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The Spanish Fort (16th Century) in the Kasbah of Bejaia (Algeria)

Maya Akouche [a], Naima Mahindad [b], Fabio Fratini [c], Silvia Rescic [d], Giulia Misseri [e], Louise Rovero [f]

[a] Institute of Architecture, University of Blida 1, Blida, Algeria, maya.akouch@gmail.com, Department of Architecture, University of Florence, Florence, Italy, maya.akouche@unifi.it, [b] Institute of Architecture, University of Blida 1, Blida, Algeria, mahindadnaima@gmail.com, [c] Institute of Heritage Science, National Research Council, Florence, Italy, fratini.fabio57@gmail.com, [d] Institute of Heritage Science, National Research Council, Florence, Italy, silvia.rescic@cnr.it, [e] Department of Architecture, University of Florence, Florence, Italy, giulia.misseri@ufini.it, [f] Department of Architecture, University of Florence, Florence, Italy, luisa.rovero@unifi.it

Abstract

In the Kasbah of Bejaia, the most imposing building is a fort built under the Spanish occupation at the beginning of the sixteenth century. This bastioned structure consists of mighty perimeter walls (from 12 to 20 meters high on the outside) which contain an embankment surmounted by a terrace.

The lower part of the Kasbah dates back to different eras, whereas the upper part was built by the Spaniards and date back to the sixteenth century. The form of the Kasbah is a rectangle which one side is adjacent to the city. It is flanked by strongholds and bastions and by three very high and very massive towers, with murder holes. The fort contains five interesting internal rooms, hidden inside the embankment and organized on three levels: two rectangular vaulted rooms, two overlapping circular rooms surmounted by a domes and a narrow rectangle covered by a barrel vault.

This paper reports the preliminary results of an in-depth interdisciplinary and multiscale study that was carried out on the fort to identify any weaknesses and vulnerabilities to external actions and natural hazards, including seismic loads.

Keywords: Kasbah, fort, vulnerability, seismic loads.

1. Introduction

The city of Bejaia, formerly called Saldae, El Nassiria, or Bougie is an Algerian coastal city located 240m from Algiers the capital.

Thanks to its history marked by the passage of several civilizations, Phoenician, Roman, Hammadid, Ottoman then French colonial, the city of Bejaïa enjoys urban prowess and unique architectural gems, (Carette, 1848). Among them, there is the Kasbah of Bejaia, the object of study of this article.

During antiquity, Bejaia served as a trading post, then developed as a Roman colony before coming under the control of the Vandals, (Féraud & Carette, 1869). In the 9th century, the Hammadid emir An-Nacer took up residence in the city and decided to designate it as the capital of the Hammadids, a decisive moment that propelled Bejaia to its peak, (El-Bekri, 1068). The city experienced remarkable expansion and important structures were erected until the 15th century, notably during the Spanish period, characterized by the construction of three forts which still stand today.

However, subsequently, the city went through a period of decline and regression that lasted for four centuries, until the arrival of the French, who brought significant changes, both urban and architecturally, (Lapene, 1839).

Although the Kasbah of Bejaia comprises an architectural heritage of great, little information and studies exist on it apart from the study carried out by (Mahindad, 2017) and the article published by (Korichi, 2015).

In this paper, some results of a research on the Kasbah of Bejaia are reported with a view to defining appropriate intervention strategies aimed at the protection and safety.

In particular, in the first part of the paper, the historical-constructive stratigraphy of the Kasbah buildings was developed, identifying the subsequent interventions and modifications. In the second part, the study focused on the Spanish fort, the most relevant and interesting building. After the analysis of the interesting constructive-structural morphology of the fort, the construction techniques were investigated, also carrying out a mineralogical investigation on samples taken in situ.

1.1. History of The Kasbah of Bejaia

The Kasbah of Bejaia is a medieval structure located southwest of the city of Bejaia, overlooking the entire bay. Its construction date has caused much controversy.

De Beylié (Beylié, 1909) through his writings places the construction date during the Spanish period, while other authors, such as El-Ghobrini (Ghobrini, 1300), believe that it predates this period.

The Spanish would have chosen this location for the advantages it offers. In fact, the strategic location it represents, its position at a high point and its proximity to the port make it a perfect location. As a result, during their occupation of the city, between 1509 and 1555, the citadel became a prominent and very important fortification point.

The Bejaia citadel is built on 3 levels to respond to the shape of the steep terrain.

Access to the citadel was via two doors (Korichi, 2015): the main door, located on the northeast facade (overlooks the city). The secondary door, known as "Bâb dar essaneaa", is located to the northwest.

During the centuries following its construction, the Kasbah of Bejaia was subject to many transformations. We can distinguish several parts (Mahindad, 2017):

The first, the oldest is the part to the southwest of the wall which otherwise constituted the city wall.

It is distinguished by its heterogeneity. This part could have existed before the arrival of the Spanish (Féraud, 1858).

The second part, the one located to the north, built by the Spanish, is in continuity with the fort.

Initially the Kasbah was surrounded by ditches.

During, the Ottoman occupation lot of modifications were made to the citadel:

-Filling of the pits of the surrounding wall

-The construction of a mosque

-The lowering of the ramparts which led to the disappearance of the loopholes and bell towers

-The transformation of part of the citadel (the upper side) into a balcony.

These are not the only transformations that this citadel has undergone. In fact, upon the arrival of the French, the citadel was once again transformed through:

-The construction of several houses and stores

-The construction of a stable

-The construction of cisterns

In the current state the following buildings still exist (figure 1):

-The wall from the Spanish period

-The four bastions Spanish period

-The two gates Spanish period and French Period

-The patio house Spanish period

-The old mosque Ottoman period

-The administration French period

- The bakery French period

-The shed French period

-Deposit French period

-The store French period

-The library French period

-The stable French period

Fig. 1- The Kasbah of Bejaia (Maya Akouche, 2023)

2. The Spanish stronghold

2.1 Spatial organization

The stronghold located to the north of the Kasbah at the highest point is the most authentic building dating from the Spanish period. Its walls constitute part the fortification's outer wall.

The stronghold is made up of five rooms:

(1) A room that comprises a longitudinal space and is topped with a barrel vault and a first space accessible by a long staircase made up of approximately thirty stone steps.

(2) A room with a rectangular shape, located at ground level and then accessible directly without a staircase. It is topped with a barrel vault supported by two arches.

(3) A little room that comprises a longitudinal space, topped with a barrel vault and located 2m50 from ground level without staircase.

(4a) (4b) two other rooms located to the east of the stronghold. They are superimposed with the same circular geometry and are topped by a dome.

The two rooms communicate with each other through a kind of shaft which reaches up to the terrace and therefore creates a skylight.

The building is crowned at the top with a terrace.

Fig. 2- Spanish stronghold (Maya Akouche, 2023)

2.2. Constructive technique

The fort is constructed using brick masonry, realized by bricks of dimensions of 30×15×15 cm and lime mortar.

The construction technique employed involves a system of reinforced walls with interior and exterior brick facings, as well as an internal filling. This filling between the two facings consists of lime mortar and fragments of bricks and stones.

- The interior facing (Figure 3) with a thickness of 75 cm (Figure 2, red area). These walls are made with masonry texture.

- The exterior facing (Figure 4), which is in continuity with the fortification wall of the citadel. It is a sloping wall with a thickness of 2.5 meters at the top and 3.25 meters at the base (Figure 3, blue area).

In the following paragraph, the results of the analyses conducted on the materials that make up the walls are presented.

Fig. 3- Interior facing (Naima Mahindad, 2017)

Fig. 4- Exterior facing (Maya Akouche, 2023)

2.3. Analysis of materials

According to the aim of the research, some samples were collected in-situ in order to perform physical and mineralogical characterization. In particular, the results are reported of samples taken from the behind space of the room (2), reported in Figure 2. The considered samples are catalogued as follows:

1A: mortar - stronghold 1

1B: brick- stronghold 1

The following analysis has been performed at the Institute of Heritage Sciences (ISPC) of the National Research Council (CNR), branch laboratories of Florence:

- Determination of the mineralogical composition through X ray diffraction (XRD) (X'Pert PRO diffractometer by PANalytical equipped with X'Celerator detector and HighScore software for acquisition and interpretation of data according to the following operative conditions: CuK $\alpha 1 = 1.545$Å radiation, 40 KV, 30 mA, $2\Theta = 3\text{-}70°$);

-Observations at the optical microscope in transmitted polarised light on thin section;

-Determination of the physical characteristics, namely the water accessible porosity and bulk volume through the hydrostatic balance method.

Results

Mortar: 1A

Table 1 and Table 2 show the main mineralogical composition and physical characteristics of masonry mortar 1A.

Table 1- principal mineralogical composition (XRD)

	1A
Calcite	XXX
Quartz	X
Hydrocalumite	XX
Ettringite	X

X : presence Tr : trace

Table 2- physical characteristics of mortar

	Porosity	Bulk density
1A	46	1.241

The petrographic study and mineralogical analysis show that mortars 1A is characterized by a mixture rich in binder (binder/aggregate > 2/1) composed of a weakly hydraulic lime, as indicated by the presence of hydrocalumite [$Ca_4Al_2(OH)_{12}(Cl,CO_3,OH)_2$ $4H_2O$], evidenced by the mineralogical analysis (Table 1). This mineral is formed during the calcination of carbonate rocks containing clay impurities.

The few grains of aggregate are unevenly distributed in the mixture. The grains, 0.5 to 1 cm in size, are subrounded in shape (indicating a provenance from sedimentary deposits) and consist of crystalline limestone, quartzite and siltstone. There are also rare charcoal remains referable to the wood used to calcinate the carbonate rock to produce the lime.

Lumps are abundant and in some cases it seems possible to recognise the texture of crystalline limestone, indicating that this type of carbonate rock was used in the production of lime. This mortar have a high water-accessible porosity 46 %.

Brick: 1B

Table 3 and Table 4 show the main mineralogical composition and physical characteristics of brick.

Table 3- principal mineralogical composition (XRD)

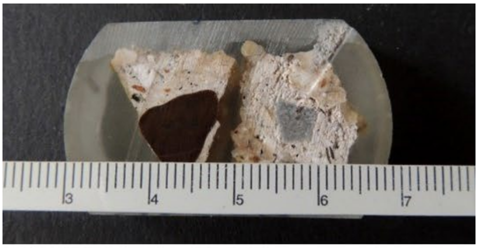
	Brick 1B
Calcite	Tr
Quartz	XXX
Anorthitis	XX
Diopside	X
Hematite	-
Gypsum	X

X : presence   Tr : trace

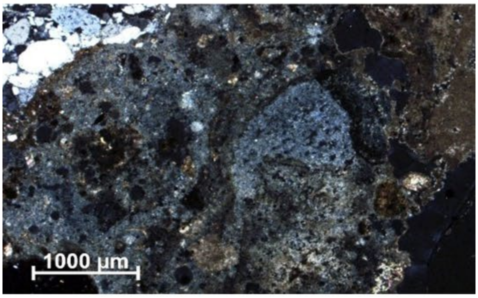
Table 4- physical characteristics

	Porosity	Apparent density
Brick 1B	32	1.58

The petrographic study in thin section shows that this brick sample exhibit a groundmass with non-birefringent characteristics, indicating a firing temperature of over 800 °C, conditions that completely destroyed the original clay minerals. These conditions are also confirmed by the presence of diopside (Table 3), a neoformed mineral originating from the reaction between silica (which results from the destruction of the clay minerals lattice) and calcium oxide resulting from calcination of calcite. In fact, relicts of calcite fragments are observed in this thin sections. In addition to these relicts, the framework is scarce, consisting of angular granules of quartz and feldspars. The distribution of the grain is homogenous and the size of this framework: in sample 1B unimodal grain size (ϕ 150-200µm). The macropores have a regular shape and the porosity accessible to water is 32%.

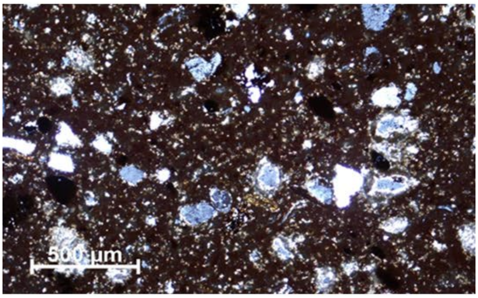


(a): A1



(b): A1

(c): B1



(d): B1

Fig. 5- Cross section of samples related thin section observed at the optical microscope in polarized transmitted light

The results obtained highlight a good construction technique aimed at creating materials with good mechanical parameters. Certainly the creation of an imposing defensive structure motivates this intent.

As regards the mortar, the results showed that the binder is lime, the binder/aggregate ratio is greater than two and that the mortar also has hydraulic capacity due to the calcination of carbonate rocks containing clay impurities. The high binder/aggregate ratio promotes cohesive capacity and good strength and the hydraulicity helps setting in the presence of water.

As regards the brick, the results showed that the firing procedure was correct, having certainly reached 800°C. So even if a porosity of 32%, typical of historic bricks, is present, it can be concluded that the mechanical characteristics of the bricks are certainly not poor.

3. Conclusion

The paper presents the first results of a study carried out on the Spanish fort of the Kasbah of Bejaia with the aim of defining protection and safety strategies. In particular, a historical investigation made it possible to reconstruct the construction phases and an accurate survey allowed the spatial reconstruction of the rooms hidden inside the fill surrounded by the fortification walls.

Numerous in situ surveys allowed the identification of the construction technique of the masonry walls and the taking samples of bricks and mortar to obtain physical and mineralogical characterization. The results allow us to highlight an effective construction technique for the grandeur and typology of building analyzed.

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