VIVERE MILITARE EST

From Populus to Emperors - Living on the Frontier
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ARCHITECTURAL FEATURES OF ROMAN HORREA IN THE AREA OF MODERN-DAY SERBIA*

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ABSTRACT

The expansion of the Roman Empire and the formation of new provinces brought about the establishment of a serious system of collecting, storing and distributing food and other goods. Food storage facilities (horrea) were built throughout the empire both for the needs of the army and for the needs of the civilian population. The subject of this paper is the analysis of the features of these specific facilities, their size, shape, constructive characteristics, in the area of Upper Moesia and Lower Pannonia.

Key words. – Horrea, late antiquity, architecture, Upper Moesia, Lower Pannonia.

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The foundation of Roman provinces in the newly conquered territories and the formation and development of military camps and settlements along the Limes and in the midlands of the provinces inevitably lead to population growth. Vast numbers of ordinary people, merchants, craftsmen, artists and their families, inhabited the immediate vicinity of the military camps, the ager publicus of the colonies, territories of the municipia or the veteran's estates, while the army was lodged in forts. With the growth of the population, the demand for larger quantities of food and facilities for food storage and distribution rose, since the areas surrounding military camps were not always suitable for agricultural use.

The problem with grain storage and food storage in general appeared as early as in prehistory, when man started gathering food from nature. The emergence of the first food storage facilities is also known from the Hellenistic period, i.e. from Pergamon (3rd century BC). Roman agronomists and architects also dealt with these problems and devoted much attention to them. Horrea, thus, came into existence out of this necessity, and their function was the storage of foodstuffs of different kinds and origins, but also the storage of other goods necessary for daily life. These were mostly massive buildings of simple construction, regular geometry, and an elongated base, whose main function was to provide a safe, dry and isolated place for storage.[1]

The remains of horrea are found throughout the Empire, in urban centres as well as in rural areas, but also within fortified military camps. Their role in providing food for the army and population in general was indispensable so, as a rule, they were ubiquitous. There is virtually no settlement or military camp without horrea. It has been established that huge public horrea existed in cities, from where grain was further distributed. Thus, in Rome alone, in the final period of the Empire, there were almost 300 granaries which could provide the city with enough grain to operate normally for several years.[2] The largest one, *Horrea Galbae*, consisted of about 140 compartments on the ground floor and occupied an area of 21,000 m², which testifies to the importance and size of these buildings, and *Horrea Antoniniani* in Ostia[3] was much the same size.

1 As G. Milošević notes (Milošević 2014, 31) in bibliography, the term horreum is related to the objects for grain storage, the granaries, which is inadequate and a simplification; we agree with this view.

2 Marteaux 1998, 14-15.

3 Rickman 1971, 5.

The specific function of the horrea imposed certain propositions concerning their size, position, orientation and the form of their architecture, which are also mentioned by Vitruvius.[4] Most often, these were massive objects, with an elongated rectangular base, double pitched roof and oftentimes multi-storied. Customarily, they were positioned near the main communications- in the vicinity of the forts' gates, so as to be easily accessible. Safety measures which included fire and theft protection were taken in their design and construction, the windows were extremely narrow, positioned high on the external walls, and the doors were secured by firm locks and bolts. A free standing position in the built environment, massively wide walls (0.90- 1.80m) and a high roof which could not be reached by flame provided fire protection. Also, the entrances often had ramps to provide easy access for carts, making loading and unloading faster and easier.[5]

Horrea can generally be classified as massive or light wooden constructions according to the materials they were built of. The massive ones can be further divided according to their spatial organisation into those whose interior was divided by one or more rows of columns and those with partition walls.[6] The classification according to the intended users differentiates civilian and military horrea, and within this classification horrea can be further divided into public and private ones.

Thus, Pliny makes a difference between two types of buildings intended for the storage of agricultural produce, and these are massive structures (made of brick, stone or their combination) - *horr*ea and light wooden structures - gr*anaria*.[7] The wooden granaries were temporary structures, and typical of the early periods of the Roman Empire and temporary military camps. However, the remains of this type of buildings have not been discovered in the area of Moesia Superior and Pannonia Inferior. There are speculations that the first earthworks had temporary structures made of wood, and thus also the wooden horrea, as is possibly the case with the wooden horreum in Donji Milanovac - *Taliata*.[8] In a later period, solid built structures appeared in provinces throughout the Empire. Structures of this

4 Vitruv. VI/vi/4.

5 No remains of this type of ramps were discovered in Moesia Superior, except for the horreum in Mediana, where this type of structure could have existed

6 Rickman 1971. 2-3.

7 Plin. 18/73.

8 Milošević 2014, 47.

type, intended for the storage of foodstuffs, had to meet very specific requirements. For example, a dry, cool and dark space is necessary for grain storage. The level of humidity should be between 10 and 15%, depending on the climate and the type of grains stored, and the temperature about 15°C.[9] Brick was used as an ideal material for the regulation of humidity, since it acts as an absorber in an atmosphere of high humidity, i.e. it absorbs water vapour while, when the humidity is low, it releases the absorbed moisture, thus securing optimal air saturation. This characteristic of brick is possible because of its structure created while it is being dried and fired, when water evaporates from the brick and micro-sized air bubbles remain in its place, and the humidity is absorbed into and released from them through the porous structure of the brick. Also, its thermal characteristics provide a constant optimal temperature of the interior, without major oscillations, while its constructional characteristics meet all the standards for this type of building. Stone, as the second most common material, is not as suitable as brick, regarding humidity regulation of the interior, but it was also widely used in construction for its thermal insulation and constructional properties, its affordability and its availability in the immediate surroundings. An important part of the construction of these buildings was the plastering of walls, primarily the interior ones, to obtain a smooth surface without holes and dents, which facilitated cleaning and the manipulation of the stored goods. Proper ventilation was an important factor in the preservation of the foodstuffs, and was provided by the windows on the facade. The windows also had the function of air conditioning, since grains release heat and there existed a danger of spontaneous combustion.[10] Also, it was necessary to secure the space from pests, such as rodents and various insects, but also birds. Structures for grain storage provided ideal conditions for pest invasion (primarily insect), which was extremely difficult to eliminate once started.[11] The only solution was to plaster the walls, which minimised the danger of pests laying their eggs and cocoons developing in joints and crevices, followed by frequent, seasonal cleaning and the use of various pest repellent coatings.

When it comes to construction, horrea were not challenging structures, but certain principles of construction had to be followed because of the specific purpose of

9 Rickman 1971, 1.

10 Milošević 2014, 33.

11 Smith, Kenward 2011, 252

these buildings. Above all, this refers to the massiveness of the structure and floor solutions. Numerous preserved horrea remains show the floor laid on dead walls or piers to reduce or avoid the capillary action of humidity from the ground. An important factor in determining wall size was the fact that grain was stored both in bulk and in sacks. Thus, the walls had to be strong enough to bear both the vertical and the horizontal pressure, which were considerable, unlike in ordinary structures where such pressure could not occur. If grain was stored in bulk, this horizontal pressure was immense, even up to 2/3 the vertical pressure, which would mean, if the vertical pressure gradient were $3t/m^2$, the horizontal, side pressure, could be as much as $2t/m^2$.[12] This imposed several constructional characteristics of the horrea structures. The first one was a large wall thickness, and they usually had pilasters, in some places against the exterior walls, in others against the interior ones, and in some cases on both sides. These served to reinforce the walls and acted against the pressure forces to a large degree. The pilasters were occasionally raised from the wall surface by up to 0.60m, depending on the wall thickness and the type of load; this also leads to the conclusion that these buildings could have had a multi-storey construction, which was not unusual. Naturally, if the structure was leaning against the fort's thick rampart, thus meeting the engineering statics requirements, there was no need for the pilasters.[13] Another important characteristic was that the space had to be dry, i.e. to prevent the penetration of humidity from the outside. For this purpose, horrea had double-pitched[14] or mono-pitched[15] roofs with long steep slopes and, if they had a courtyard, they always contained swales (canals) across the middle of the yard to capture and divert the surface runoff away from the structure. Yet another important feature were the raised floors of the horrea, which prevented the drawing up of moisture from the ground by capillary action. This was achieved by the construction of the so-called dead walls built of brick, or stone and hydrostatic mortar, laid on the ground in rows inside the structures or with evenly distributed piers onto which a massive, solid floor, resistant to high pressure, was constructed. In a very small number of cases, the space between the ground and the floor could be accessed through small openings used for cleaning and ventilation.

12 Rickman 1971, 2.

13 As was the case with the horreum leaning against the south city rampart in Sirmium.

14 This was the most common type of roof structure.

15 Very rare, but still occasionally identified due to the specific characteristics of their location.

The main classification of the type of horrea recognises a difference between *the civilian granaries (horrea publica*), located in big cities and towns from where the distribution of goods was carried out, and military granaries (*horea militaris*) which supplied the army.[16]

The civilian granaries, which, according to their ownership, can be further divided into public and private ones, were by far the most common type of these structures, built both in urban and rural environments. Public horrea were owned by emperors, i.e. by the state of Rome, and had a well-developed system of management and control. Since an important resource - food- was in question, the state had to supervise the import and distribution of grain. On the other hand, private granaries begin to emerge, owned by rich Roman families, merchants or retailers. It is common knowledge that the price of grain before and after the harvest differed, so private owners used these differences to their advantage and, having stored large quantities of grain, waited for the increase in prices and a larger profit.[17] The conclusion reached by contemporary researchers of economic history is that in the Roman imperial economy mostly relied on the private market.[18]

Military horrea were typically found in military forts, and served to supply the army with grain. As structures of great importance, they played a significant role in the design of the organisational scheme of military forts. Thus, this type of structure was typically located near the principia building, in the central part of the fort, or near the gate leading to the port, if the fortification was located by a river.[19]

In the territory of modern-day Serbia, whose central part used to be the province of Moesia Superior,[20] while the area of Vojvodina belonged to the southern part of the province of Pannonia Inferior, both types of horrea were found, both civilian and military granaries. (Fig. 1) A great number of the remains of Roman buildings which could be identified as civilian granaries has been discovered and registered in Sirmium, Municipium DD, Maskar, in the suburbs of Peć, in Mediana, Justiniana Prima and Gamzigrad (Felix Romuliana). The other type of buildings whose

16 Popović 1988, 202.

17 The same situation is observed even today, when large companies store grain in silos after the harvest, when it is cheapest, and sell it later, when its price on the market increases.

18 Kessler, Temin 2007, 313-332.

19 Rickman 1971, 234.

20 Modern-day Serbia occupies territory of the provinces of Pannonia and Moesia.

remains have been discovered in Serbia, can be classified as military granaries, and they were typically found in military forts. This type of horrea was identified in the castra along the Limes, namely in the military camps on the Čezava, in Boljetin, Pontes, Veliki Gradac, Karataš, Sapaja, Konopište, Kurvingrad, Taliata castrum, the mouth of the Porečka river, and in the castrum in Singidunum. The horreum in Ravna, the fort outside of the Limes, should also be mentioned here.

PUBLIC HORREA

Sirmium, as an imperial city, had several granaries, whose remains were discovered on sites 31 and 30. Two structures of the same type, but with a different spatial and constructional arrangement, discovered on site 31 next to the south rampart most likely belong to the complex of the imperial palace, for which reason they were named royal horrea. They were of an internal character. However, by their spatial organisation, concept and system of construction, as well as the materials, they are equal to other similar structures of this type and do not differ from them in any aspect. The research of these two structures, building 1 and building 2, has not been completed, but their graphic reconstruction can easily be performed since their bases were formed by the simple laying of the same elements of approximately the same dimensions (plan 1). These two buildings represent two separate units, both spatially and chronologically. It is clear that they were intended for grain storage, of simple construction and erected at different times and locations.[21]

Building 1 has a rectangular base, its interior dimensions being 40.00 x 10.50 m, and it corresponds to the dimensional ratios of most horrea. The interior is partitioned by a row of seven columns[22] and probably had wooden partitions between the columns and the walls. This structure was leaning against the old south rampart (which at one point started slanting towards the south due to the pressure of the stored goods and the settling of the underwater surface) while it was still functional. Building 2 was erected at the end of the 3rd century, along the new route of the south ramparts, determined by the new urban concept of the Imperial palace.

21 Jeremić 1998, 241.

22 Partitioning with piers emerged from the constructional requirements that had to be met when building a double pitched roof structure.

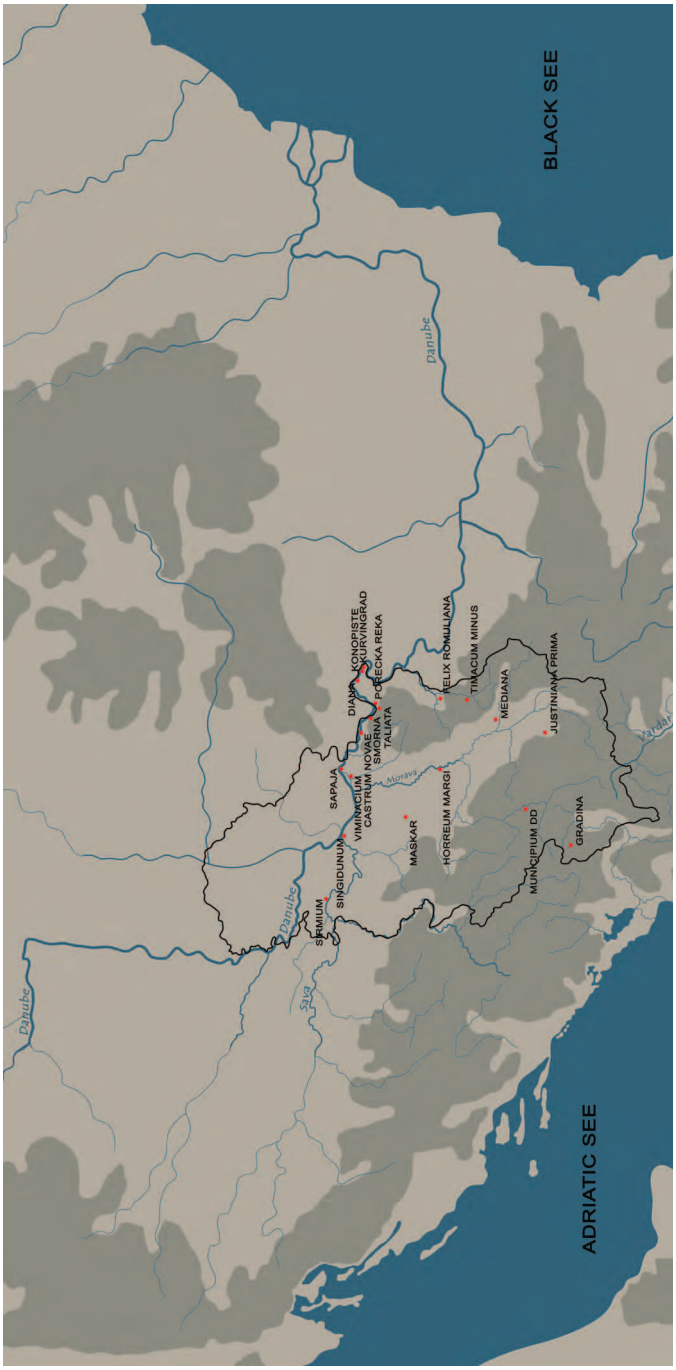
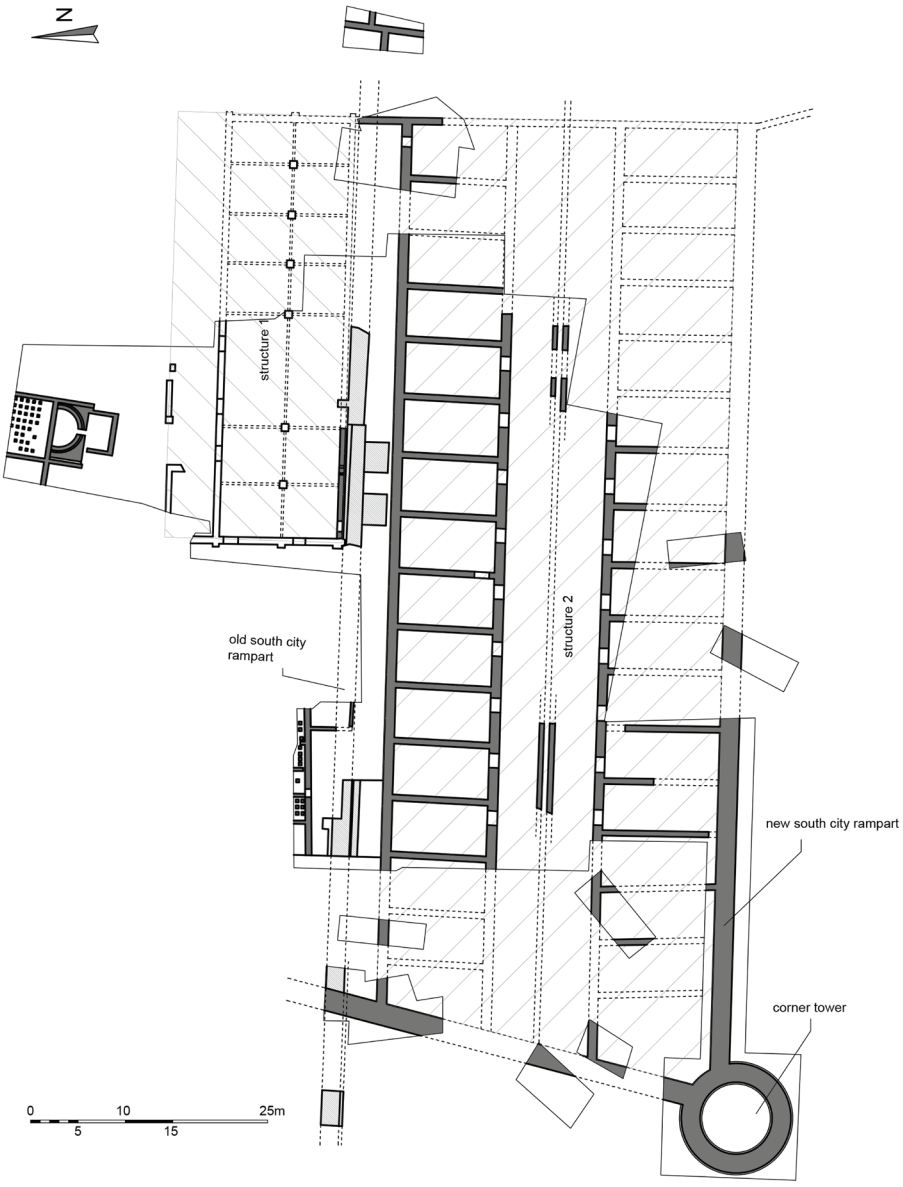


Fig. 1 – Position of horrea in the area of modern-day Serbia

Plan 1 – Sirmium horreum - site 31, after: M. Jeremić 1998.



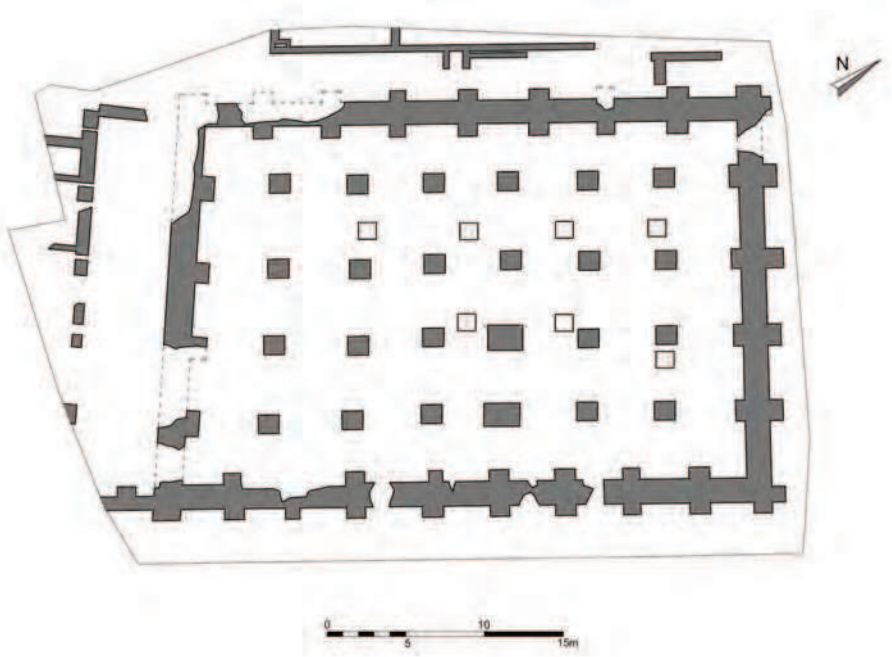
The south rampart was moved 35 m towards the south, taking into account the width of the future building. Thus, the south rampart embraced the horreum and, at the same time, represented its exterior walls. Building 2, 85.0 m long and 33.0 m wide,[23] was comprised of two sections divided by the courtyard with a rigole (canal) for capturing surface runoff. Both sections, each 10 m wide, consisted of rows of cells of approximately the same dimensions. The north section consisted of 16, while the south one consisted of 17 compartments. The main entrance could have been located only on the east side,[24] which confirms the speculation that the new horreum was located within the palace complex.[25]

A structure of utility architecture, which probably belongs to the granaries of the public type, was discovered on site 30 in Sirmium (plan 2). The horrea were located in the central zone of the Roman city, more to the south than the Licinian Baths. The building on site 30 was bordered by streets and, during the excavation, a deep portico was discovered on its south side, so it can be presumed that the entrance to the building was on this side, which also opens towards the port. It was erected at the end of the 3rd or at the beginning of 4th century on the location of the previous settlement since, under the floor gradient, a richly decorated residential building dated to the 2nd century was discovered. Two phases were identified, the younger building was erected over the levelled remains of the older one, of which about ten piers remained in the foundation zone, while the exterior walls were not registered. The younger building has been completely unearthed; it is a structure of a trapezoidal base, its outer dimensions being 44.0 x 22.0 m, with a 5.0 m wide portico. The interior is divided by four rows of six piers, forming regular 5.0 x 5.0 m fields. The exterior walls are fortified by pilasters whose position corresponds to the position of the interior piers only on the narrower sides. Because of the massive walls (1.8 m) with pilasters and the interior piers (1.30 m), it can be assumed that the structure had a story supported by arches lengthwise, and by wooden beams along its width. The first floor was covered with thick wooden slabs which were also on the second floor, raised from the ground for isolation and mois-

23 This is, at the same time, the largest fully researched horreum in Serbia.

24 The rampart was located on the south and west side and the northern wing of the building on the north side.

25 Jeremić 1998, 243.



Plan 2 – Sirmium horreum - site 30, after: M. Jeremić 1998.

ture control.[26] Several millstones were discovered inside the building, which also points to its purpose.

At both sites, the granaries are oriented towards the city's port, i.e. towards the gate on the south city rampart which leads to the port, which also represented one of the tenets of horrea construction, since supply was mostly carried out by ships. Also, apart from the difference in the interior design, which depended on the large dimensions of these buildings, there is a difference between the city and palace horrea, whereby each had different users. If we compare the size of both structures to the number of potential users, at least two more large structures of this type necessary to provide food for the residents can be expected to have existed on the territory of Sirmium. Since Sirmium was surrounded by a multitude of streams and swamps, on the shore of the Sava, it can be deduced that this area was not used for cultivation and that grain was probably shipped from other regions of the Empire, so the existence of the horrea was vital for the city to function normally.

A larger group of granaries is comprised of public horrea on the mainland of Moesia Superior. Structures of similar dimensions, construction type, spatial or-

26 Jeremić 1998, 246.

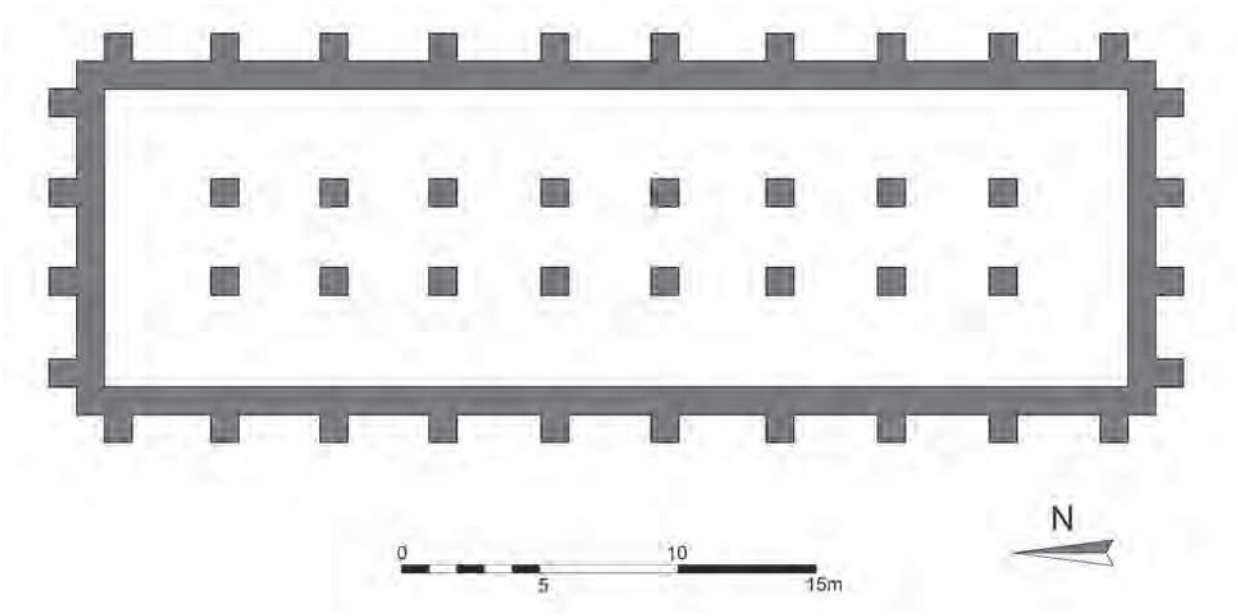
ganisation and materials have been discovered on several sites, and they can all be dated to the same short span of time during which they were erected.

The Late Roman granary in Maskar, near Topola, belongs to this group. It is a structure registered during the archaeological research carried out by the National Museum in Kragujevac, on the site of Crkvine. According to discovered coins, it can be dated to the 4th century. During the archaeological research, a large building from the period of Late Antiquity was researched and it can be classified as a granary according to numerous analogies with other structures across the Empire with almost identical bases. This is confirmed by the thick walls fortified by pilasters. The depth and massiveness of the foundations point to a multi-story construction. The structure has a rectangular base, its dimensions being 38.20 x 11.00 m, and consists of one large room divided into three naves with two rows of eight columns in each (plan 3).[27] Since the columns are placed towards the centre, the central nave is narrower and it can be assumed that it served as a passageway, while between the columns and lateral walls there were wooden partitions. The position of the entrance cannot be identified with certainty, since only the remains of the foundations are preserved, but it can be assumed that it was located in the middle of the frontal part of the structure because of the passageway across its central part. The capacity of this horreum with a 380 m^2 base, if we suppose that one kind of grain was stored and the structure was fully loaded, could be about 540 m^3 of grain.

Sočanica (Municipum DD) is an important site, on which an elaborate structure interpreted as a horreum was discovered. This structure consists of two triple-naved segments, 1 and 2, divided by two rows of seven piers, with a central courtyard, 3, between segments 1 and 2, with deep porticos along the facades of these segments and a segment with an exedra, 4 (plan 4). Facing the frontal side of the object, a row of columns was discovered, so it is maintained that there was a porch on that side. The interior of segments 1 and 2 is divided into three naves by a double row of seven columns, and the distance between the columns corresponds to that between the interior pilasters and the pilasters on the exterior. In order to build this monumental architectural complex, all older buildings had to be pulled down, the ground levelled and the temple which was located here negated.[28] The

27 Srejović 1982-83, 35-38.

28 Čerškov 1970, 15-21.

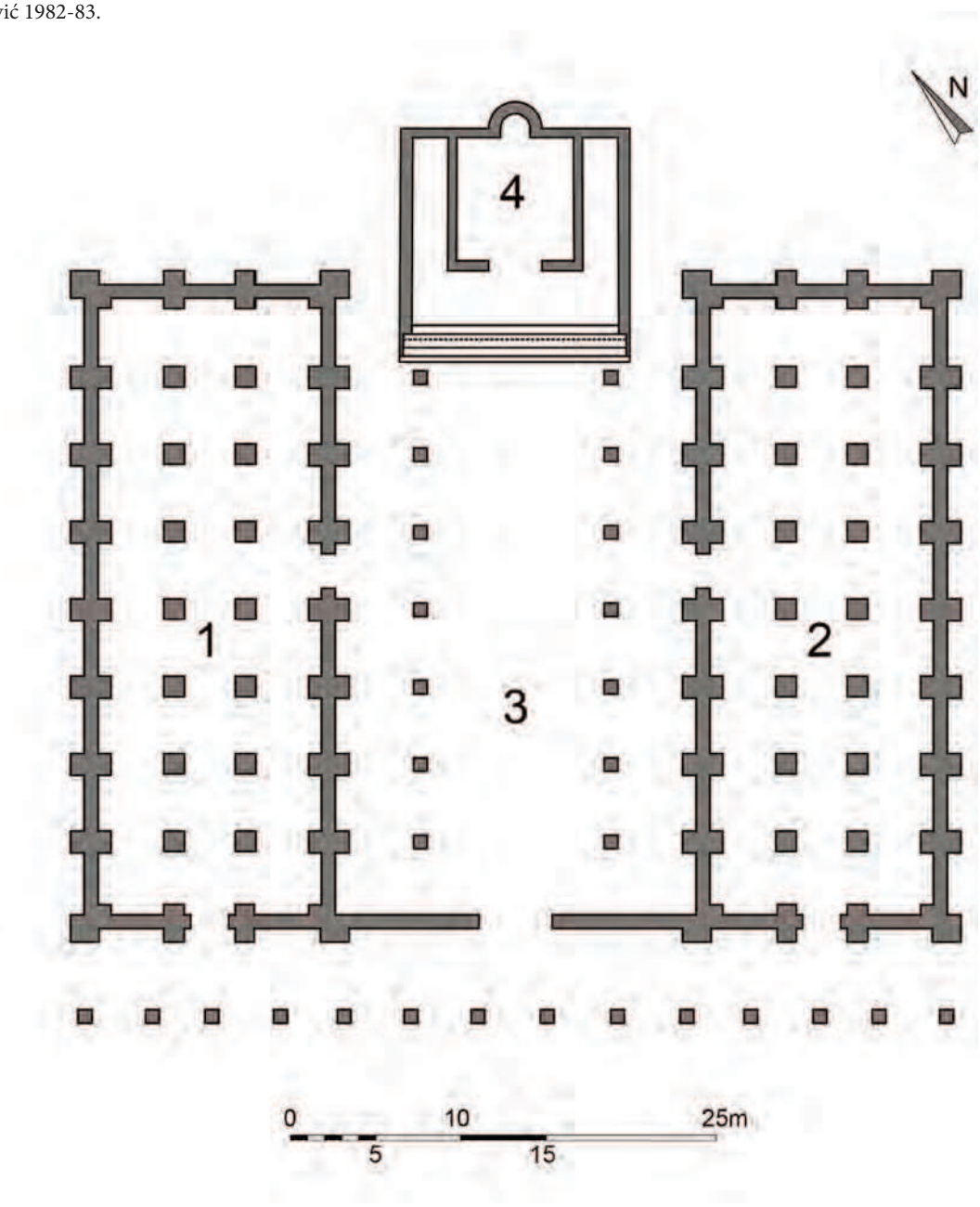


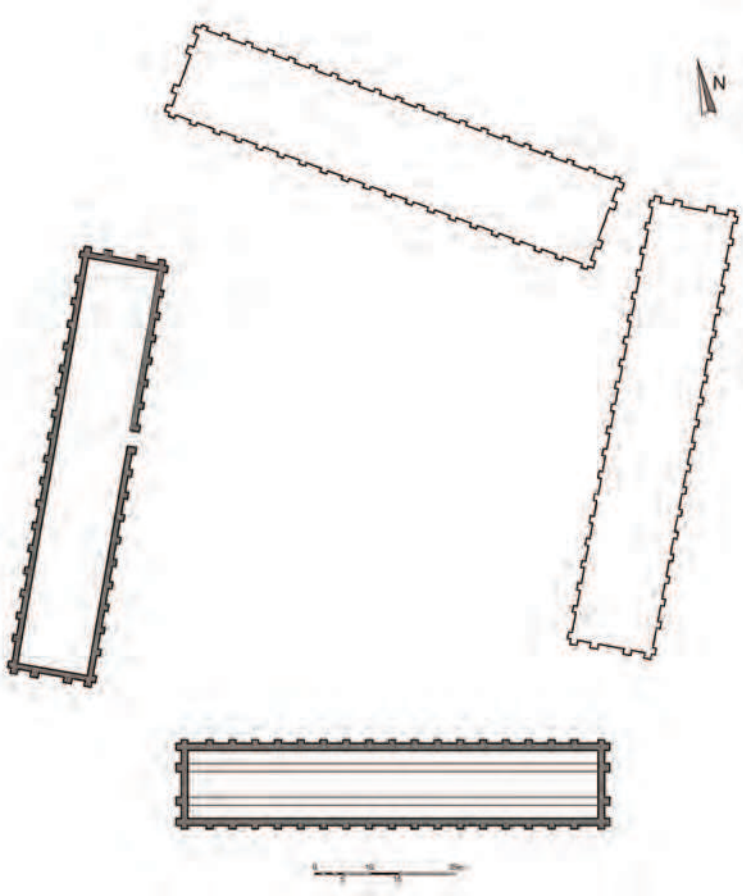
Plan 3 – Maskar horreum, after: D. Srejović 1982-83.

dimensions of the triple-naved segments are similar to those of the granary in Maskar (43.30 x 16.00 and 42.70 x 15.50 m), the only difference being the occurrence of the massive pilasters on both sides of the exterior walls, which could point to a multi-story structure. The position of the entrances, oriented towards both the outer space and the inner courtyard, i.e. both on the longer and shorter side of the base, is also of great importance. The periods of construction of these buildings also coincide. For a settlement like Municipium DD, the volume of this horreum of about 1,800 m^3 was sufficient to secure the supply of grain for an entire year.

The site of Gradina near Peć, with a whole complex of buildings, represents the most important food distribution centre in Moesia Superior. Archaeological research has shown that there were four buildings of the same form which were placed around a large trapezoidal courtyard. Each of these buildings was actually a large room whose dimensions were 75.00 x 12.00 m with 1.2 m thick walls fortified by pilasters on the exterior walls (plan 5). The entrance was on the longer side, turned towards the courtyard. According to the content and structure of this cultural layer it can be deduced that the complex was erected at the end of the 3rd or the beginning of 4th century, and that it was erected on an uninhabited area. The discovered ceramic vessels, coins and decorative objects show that this

Plan 4 – Sočanica horreum,
after: D. Srejović 1982-83.





Plan 5 – Gradina horreum, after: D. Srejović 1982-83.

was the food distribution centre of this region until the end of the 4th century.[29] Srejović mentions an unexpected premise- that these buildings were partitioned into three segments of equal width by lengthwise walls. Since the entrance was on the lateral side, it would be impossible to use the other two parts of the horreum, and the lighting of the central space would be questionable. The only logical explanation of these walls (that were not very thick) is that they were dead walls and served to support the substructure of the raised floor. Another problem is the roof construction solution, which is only possible as a tie-beam truss, with beams of a large cross section because of their length of 12 m and roof trusses which create a double-pitched roof. The assumption that this was the distribution centre of the

29 Srejović 1982-83, 39.

whole region is supported by the total volume of the four buildings, which was 5,250 m³, much more than the sum of the volumes of the horrea discovered on the Danubian Limes, which was about 3,350 m³.

A rectangular building oriented northeast-southwest, whose dimensions were 92.0 x 27.0 m, was discovered in Brzi Brod, near Niš *(Mediana)*, 150 m west of the villa with a peristyle. This structure was more elaborate than others discovered in Serbia (plan 6). It consisted of one large room whose dimensions were 80.0 x 18.0 m, divided into three naves of equal width by two rows of 11 piers, and an open passageway in its central part turned into a portico. On the west side, there were several smaller rooms of different sizes and unknown function. This structure was used until the second half of the 4th century.[30] What makes this building different from others with the same function is the absence of pilasters on the exterior walls. The discovery of 37 large pithoi partially sunk into the ground is of great importance. Also, pools up to 1.40 m deep were identified by the west wall of the structure. The pools were plastered with hydrostatic plaster, which indicates that a large quantity of liquid was stored in them. The assumption that wine was produced and stored in this building[31] partly explains the absence of pilasters on the exterior walls[32] and points to a specific type of horrea. It should be noted that another structure which corresponds to the unearthed horreum in its form and characteristics[33] was detected east of the villa with a peristyle during the geomagnetic exploration in 2010, so the data about this horeum is as expected.

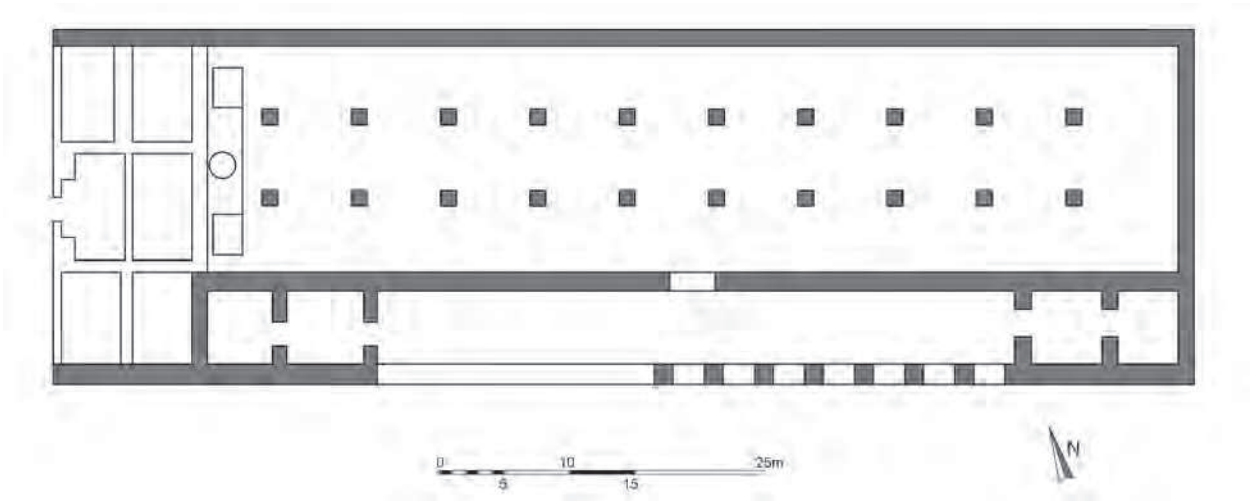
A five-naved structure of a rectangular base of 51.20 x 19.40 m (plan 7) was discovered in the southwest part of the imperial palace fortification in Gamzigrad (Felix Romuliana). The entrance hall (4.0 x 18.0 m) was on the north side of the structure and it could be assumed that it was added subsequently, since its wall was simply attached to the northeast corner of the structure. The hall actually had two entrances, the main one on the north side, and the side entrance on the south side. The interior of the structure was divided into five compartments of different sizes by four rows of six piers (1.20 x 1.20 m). Facing these pilasters, on the north

30 Vasić et all. 2015, 43.

31 Ibid. 42.

32 There was no lateral pressure so, in terms of the construction requirements, pilasters were unnecessary.

33 Milošević et all. 2011, 278.



Plan 6 – Mediana horreum, after: D. Srejović 1982-83.

and south wall, there are interior piers, which indicates the existence of arches in the lengthwise direction, and by that fact itself, some sort of multi-story structure. On the exterior, pilasters divided the lengthwise facade into ten segments and the narrower one into seven, ending in blind arches.[34] According to the shape of the base, the dimensions, the constructive structure and the position within the fortification, it can be assumed that it is a granary, however, discovered wall decorations that are no less than those in the palace and the pillars of the columns question this claim. For the time being, it is only speculation that this was a horreum.

What can be said with certainty is that the remains of a horreum erected in about 310 were discovered during archaeological research at the site of Malo Gradište, 250 m from the west rampart of the fortified palace. This granary is almost identical to the one in Maskari, the only difference being its slightly larger dimensions (plan 8). A rectangular room with a 44.0 x 16.0 m base was partitioned by two rows of eight piers. The exterior walls were fortified by pilasters which most likely ended in blind arches. The positions of the piers and pilasters are correspondent, while the remains of the imposts on the interior side of the walls (in the direction of the pilasters) and massive foundations point to a structure which had a second level, which is assumed to have been a cross vault. With minor reconstructions in the 5th century, this horreum was functioning until the

34 Čanak-Medić, Pavelka 2010, 99-100.

7th century.[35] If we assume that this horreum, with a 1,000m³ capacity, was sufficient to supply the imperial palace with grain and foodstuffs, the demand for another horreum is highly questionable. On the other hand, recent geophysical scanning revealed the existence of a settlement north of Romuliana, where another object with the function of a horreum may be discovered.

The remains of a settlement and a public building were discovered during excavations in 2012 and 2013 in Caričin Grad (*Justiniana Prima*), on the area of the north slope of Gornji grad[36]. This large structure of a simple 25.0 x 12.50 m base consisted of a central room and a smaller vestibule on the west side (plan 9). The larger room was divided into two naves with a row of piers, but, surprisingly, pilasters do not exist on the exterior walls. This structure is interpreted as a horreum, and several segments of millstones have been discovered in its immediate vicinity, which confirms this assumption.[37] This represents an important discovery, which contributes to the already acquired knowledge about the urbanism and functioning of the city and, according to the size of the structure and its capacity of about 300 m³, it can be deduced that there existed several more granaries like this that supplied *Justiniana Prima* with food and other consumables.

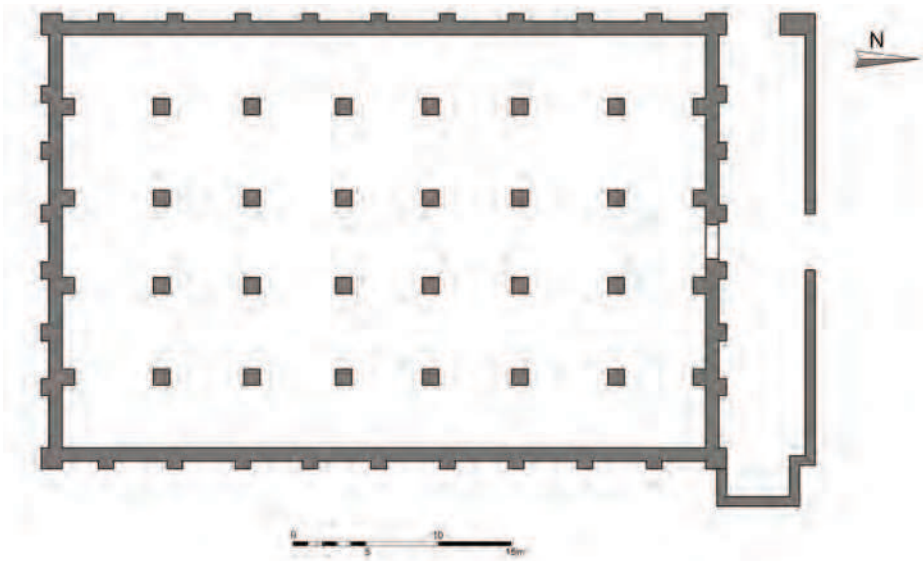
MILITARY HORREA

The huge army deployed across the Empire had its own demands when it came to food supply. Thus, in Moesia Superior, i.e. along the Limes, fortifications with a specific mode of operation began to emerge. This primarily refers to the procurement and storage of grain. Since the area around the Djerdap section of the Limes was not suitable for the cultivation of grain, it was necessary to provide the supplies of grain from more remote parts of the Empire or from the population of the immediate or more remote surroundings. Land and water transport played an important role here. An extensive road network secured a good connection and easy access to all the important centres that constituted the distribution network, but wa-

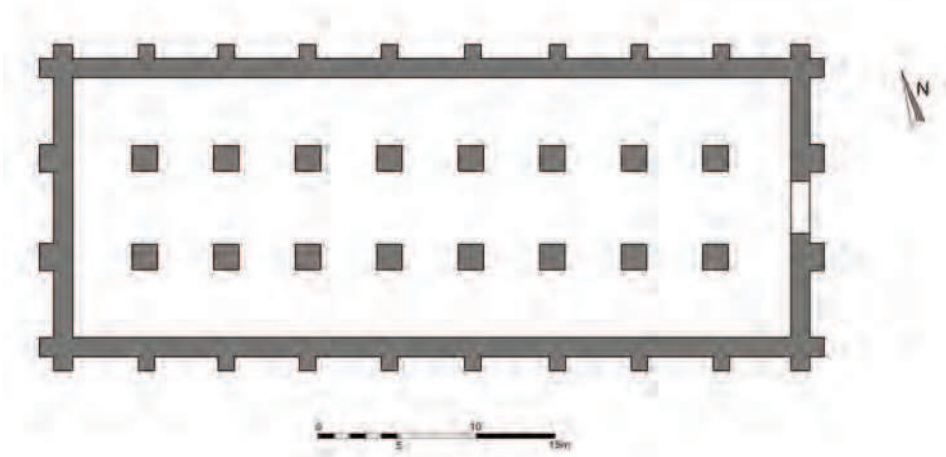
35 Srejović 1982-83, 42.

36 Building no. 20.

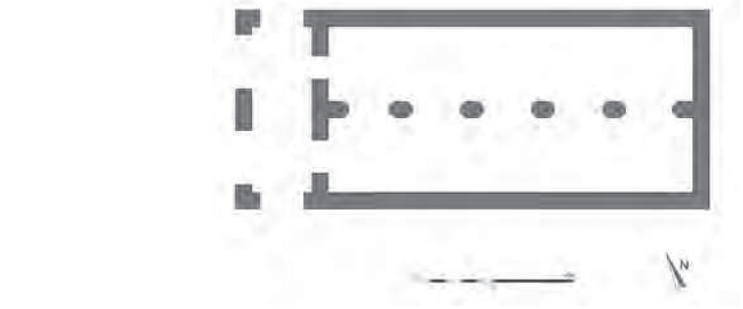
37 Ivanišević et al. 2017, 130.



Plan 7 – Gamzigrad horreum, after: Čanak-Medić, Stojković-Pavelka 2010.



Plan 8 – Malo gradište horreum, after: D. Srejović 1982-83.



Plan 9 – Justiniana Prima horreum, after: V. Ivanišević 2014.

ter transport was more economical. Thus, the fortifications had to possess ports, as mentioned in Singidunum, Viminacium, Diana, Margum and Egeta. Certainly, supplying the forts along the Limes was carried out using both water and land transport.

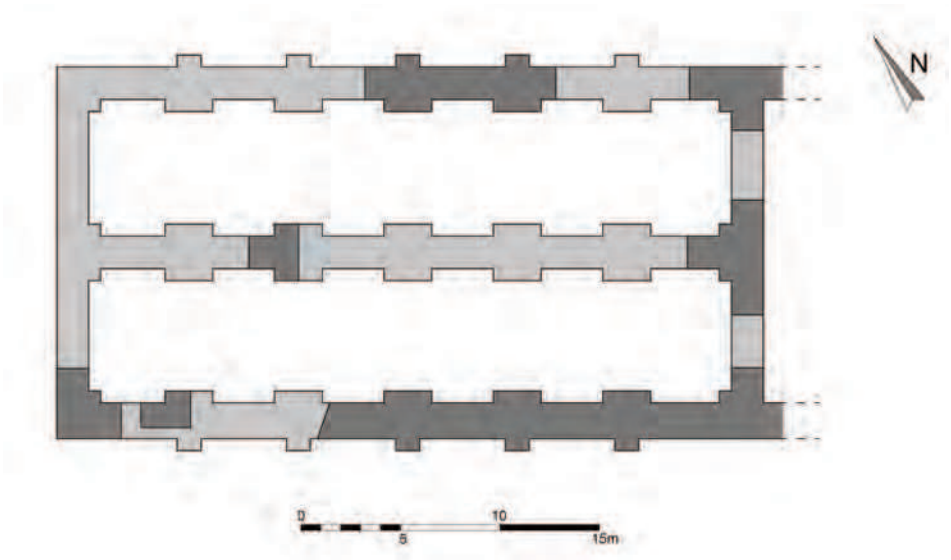
Along the Limes of Moesia Superior, two large castra appeared: *Singidunum,* in which the *Legio IV Flavia Felix* was lodged, and *Viminacium,* with the *Legio VII Claudia*, and, beside these, several smaller ones for the lodging of auxiliary troops, such as Veliki Gradac and Karataš (between 500 and 750 soldiers) and Livadice, Sapaja, Čezava, Saldum, Boljetin, Pontes, Porečka reka, Konopište, Kurvingrad, Golubinje and Hajdučka vodenica (40 to 80 soldiers).[38] The fort in Ravna, near Knjaževac, on the bank of the Beli Timok, was also researched. Only a few of these have been researched thoroughly enough to provide us with clear information.

Singidunum, as the castrum of the *IV Flavia* legion, was founded around the beginning of the 2nd century AD, and around the castrum, a civilian settlement soon emerged and acquired the status of a Municipium during the time of Emperor Hadrian.[39] On the territory of Gornji grad, where the existence of a castrum was confirmed, in the park in front of the modern-day Sahat gate, the remains of a horreum were discovered immediately below the ground surface level. Only the foundation zone of this structure is preserved, since it was levelled in the later periods. It was a structure with two naves (divided by five piers) and a 34.90 x 17.80 m rectangular base (plan 10). The lateral walls and the foundations of the horreum were fortified by massive pilasters on the interior side, and on the exterior side there were pilasters in the same positions, only narrower. The pilasters on the exterior walls correspond to the arrangement of the partition piers across the middle part of the structure.[40] The aboveground part is not preserved, so the exact position of the entrance cannot be determined, but according to the base, it can be assumed that it was on the east side. The manner of construction cannot be determined either, so a reconstruction of the building is not possible. The coin finds indicate that the structure was erected in the

38 Petrović 1980, 53-54.

39 Popović 1997, 14.

40 Bikić, Ivanišević 1996, 257-262.



Plan 10 – Singidunum horreum, after: V. Bikić, V. Ivanišević 1996.

second half of the 4th century. This is the largest military horreum that has been researched so far. With its potential capacity of about 880m³, it could store an amount of grain sufficient to feed 2,200 soldiers[41] for a year, which leads to the conclusion that there was another similar or even larger structure for food storage in the castrum.

No horrea have been found so far during the archaeological research of Viminacium. The geomagnetic prospection registered the forms of important structures in the vicinity of the main communications.[42] One of these massive structures probably had the function of a horreum. Interestingly, a monument devoted to Mitra was also discovered here, erected by a *nauclerus,* a citizen whose occupation was maritime transport and trade.[43] This shows that trade and transport of grains were prevailing activities on the territory of Viminacium.

41 The estimate is made according to the data given by Campbell (Campbell, 1994, 18-185), where the allowance of one legionary was 3 pounds of grain, 2 pounds of meat, 2 pints of wine and 1/8 pint of oil. Hence, each soldier's daily allowance of grain was, in contemporary measures, 650 g of grain, which totals 240 kg per year. The volume of 240 kg of grain is 0.4 m³.

42 MIletić and Miletić 2012, 13.

43 Petrović 1991, 207-216.

The *Taliata* fortification in Veliki Gradac had three horizons of horrea near the north gate (plan 11). The oldest horreum (first phase) can be attributed to the castrum which was originally located there, but it is impossible to give any detailed information about it since the research has not been completed. It was discovered that the walls were 0.90 m thick and fortified by pilasters. Rows of piers (four rows with five piers in each) were positioned in the direction of the pilasters, which leads to the premise that the building had arches and a cross vault, i.e. that the structure had an upper story. Only the east wall, 21.00 m long (which corresponds to the length of the later horrea), was unearthed, while the west wall has not yet been discovered, so it is impossible to determine the width of this structure. The artefacts make it possible to date the building to the second half of the first century.[44]

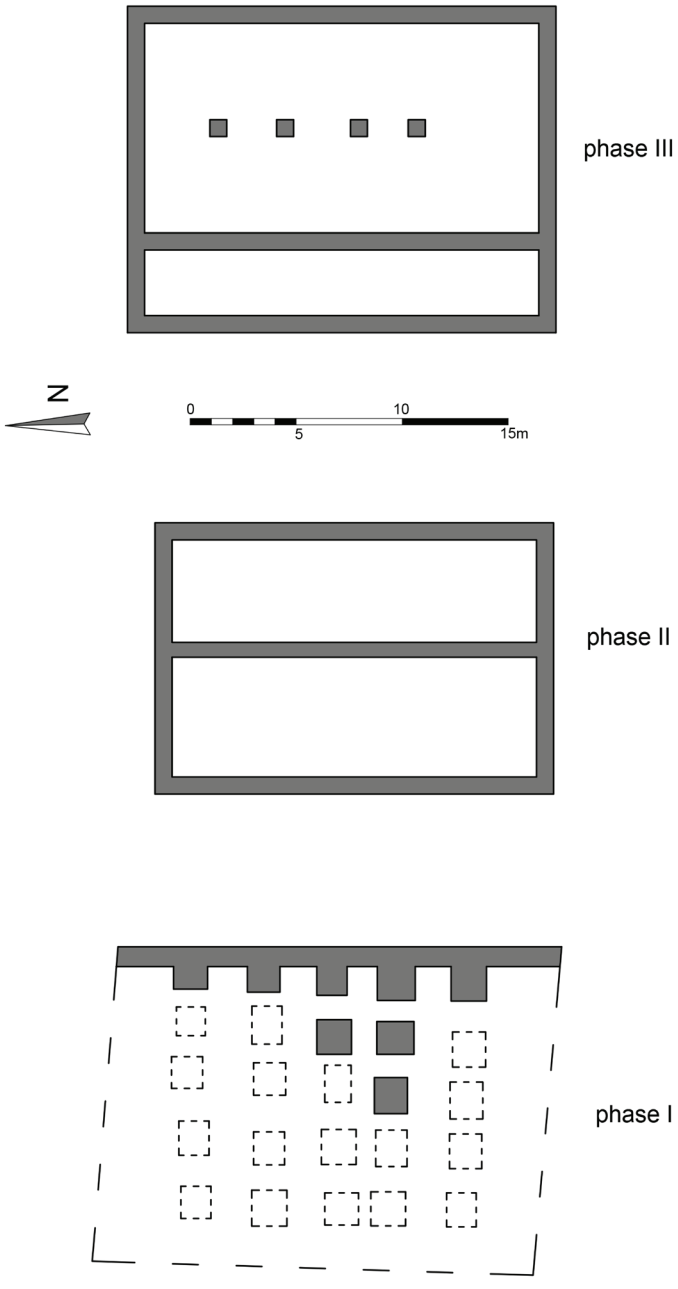
The major part of the younger horreum (second phase) was erected over the first granary, whose walls had been levelled. This structure with a rectangular (18.80 m x 12.85 m) base was divided lengthwise into two segments of different dimensions. It is assumed that there was a barrel vault above these rooms or that the ceiling was flat. It has been concluded that the entrance was located on the south wall, which was attached. It is difficult to say when this structure was erected, but according to the artefacts it can be approximately dated to the 4th century.[45]

The time of construction of the youngest horreum (third phase) is difficult to determine. The building with a porch towards the street can be dated to the period of the Early Byzantium fort, i.e. the 6th century, with relative certainty. The preserved parts of the walls, i.e. the layer of brickwork of the Early Byzantine format (37 x 30 x 6 cm) and 5 to 7 cm thick mortar joints clearly indicate it was built during that period. The structure had a 20.20 x 10.70 m rectangular base, with 1.0 m thick walls and massive foundations made of cut rubble and lime mortar. A 20.20 x 3.10 m porch with a well-preserved mortar floor was subsequently attached. The large room was partitioned into two naves by five identical piers, which indicates a multi-story structure. A large number of millstones indicates that grain was also ground here, most likely under the wide porch.

All three phases of the horrea were erected on the same location, by the north gate of the fort, indicating the possible existence of a port in that area and the connection of the horrea with it, since the main access for carts was on the south

44 Popović 1982-83, 268-269.

45 Ibid. 272.



Plan 11 – Taliata horreum, after: V. Popović 1982-83.

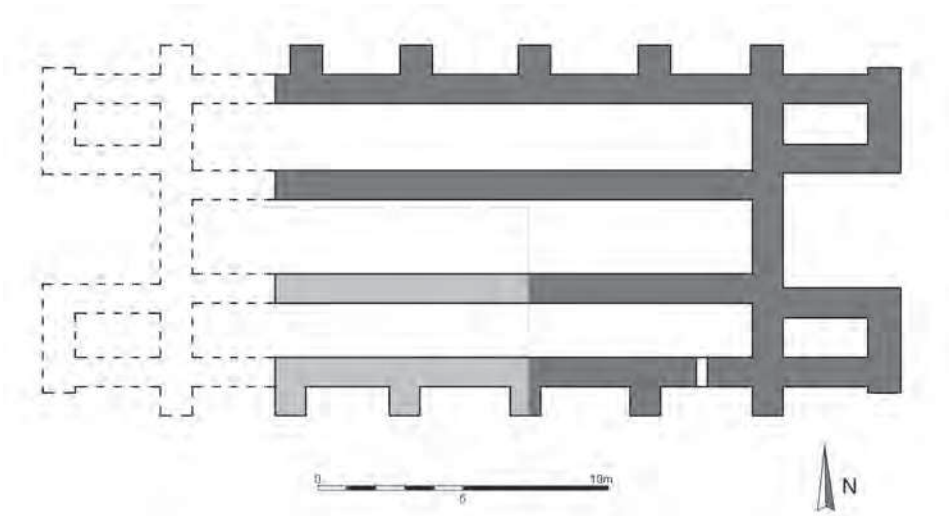
side. Furthermore, this leads to the conclusion that foodstuffs reached the horrea via water transport. The capacity of the horreum of the last phase of about 280 m^3 of grain was enough to provide a yearly supply of grain for about 700 soldiers, which corresponds to the premise that 500 to 750 soldiers were lodged in this fort.

A military fort that had several phases of construction was discovered at the site of Karataš (*Diana*), lying 8 km upstream from Kladovo and 2 km downstream from Djerdap I (Iron Gate) Hydropower Plant. The phase of solid stone walls and ramparts, which begins with Trajan's and Hadrian's reconstruction, continues throughout the phases of the Antonine dynasty and lasts until the end of the Severus dynasty,[46] is of relevance to this paper. The interior of the fort had a typical three partition spatial arrangement, parts of which were discovered during the research carried out so far. A large rectangular building of a characteristic floor plan, made of stone and located in the north part of the fort, next to the north gate, is one of them. This building was identified as a horreum[47] (plan 12). The structure is 9 m wide, while its researched length is 18 m. However, this is not the final measurement, since the research of the building has not been completed. Massive, 0.9 m thick exterior walls, were fortified with pilasters on the outside, while the interior was longitudinally partitioned into three sections by walls. The interior walls were probably dead walls which supported the floor structure. The entrance was most likely on the east, frontal wall, on which two rectangular rooms were formed. The floor plan reconstructions of J. Rankov-Kondić presuppose the existence of three identical rooms on the west, frontal wall. However, there are no analogies which could account for the existence of these rooms on the opposite side nor do they hold up in terms of functionality. Another principle is observed here, the position of the horreum in the immediate vicinity of the gate facing the river. Bearing in mind that Diana had a large port,[48] it could be deduced that the transport of grain was carried out by ships. It could even be presumed that there were other similar structures for the temporary storage of various goods during the transhipment. The speculated size of the horreum (20.0 m x 9.0 m) could accommodate 225 m^3 of grain, which is enough to meet the yearly demands of about 550 soldiers which, in turn, corresponds to the premise that 500 to 750 were lodged in this fort.

46 Rankov-Kondić 2009, 379.

47 Ibid. 382.

48 Ibid. 374.



Plan 12 – Diana horreum, after: J. Rankov-Kondić 2009.

The site of Porečka reka, at the mouth of the Danube's tributary of the same name, is one of the most important centres in Djerdap. Its geographic location and fertile, vast plain create an open passageway to the midlands of the province. This is the location of the crossroads of the most important ancient and modern-day roads, an important interchange. During archaeological research, several different structures were discovered here. They are mostly the remains of ramparts, towers, thermae, horrea, etc.

Two of these structures relevant for this paper have rectangular bases of similar dimensions (16.0 x 9.0 m and 15.0 x 9.0 m). In all likelihood, they are horrea (plan 13). According to the artefacts, they can be dated to the 4th century.[49] Both structures are positioned by the rampart near the river and fort. The massive walls (1.50-1.80 m) and foundations built of stone and lime mortar, as well as the substructure of the floor made of canted brick courses indicate that the space had to be dry and stored heavy goods. The charred traces of beams on the mortar floor and the fragments of deformed tegola tiles and ceramics indicate that the building had a wooden roof structure which was destroyed in a fire. One of the buildings has a brick pier (1.0 x 1.0 m) on the south side, on its lengthwise axis, and it is presumed that an identical pier existed on the north side. The existence of an upper story can also be presumed, however, a mezzanine structure type has not been registered. The size of these horrea is small in comparison to the rest of the horrea along the

49 Petrović 1982-83, 288-290.

Limes, which calls the claim that this was a distribution centre for the whole Djerdap area (P. Petrović) into question; G. Milošević also disputes this statement[50]. Both structures identified as the horrea could store about 300 m³ of grain, an amount too small to make the claim that this was a distribution centre plausible.

Boljetin (*Smorna*) military camp is located upstream from the junction of Porečka reka and the Danube. This military camp had four construction phases, from the stage of earthworks to a solid built castrum. Several structures within the rampart have been researched so far. One of them was a horreum, dated to the beginning of the 3rd century,[51] with a 11.70 x 4.80 m rectangular base (plan 14). The interior of the structure was divided into eight compartments of varying width by transverse partition walls (0.50 m thick). The exterior walls were not very thick (0.60 m) because of the small size of the entire structure. It was built of cut rubble and lime mortar, and constructed on a widened footing of an older cultural layer. The walls were coarsely rendered on the outside and plastered on the inside.[52] As noted by Lj. Zotović, the interior was partitioned by numerous partition walls and, thus, divided into a large number of miniature compartments, 0.60 to 1.30 m wide. We do not support this thesis, and consider it more likely that the partition walls were elements of the floor substructure. The illogicality of the said thesis lies in the lack of functionality of a room which is only 0.60 m wide. Such a room is not even large enough for a human being to move about, let alone load it with goods. Another fact which supports our claim is that the structure of such a concept would have had eight doors, for which there are neither analogies nor any logical reason.

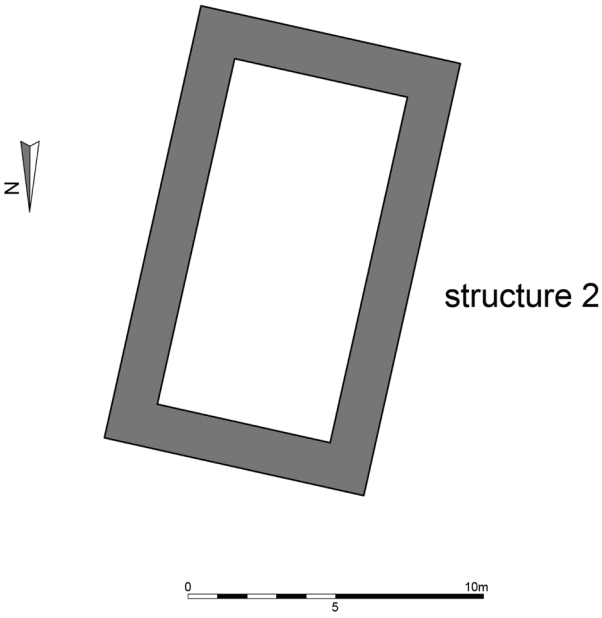
The premise that 80 soldiers were lodged in this castrum makes sense, taking into account the capacity of this horreum of about 36 m³.

Parts of a military fortification which went through several phases of construction during its long existence were discovered on the site of Pontes, downstream from the Iron Gate (Djerdap I) Power Station and the military fort of Diana. The remains of the abutments of Trajan's bridge across the Danube were also discovered in its immediate vicinity. In the course of the research carried out so far, parts of gates and ramparts have also been discovered, as well as a couple of buildings within the fort itself. One of these buildings, discovered right next to the east gate

50 Milošević 2014, 43.

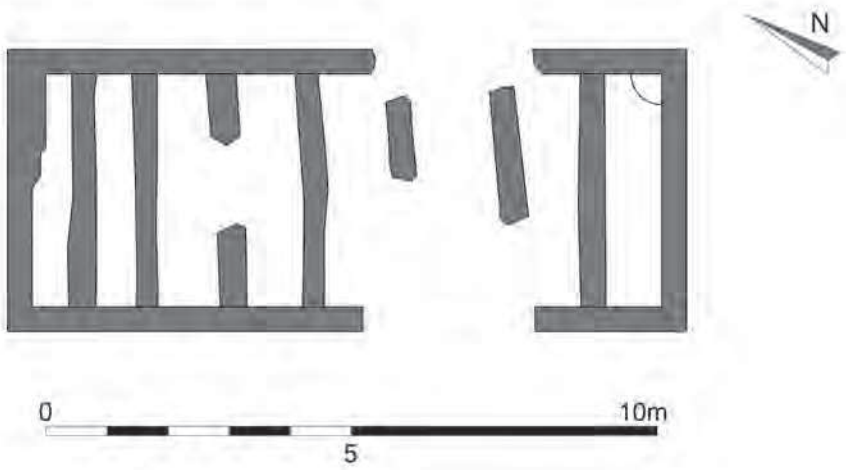
51 Zotović 1982-83, 216

52 Ibid. 217.



Plan 13 – Porečka reka horreum, after: P. Petrović 1980.

Plan 14 – Smorna horreum, after: Lj. Zotović 1982-83.



and identified as a horreum, is of relevance for this paper. The research unearthed a part of a horreum built on the route of the former *via principalis*, towards the east gate. The remains of the walls and a part of the east facade were discovered too. (plan 15) The walls are solid, built of crushed stone bound by lime mortar. There were pilasters on the exterior of the facade wall. A mortar floor, made of lime mortar and powdered brick, was discovered inside the horreum. The structure is dated to the end of the 3rd - beginning of the 4th century.[53] The remains of the walls point to an orthogonal base of the building, oriented north-south but, due to incomplete research, the definite dimensions, as well as its capacity, remain unknown.[54]

The fort on the site of Čezava (*Castrum Novae*) is located downstream from Golubac. Within the researched section of the castrum, a rampart and a small number of structures have been discovered inside the fort. The largest one among them, located in the central part, was the principia building, and north of it, towards the west gate, a horreum dated to the end of the 2nd or the beginning of the 3rd century.[55] This structure with an irregular, trapezoidal base (11.50 x 12.60 m), had a west entrance (plan 16). The 1.0 m thick walls, built of stone, were not forti-

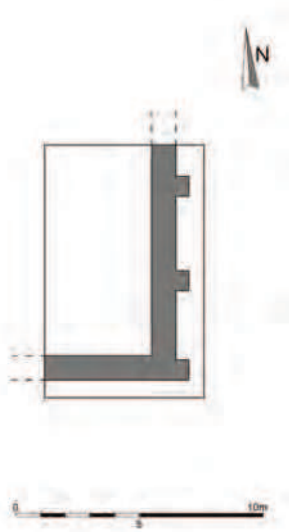
53 Гарашанин, Васић 1987, 82.

54 It is noteworthy that in spatial and organisational terms the fort of Pontes bears a striking resemblance to the one in Drobeta, on the opposite side of the Danube. Thus, the assumption that there existed another horreum within the fort of Pontes, as was the case in Drobeta, proves tenable.

55 Vasić 1987, 99.

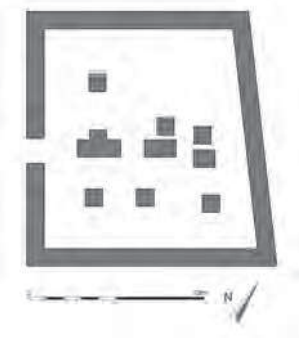
fied by pilasters. Ten massive columns which divided the base into three sections have been discovered inside of the structure. The capacity of about 180 m³ was enough to store grain for about 400 to 450 soldiers, which leads to the conclusion that this was the actual number of soldiers lodged here, but also suggests the possibility of the existence of another structure of similar function in the fort itself or in its immediate vicinity.

Sapaja, a river island on the Danube between Ram and Stara Palanka, disappeared during the construction of a dam on the Danube. It can be seen occasionally, when the water is low. The archaeological research conducted prior to the construction of the dam confirmed the existence of a fort (93.0 x 93.0 m). There was a small horreum in front of the west rampart. It had a rectangular base of 9.50 x 5.90 m, and can be dated to the end of the 2nd century.[56] (plan 17) The building was made of crushed stone bound by mortar, while the roof was probably double-pitched and with a tegoula covering. The interior was divided into three compartments by two transverse walls. It remains unclear whether the interior walls ended at the floor level and served as dead walls, or they continued up to the ceiling of the first story. Most likely, they were dead walls. This horreum can be connected to the one in Boljetin, which has a similar form of base, partitioned by transverse walls, and we can presume that both horrea had dead walls as moisture insulation. The capacity of the horreum can be deduced from its dimensions, and would have been about 70 m³, which is not enough to meet the demands of the inhabitants of the fort, leading to the conclusion that there was another, larger horreum, probably inside the fort.



Plan 15 – Pontes horreum, after: P. Petrović, M. Vasić 1996.

The sites of Konopište and Kurvingrad, downstream from Pontes, have been researched only partially. On the site of Konopište, a complex of structures with compartmentalised bases, whose two wings were at right angles to each other, has only been partially researched. (plan 18) It is presumed that a section of this structure was used for lodging the army and for food storage.[57] On the site of Kurvingrad, a structure presumably used for food storage, army lodging and other purposes[58] was researched to a degree. (plan 19) Since the research of these sites has not been completed, neither the dimensions nor the exact function of the two

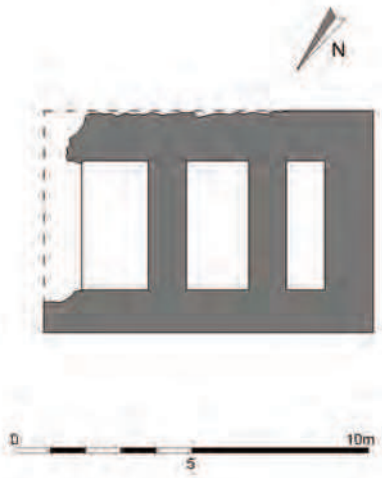


Plan 16 – Castrum Novae horreum, after: M. Garašanin, M. Vasić 1987.

56 Dimitrijević 1984, 29-71.

57 Milošević 2014, 44.

58 Ibid. 45.



Plan 17 – Sapaja horreum, after: D. Dimitrijević 1984.

structures can be determined.

A fort discovered on the Roman site of Ravna (*Timacum Minus*) near Knjaževac, in the east of Serbia, testifies to an early presence of Romans in this region. A large building measuring 30.0 x 15.0 m[59] was discovered inside the fortified castrum, north of the *via principalis* (plan 20). In the period of Late Antiquity, this building performed the function of a granary, which is confirmed by finds of pithoi and carbonated remains of grain in the structure, on the floor level.[60] Judging by its capacity of about 600 m^3, the building could provide a yearly supply of grain for about 1,500 soldiers. The figure significantly exceeds the presumed number of soldiers which comprised one cohort (480 soldiers). [61]

***

The construction of buildings intended for food storage across the Empire illustrates the methodical approach of the State of Rome to the problem of grain storage and distribution. Thus, on the area of the newly founded province of Moesia Superior and in southern parts of Pannonia Inferior, construction of horrea was conditioned by the formation of a new organisational system of operation of the army and civilians.

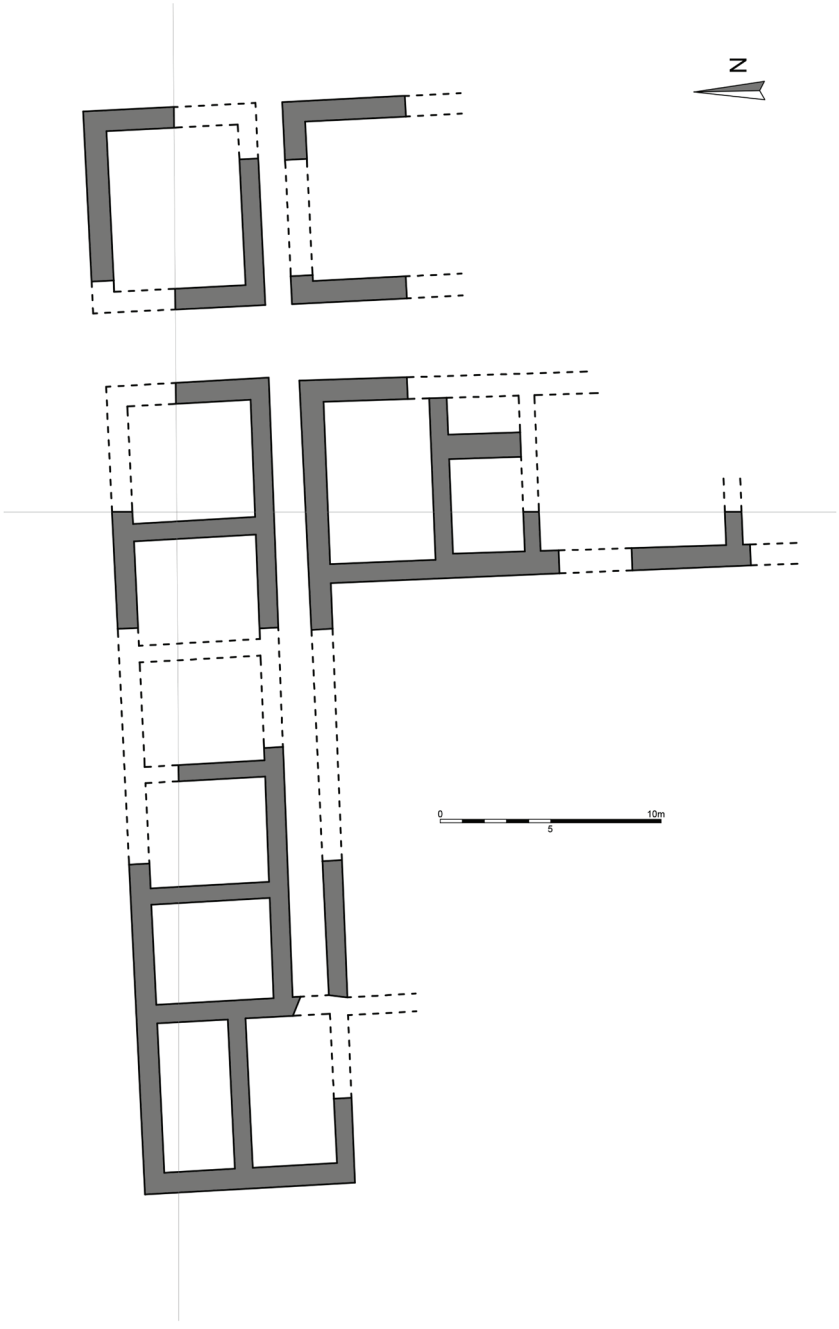
According to the researched remains of the horrea erected on the territory of the modern-day Republic of Serbia, certain conclusions concerning the time of their construction can be reached. All of the abovementioned horrea were erected during the period from the end of the 1st until the end of the 4th century, where the military horrea were mostly built during earlier periods, and the civilian ones during later periods. The construction of monumental horrea must have been conditioned by a new system of organisation of food collection and distribution in the midlands of the province to meet the needs of the civilian settlements and castra along the Limes. The corresponding periods of construction of the civilian granaries could be connected to the new economic measures taken by the supreme state authorities around the end of the 3rd century.

In the case of the civilian horrea, the time of construction can be traced from the earliest ones in Sirmium to the horreum erected in Caričin grad (Justiniana

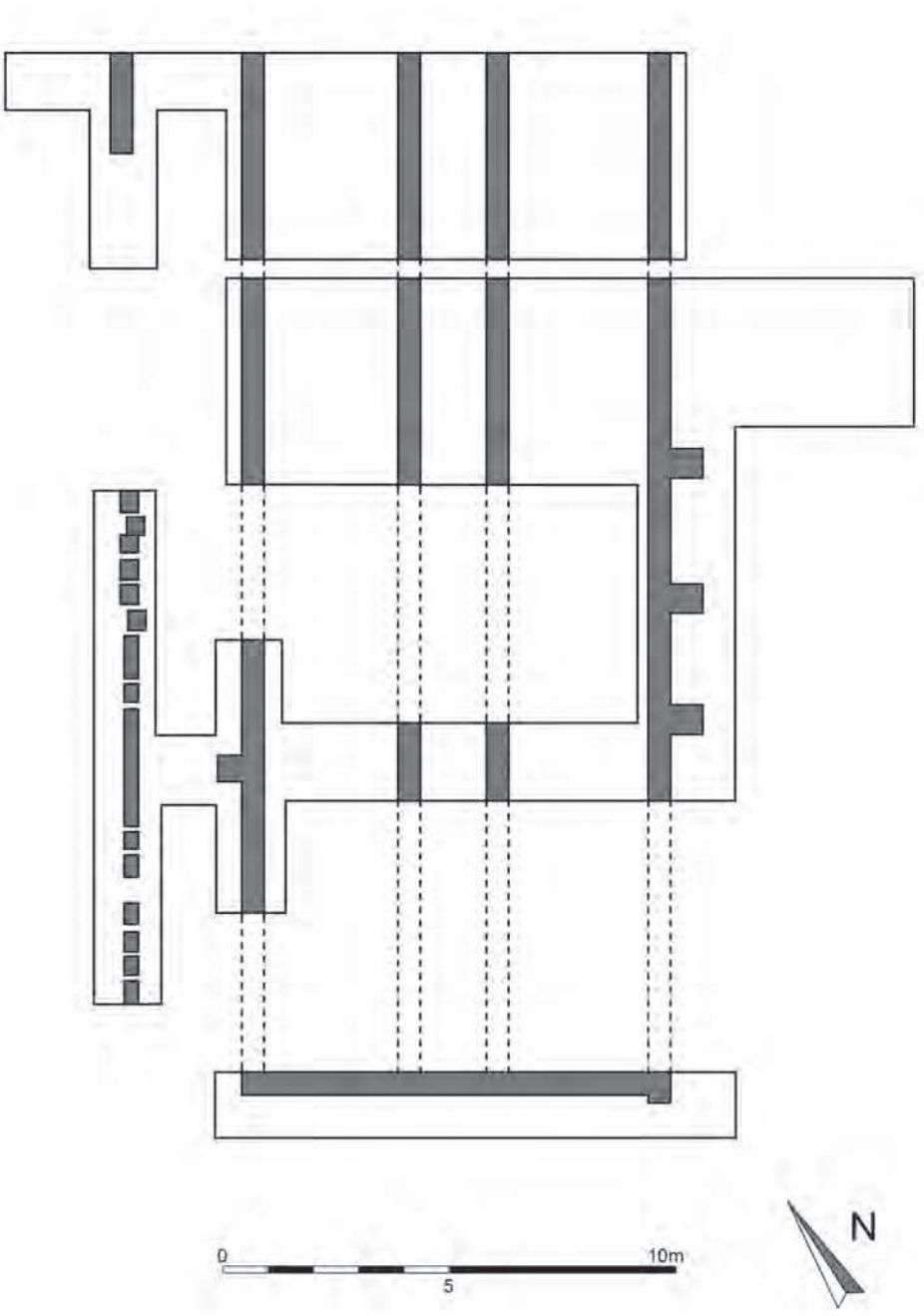
59 Petrović 1997, 115-131.

60 Petrović 1995, 42.

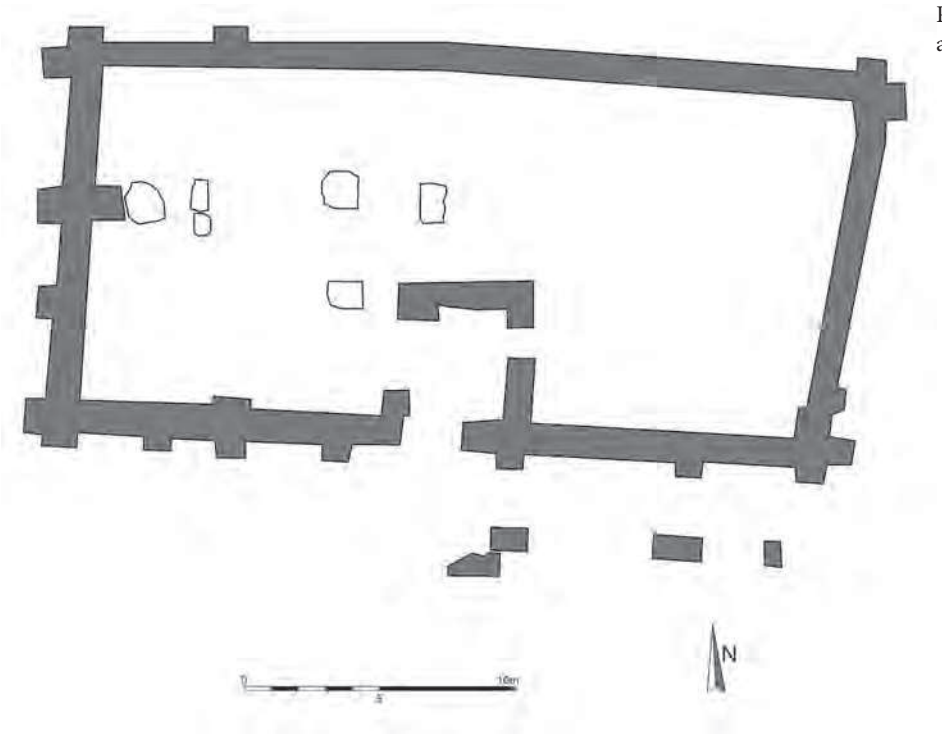
61 *Cohors II Aurelia Dardanorum* had been located here since 169. AD



Plan 18 – Konopište horreum, after: P. Popović 1996.



Plan 19 – Kurvingrad horreum, after: L. Trbuhović 1986.



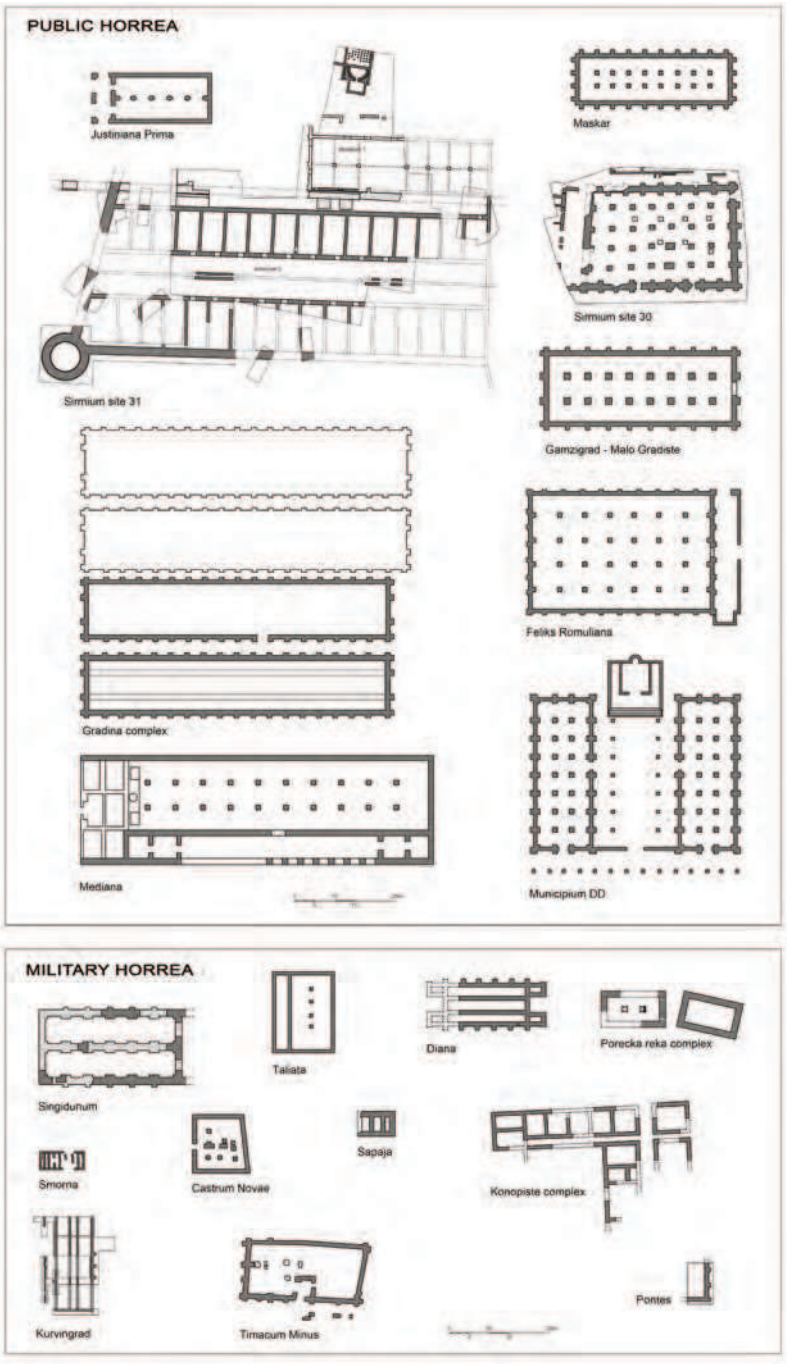
Plan 20 – Timacum Minus, after: S. Petković 2013.

Prima). It is even possible to draw a parallel among the horrea erected within several consecutive years, in Maskar, Sočanica and Malo Gradište, near Gamzigrad (Felix Romuliana), which are, according to their size, appearance, manner of construction and types of materials used in their construction, presumed to have been built by the same masons, which cannot be said of the military horrea. The military horrea differ from one another, as if they were built by masons from different parts of the Empire. What is common to all of the horrea is that they were built of solid material, primarily stone and brick, that they had double- or single-pitched roofs covered by roof tiles, and that they had raised floors for moisture control.

Considering the position of these buildings, it can be concluded that the military horrea were, without exception, freestanding structures. Generally, they occupied a position in the vicinity of the forts' gates or in the central part, next to the principia building. There are, additionally, a few cases in which they were located outside the rampart. The civilian horrea were built both inside and outside the forts. They were mostly freestanding but, in Sirmium, the structure of

the older horreum was leaning against the south rampart, and when the rampart was moved towards the south, a younger horreum was leaned against it. This is the only case in which the horreum building was leaning against another structure. Such constructional solutions were usually avoided for the purposes of fire protection. From an organisational standpoint, horrea in Moesia Superior can be divided into those whose interior was partitioned by walls or piers, and those without partitions. The predominant type of civilian horrea is one with piers and partitions, while the military horrea appear both with and without partitions. This mostly depends on the size of the structure, but also the requirements for keeping the stored goods unimpaired. Larger structures could not be built without partitions to support them since the roof structure, being made of wood, could not bridge the large distance between the walls.

One of the main differences between military and civilian horrea is in their size, i.e. the capacity. Taking all of the researched horrea into account, the difference in size is significant. (plan 21) Civilian horrea were much larger, usually comprised of several units, which is not the case with the military horrea. The structure on the site of Konopište is an exception to this rule, since it was made of several structures considered to have belonged to the horreum. The horreum from Singidunum stands out among the other military horrea by its size, but it is, in turn, much smaller than the civilian ones. It is speculated that the military horrea could have been loaded more often than once a year, that is, at least twice a year, meaning that the storage space could be smaller. In that case, the positions of the distribution centres should be considered. Konopište, Kurvingrad and Porečka reka are the potential locations of these centres. It is less likely that Porečka reka used to be a distribution centre, since its horrea are too small. We maintain that the main distribution centre for military horrea was in modern-day Ćuprija (Horreum Margi), which is actually the very meaning of its name. This is also a strategic position, which is connected to all the important points from the production to the end-users both by land and by water. The size of the horreum on the site of Gradina, near Peć, testifies to an exceptionally well-developed cultivation of grain, and this was an important repository centre from which grain was further distributed. Contemporary researchers are in a dilemma as to whether the province could have produced a sufficient amount of grain to meet the demands



Plan 21 – Plans of civil and military horrea in the area of modern-day Serbia

of its population and the army or not.[62] Our opinion, based on the size and position of the horrea discovered so far, is that the province could produce a sufficient amount of grain, but this is still no more than speculation, since climate slightly varies yearly so, in times of drought, it was probably necessary to import grain from other provinces of the Empire.

It could also be deduced that different levels of state administration (supreme, province and military) and civilians alike (merchants, ship owners etc, mentioned on tombstones) took part in the elaborate system of the procurement and distribution of grain.

Translated by Jelena Mitić
English language editing Dave Calcutt

62 O.Ilić claims that the quantities of grain were not sufficient (Ilić 2012, 202.) while J. Živanović concludes that they were still sufficient (Живановић 2013, 146.) for the needs of the army and the population.

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