THE BUILDING MATERIALS OF "ROCCA VECCHIA" (OLD FORTRESS) IN THE GORGONA ISLAND

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Abstract – The research examines the building materials of the ancient fortress known as Rocca Vecchia (Old Fortress), in the Gorgona Island, built by the Republic of Pisa and dated to the 13th century. Particular attention is paid to the composition of the artificial stone materials (bricks, bedding mortars, plasters and renders) in order to better understand and define the different construction phases. The results will be useful from the historical point of view (origin of the raw materials from inside or outside the island) and for the future conservation intervention which, under the auspices of the former director of the jailhouse, will have to involve a group of prisoners who will also have the task of the subsequent maintenance.

Introduction

The ancient fortress commonly known as Rocca Vecchia (Old Fortress), dominates the Gorgona island from a rocky spur on the western side, at about 200 metres a.s.l. It was built by the Republic of Pisa and dated to the 13th century, but it seems that the settlement was originally represented by a single tower dating back to the 11th century, as evidenced by the dating of some ceramic finds in a recent archaeological excavation [1, 2]. As reported by Guarducci et al. [3] "it seems that the first hermits reached Gorgona in the 4th century to be replaced, two centuries later, by an initial Benedictine nucleus" [...] in the middle of the 11th century the Benedictine monks of St. Mary and St. Gregory of Gorgona obtained a bull from Pope Alexander II, sent from Lucca on 16th August 1070 to the Abbot Adam, declaring the monastery of Gorgona to be immediately subject to the Apostolic See". The tower was erected above previous structures that could be very ancient. Around this structure, still identifiable in the current structure, other parts were added, up to give it a polygonal and asymmetrical plan, with three quarters of the perimeter exposed on a cliff overlooking the sea (Fig.1).

The access to the fortress is by means of a narrow three ramps staircase that opens into a large courtyard. The part leaning against the eastern wall (to be referred to the 13th century) shows a patrol walkway obtained in the same thickness of the masonry and a sentry box, architectural elements that allow it to be identified as a fortress. Moreover, arched windows and a machicolation above the single access door are present.

The interior of this structure is characterized by a barrel-vaulted roof, at the apex of which a square trap door opens, probably usable as a defensive hallway in the event of

Referee List (DOI 10.36253/fup_referee_list)
FUP Best Practice in Scholarly Publishing (DOI 10.36253/fup_best_practice)
Fabio Fratini, Francesca De Vita, Daniela Pittaluga, Silvia Rescic, *The building materials of "Rocca Vecchia" (Old Fortress) in the Gorgona Island*, pp. 834-843 © 2022 Author(s), CC BY-NC-SA 4.0, 10.36253/979-12-215-0030-1.79

an enemy invasion to perch upstairs using a retractable ladder (Fig.2). Inside this room remains of plaster with red decorations depicting lilies can be observed.

Figure 1 – The fortress built over a rock spur on the western side of the island, (view from the south).

Figure 2 – The barrel-vaulted room with remains of plaster with red decorations (older part of the fortress).

This older part probably had a simple function as a watchtower and this would justify the most common toponym of Torre Vecchia, while the current appearance is that of a fortress.

Contiguous to this nucleus and subsequent, as evidenced by the stratigraphic reading of the masonries (clamping and texture of the masonries), a multi-storey building was built with large windows, a double-pitched roof in a wooden supporting structure and mantle made of bent tiles and imbrexes.

This part of the building, which also shows a sort of battlements, has unfortunately collapsed in the early 90's, and rebuilt in 1997.

In the courtyard, there is a cistern, and a large basin, probably dug in the early 60's of the last century, which would have involved the demolition of another cistern of ancient origin and, probably, other volumes also present, as can be seen from the old floor plans, below the current floor level. Another cistern is located near the southwest corner of the building. In front of the cockpit of this cistern there was another barrel vault construction, semi-underground. The shape and location of the cistern in relation to the above building seems to confirm the subsequent construction of this part with respect to the tower.

Regarding the masonries along the perimeter of the fortress, it is particularly striking an external arch built along the southern wall with the function of supporting the masonry above which, otherwise, would not have had a solid natural support base and which allowed to obtain a greater volume to the fortress (Fig. 3).

The fortress and the annexed building where the residence of the island parish chaplain named after Santa Maria and San Gorgonio. In 1723, inside the fortress a new church was built in substitution of the old chapel that was destroyed many times. According to the updating of the cadastral parcels dating back to 1904, carried out in 1933, it appears that the fortress, still a prison site until a few years earlier, was reserved for traffic lights and then completely abandoned [1, 2, 4, 5, 6].

Figure 3 – External arch built along the southern wall in order to obtain a greater volume to the fortress.

The whole structure is currently in a severe state of conservation both because of its location and probably because of the abundance of construction phases built at different times and with poor interlocking of the masonry. The collapses are evident with the fall of some roofs and most of the summit ridges and with the presence of structural lesions. The action of the marine aerosol, in particular on the seafront, has caused extensive phenomena of alveolization in the bricks and in the stone ashlars with erosion of the plasters and bedding mortars. On the walls less subjected to the wind action (N, NE, SE) a thick vegetation has grown with particularly aggressive tree species such as the fig trees. In the recent past (1999), a shoring with hollow bricks was accomplished.

The building materials

The building materials are the local stone (calcschists), the bricks, the mortars (bedding mortars, plasters and renders). Generally, the buttress and the corners are in stone (Fig. 4) while in the overhanging wall, the bricks are more present, with different distributions depending on the sides (Fig. 5). Widespread interventions are visible on the masonry, carried out at different times. The part leaning against the eastern wall is made of bricks. The most recent Renaissance-style windows are finished in Pietra Serena sandstone (frequently used in Medici buildings), as well as two fire mouths realized in the thickness of the east and north-east perimeter walls (Fig. 6). The calcschists are the most widespread rocks of Gorgona, which from a geological point of view represents a fragment of the Western Alps. In fact, rocks referable to the Ligure-Piemontese Domain, the so-called "Schistes Lustrés", outcrop on the island [7, 8, 9]. These rocks originally constituted calcareous clayey sediments of the Ligure-Piemontese oceanic basin. During the Alpine orogeny they were involved in a subduction process with high pressure metamorphism in Blue Schists facies and a subsequent phase of low-pressure metamorphism in Green Schists facies. Compositionally, the calcschists are composed of calcite, light mica, biotite, quartz.

Figure 4 – The buttress and the corners in calcschists.

Figure 5 – In the overhanging wall the bricks are more present. Remains of the original render are visible.

Figure 6 – A fire mouth realized in Pietra Serena sandstone.

The structure is more or less schistose depending on the amount of mica and this allows an easy splitting both in slabs for roofing and in blocks for masonry. However, this schistosity is also a factor of decay because it favours the exfoliation of the rock.

The research examines in particular the composition of the artificial stone materials (bricks, bedding mortars and plasters) belonging to the most ancient phases. The results will be useful from the historical point of view (origin of the raw materials from inside or outside the island) and for the future conservation intervention. In this regard, we have to remind that the island houses a detention centre where, since the ‘80s, prisoners have been involved in various work projects with the aim to improve social reinstatement and considerably reduce recidivism [10]. Therefore, under the auspices of the former director of the jailhouse, the idea is to involve in the conservation works a group of prisoners who will also have the task of the subsequent maintenance.

Materials and methods

With the permission of the “Soprintendenza Archeologia Belle Arti e Paesaggio per le Province di Pisa e Livorno” and the Direction of the Gorgona Prison, bricks, bedding mortars and plasters were sampled and investigated through mineralogical and petrographic methodologies [11, 12, 13].

The mineralogical composition has been was determined with a PANalytical diffractometer X’PertPRO with radiation CuKα1 = 1.545 Å, operating at 40 KV, 30 mA, investigated range 2θ = 3-70°, equipped with X’ Celerator multirevelator and High Score data acquisition and interpretation software; the petrgraphical study was performed on thin sections (30 microns thickness) observed at the optical microscopy in transmitted polarized light (ZEISS Axioscope.A1 equipped with a camera [resolution 5 megapixel and dedicated image analysis software [AxioVision] for evaluating the microstructural parameters).

The petrographic study of the bricks allows to understand if these materials have been realized in the island. Indeed, in the locality “Piazza d'Armi” there was a furnace that used the local earth, originated from the alteration of the local schistose rocks. It is a "lean" earthen material, rich in metamorphic rock fragments easily recognizable in the fired products. Bricks produced in the Livorno coast would display a different aspect.

Regarding the mortars (for masonries and plasters), there are many characteristics to investigate, such as the amount and type of binder, the grain size and composition of the aggregate, the type of lime lumps. This makes it possible to differentiate them, to confirm different construction phases and to identify new ones. Concerning the binder, the study of lumps will give indications on the carbonate stone that was burnt to produce the lime. Indeed, in the island there are only little outcrops of crystalline limestones suitable for producing lime otherwise clods of quicklime had to be transported to the island, as it was the case for the construction of the watchtowers of the island of Capraia [14]. Figure 7 reports the collected samples and their position in the map.

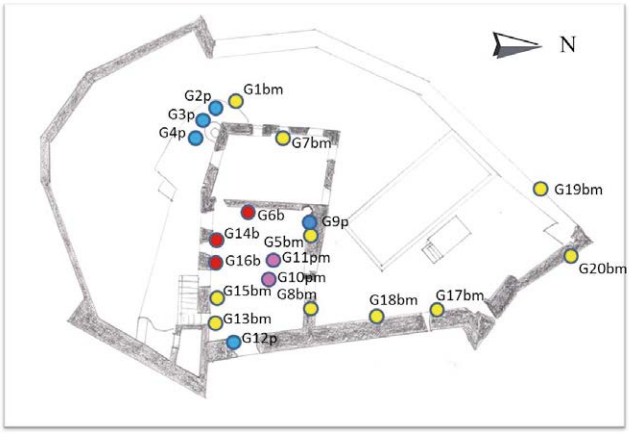

Figure 7 – The position in the map of the samples (b= bricks; p= plasters; bm= bedding mortars; pm= paving mortars).

Results

Bricks from the east room with barrel vault

There are two types of bricks, those of local origin realized from a coarse-grained earth rich in calcschists (Fig. 8) and bricks obtained from a finer earth (Fig.9). For these bricks it is possible to assume a provenance from the Tuscan coast or possibly a local selection of a fine raw material.

Bedding mortars from the east room with barrel vault

There are many typologies:

- mortar G5, characterized by an abundant binder of air hardening lime that seems to have been produced by burning crystalline limestones (presence of under burnt marble fragments) and quite fine aggregate of local origin (presence of calcschists and crushed bricks containing calcschists) (Fig. 10);
- mortar G8, characterized by an abundant binder that seems slightly hydraulic (from burning of impure marbles). The aggregate is relatively fine-grained and appears to be of local origin;
- mortar G13, characterized by an abundant binder of air hardening lime. The aggregate does not appear to be local in origin due to the presence of micritic and organogenic limestones (Fig 11);
- mortar G15, characterized by a scarce binder of air hardening lime. The aggregate is very fine, of unimodal grain size. It does not appear to be of local origin.

Paving mortars, from the east room with barrel vault

There are two typologies:

- -mortar G10, made of an abundant air hardening lime binder and an aggregate made almost exclusively by crushed bricks of local origin (containing calcschists);
- mortar G11, made of an abundant binder of mixed lime and earth. The aggregate is coarse grained, made of crushed bricks, calcschists and quartz, therefore of local origin.

Figure 8 – Cross section of a brick realized with a coarse-grained raw material rich in calcschists.

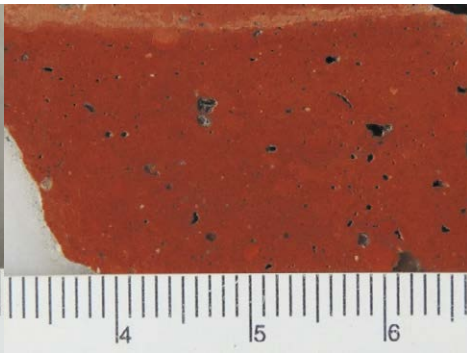

Figure 9 – Cross section of a brick realized with a fine earth.

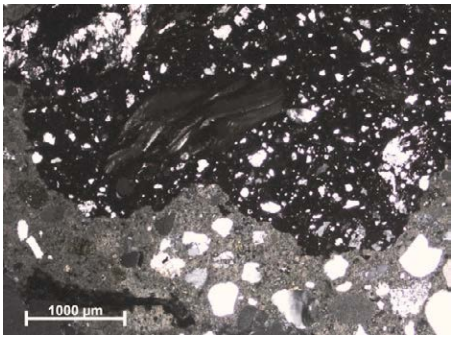

Figure 10 – Bedding mortar with a crushed brick containing a calcschist (local origin) (image at the optical microscope in thin section, XPL).

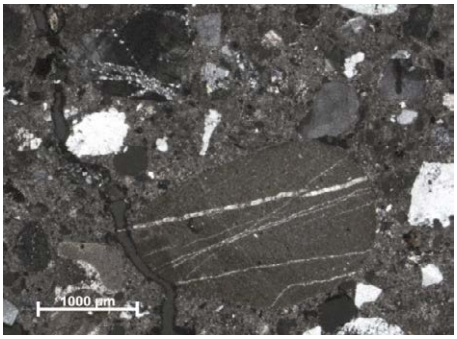

Figure 11 – Bedding mortar with a grain of aggregate made of veined micritic limestone (image at the optical microscope in thin section, XPL).

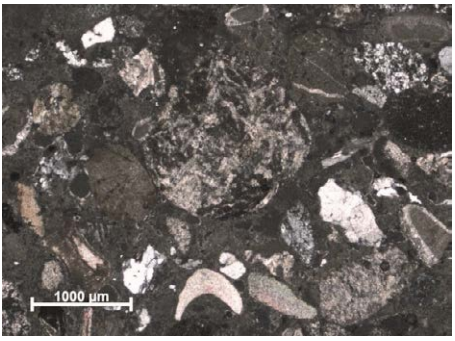

Figure 12 – Fragment of an organogenic limestone in the aggregate (image at the optical microscope in thin section, XPL).

Bedding mortar G7 from single lancet window in brick (east room)

- made of a scarce air hardening lime binder. The aggregate seems not of local origin because of the presence of organogenic limestones (Fig. 12).

Plasters

There are two typologies:

- mortar G9 (east room with barrel vault, north side), made of an abundant binder that seems slightly hydraulic (from burning of marly limestones). The aggregate is fine grained, of local origin because of the presence of calcschists;
- mortar G12 (east room with barrel vault, east side) made of a scarce binder that seems slightly hydraulic. The aggregate, of fine granulometry, seems not of local origin.

Bedding mortar of firemouth (G17) (east perimeter wall, interior)

- made of a scarce binder that seems slightly hydraulic as testified also by the presence of under burnt fragments of marly limestones (from the Tuscan coast). The aggregate, of fine granulometry, seems not of local origin.

Bedding mortar (G18) (east perimeter wall, interior)

- this mortar, similar to G17, is made of a scarce binder that seems slightly hydraulic as testified also by the presence of under burnt fragments of marly limestones (from the Tuscan coast). The aggregate, of fine granulometry, seems not of local origin.

Bedding mortar (G19) (NW perimeter wall, near the entrance)

- this mortar is made of an abundant air hardening lime binder. The aggregate is of local origin because of the presence of calcschists.

Bedding mortar (G20) (buttress, NE perimeter wall)

- this mortar is made of an abundant binder that seems slightly hydraulic as testified also by the presence of under burnt fragments of marly limestones (from the Tuscan coast). The aggregate, of fine granulometry, is of local origin because of the presence of calcschists.

Bedding mortar (G1) medieval cistern

This sample consists of two different unmixed mixtures:

- -fat mixture made of an air hardening lime binder and an aggregate of crushed bricks (800 μm - 1.5 mm) and rare quartz. Rare lumps are present;
- lean mixture made of an air hardening lime binder and an aggregate with prevailing angular quartz grains (200 – 300 μm) and rare crushed bricks. This aggregate seems of local origin.

Plasters of the medieval cistern (innermost zone)

- the external layer (G2) is made of an abundant aerial lime binder obtained from burning crystalline limestones (presence of under burnt fragments). The aggregate is made of quartz and crushed bricks and seems of local origin;
- the internal layer in contact with the masonry (G3) is made of an abundant aerial lime binder and an aggregate of quartz, crushed bricks and calcschists of local origin.

Plasters of the medieval cistern(G4) (near the mouth)

- the external layer is made of a scarce aerial lime binder. The aggregate, of bimodal grain size, is made of quartz, pozzolan and rare pyroxenes (Fig.13);
- the internal layer is made of an abundant aerial lime binder. The aggregate is made of quartz and fragments of micritic limestones.

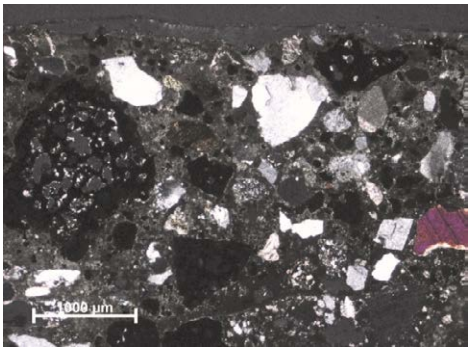

Figure 13 – Fragments of pozzolan and pyroxenes in the aggregate (image at the optical microscope in thin section, XPL).

Conclusions

The compositional analyses of the bricks and mortars used in the construction of the “Rocca vecchia” (up to the interventions of the Medici period) indicate that the origin of the raw materials is both local and from the Tuscan coast. With regard to the oldest part of the fortress (east room with barrel vault), there are bricks of local production (lean clayey raw material, rich in fragments of calcschists) but also bricks produced with a finer clayey raw material possibly selected locally or bricks imported from outside.

As for the mortars, the lime was produced both locally from the burning of crystalline limestones (particularly for the older samples), as evidenced by the presence of under burnt marble fragments but it was imported also from the Tuscan coast from the burning of marly limestones. The bedding mortars of the oldest nucleus are generally rich in binder with an aggregate of local origin (presence of calcschists) but mixtures poor in binder with an aggregate that does not seem local (presence of organogenic limestones) are also found. It is possible that these mortars should be referred to subsequent interventions. The bedding mortars of the external masonry (in the portion built in calcschists) are realised with an abundant binder and an aggregate of local origin, while the interventions of the Medici period are characterized by mixtures poor in binder with an aggregate of non-local origin. With regard to the plasters of the oldest nucleus, in analogy with the bedding mortars, there are fat mixtures with aggregate of local origin and lean mixtures with aggregate from the Tuscan coast. This information will contribute to better understand and define the different construction phases and will be useful for the future conservation intervention.

Acknowledgments

We would like to thank the "Soprintendenza Archeologia Belle Arti e Paesaggio per le Province di Pisa e Livorno" and the Direction of the Gorgona Prison, for the opportunity they gave us to carry out the sampling that made this study possible.

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