The fortlet at St Elias Hill was described as a rectangular castellum strengthened with an inward tower in the most accessible, south-eastern corner. The ground-plan was sketched of a 60 m by 50 m large fort, with its ramparts drawn with broken lines and undefined corners (Fig. 2.1). The Gornje Gradište fortification in Svinjarica was, and still is, covered with vegetation. Only a rampart with a rectangular trench in front of it were mentioned, some 150 m long, together with another wall directed towards the Svinjarička rivulet. Deroko and Radojčić noticed that this fortlet had been erected on the aqueduct route.

The fortification in Sekicol was only briefly described, with its stone rampart encompassing the hill summit and a two-metre-high protruding tower facing the approach from the east, where two trenches were registered as well – a small outer trench and a larger inner one. Particularly important is the ground-plan left by the authors, showing a polygonal fort with a clearly defined eastern rampart and suggesting its western route. A pentagonal tower, a church, and a 12 m by 6 m large building next to the south-eastern rampart were also recorded, along with the foundations of houses in the northern and southern sections of the fortification (Fig. 2.2).[12]

Slobodan Nenadović supplied further information on the Sekicol fortification, claiming that the traces of two additional towers could be seen on the terrain surface, one of them in the lower part of the fort. He also mentioned two or three lines of walls, the lower one bordering a trench, and the foundations of buildings leaning on the ramparts. The author's article also includes a ground-plan with the dimensions of the single-nave church. With regard to Kulište–Jezero, Novaković left an important piece of information, namely that the fortlet was built along a Late Roman road, ruined by the locals, which had led from St Elias towards the village of Vrbovac. Furthermore, he described the church at St Elias and architectural sculpture found at the end of the 19th century in the debris cleared from the site to make room for its construction; at the time some sculptural elements had been built into the church and can still be seen today.[13]

Several new insights into these fortifications were briefly published in the well-known 1977 catalogue by Vladimir Kondić and Vladislav Popović. They suggested that the fortlet at St Elias Hill had round corner towers, at that time visible in the terrain, and that the

[11] Дероко, Радојчић 1950b, 175–176; Ненадовић 1950, 147–160.

[12] Дероко, Радојчић 1950b, 175–176.

[13] Ненадовић 1950, 147–159.

| | ***Caričin Grad, St Elias, Svinjarica, Kulište–Jezero*** | ***Sekicol*** |
|---|---|---|
| *Date* | 05.12.2011. | 01.12.2015. |
| *Scanned and processed by* | Flycom d.o.o. Slovenia | GeoGIS Consultants, Serbia |
| *Area* | 12 km² | 4 km² |
| *Helicopter* | Eurocopter EC120B | Robinson R44 Raven II |
| *Flight speed* | 93 km/h | 60 km/h |
| *Scanning height* | 600 m | ≥ 500 m |
| *Trajectories* | 21 N-S trajectories and one across | 24 N-S trajectories and 7 across |
| *Laser scanner* | Riegl LM5600 | Riegl VUX-1-SYS |
| *Laser frequency* | 180 kHz | 50 kHz |
| *Point-cloud density* | 20 pts/m² | 40 pts/m² |
| *Software package* | *Microstation v2004 Terrasolid* | *RiPROCESS* |
| *GPS/ GNSS/IMU processing* | *Grafnav IGI AeroOfjice* | *RiPROCESS* |
| *DTM resolution* | 0.25 m | 0.25 m |

*Table 1: Flight, scanning and processing parameters (2011 and 2015 surveys)*

entrance had been positioned in its north-western part. The church was described in more detail, with its original construction dated to the 15th century. Basing themselves on the results of a single-trench excavation conducted in 1976, Kondić and Popović dated the fortification to the Early Byzantine period; they also underscored that there were no remains of an earlier Roman settlement or fort. The Kulište–Jezero fortlet was interpreted as a watchtower, while the rest of their text built upon two earlier articles quoted above.[14]

**LiDAR Data for Fortifications around Caričin Grad and DTM Visualisations**

This article presents new data on fortifications in the neighbourhood of Caričin Grad, obtained through LiDAR technology and evaluated during field surveys which followed. Located in a 12 km² area around the metropolis of Justiniana Prima, St Elias, Kulište–Jezero and Gornje Gradište in Svinjarica were LiDAR scanned during the first campaign (December 2011), while the Sekicol fort with its 4 km² spacious surroundings was subjected to the same technology – which has, in the meantime, improved the accuracy of different tasks – four years later, in December 2015.[15]

The 2011 scanning was performed with a point-cloud density of 20 points per square metre, while the obtained DTM (three-dimensional terrain model without vegetation) was in a 0.25 m resolution. Although the results were highly satisfactory, the second survey was performed with more trajectories and even more accuracy, with 40 points per square metre, whereas the DTM was the same in resolution.[16] The trajectories overlapped to at least 30 per cent above a flat surface and 50 per cent above hilly terrain. The second survey saw more transverse trajectories as well, with reduced flight height and speed (Table 1).[17]

Our analysis of the outer fortifications of Justiniana Prima is based on visualisation of the obtained digital terrain models and field observations; in the case of the St Elias fort, we also use the results of the 1976 excavations.[18] To present digital data and extract three-dimensional georeferenced models, one needs to employ different techniques and methods of visualisation,[19] creating greyscale or colour rasterised images. In interpreting our models, we first used standard visualisation techniques, available in most GIS environments. The first result was the creation of two-dimensional heat

[14] Кондић, Поповић 1977, 147–152.

[15] Elaborat 2012; Технички извештај 2019.

[16] For comparison, even 1 m data records most archaeological features, except in woodland (Crutchley 2013, 144), while the greatest density used for an archaeological project, at least up until recently, was 60 points per square metre, taken at the Hill of Tara in Ireland (Corns, Shaw 2013).

[17] Elaborat 2012; Технички извештај 2019.

[18] Documentation of the Institute of Archaeology, Belgrade. Unpublished.

[19] Devereux *et al.* 2008, 470–479.

maps using the Heatmap tool in QGIS; then the contour lines were interpolated using Contour Extraction. The hill-shading technique is probably the most widely applied tool for the analysis of LiDAR-derived digital models,[20] resulting in a clear and most natural impression of the relief. Moreover, hillshade models are simple to use and interpret. As one can apply different colour scales to heat maps and choose contour intervals, light angles and intensity, the combination of these techniques makes the possibilities for visualisation limitless.

Regarding our case studies, already the application of standard methods has given fascinating results, and some advanced visualisation freeware has recently become accessible, such as Relief Visualisation Toolbox (RVT)[21] and RTIViewer.[22] The choice of RVT techniques depends on the relief conditions; we had the best results with Sky View Factor and Local Dominance. While the former technique is used for modelling terrains most exposed to the sun, which makes wall-like structures brighter than e.g. trenches (Figs 4.3, 7.1, 8.2, 8.4),[23] the latter is based on computing, for every pixel of the model, how dominant an observer standing at that point would be for a close surrounding area (Figs 4.3–4; 5.3; 8.3–4).[24] RTIViewer is, on the other hand, based on hill-shading; yet, this application enables interactive illumination of a model from any direction and at any angle, revealing details not usually visible to the naked eye (Figs 5.4; 8.1). A series of images of the same model can be taken quickly with different illuminations and shadows.

The Focal Statistics function of the ArcGIS software package, a tool for space analysis, compares the values of neighbouring pixels, recognises parts with sudden changes in height and contrasts their colours (Fig. 5.3). This method has proved to be one of the most successful, especially for the analysis of the terrain configuration, structure and urban planning of Caričin Grad.[25]

The importance of Geographic Information Systems in the visualisation goes beyond the creation of rasterised two-dimensional images; they also create a virtual space and transform it into a three-dimensional model. The 3D application ArcScene permits the handling and measurement of digital models in three spatial dimensions as well as displaying the scene from different viewpoints. Such three-dimensional DTM greatly helps in understanding the topography and the anthropogenic structures – in our case, trenches, flattened terraces and plateaus. ArcScene also provides additional tools for interpreting the model, such as Vertical exaggeration of terrain, very useful for highlighting subtle surface changes. In our analysis, barely visible ramparts became clearly defined after the exaggeration of LiDAR data.

The digital visualisation process is only one step towards the even more important process of data reading and interpretation. Along with an understanding of different visualisation techniques, practice and experience in interpreting the LiDAR data are of key importance for reaching sustainable conclusions. In what follows, we will present the results of our analyses.

**St Elias Fortification**

This fort was built just east of Caričin Grad, on a hill above the right bank of the Caričinska rivulet, which encircles it from three sides. St Elias was to defend the eastern approach to the city and a dam between them which, according to earlier researchers, at the same time served as a bridge.[26]

The fortlet was briefly excavated in 1976 in order to gain some knowledge of the ramparts and the stratigraphy.[27] The archaeological trench, oriented north-south and 8 m by 2.5 m in plan, was opened on the route of the northern rampart, near the north-eastern corner of the fortification. The rampart was 2.3 m wide, built with stone in the lower and brick bound with hydraulic mortar in the upper part. The bricks measured 36 by 30 by 4.5 cm and 34 by 30 by 5 cm. In the southern part of the trench, a corner of a building made out of stone was excavated – the northern wall to a length of 1.5 m, and the eastern to a length of 1.9 m (Fig. 3). Its floor was apparently paved with stone and brick.[28]

Five different layers were identified in the course of the excavation. A natural hill surface, composed of rock and yellow virgin clay, was labelled layer E; it was superposed by layer D – a cultural layer with the remains of a paved fire-place and a significant number of pot-sherds and animal bones. Matching the evidence from

[20] Zakšek *et al.* 2011, 400–401; cf. Horn 1981, 38–42.

[21] https://iaps.zrc-sazu.si/en/rvt; cf. Kokalj *et al.* 2018.

[22] http://culturalheritageimaging.org/What_We_Offer/Downloads/View/

[23] Kokalj *et al.* 2011, 266–268; Kokalj *et al.* 2018, 32–35.

[24] Hesse 2016, 116.

[25] Иванишевић *et al.* 2016, 148.

[26] Ненадовић 1950, 146–147.

[27] The excavations of the Institute of Archaeology, Belgrade, directed by Vladimir Kondić and Vladislav Popović, lasted from 27 September to 6 October 1976. The results have not been published.

[28] Documentation of the Institute of Archaeology, Belgrade.

*Fig. 3. St Elias, 1976 trench: northern rampart in the front plan, corner of the building in the background (Documentation of the Institute of Archaeology, Belgrade)*

*Сл. 3. Утврђење на Св. Илији, сонда из 1976: северни бедем утврђења у првом плану и угао објекта у другом (документација Археолошког института)*

Caričin Grad, the pottery was processed by Ljiljana Bjelajac.[29] Together with fragments of bases and body sherds, pot rims and lids of the I/2 and VIII/1 types were found.[30] In the layers of the rampart and building collapse (C–A), a mediaeval grave from a churchyard cemetery was dug; 15th–16th century pottery was recovered from the upper layers of the trench as well.

The 1976 excavations, although limited in scope, established two main phases of occupation. The first can be dated to the Early Byzantine period, i.e. to the 6th and probably the beginning of the 7th century, while the second horizon dates from the 15th–16th centuries, when the church was built and the cemetery laid out.[31] A precise description of the rampart reveals not only that it was built in the same technique as those at Caričin Grad – opus mixtum – but with the same width as well.

The DTM visualisation and analysis provided new information on the ground-plan, the dimensions and the vicinity of the fortification (Fig. 4.1–4). The line of the northern and eastern ramparts can be traced following the trenches left by the locals dismantling the walls, while the routes of the southern and eastern ones are presented as raised lines on the surface. The 0.21 ha large fortlet is trapezoidal in plan, with unequal rampart lengths: the northern rampart is some 42 m long, the eastern and southern about 52 m and 55 m respectively, while the length of the western rampart approximates 46 m. This irregular plan was dictated by the topography. Semicircular protrusions, depicted in the processed DTM, point to the existence of corner towers. The south-eastern is barely visible, as this part of the fortification has been damaged by a modern cemetery; however, from the description by Aleksandar Deroko and Svetozar Radojčić, we can assume that it had been constructed.[32] As the authors had suggested, the entrance might have been located in the north-western part of the fort where, in the northern rampart, one can observe a small recess (Fig. 4.A).

As can be discerned from the topography, a fence ran parallel to the eastern rampart, continuing towards the north-east. It was some 78 m long (Fig. 4.B). Perhaps this was a palisade protecting the most accessible, eastern approach. It apparently turns towards the west and runs parallel to the northern rampart, enclosing some 25 m wide area. Furthermore, there is a spacious platform to the west of the fort, framed on the north-west by two retaining walls (?), 20 m and 28 m long (Fig. 4.C).

In the course of a 2015 ground-penetrating radar survey, a large three-nave basilica – most certainly Early Byzantine – was recorded in the middle part of the fortification's interior.[33] This finding reopens the

[29] Documentation of the Institute of Archaeology, Belgrade.

[30] Bjelajac 1990, 165–181.

[31] One of the present-day hamlets of the Štulac village, to which both the active church and graveyard at St Elias belong, is called Caričina (*empress's*). It was mentioned (twice) in the 1434 merchant's book of Mihailo Lukarević (Динић 1962, 36).

[32] Дероко, Радојчић 1950b, 175–176, сл. 2.

[33] The GPR survey of spring 2015 was organised in cooperation of the Institute of Archaeology, Belgrade, with the Roman-Germanic Central Museum, Mainz, and the Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology (LBI ArchPro) from Vienna. The results remain unpublished (*cf.* Иванишевић *et al.* 2016, 147, н. 10).

[34] Кондић, Поповић 1977, 148–149.

[35] Ivanišević 2016, 120; Ivanišević 2017, 103.

question of the origin of the architectural sculpture built into the modern church: it may have belonged to the 6th century basilica at St Elias, rather than being brought from Caričin Grad as had been suggested.[34] Moreover, the existence of the church and of other buildings, documented either during the excavations or due to the application of different prospection methods, is of wider importance, as these may indicate that within the fortification circuit there used to be a monastery complex.[35] Taking into account the described structures north and west of the fortlet, its immediate vicinity might have been settled as well.

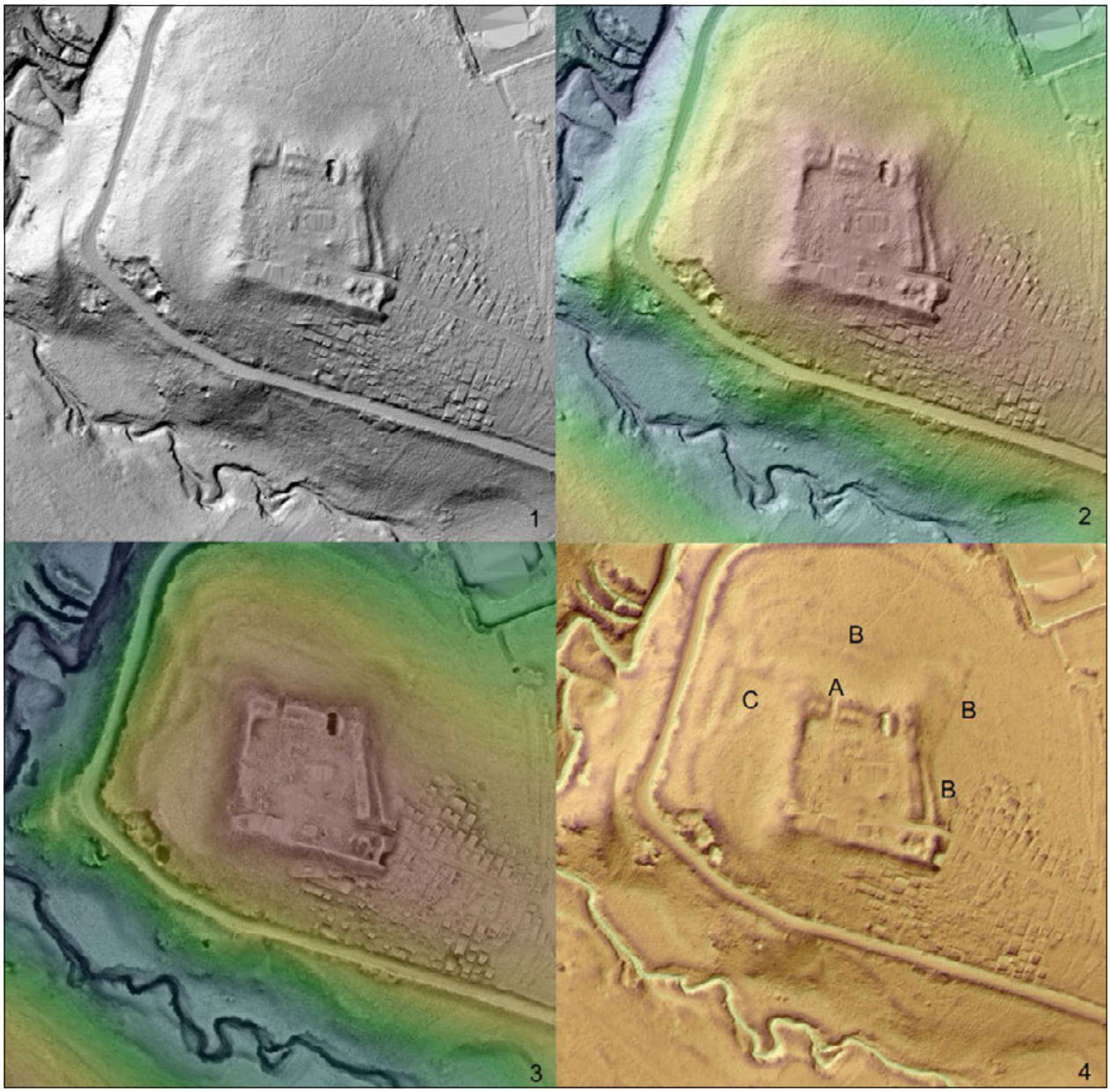


*Fig. 4. St Elias: 1) Hillshade; 2) Hillshade and Digital Terrain Model; 3) Local Dominance, Sky View Factor and Hillshade; 4) Local Dominance and Hillshade; A – Entrance (?); B – Palisade (?); C – Platform and retaining walls (?) (Documentation of the Institute of Archaeology, Belgrade)*

*Сл. 4. Утврђење на Св. Илији: 1) Hillshade; 2) Hillshade и Digital Terrain Model; 3) Local Dominance, Sky View Factor и Hillshade; 4) Local Dominance и Hillshade; А – улаз (?); В – одбрамбени зид (?); С – платформа и подзиди? (документација Археолошког института)*

**Gornje Gradište in Svinjarica**

Gornje Gradište is situated one kilometre south-west of Caričin Grad, on the northern slope of the hill above the Svinjarička rivulet. The fort dominated the valley and had visual communication with the city. The Caričin Grad aqueduct ran just south of it, between the rampart and the trench. This fortification stands out for its hexagonal plan with ramparts of unequal

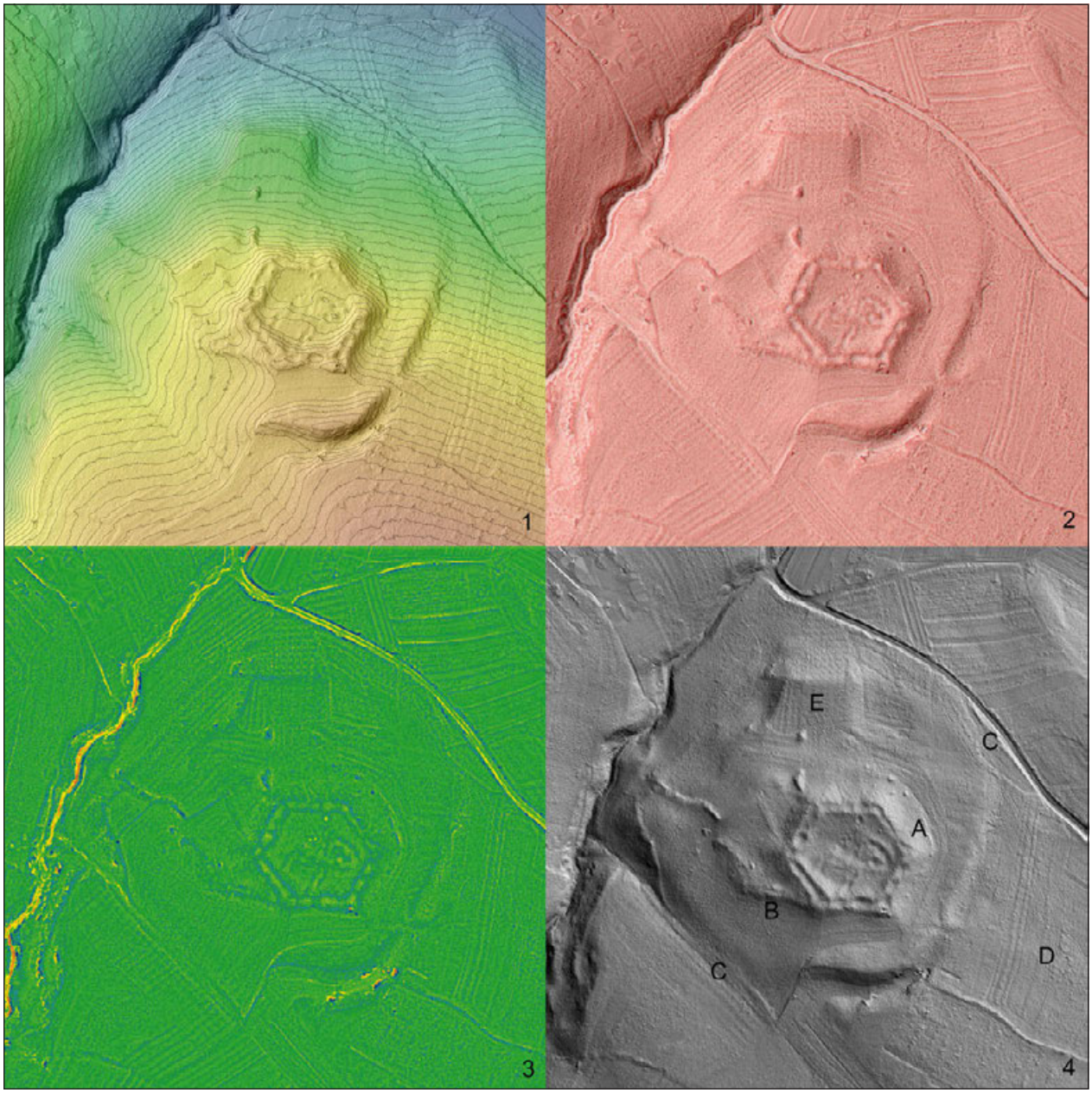


*Fig. 5. Gornje Gradište in Svinjarica: 1) Hillshade, Digital Terrain Model and contour lines at 1 m intervals; 2) Focal Statistics and Hillshade; 3) Local Dominance; 4) Reflectance Transformation Imaging; A – Entrance (?); B – Stone agglomeration; C – Vallum and trench; D – Aqueduct route; E – "Bastion" (Documentation of the Institute of Archaeology, Belgrade)*

*Сл. 5. Горње градиште у Свињарици: 1) Hillshade, Digital Terrain Model и изохипсе на 1 m; 2) Focal Statistics и Hillshade; 3) Local Dominance; 4) Reflectance Transformation Imaging; A – улаз (?); B – агломерација камена; C – остаци рова и земљаног бедема; D – траса акведукта; E – „бастион" (документација Археолошког института)*

*Fig. 6. Gornje Gradište in Svinjarica: Trench (Documentation of the Institute of Archaeology, Belgrade)*

*Сл. 6. Горње градиште у Свињарици: ров (документација Археолошког института)*

length: the northern, southern and south-western are ca 32 m long, and the north-eastern, south-eastern and north-western some 30 m (Fig. 5.1–4). The rampart perimeter measures about 190 m and encloses some 0.21 ha, the same area as that of the St Elias fortlet; no towers can be seen in the DTM. A small recess can be observed in the middle of the north-eastern rampart, presumably the entrance to the fort (Fig. 5.A).

Both on site and in the DTM, a ca 35 m long stone agglomeration (wall?) is visible, leaning on the fort's south-western corner and extending westward. Those stones were probably piled up when cleaning the fields around the fortlet. It could be that beneath this agglomeration lie the remains of a rampart, as was the case with that of the north-eastern outer town at Caričin Grad,[36] or perhaps of a palisade (Fig. 5.B), but this can only be resolved by archaeological excavation.

Inside the fortification, traces of two large buildings can be discerned. Abutting on the inner face of the south-western rampart, the first is rectangular in shape and some 21 m by 16 m in size; judging by its dimensions, it may have served as a storage building. The second construction, located in the eastern section of the fortification, is somewhat smaller – 20 m by 12 m. Oriented west-east and inclining to the south-east, it ends in a semi-circular apse (?) facing east. The layout of this building, probably a church, was dictated by the location of the first one and the available space. In the fortification's interior and on the rampart routes, large blocks of collapsed walls have been observed in the course of our field surveys, some of them in the very centre of the enclosure. The size and thickness of these opus mixtum blocks indicate that the ramparts were tall.[37]

[36] Иванишевић, Бугарски 2013, 82–83.

[37] Documentation of the Institute of Archaeology, Belgrade. Unpublished.

As the fort was built on a slope descending to the Svinjarička rivulet to the north, it was encircled by a vallum and trench. Preserved on the eastern and southern sides, in the south-eastern section the vallum was intersected to support the road to the fortlet. The north-western section of the vallum can be observed in the DTM, all the way to a gully leading to the rivulet. Although largely ruined by agriculture, part of the vallum can be traced to the north-east as well, in the direction of a modern road (Fig. 5.C). The southern part of the fossa is well preserved as it was cut through the rock (Fig. 6), while broken stones were used for the rampart construction.

A digital visualisation clearly shows the base of the aqueduct running beneath a passage through the vallum's south-eastern section (Fig. 5.D). From there, the canal can easily be traced in the micro-topography, all the way to an earthwork with a palisade enclosing the southern outer town of Caričin Grad and the south-western corner tower of the city's Lower Town (Fig. 9). In the opposite direction, towards the village of Bačevina and the remains of a large aqueduct bridge there, parts of the brick and stone construction of the canal can only be seen in gullies.[38]

A peculiarity of Gornje Gradište are large earthworks, easily visible in the terrain. To the north of the fort there is a massive rectangular protrusion, ca 40 m by 30 m and six metres high (Fig. 5.E). It appears to be artificial, but its function remains unclear; perhaps it was an earthen "bastion" controlling the approach from the Svinjarička rivulet valley. To the west there are two terraces which were possibly an integral part of the fortification.

**Kulište–Jezero**

Located one kilometre north-east of Caričin Grad, at the top of a rise gently sloping towards St Elias and the city in the west, and the Mrveška and Pusta River valleys in the east, is another, very small fortlet of Kulište–Jezero – undoubtedly a watchtower. In the DTM a ground-plan of a round tower is revealed, some 18 m in diameter and 150 m² in surface area (Fig. 7.1–2.A), also preserved in the toponym itself (*kula* = *tower*). Its perimeter is underlined with 2.5–3 m wide trenches, left after dismantling the rampart. The rampart width approximated those at Caričin Grad and the neighbouring fortlets. On the surface we have observed numerous fragments of bricks and stones; therefore it

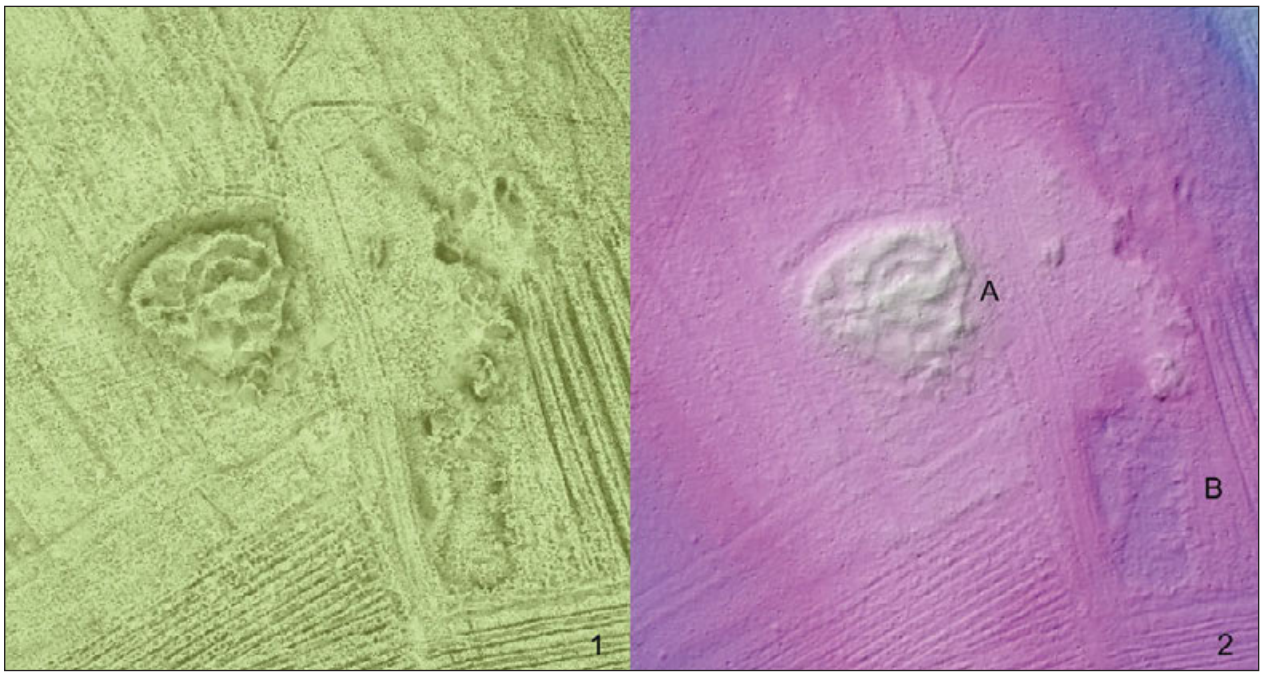


*Fig. 7. Kulište–Jezero: 1) Digital Terrain Model and Sky View Factor; 2) Digital Terrain Model and Hillshade; A – Tower; B – "Quarry" remains (Documentation of the Institute of Archaeology, Belgrade)*

*Сл. 7. Кулиште – Језеро: 1) Digital Terrain Model и Sky View Factor; 2) Digital Terrain Model и Hillshade; А – кула; В – остаци каменолома (документација Археолошког института)*

may be suggested that Kulište was built in opus mixtum as well.[39]

As at Caričin Grad, its roof construction comprised large lead plates, found within the tower some decades ago by the villagers of nearby Prekopčelica. Other finds have not been recorded.

There are no traces of other constructions in the immediate vicinity of Kulište, but shallow depressions in the rock east of it, left from a small "quarry", deserve mention. The best preserved is a rectangular depression in the south-east, some 32 m by 16 m across and only half a metre deep (Fig. 7.B). Much as at Svinjarica, it could well be that this rock was chiselled out for the construction of the watchtower itself. These depressions also hold water; hence the place-name (*Jezero = lake*).

**Gradište in Sekicol**

Approached via a saddle from the east, the Sekicol fortlet occupies a summit plateau and the upper parts of the steep southern and western slopes of a hill above the Caričinska rivulet, some 3 km to the north of Caričin Grad. This fortification differs greatly from those described above; it could be assigned to the most common group of Early Byzantine localities in the region, namely to that of fortified settlements – refugia.[40] We suggest that Gradište in Sekicol had originally been built in Late Antiquity and enlarged with an outer fortification line in the 6th century, at the time of the construction of Justiniana Prima, when it may have served to overlook the approach to the metropolis from the north. It was apparently used in later centuries as well: from the area of Sekicol comes a nomisma histamenon of Emperor Constantine VIII (1025–1028),[41] and the church at Gradište was reconstructed in the Middle Ages.

The fortification consists of three units – the Upper, Middle and Lower Forts (Fig. 8.1–4). The Upper Fort, triangular in plan and nearly 0.64 ha in surface area, occupies the top of the hill and its western slopes. At the highest point in its eastern section, there are the remains of a pentagonal watchtower observing the eastern approach. The north-eastern rampart was ca 90 m long, the south-eastern some 96 m, and the western about 130 m. Judging by its ground-plan, and the lack of confirmation that it had been built in opus mixtum, the Upper Fort may date from the 4th century. The Middle Fort was a separate fortification, approximately 1.23 ha in size, whose northern and eastern ramparts can easily be traced – some 153 m and 35 m long respectively – and the southern to some extent too, for ca 66 m, while the western rampart can only be discerned in the DTM; it might have been 161 m long (Fig. 8.A). The Lower Fort's ramparts defended the northern and, partly, the eastern sides of the hill. The northern, eastern, and southern ramparts were some 134 m, 29 m and 43 m in length, while one can only suggest that the western one was 41 m long (Fig. 8.B). This unit was around 0.63 ha in size.

The entire surface area of Gradište in Sekicol measured 2.5 ha. There was a trench in front of the Lower Fort, protecting access from the north-east, east, and south (Fig. 8.C). For the most part it is visible in the terrain, and the digital model depicts its otherwise almost unrecognisable sections; however, we have not observed the two towers mentioned by Slobodan Nenadović.[42]

As already mentioned, the early researchers had recorded the remains of several buildings in the Upper Fort – the church in its eastern part (particularly visible in the DTM), the large building next to the south-eastern rampart, and vague outlines of other constructions.[43] Our analysis reveals two rows of buildings spreading along the north-eastern and south-eastern ramparts. These buildings are 6 to 12 m long, and between them one can discern numerous other constructions; this layout resembles that of the settlement at the Upper Town's northern plateau in Caričin Grad.[44] In the Middle and Lower Forts only the platforms can be observed, apparently left from the levelling of the terrain prior to the construction, excluding the remains of a ca 24 m by 20 m large building in the south-eastern corner of the Lower Fort. Its walls are well preserved and were most likely massive; perhaps this building was a cistern (Fig. 8.D).

**Conclusion**

With its outer defence line, Caričin Grad differs from other fortifications in Illyricum. The erection of a new polis was part of a larger engineering project in a rural, hilly setting of the western areas of Dacia

---

[38] Иванишевић 2012, 24–25.

[39] Documentation of the Institute of Archaeology, Belgrade. Unpublished.

[40] *cf.* Ivanišević, Stamenković 2014, 223.

[41] The find is housed in the National Museum, Leskovac, bearing inv. no. A–12.

[42] Ненадовић 1950, 152–153.

[43] Дероко, Радојчић 1950b, 175–176, сл. 4.

[44] Иванишевић *et al.* 2016.

Mediterranea, which also included construction of the aqueduct and the dam. The St Elias, Gornje Gradište in Svinjarica and Kulište–Jezero fortlets were parts of the original construction programme for Justiniana Prima. Just like those protecting the metropolis, their ramparts were built in opus mixtum.

Together with its nearby forts and the watchtower, Caričin Grad provides a unique example of an Early

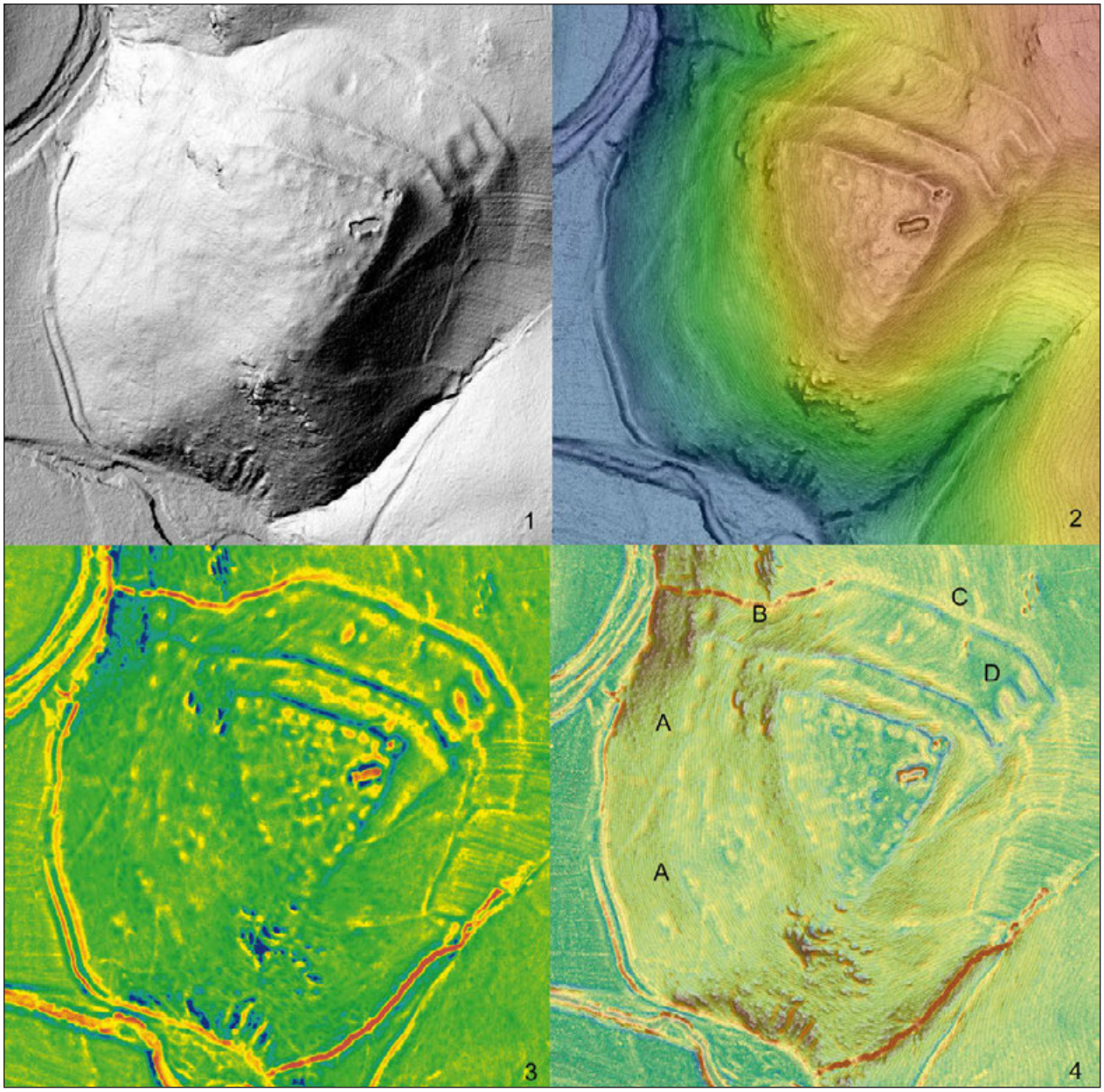


*Fig. 8. Gradište in Sekicol: 1) Reflectance Transformation Imaging; 2) Sky View Factor, Digital Terrain Model and contour lines at 1 m intervals; 3) Local Dominance; 4) Sky View Factor, Local Dominance and contour lines at 1 m intervals; A – Western rampart of the Middle Fort (?); B – Western rampart of the Lower Fort (?); C – Rampart and trench; D – Cistern? (Documentation of the Institute of Archaeology, Belgrade)*

*Сл. 8. Градиште у Секицолу: 1) Reflectance Transformation Imaging; 2) Sky View Factor, Digital Elevation Model и изохипсе на 1 m; 3) Local Dominance; 4) Sky View Factor, Local Dominance и изохипсе на 1 m; А – западни бедем Средњег утврђења (?); B – западни бедем Доњег утврђења (?); C – бедем и ров; D – цистерна? (документација Археолошког института)*

Byzantine city's complex defence system. One may understand why Procopius, in his *De aedificiis*, did not mention minor forts around cities. The chronicler described the establishment and the repair of many important fortifications from across the Empire, at the same time neglecting many others, and even large areas.[45] Leif Inge Ree Petersen, one of the few scholars devoted to the study of suburban fortifications, discusses the mid-5th century examples from the vicinity of Ratiaria and such 6th century fortlets on the outskirts of Neapolis, Thessalonica and Mediolanum.[46] In another seminal work, *De bellis*, Procopius mentioned the taking over of a suburban fort (φρούριον) of Neapolis in the year 536,[47] while *Miracula St. Demetrii* described how, in the course of the siege of Thessalonica of 586, the nearby forts (φρούρια), suburbs and fields were destroyed.[48] Furthermore, Gregory of Tours noted that the Franks captured suburban forts of Mediolanum as part of their 590 conquest of Italy.[49] These were apparently larger fortifications, erected in their cities' territories.

To this group could belong the 6th century fortifications at Sekicol and, especially, Rujkovac/Radinovac, which might have hosted troops in case of danger. Those units would leave them and attack the enemy's rear and their siege engines if the city was threatened. Many operations of this kind have been described by chroniclers.[50] From such fortlets, garrisons could be sent to endangered cities; such was the case of Salona in 537.[51] Other fortifications in the wider area of Caričin Grad, i.e. in the middle and western parts of the Leskovac Valley, shared this task.[52] In that way, the absence of military barracks at Caričin Grad may be explained, at least to some extent;[53] soldiers might have lived in numerous houses in the city, and in Sekicol as well. In this period, they often resided with their families.[54] In 544, the troops from Illyricum withdrew from Bononia (Bologna) not only because of significant debts owed to them for their military service, but also in response to the news that the "Huns" had made an incursion into their lands and had captured women and children.[55] That Caričin Grad was home to military personnel is witnessed by numerous finds of arms and armour, including fragments of the prestigious Baldenheim type helmets;[56] moreover, a large building in the Upper Town has been interpreted as Principia, the headquarters of a military commander.[57]

The St Elias, Gornje Gradište and Kulište fortifications had manifold functions. On the one hand, they overlooked the approaches to the city and its infrastructure, and on the other, they also served as shelters for the local population – refugia. Judging by their size, according to the estimations by Florin Curta, the first two fortlets could accommodate ca 130 soldiers each.[58] Yet, we have already mentioned that the 2015 GPR survey revealed the outlines of a church in the middle of the St Elias fort. This three-nave basilica was 36 m by 16 m across, occupying almost a quarter of the fortlet's interior. With its atrium leaning on the western rampart, the church was oriented west-east. The same survey provided information on other buildings along the ramparts as well, which is in line with the results of the 1976 excavations; this may well have been a fortified monastery.

Here we should also mention that Procopius, while describing the construction of Justiniana Prima, made an interesting remark on nearby Taurisium, the birth village of the emperor (χωρίον Ταυρίσιον), which was ramparted and turned into a quadriburgium (Τετραπυργίαν) – a quadrangular fort with corner towers – apparently within the same construction programme.[59]

The same source informs us that, apart from numerous churches, Justinian built fortified monasteries as well. The one at Sinai is particularly well known, established on a cult site below steep hillsides.[60] Procopius further describes a fortified monastery at Carthago, near the Mandrakion Harbour inside the city walls, which was heavily ramparted and turned into an impregnable fortress.[61] Similar to St Elias is a 0.16 ha large fortlet in Pirdop, in the south-west of present-day Bulgaria, which accommodated a 5th or 6th century church measuring 30.5 m by 17 m in plan.[62] Yet, the

[45] Procop. *Buildings*.
[46] Petersen 2013, 300.
[47] Procop. *Wars* V.viii.6–7.
[48] *Miracula St. Demetrii* 1.13–14.
[49] Gregory of Tours 10.3.
[50] cf. Peteresen 2013, 290–293.
[51] Procop. *Wars* V.xvi.12–15.
[52] Ivanišević, Stamenković 2014.
[53] Ivanišević 2016, 114–115, Fig. 4.
[54] Petersen 2013, 151.
[55] Procop. *Wars* VII.xi.12–16.
[56] Bavant 2008.
[57] Bavant 1990.
[58] Curta 2001, 182–183.
[59] Procop. *Buildings* IV.i.17–18.
[60] Procop. *Buildings* V.viii.4–9.
[61] Procop. *Buildings* VI.v.8–11.
[62] Bǎjenaru 2010, 145–146, Pl. 86.321.

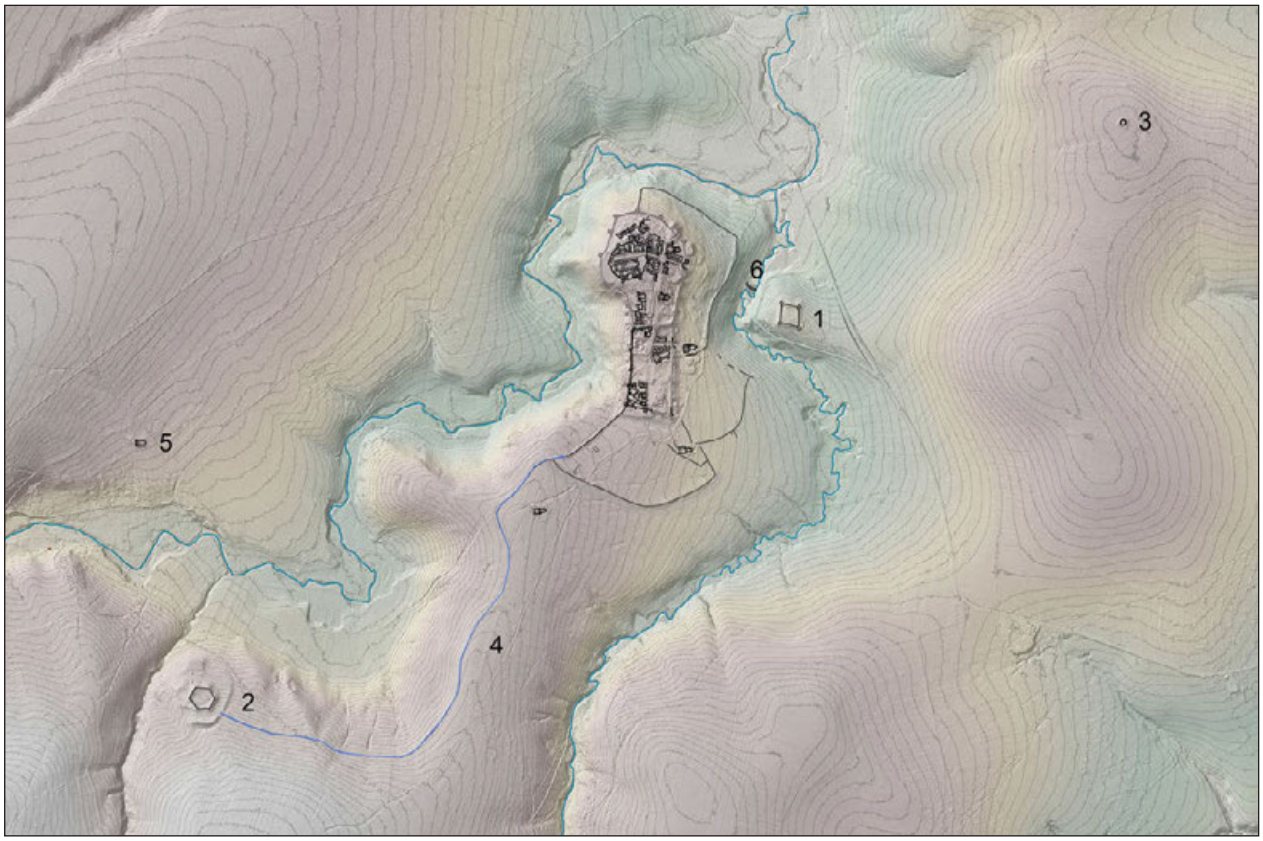


*Fig. 9. Ground-plan of Caričin Grad and nearby fortlets: 1) St Elias; 2) Gornje Gradište in Svinjarica; 3) Kulište–Jezero; 4) Aqueduct; 5) Svinjarica basilica; 6) Dam (Documentation of the Institute of Archaeology, Belgrade)*

*Сл. 9. План Царичиног града са оближњим утврђењима: 1) Утврђење на Св. Илији; 2) Горње градиште у Свињарици; 3) Кулиште – Језеро; 4) Акведукт; 5) Базилика у Свињарици; 6) Брана (документација Археолошког института)*

closest example comes from nearby Justiniana Secunda (Ulpiana). A martyrium-basilica was built in the 5th or 6th century within a former Roman temple's portico near the northern gate of Ulpiana. It was enclosed by 1.75 wide ramparts during Justinian's reconstruction of the city, which was then renamed to celebrate the emperor, and turned into a 0.28 ha large quadriburgium, somewhat larger than St Elias. The martyrium-basilica occupied a smaller area than the church in our fortlet, and it is interesting that the ramparts at St Elias were thicker (2.3 m) than those at Justiniana Secunda, the more so as the former had been built on a hill, and the latter on flatland.[63]

However, the hill is not high; the St Elias fortlet was therefore hidden in the terrain and could observe and protect, apart from the city, the structures in its immediate vicinity: the road, the dam, and the workshops at its foot (Fig. 9). Near the confluence of the Svinjarička and Caričinska rivulets, the remains of a melting furnace have been recorded.[64] Our visual contact analysis confirms that St Elias provided a very limited view, restricted to the closest surroundings and a small section of slopes north-west of the city (Fig. 11.1).[65]

Gornje Gradište in Svinjarica could observe somewhat wider surroundings, particularly the slopes around the Svinjarička rivulet. On the other hand, it is

[63] Teichner 2015, 294–322.

[64] Петковић 1937, 83.

[65] The extent of the DTM used in the visibility calculations was established by computing an average viewing distance of 6,600 m, as set by Wheatley, Gillings 2000, 17–18.

[66] Месеснел 1938, 197, сл. 18.

striking that this fort did not control the most vulnerable, southern approach to Caričin Grad (Fig. 11.2); we therefore assume that it was meant to overlook villages and workshops in the city's neighbourhood. A brick kiln was found on the rivulet's shore below the fortlet, as well as the remains of an Early Byzantine basilica to the north of it. France Mesesnel noted that other buildings' walls could be discerned in the terrain around the church.[66] Another role of Gornje Gradište might well have been to guard the aqueduct, particularly its

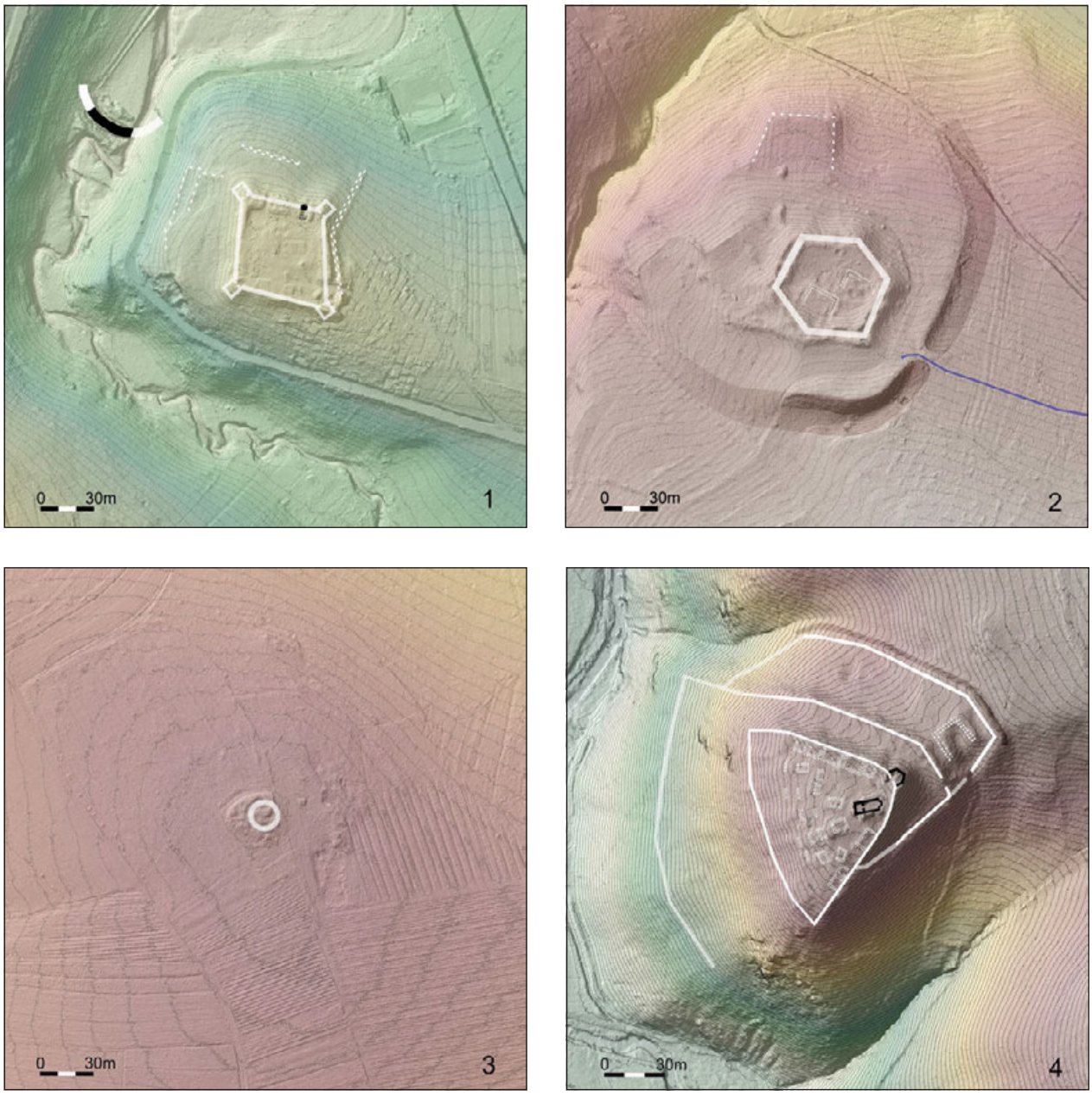


*Fig. 10. Results of the DTM analyses – ground-plans of the fortlets:*
*1) St Elias; 2) Gornje Gradište in Svinjarica; 3) Kulište–Jezero; 4) Gradište in Sekicol*
*(Documentation of the Institute of Archaeology, Belgrade)*

*Сл. 10. Резултати анализа дигиталних модела терена – основе утврђења:*
*1) Св. Илија; 2) Горње градиште у Свињарици; 3) Кулиште – Језеро; 4) Градиште у Секицолу*
*(документација Археолошког института)*

above-ground sections – bridges spread between this fortlet and the present-day village Bačevina.

In contrast to St Elias and Gornje Gradište, the Kulište–Jezero watchtower overlooked a wide area encompassed by heights on all sides, partly excepting the northern part of this tract. Its control over the road leading from Naissus, approaching the city from the north-east, through the Mrveška rivulet valley, was of the utmost importance, while the northern access was guarded by the larger fortification at Sekicol. Kulište–Jezero had visual communication with Caričin Grad, St Elias and Gornje Gradište in Svinjarica (Fig. 11.3), but not with the Sekicol and Rujkovac/Radinovac forts. The watchtowers were common Roman fortifications, particularly numerous along the limes. Many such fortlets are known from around the Empire – from Britain to the Danube border and all the way to Mesopotamia; for instance, numerous watchtowers were erected along the desert roads in Egypt to control these communication routes and especially water sources.[67]

The fortlets we are concerned with were built on rocky rises, chiselled out for rampart construction. Besides the above-mentioned shallow depressions in the rock left from these small "quarries", below St Elias and

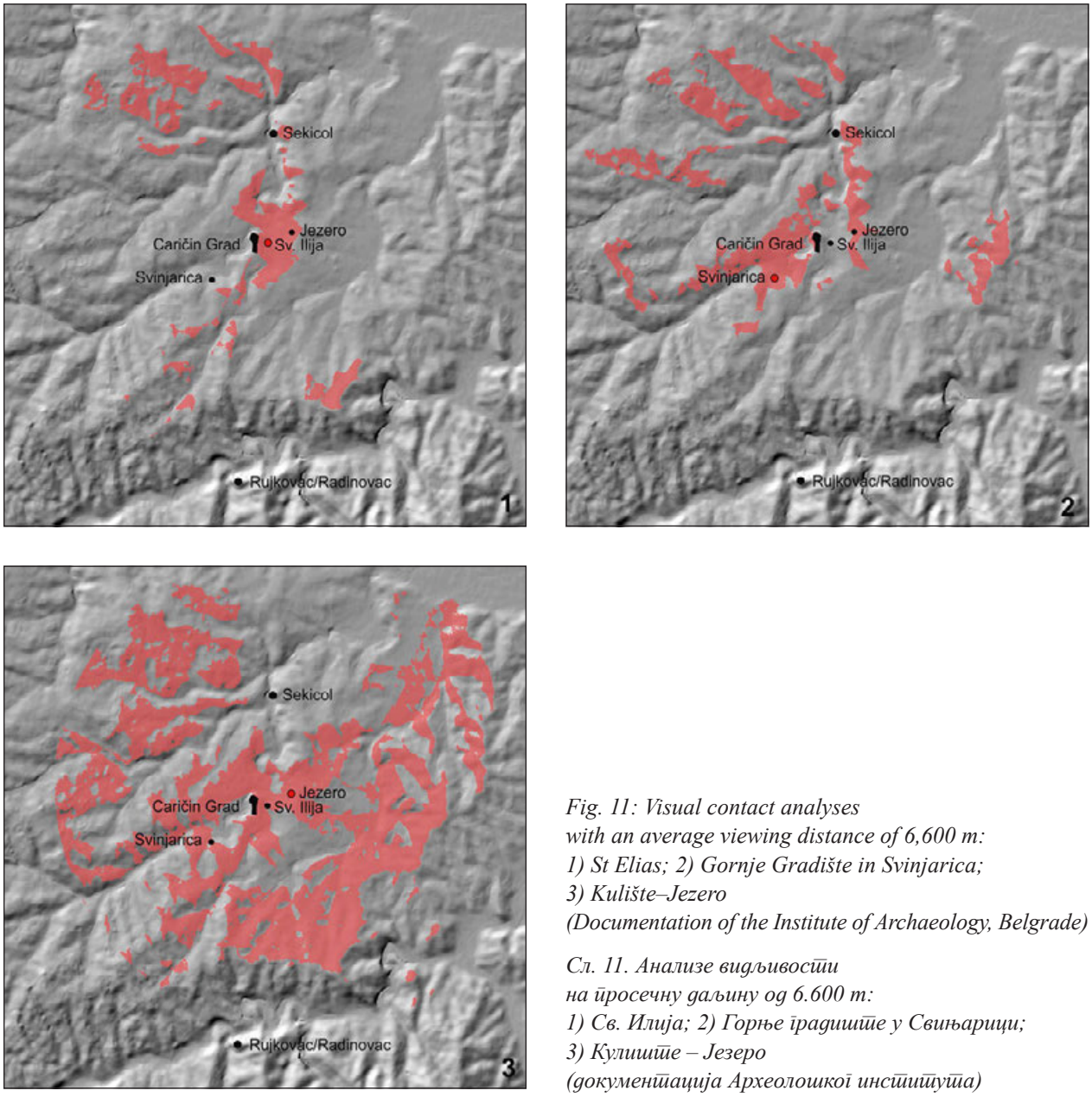


*Fig. 11: Visual contact analyses with an average viewing distance of 6,600 m: 1) St Elias; 2) Gornje Gradište in Svinjarica; 3) Kulište–Jezero (Documentation of the Institute of Archaeology, Belgrade)*

*Сл. 11. Анализе видљивости на просечну даљину од 6.600 m: 1) Св. Илија; 2) Горње градиште у Свињарици; 3) Кулиште – Језеро (документација Археолошког института)*

Gornje Gradište there are remains of modern quarries as well, which were in use until the 20th century. These resources had certainly been exploited in the Early Byzantine period too.

Caričin Grad, with its sophisticated defence system consisting of several rings of ramparts built in opus mixtum with at least 40 towers of different shapes, earthworks with palisades and a large trench in the immediate area of the city, and the outer fortlets described in this article, represents an exquisite example of Early Byzantine military architecture and the way it was adjusted to the topography. Future research of these forts should provide more detailed information on their chronology and function, complement the outstanding results of the LiDAR and geophysical surveys, and contribute to a better understanding of Justiniana Prima itself.

*Translated by Ivan Bugarski*



[67] Adams 2007, 223.

## BIBLIOGRAPHY:

**Sources:**

**Gregory of Tours** ..... Gregory of Tours, *Decem Libri Historiarum*, eds B. Krusch, W. Lewison, *MGH SRM* I 1, Hannover 1951.

***Miracula St. Demetrii*** ..... P. Lemerle, *Les plus anciens recueils des miracles de saint Demetrius et la pénétration des Slaves dans les Balkans*. *I Le texte. II Commentaire*, Paris 1979-1981.

**Procop. *Buildings*** ..... Procopius, *On Buildings*, trans. H. B. Dewing with G. Downey, Loeb Classical Library, London 1971.

**Procop. *Wars*** ..... Procopius, *Wars*, trans. H. B. Dewing with G. Downey, Loeb Classical Library, London 1914–1928.

**References:**

**Adams 2007** – C. Adams, War and society, in: *The Cambridge History of Greek and Roman Warfare, Volume 2. Rome from the Late Republic to the Late Empire*, (eds.)P. Sabin, H. van Wees, M. Whitby, Cambridge 2007, 198–232.

**Băjenaru 2010** – C. Băjenaru, *Minor fortifications in the Balkan–Danubian area from Diocletian to Justinian*, Cluj–Napoca 2010.

**Bavant 1990** – B. Bavant, Identification et fonction des bâtiments, in: *Caričin Grad II: Le quartier sud-ouest de la Ville Haute*, (éds.) B. Bavant *et al*., Belgrade – Rome 1990, 123–160.

**Bavant 2008** – B. Bavant, Fragments de casques de type Baldenheim trouvés à Caričin Grad, *Mélanges de l'École française de Rome – Moyen Âge* 120, 2008, 327–353.

**Bjelajac 1990** – Lj. Bjelajac, La céramique et les lampes, in: *Caričin Grad II: Le quartier sud-ouest de la Ville Haute*, (éds.) B. Bavant *et al*., Belgrade – Rome 1990, 161–190.

**Бугарски, Иванишевић 2014** – И. Бугарски, В. Иванишевић, Примена аерофотографије у српској археологији, *Саопштења* XLVI, 2014, 251–263. (Bugarski, Ivanišević 2014 – I. Bugarski, V. Ivanišević, Primena aerofotografije u srpskoj arheologiji, *Saopštenja* XLVI, 2014, 251–263).

**Corns, Shaw 2013** – Lidar and World Sites in Ireland: why was such a rich data source gathered, how is it being utilised, and what lessons have been learned?, in: *Interpreting Archaeological Topography. Airborne Laser Scanning, 3D Data and Ground Observation*, (eds.) R. S. Opitz, D. C. Cowley, Oxford – Oakville 2013, 146–160.

**Crutchley 2013** – S. Crutchley, Using lidar data – drawing on 10 year's experience at English Heritage, in: *Interpreting Archaeological Topography. Airborne Laser Scanning, 3D Data and Ground Observation*, (eds.) R. S. Opitz, D. C. Cowley, Oxford – Oakville 2013, 136–145.

**Curta 2001** – F. Curta, *The Making of the Slavs. History and Archaeology of the Lower Danube Region, c. 500–700*, Cambridge 2001.

**Дероко, Радојчић 1950a** – А. Дероко, С. Радојчић, Откопавање Царичина Града 1947 године, *Старинар* I, 1950, 119–142. (Deroko, Radojčić 1950a – A. Deroko, S. Radojčić, Otkopavanje Caričina Grada 1947 godine, *Starinar* I, 1950, 119–142).

**Дероко, Радојчић 1950b** – А. Дероко, С. Радојчић, Византиске старине у Јабланици и Пустој Реци, *Старинар* I, 1950, 175–180. (Deroko, Radojčić 1950b – A. Deroko, S. Radojčić, Vizantiske starine u Jablanici i Pustoj Reci, *Starinar* I, 1950, 175–180).

**Devereux *et al.* 2008** – B. J. Devereux, G. S. Amable, P. Crow, Visualisation of LiDAR terrain models for archaeological feature detection, *Antiquity* 82, 2008, 470–479.

**Динић 1962** – М. Динић, *За историју рударства у средњовековној Србији и Босни* II, Београд 1962. (Dinić 1962 – M. Dinić, *Za istoriju rudarstva u srednjovekovnoj Srbiji i Bosni* II, Beograd 1962).

**Elaborat 2012** – *Elaborat o realizovanom laserskom skeniranju arheoloških lokaliteta Caričin grad i Margum*, Beograd 2012: GeoGIS Consultants.

**Hesse 2016** – R. Hesse, Visualisierung hochauflösender Digitaler Geländemodelle mit LiVT, in: *3D-Anwendungen in der Archäologie. Computeranwendungen und quantitative Methoden in der Archäeologie.* Workshop der AG CAA und des Exzellenzclusters Topoi 2013, (eds.) U. Lieberwirth, I. Herzog, Berlin 2016, 109–128.

**Horn 1981** – B. K. P. Horn, Hill Shading and the Reflectance Map, *Proceedings of the IEEE* 69.1, 1981, 14–47.

**Иванишевић 2011** – В. Иванишевић, У сусрет стогодишњици истраживања Царичиног града, *Лесковачки зборник* LI, 2011, 353–366. (Ivanišević 2011 – V. Ivanišević,

U susret stogodišnjici istraživanja Caričinog grada, *Leskovački zbornik* LI, 2011, 353–366).

**Иванишевић 2012** – Акведукт Царичиног града – Јустинијане Приме, *Саопштења* XLIV, 2012, 13–31. (Ivanišević 2012 – Akvedukt Caričinog grada – Justinijane Prime, *Saopštenja* XLIV, 2012, 13–31).

**Ivanišević 2016** – V. Ivanišević, Caričin Grad (Justiniana Prima): A New-Discovered City for a 'New' Society, in: *Proceedings of the 23rd International Congress of Byzantine Studies, Belgrade, 22–27 August 2016, Plenary papers*, (ed.) S. Marjanović-Dušanić, Belgrade 2016, 107–126.

**Ivanišević 2017** – V. Ivanišević, Une capitale revisitée : Caričin Grad (Justiniana Prima), *Comptes rendus des séances de l'Académie des Inscriptions et Belles-Lettres* I (janvier–mars), 2017, 93–114.

**Иванишевић, Бугарски 2012** – В. Иванишевић, И. Бугарски, Примена LiDAR технологије у анализи топографије Маргума/Мораве и Кулича, *Старинар* LXII, 2012, 239–255. (Ivanišević, Bugarski 2012 – V. Ivanišević, I. Bugarski, Primena LiDAR tehnologije u analizi topografije Marguma/Morave i Kuliča, *Starinar* LXII, 2012, 239–255).

**Иванишевић, Бугарски 2013** – В. Иванишевић, И. Бугарски, Прва домаћа искуства у документовању ширих зона археолошких налазишта путем LiDAR технологије, *Гласник Друштва конзерватора Србије* 37, 2013, 79–84. (Ivanišević, Bugarski 2013 – V. Ivanišević, I. Bugarski, Prva domaća iskustva u dokumentovanju širih zona arheoloških nalazišta putem LiDAR tehnologije, *Glasnik Društva konzervatora Srbije* 37, 2013, 79–84).

**Иванишевић, Бугарски 2014** – В. Иванишевић, И. Бугарски, Примена аерофотографије у српској археологији, *Саопштења* XLVI, 2014, 251–264. (Ivanišević, Bugarski 2014 – V. Ivanišević, I. Bugarski, Primena aerofotografije u srpskoj arheologiji, *Saopštenja* XLVI, 2014, 251–264).

**Иванишевић, Бугарски 2015** – В. Иванишевић, И. Бугарски, Дигитална фотограметријска снимања античких и средњовековних локалитета у Србији, *Саопштења* XLVII, 2015, 165–180. (Ivanišević, Bugarski 2015 – V. Ivanišević, I. Bugarski, Digitalna fotogrametrijska snimanja antičkih i srednjovekovnih lokaliteta u Srbiji, *Saopštenja* XLVII, 2015, 165–180).

**Иванишевић *et al.* 2016** – В. Иванишевић, И. Бугарски, А. Стаменковић, Нова сазнања о урбанизму Царичиног града, *Старинар* LXVI, 2016, 143–160. (Ivanišević et al. 2016 – V. Ivanišević, I. Bugarski, A. Stamenković, Nova saznanja o urbanizmu Caričinog grada, *Starinar* LXVI, 2016, 143–160).

**Ivanišević, Stamenković 2014** – V. Ivanišević, S. Stamenković, Late Roman fortification in the Leskovac Basin in relation to urban centres, *Starinar* LXIV, 2014, 219–230.

**Kokalj et al. 2011** – Ž. Kokalj, K. Zakšek, K. Oštir, Application of Sky-View Factor for the Visualization of Historic Landscape Features in LiDAR-Derrived Relief Models, *Antiquity* 85, 2011, 263–273.

**Kokalj et al. 2018** – Ž. Kokalj, R. Hesse, A. Mulahusić, *Vizuelizacija rasterskih podataka laserskog skeniranja iz zraka*, Ljubljana 2018.

**Кондић, Поповић 1977** – В. Кондић, В. Поповић, *Царичин град, утврђено насеље у византијском Илирику*, Београд 1977. (Kondić, Popović 1977 – V. Kondić, V. Popović, *Caričin grad, utvrđeno naselje u vizantijskom Iliriku*, Beograd 1977).

**Месеснел 1938** – Ф. Месеснел, Ископавање Царичина Града код Лебана год. 1937, *Старинар* XIII, 1938, 179–198. (Mesesnel 1938 – F. Mesesnel, Iskopavanje Caričina Grada kod Lebana god. 1937, *Starinar* XIII, 1938, 179–198).

**Ненадовић 1950** – С. Ненадовић, О неким споменицима из Царичиног Града и околине, *Музеји* 5, 1950, 140–166. (Nenadović 1950 – S. Nenadović, O nekim spomenicima iz Caričinog Grada i okoline, *Muzeji* 5, 1950, 140–166).

**Petersen 2013** – L. I. R. Petersen, *Siege Warfare and Military Organization in the Successor States (400–800 AD)*, Leiden – London 2013.

**Петковић 1937** – В. Петковић, Ископавање Царичиног Града код Лебана, *Старинар* III, 1937, 81–92. (Petković 1937 – V. Petković, Iskopavanje Caričinog Grada kod Lebana, *Starinar* III, 1937, 81–92).

**Петровић 1970** – Н. Петровић, О водоводу Царичиног града, *Старинар* XX/1969, 1970, 289–297. (Petrović 1970 – N. Petrović, O vodovodu Caričinog grada, *Starinar* XX/1969, 1970, 289–297).

**Технички извештај 2019** – *Технички извештај о реализацији радова на изради дигиталног модела висина на археолошком локалитету Секицол*, Београд 2019: Геогис консултанти д.о.о. *(Tehnički izveštaj 2019 – Tehnički izveštaj o realizaciji radova na izradi digitalnog modela visina na arheološkom lokalitetu Sekicol*, Beograd 2019: Geogis konsultanti d.o.o.).

**Teichner 2015** – F. Teichner, Neue Forschungen zur dardanischen Doppelstadt *Ulpiana – Iustiniana Secunda* (Kosovo), *Bericht der Römisch-Germanischen Kommission* 96, 2015, 281–338.

**Wheatley, Gillings 2000** – D. W. Wheatley, M. Gillings, Visual perception and GIS: developing enriched approaches to the study of archaeological visibility, in: *Beyond the map: Archaeology and Spatial Technologies*, (ed.) G. Lock, Amsterdam 2000, 1–27.

**Zakšek *et al.* 2011** – K. Zakšek, K. Oštir, Ž. Kokalj, Sky-View Factor as a Relief Visualization Technique, *Remote Sensing* 3.2, 2011, 398–415.

Vujadin IVANIŠEVIĆ, Ivan BUGARSKI, Aleksandar STAMENKOVIĆ
The Outer Forts of Caričin Grad: Visualisation of Digital Terrain Models and Interpretation (297–317)

*Резиме*: ВУЈАДИН ИВАНИШЕВИЋ, Археолошки институт, Београд
ИВАН БУГАРСКИ, Археолошки институт, Београд
АЛЕКСАНДАР СТАМЕНКОВИЋ, Републички завод за заштиту споменика културе, Београд

# СПОЉАШЊА УТВРЂЕЊА ЦАРИЧИНОГ ГРАДА: ВИЗУЕЛИЗАЦИЈА И ИНТЕРПРЕТАЦИЈА ДИГИТАЛНИХ МОДЕЛА РЕЉЕФА

*Кључне речи* – Јустинијана Прима, спољашња утврђења, рефугијуми, осматрачница, манастир, лидар, дигитални модели терена

Истраживања Царичиног града отпочета су пре више од једног столећа. Пажња стручњака је, из сасвим разумљивих разлога, пре свега била усмерена на истраживања града, док су околна утврђења изазивала знатно мање пажње (сл. 1, 2). Кад је реч о самим ископавањима, исто је и данас, али је примена савремених метода археолошке проспекције и детекције са земље и из ваздуха, нарочито заступљена у последњих десетак година и праћена теренском провером добијених података, довела и до важних сазнања о околини метрополе Северног Илирика. У чланку се коментаришу објављена запажања претходних истраживача – Дерока, Радојчића, Ненадовића, Кондића и Поповића – у светлу нових података.

Лидарска снимања ширих зона налазишта уведена су у српску археологију почетком ове деценије, у склопу учешћа Археолошког института у међународном пројекту *Archaeo-Landscapes Europe*. Међу првим скенираним локалитетима био је управо Царичин град, са одличним резултатима које су пратиле прелиминарне публикације. Зоном лидарског снимања од 12 km² из 2011. године, осим самог Царичиног града, био је обухваћен и део трасе акведукта, али и оближње утврде Св. Илија, Горње градиште у Свињарици и Кулиште – Језеро. Године 2015. извршено је снимање простора површине 4 km² око утврђења у Секицолу. Иако су и претходно добијени ласерски модели рељефа без вегетације били више него довољни за плодотворну анализу, у међувремену је омогућено побољшање параметара снимања, па су она из 2015. године бележила чак 40 тачака по квадратном метру – двоструко више него скенирање терена из 2011. године, уз више контролних трајекторија и смањену брзину и висину лета (табела 1).

Рад на визуелизацији добијених тродимензионалних модела терена одвијао се уз коришћење различитих техника – од стандардних, попут прављења дводимензионалних топлотних мапа помоћу алатке *Heatmap* у програму *QGIS*, интерполације изохипси (*Contour Extraction*) и сенчења (*hill-shading*), до рада у напредним слободно доступним софтверима као што су *Relief Visualisation Toolbox (RVT)* и *RTIViewer*. Функција *Focal Statistics* из *ArcGIS* пакета препознаје делове терена са изразитим висинским разликама и показује контрасте у боји, због чега се показала као једна од најуспешнијих у анализи конфигурације терена, структуре и урбанизма Царичиног града. Апликација *ArcScene* приказује тродимензионалне дигиталне моделе из различитих углова, а њена алатка *Vertical exaggeration of terrain* такође је веома корисна за наглашавање благих промена у терену. Процес дигиталне визуелизације је само корак у рашчитавању и интерпретацији добијених података, чему је посвећен преостали део текста у којем је показано како је примена савремене технологије снимања терена из ваздуха допунила досадашња сазнања о фортификацијама из најближег окружења Царичиног града (сл. 4, 5, 7, 8).

Утврда на брду Св. Илија је смештена непосредно уз Царичин град, надзирући источни прилаз граду и брану његовог акумулационог језера. Локалитет је сондажно ископаван 1976. године у организацији Археолошког института, када су установљена два главна хоризонта (сл. 3). На основу градитељске технике (*opus mixtum*) и покретних налаза, старији хоризонт је поуздано датован у 6. век и, вероватно, почетак 7. века, док познији припада средњем и новом веку. Визуелизација дигиталног модела рељефа, рачунарским путем ослобођеног постојеће вегетације, донела је нове податке о утврђењу. Основа ове трапезоидне фортификације сада може лако да се сагледа и премери. Утврђење је заузимало 0,21 ha и имало је угаоне куле, а у дигиталном моделу се уочава и ограда паралелна са источним бедемом, можда палисада, која је штитила најлакши источни прилаз. Скретала је ка западу, паралелно са северним бедемом, док се западно од утврде уочава пространа платформа коју оивичавају два подзида. Током георадарских снимања, која је у пролеће 2015. године извела екипа *Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology* из Беча, у централном делу утврђења је откривена велика рановизантијска базилика (сл. 4).

Утврђење Горње градиште налази се у селу Свињарици, на километар југозападно од Царичиног града. Било је, а и остало је веома урасло у вегетацију, тако да се запажања претходних истраживача углавном заустављају на опису четвороугаоног рова испред утврде и на њеном положају на траси акведукта. Лидарским снимком је пак откривена шестоугаона основа фортификације, састављена од зидова дужине око 30 m и 32 m, која заузима исту површину као и Св. Илија. Уз то, у дигиталном моделу, и у мањој мери на самом терену, уочавају се обриси двеју великих грађевина. Док је једна могла да служи као складиште, друга је била црква. Током обиласка локалитета уочили смо велику количину шута од камена, опеке и малтера. Утврђење је било опасано ровом и шанчевима, што се нарочито добро види са јужне стране, где је ров укопан у стену чији су блокови након вађења били уграђивани у бедеме и, вероватно, друге објекте. Делови северне трасе бедема су, пак, тешко оштећени

земљорадњом. Југоисточна секција валума је пресечена прилазним путем, а са истог одсечка траса акведукта може лако да се прати у микротопографији, све до угаоне куле кроз коју је вода улазила у Царичин град. Посебна одлика Горњег градишта јесу масивни земљани „бастиони" северно и, чини се, западно од утврде (сл. 5).

Кулиште – Језеро заузима врх благог успона на километар североисточно од Царичиног града. Судећи по површинским налазима опеке и камена, то веома мало утврђење, пречника око 18 m, које је у дигиталном моделу рељефа назначено рововима од вађења грађе, било је сазидано у техници *opus mixtum*. Имало је функцију осматрачнице, која је остала сачувана и у једном топониму, док други назив упућује на воду која се задржавала у плитким депресијама насталим вађењем стене за изградњу бедема, од којих је највећа четвороугаоног облика, површине 32 m x 16 m и дубине око пола метра (сл. 7).

Градиште у Секицолу је подигнуто на врху и стрмим падинама брда над Царичинском реком, око 3 km северно од Царичиног града. Утврђење се доста разликује од претходно описаних. Можда потиче из 4. века, да би у 6. столећу, у доба изградње Јустинијане Приме било увећано доградњом двају спољних бедема. Највиша утврда је троугаоне основе, а на терену није потврђено да је била сазидана уз коришћење опеке и малтера. Њена површина износи 0,64 ha. Претходни истраживачи су у источном делу те целине забележили цркву, која се нарочито јасно оцртава у дигиталном моделу, већу грађевину уз њен југоисточни бедем, као и слабе обрисе других зграда. Наша анализа је довела до открића два низа зграда уз бедеме и бројних грађевина између њих. По лепезастом распореду зграда, поседање ове утврде подсећа на насеље на северном платоу Царичиног града. Средњи прстен је скоро двоструко већи, док је доња утврда, придодата на североисточној страни, исте површине као и највиша. У њеном југоисточном крају налази се правоугаона грађевина димензија 32 m x 16 m – можда цистерна. Укупна површина Градишта у Секицолу је 2,5 ha. Испред доњег утврђења налази се ров, који се у појединим партијама види само у дигиталном моделу, док је на терену непрепознатљив (сл. 8).

Са својим спољним прстеном утврда, Царичин град се разликује од других утврђења у Илирику. Велика грађевинска активност у руралном залеђу Средоземне Дакије није била ограничена на подизање нове метрополе, већ је подразумевала и изградњу инфраструктурних постројења као што су акведукт и брана. Четири испитана утврђења представљала су део јединственог градитељског програма Јустинијане Приме, о чему сведочи и примењена техника зидања са опекама и малтером. У историјским изворима нема пуно података о мањим утврдама покрај градова. Већа утврђења, фруриони попут Градишта у Секицолу и Рујковца/Радиновца, могли су да у случају опасности прихвате трупе које би из њих нападале непријатељску позадину и опсадне справе. У то време, војници су често становали са својим породицама. Остала три утврђења имала су различите функције. Кулиште – Језеро била је добро постављена осматрачница, какве су уобичајене у римском војном градитељству, која је имала визуелну комуникацију са Царичиним градом, Св. Илијом и свињаричким Градиштем, али не и с већим утврдама у Секицолу и Рујковцу/Радиновцу.

Утврђења на Св. Илији и у Свињарици су, попут рефугијума, могла да збрину живаљ у тешким временима. Ипак, Св. Илија је изворно имао другу намену. Велика базилика откривена приликом георадарских снимања заузимала је чак четвртину утврде, а постојање зграда уз бедеме снажи претпоставку да је реч о утврђеном манастиру. Поред тога, у свом опису Јустинијане Приме Прокопије наводи да је цар овај град подигао поред свог родног села које је обзидао и од њега начинио квадрибургијум, очигледно као део јединственог градитељског програма. Познати су још неки утврђени манастири који су подигнути за владе цара Јустинијана, од којих је Св. Илији најсличнији онај у Јустинијани Секунди, дотадашњој Улпијани. На то да Св. Илија није представљао класично војно утврђење упућује и наша анализа видљивости, која показује да је поглед са те тачке веома ограничен. Према истој анализи, Горње градиште у Свињарици је надзирало села и радионице у околини града, као и акведукт (сл. 11).

Детаљно разрађен одбрамбени систем Јустинијане Приме састојао се од неколико прстенова градских утврда са најмање 40 кула, ровова, палисада и спољашњег прстена фортификација, који је обухватао, пре свега, овде коментарисана утврђења. Одбрамбена постројења новоустановљене метрополе и начин на који су се она прилагодила топографији представљају изузетан пример рановизантијског војног градитељства. Будућа истраживања би сигурно обезбедила поузданије податке о њиховој хронологији и функцији и тако надоградила изузетне резултате лидарских и геофизичких снимања, што би допринело и јаснијем сагледавању самог Царичиног града.