

Materials and Techniques Used for Roman Buildings in Dobrogea

Delia-Ioana Andrieș, Tudorel Șeitan and Ana Maria Grănescu

Abstract – The restoration and enhancement of ancient vestiges is of particular importance for the development of knowledge. The article makes a brief review of the materials, methods and techniques used by the Romans to make constructions throughout the Roman Empire, analyzing first of all the techniques that we find used to build the fortresses in Dobrogea.

Keywords – *arheological sites, fortresses, materials, restauration, techniques*

1. INTRODUCTION

The construction techniques used by the Romans evolved along with the flourishing of the Roman Empire, this evolution being closely related to the materials they had at their disposal and the particularities of execution required by different locations or functions of the elements they intended to construct. Knowing these techniques allows the dating of fortress walls and buildings built in the Dobrogea area.

2. CONSTRUCTION MATERIALS

The main building material found in the ruins of ancient fortresses is stone. Used for both foundations and walls, it was generally extracted from local quarries. Stone blocks were imported for important constructions or for decorative elements that were difficult to make from local materials. The Romans, unlike the Greeks, used mortar to bond the masonry. The mortar could be an earthen mortar, made from local clay or, for important constructions, a lime mortar to which crushed ceramics could be added, to improve the quality of the mortar, giving it similar properties as Roman cement.

The Roman mortar recipe can be found in the book of the Roman architect Vitruvius, "De architectura": "When the lime has been slaked, it is necessary to mix it in the following manner: a part of the lime is put with three parts of quarry sand, or two parts of river or sea sand; this is the correct proportion for this mixture and this will be even better if one adds to the sea sand [that the author considers the most inferior and dangerous to use '...because of the salt that dissolves and makes everything crumble...' in which he was not mistaken] and the river sand a third part of crushed and broken tiles." Vitruvius devotes an entire chapter of Book II to volcanic sand, pozzolana, noting its quality of giving "There is a type of powder to which nature has given an admirable quality; it is found in the country of Baiae [north of the Bay of Naples where the volcanic area of the 'Phlegrean fields' is

situated] and in the earth around Mount Vesuvius. This powder mixed with lime and broken stones make the masonry so hard that it hardens, not only in ordinary buildings but also under water."

As an alternative to stone masonry, the Romans used unbaked brick masonry. The bricks were made of white clay, or of red clay mixed with straw. The season of making the bricks was important: spring or autumn and the drying time – at least two years. The blocks were square in shape and, if necessary, could be broken to make walls one and a half bricks thick.

Ceramic brick is another material used by the Romans in the constructions made in Dobrogea, but not as we use it today, like masonry blocks bound together with mortar, but either in the form of rows of brick masonry that separate and strengthen the masonry of stone either in the form of facing for composite walls with emplecton in the middle.

Ceramic brick began to be used in construction in the 1st century AD, a period from which the standardization of dimensions also dates. Square bricks which could be broken into smaller pieces, generally triangular in shape were used. These bricks could be easily adapted to masons' requirements and the rough surface that remained gave good grip to the mortar.

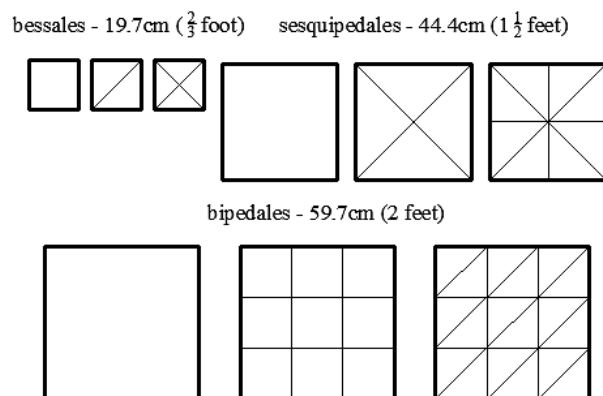


Fig. 1 Types of bricks used by the Romans

Wood is, probably, the most used building material since the beginning of civilization, but few wooden elements have been preserved to this day, many of the fortresses being burned before being abandoned. Wooden elements were identified at the port of the fortress from Păcuil lui Soare (Figure 1) and we can see the places where the wooden beams used to be placed, for supporting the floor or to close the city gates.



Fig. 2 The wooden substructure of the Byzantine fortress from Păcuil lui Soare

3. CONSTRUCTIVE PRINCIPLES

The Romans learned the most important constructive principles from the Greeks and, in most cases, developed them. The importance of foundations is one of them. The Romans always sought to place their constructions on solid ground, and when no proper ground was found they prepared the ground artificially, using a layer of crushed and broken tufa, reaching, in the case of the temple of Portunus in Rome, more than 3.00 m depth. For marshy land they used wooden piles. The piles were made of alder, oak or olive wood slightly burned before being put into work to strengthen it and be easier to drive into the ground. The foundation width was greater than the width of the walls in order to insure a good stability for the building by increasing the area the load was distributed on.

They also took over the methods of building walls from the Greeks, but improved them, using lime mortar to bind the stones. The Greeks used mortar only for plastering.

4. MASONRY TECHNIQUES

In the first period (6th-4th century BC) of the Roman Empire the walls were made of large stone blocks without mortar, called *cyclopean walls* because of the impressive size of the blocks.



Fig. 3 Cyclopean masonry - The wall attributed to Servius Tullius (578-534 BC)



Fig. 4 The wall of the Acropolis at Alatri

The evolution of the stone-cutting technique led to the development of another technique in which the masonry was made of small rectangular stone blocks laid without mortar, called *opus quadratum*. The resulting masonry had a pleasant, regular appearance, which is why it was used until late in the Roman Empire, being combined with other types of techniques.



Sacidava – City gate



Tomis – Thermae

Fig. 5 *Opus quadratum*

Probably the most important technique, the one that most influenced the greatness of Roman constructions is *opus caementicium*. Roman walls had three layers: two outer ones made of stone or brick, the facing, and an inner one consisting of a mixture of mortar and stone of various sizes. Unlike modern cement which is fluid and can be poured, Roman cement was viscous, and was pushed using wooden rods to fill all the voids and embed the stones in the mixture. Used since 3rd century BC it allowed the construction costs to decrease by using smaller sized blocks that are easier to produce and transport.



Carsium – City gate



Ulmetum-tower

Fig. 6 *Opus caementicium*

In the 3rd century BC a technique called *opus incertum* is used. Small, irregularly shaped stone blocks made up the facings of the walls. It is a typical technique for masonry from the 2nd-1st centuries BC.

The combination of several techniques in the execution of a wall is called *opus mixtum*. The characteristic aspect of this technique is given by the presence of brick rows between the stone rows. Before the use of ceramic brick as a building material, the separation of stone rows was done using tiles.



Carsium



Ulmetum

Fig. 7 Opus incertum

As a construction technique, it is widely used since the century. III AD In Italy, the rows of bricks are only elements of the facings used to check the level of the walls, the Gallo-Roman builders used this technique to create horizontal connections between the two faces of the walls, joining the facings and the core at certain intervals. In Dobrogea it is present in many fortresses, the technique being also used during the Byzantine Empire, for example, in the enclosure wall of Dinogetia.



Tomis – Therme



Capidava –
horreum column



Capidava – wall

Fig.8 Opus mixtum

In the 1st century AD in Rome a technique called opus testaceum began to be used. The difficulty of finding stone for monumental constructions led the Romanian builders to look for easier solutions and thus appeared the external facings of the walls made of triangular brick.

In Dobrogea we find this technique used in the walls of the thermal baths in Tomis.



Fig.9 Opus testaceum– Tomis – Therme

During The Augustinian period, a masonry technique of small blocks arranged in parallel rows called *opus vittatum* began to be used. The technique began to be used in the Augustinian period, but only in the 3rd-4th century AD it becomes widely used because it offered the possibility of reusing the stone from other demolished constructions. In Dobrogea we find it, among others, at Argamum.



Argamum –Basilica



Argamum –City gate

Fig. 10 Opus vittatum

5. CONCLUSIONS

The knowledge of the different techniques of execution of the walls of the buildings allows archaeologists to date them. The quality of the mortar, the stone used or reused bring precious clues about the level of civilization and well-being of the inhabitants of the fortress. There are also important clues deduced from the sometimes hasty manner of execution in certain periods which is associated with historical events, for example the invasions of migratory peoples.

All this wealth of information can be used by specialists to develop the most appropriate methods for the rehabilitation and enhancement of ancient vestiges.

6. REFERENCES

- [1] Jean-Pierre Adam (2005) - *Roman Building Materials and Techniques*, Taylor & Francis e-Library
- [2] Buletin Limes, nr. 8/2020
- [3] Cronica Cercetărilor Arheologice din România

Note:

Delia-Ioana Andrieș - – PhD, Ovidius University of Constanta, Institute of Doctoral Studies, Bd. Mamaia nr. 124, 900356-Constanta, Romania (corresponding author to provide e-mail: delia.andriesh@gmail.com)
Tudorel Șeitan – PhD, Ovidius University of Constanta, Institute of Doctoral Studies, Bd. Mamaia nr. 124, 900356-Constanta, Romania (corresponding author to provide e-mail: seitandoru@gmail.com)
Ana Maria Gramescu - Ovidius University of Constanta, Institute of Doctoral Studies, Bd. Mamaia nr. 124, 900356-Constanta, Romania (e-mail: am_gramescu@yahoo.com)