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The ruins of Castiglion Balzetti: building materials and construction techniques

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Abstract

The ruins of Castiglion Balzetti, from the aristocratic family that initially had lordship over this territory, lie isolated, far from roads, communication routes and inhabited places, in the woods of the Val di Merse, in the province of Siena. This is why it is commonly known as "Castiglion che Dio sol sa". Few historical sources are available on this settlement. It is mentioned for the first time in the Sienese statutes in 1262, being under the jurisdiction of Siena. In the early 14th century, it belonged to the powerful Sienese Saracini family with an important mill located in the Merse river. The ruins are impressive. The castle consists of a large rectangular donjon, on which the eastern side was leaned another building that originally housed the church, and a second probably used as stables. A smaller tower stands at the south-west corner, with an oven and well inside. The buildings are connected by a curtain wall that delimits the courtyard, with the main entrance door opening on the southern side. Around this complex, a village developed in ancient times, included within a second fortified circuit of which numerous remains are visible. The castle, like the neighbouring villages of Orgia and Brenna, suffered various pillages during the 14th century and, with the end of the Sienese Republic, gradually fell into ruin until it was completely abandoned and forgotten. The research will examine the different construction phases through the study of the wall apparatus and the natural and artificial stone materials according to mineralogical and petrographic methodologies. The data will be correlated with the local supply sources.

Keywords: medieval buildings, Southern Tuscany, geomaterials, building techniques.

1. Introduction

The ruins of Castiglion Balzetti are commonly known as 'Castiglion che Dio sol sa', an appellation that perfectly describes the place where it stands, located south-west of Siena, in a sparsely inhabited hilly area covered by extensive Mediterranean scrub woods (Fig. 1, 2). These ruins are to be identified with the ancient Castellione Bencetti, first mentioned in the statutes of Siena in 1262. This name most likely derives from the aristocratic family that had lordship over this territory. There are very few historical sources available on the castle. Among the most important information that has come down to us is that at the end of the 13th century, the castle was under Sienese jurisdiction, as reported in a sentence received for not sending foot soldiers to the service of the municipality. However, another document from 1271 shows that Siena did not send its own rector to the castle, thus recognising a certain political and jurisdictional autonomy to the local lords. At the time, these must have been the Saracini, a powerful Sienese family that in 1318 nonetheless owned the fortress, much of the surrounding land and a mill located not far away on the Merse river.

The research will examine the different construction phases through the study of the wall apparatus and the natural and artificial stone materials according to mineralogical and petrographic methodologies. The data will be correlated with the local supply sources [SR, AA, FF, MM].

Fig. 1- The ruins of Castiglion Balzetti surrounded by the Mediterranean scrub woods (photo by F. Fratini)

Fig. 2- Position of Castiglion Balzetti with respect to Siena (after Google Earth, modified, 2022)

2. Geological setting and building materials

From a structural-geological point of view, the territory where Castiglion Balzetti is located, belongs to the "Middle Tuscany Ridge", a geological alignment that runs from Monte Pisano chain up to Uccellina and Monte Argentario in Southern Tuscany. This ridge represents the deepest part of the structural edifice of the Northern Apennines, in which it is possible to observe the basement of the Tuscan metamorphic units, consisting of relicts of the ancient European Hercynian chain and of the "post-Hercynian" Palaeozoic-Triassic sedimentary succession [Conti et al. 1991]. Particularly, in this sector of the "Middle Tuscany Ridge" it is mostly exposed the Monticiano-Roccastrada Unit, represented by metamorphic rocks in green schist facies of Upper Palaeozoic to Cretaceous age. The basal part is represented by small outcrops of "post-Variscan" Palaeozoic sedimentary succession consisting of phyllites, metasandstones, metaconglomerates with local carbonate levels attributed to Mississippian-late Permian [Capezzuoli et al. 2021]. The uppermost part of the succession is represented by the typical Triassic continental quartz-dominated clastic sedimentation belonging to the Verrucano Group [Brogi et al. 2023] overlain by Upper Triassic and Jurassic carbonate formations. The Monticiano Roccastrada tectonic unit is overlain by the Tuscan Nappe Unit, which in this area is represented by the Cavernous Limestone of the Upper Triassic. During the Apennines collisional stages, the above-mentioned Palaeozoic-Triassic successions were involved in duplex structures, up to HP-LT conditions ($P \geq 1.1$ GPa and $T \sim 350–400$ °C) and retrograde green schist metamorphic conditions [Giorgetti et al. 1998; Brogi & Giorgetti 2012]. Their exhumation was favoured by the development of Miocene extensional detachments [Liotta et al. 1998], which produced extensional horses and the lateral segmentation of the previously stacked tectonic units. In particular, the geological formations that crop out in the area surrounding the castle and from which come the lithotypes used for its construction are the following [Explanatory Notes Geological Map of Italy]:

- Anageniti minute Formation: these are quartzarenites and fine metaconglomerates with white and pink quartz elements interspersed with purple or grey-green metasiltites. The size of the clasts is about 1 cm. The thickness is 100-150 m. The sedimentation environment is continental floodplain. The age is Middle Triassic. The quartzarenites and fine metaconglomerates, due to their particular resistance to erosion, form the major reliefs in the area and give rise to steep slopes and gorges where they are incised by watercourses;

- Grezzoni Formation: these are grey, hazel-grey, massive or coarsely stratified dolomites, sometimes interspersed with thin marly limestone levels. There are levels, sometimes several tens of metres thick, of intra-formational breccias with angular elements consisting of dolomite fragments in a dolomite matrix. Subjected to weathering, these levels take on a carious appearance that makes them resemble Cavernous limestone. The thickness of the formation is about 70 m. The sedimentation environment is shallow water. The age is Upper Triassic. These dolomites exhibit high weathering durability even in the carious varieties;

- Cavernous limestone: it is a tectonic and autoclastic breccia of grey carbonate elements and calcareous cement with a typical 'cellular' structure sometimes filled with grey dolomitic dust. It rarely presents a coarse stratification. The maximum thickness is a few hundred metres. This lithotype derives from the Burano Anhydrite Formation, which consists of alternating layers of anhydrite and dark dolostones. When this formation is exposed in a subaerial environment, the anhydritic layers hydrate to gypsum, generating stresses that shatter the dolomitic layers, resulting in the formation of the autoclastic breccia. The sedimentation environment of the anhydritic formation is evaporitic and the age is Upper Triassic. This lithotype has a high durability to weathering and was used in Siena in the medieval period where it is known as “Pietra da Torre” (stone for towers);

- Breccia di Grotti: it consists of breccias and conglomerates, locally coarsely layered, with clasts varying in size from 2 to 30 cm mostly from the Burano Anhydrite Formation-Cavernous Limestone. Subordinate clasts of fine metaconglomerates, quartzites and limestones of the Tuscan and Ligurian units may be present. The matrix consists of orange-yellow or rust-red calcareous sands and silty sands. Where the matrix is sparse or absent, this lithotype is poorly distinguishable from the Cavernous Limestone. The maximum thickness is about 180 m, the formation environment is continental, subaerial alluvial to lacustrine, and the age is Messinian. This lithotype is highly resistant to the action of atmospheric agents and, like the Cavernous Limestone, from which it is difficult to distinguish, it was used in Siena in the construction of towers, indeed, it appears to be the prevalent [Gandin et al. 2008];

Travertine: an extended outcrop of this lithotype lies to the east of the village of Orgia. Travertines are “continental carbonate rocks” which are formed in relation to the presence of springs fed by supersaturated calcium carbonate waters coming from a deep hydrothermal circuit. The presence of normal faults that allow the rise of deep fluids heated both by the geothermal gradient and by the possible presence of magmatic bodies, as it is the case in southern Tuscany, favours this circulation. These travertine deposits are compact, well stratified and have a whitish colour that indicates the absence of life in the immediate vicinity of the source [Capezzuoli & Gandin 2005].[SR, FF].

3. The study of construction phases: methodology

The castle, in its summit portion, presents a well-preserved architecture that allows for almost complete stratigraphic legibility of its exterior walls. Unfortunately, the interiors are inaccessible as they are in a clear state of decay, while the areas relating to the village, built at the foot of the summit area, are concealed under thick layers of earth and vegetation. The archaeological analysis, carried out using the tools of the archaeology of architecture [Brogiolo-Cagnana 2012], therefore focused on the external facings of the architectural complex of the noble area, attempting to recognise a construction macro-sequence attributable to reference building and construction phases. The phases were subsequently connected in order to define the construction periods of the four buildings bodies (CF) that make up the current complex (Fig.3) [AA].

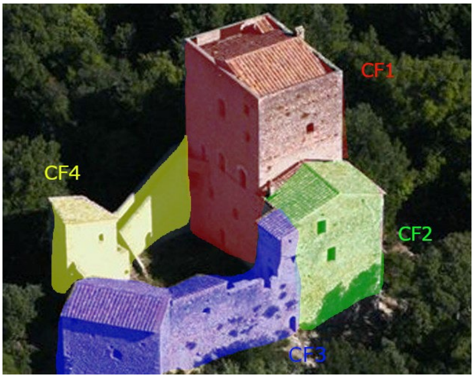

Fig. 3- The buildings that make up the top portion of the castle: the oldest tower (CF1), the second tower (CF2), the east wall with the corner tower (CF3), the west wall (CF4). (photo elaboration by A. Arrighetti)

3.1 Analysis

The archaeological investigation envisaged an initial subdivision of the buildings by assessing the stratigraphic relationships between them and reporting everything within an overall plan. Subsequently, the individual buildings were analysed to assess whether different construction techniques were present in the facings walls or whether they appeared homogenous from a constructional point of view (Fig.4). Finally, the data from the previous analyses were compared in order to achieve an overall chronological-constructive interpretation.

Fig. 4- The north façade of the summit area with the evident resting of the second-period tower to the left (CF2) on the older tower (CF1) to the right (photo by F. Fratini)

The results of the stratigraphic investigation can be summarised as follows:

- PERIOD 0: construction of a large wall (cross-section of approximately 1.80 metres) characterised by a course that does not conform to the rest of the buildings of the site and stratigraphically placed below the cantonal of the oldest tower, therefore ascribable to a pre-existence with respect to the complex. Given its construction characteristics, it could be a boundary wall built prior to the first tower of the settlement, reused during the first phases of the castle's life. The technique used is characterised by partially worked pebbles and stones, on thick mortar layers and with very wide joints and beds.

The lithotype used is attributable to cavernous limestone, which is present in the area in a limited outcrop that forms the very base on which the castle is founded.

- PERIOD 1: the construction of a large tower (CF1), located in the north-western part of the summit area of the site, seems to refer to the first construction period. The building, the first phase of which reaches a height of approximately three metres, is built with a masonry technique characterised by the use of roughly hewn and split stones, set in a fairly regular fashion, with wide and irregular joints. The corners are of squared stone, with large ashlars and a surface finish worked with subbia. Again, the lithotype used is attributable to the Cavernous Limestone (Fig.5).

Fig. 5- Detail of the construction technique of Period 1 (photo by F. Fratini)

- PERIOD 2: The second period saw an overall reconstruction of this portion of the archaeological site with an internal redefinition of the spaces. In fact, several construction phases can be ascribed to this period, which involved all the buildings that make up the summit area. In particular, the following can be included in this large construction yard: the raising of the oldest tower (CF1-Phase 2), the construction of a second tower (CF2-Phase 1) leaning against the east wall of the previous one and smaller in size, and the construction of a defensive circuit (CF3-Phase 1 and CF4-Phase 1) surrounding an inner courtyard. The masonries are all homogenous in typological terms and are characterised by the use of partially dressed stone, with very wide joints and perfectly squared corners using the subbia and the chisel (Fig. 6). The corner ashlars are made of travertine (Fig.7), while different lithotypes such as Cavernous limestone/Breccia di Grotti, quartzites and microconglomerates from the "Anageniti minute Formation" (Fig.8) were used for the masonry ashlars. In addition, wedges of purple metasiltites yet belonging to the "Anageniti minute Formation" are present to stabilise the angular ashlars (Fig.9).

Fig. 6- Detail of the construction technique of Period 2 (photo by F. Fratini)

Fig. 7- Corner stones made of travertine (photo by F. Fratini)

Fig. 8- Masonry ashlars in microcronglomerate from the "Anageniti minute Formation"(photo by F. Fratini)

The use of travertine for corner ashlars denotes a period of particular economic prosperity as the travertine was sourced from an outcrop some distance from the castle site.

Fig. 9- Wedges of purple metasiltites (photo by F. Fratini)

- PERIOD 3: the reconstruction of the top portion of CF2 takes place, whose construction technique appears different from all the others visible on the site and to which the second construction phase of CF3, carried out in Period 4, is stratigraphically related. The masonry of this phase is made of split stones of a heterogeneous nature, arranged in irregular rows with the frequent use of stone and brick wedges and with cornerstones made of perfectly squared ashlars (Fig.10).

Fig. 10- Detail of the construction technique of Period 3 (photo by A. Arrighetti)

In this phase one observes the introduction of brick as a building material, albeit in a fairly sporadic manner and often as a wedge. As for the lithotypes used, the corner ashlars are made of Cavernous Limestone/Breccia di Grotti (Fig.11), while the masonry is a mixture of Cavernous Limestone/Breccia di Grotti, quartzites and microconglomerates.

Fig. 11- corner stones made of Cavernous limestone/Breccia di Grotti (photo by A. Arrighetti)

- PERIOD 4: comprises the phases relating to the raising and redefining of the high portions of CF3 and CF4. In this case, the techniques are extensively influenced by the use of bricks for the construction of the openings and for the realisation of specific architectural details (e.g. pontoon holes). With regard to the stone materials of the masonry, Cavernous limestone/Breccia di Grotti stone ashlars seem to prevail (Fig.12)[AA].

Fig. 12- Detail of the construction technique of Period 4 (photo by F. Fratini)

4. The study of the bedding mortars

Among the materials used in the construction of the fortress there are also bricks and bedding mortars. The bricks in particular have been used as wedges and for the construction of openings and specific architectural details (period 4). Unfortunately, it was not possible to sample these bricks because they were located in positions that can not be reached from the ground level. However, it was possible to take samples of the bedding mortars from period 0 and from the construction phases (CF) 1, 2, 3, and 4. From each construction phase four samples have been taken. The following investigations were carried out:

-the mineralogical composition was determined on the ground samples using a PANalytical X'PertPRO diffractometer with CuK1 = 1,545 Å radiation, operating at 40 KV, 30 mA, investigated range 2θ =3-70°, equipped with an X' Celerator multidetector and High Score data acquisition and interpretation software;

-the petrographic study was carried out on thin section (30 microns thick) observed under a transmitted polarised light optical microscope (ZEISS Axioscope. A1 equipped with a camera (5-megapixel resolution) [Pecchioni et al 2014a; Scala et al. 2021].

The mineralogical-petrographic study of the mortars made it possible to recognise the presence of three groups:

-the mortars of the oldest structures [period 0 and first phase of CF 1] consist of an abundant calcitic binder rich in impurities presumably present in the original stone for lime that provided slightly hydraulic characteristics. The aggregate consists mainly of fragments of carbonate rocks of dolomitic composition (as also evidenced by diffractometric analysis), referable to the Grezzoni formation (Fig. 13). Numerous lumps are present;

- the mortars of the second phase of CF1 consist of an abundant binder of pure air lime. The aggregate consists almost exclusively of silicate rocks (mycascists and quartzites), quartz and rare carbonate rocks. Lumps are abundant (Fig. 14);

- CF2 and CF3 mortars are similar. They consist of a binder present in medium quantities, which is very rich in impurities. This may indicate the addition of earth to the lime. The aggregate consists predominantly of silicate rocks (micaschists, quartzites, sandstones) and secondarily of carbonate rocks (Fig. 15). Rare lumps are present. The characteristics observed indicate that in the earliest phase, the aggregate was taken directly from the ground on which the fortress was being built, a ground consisting of a limited outcrop of Cavernous Limestone, while the aggregate of the other two groups were sourced from the beds of nearby streams. As for the binder, for the first group an impure limestone was burned while for the second group a pure limestone was used. For the third group, lime and earth were mixed.

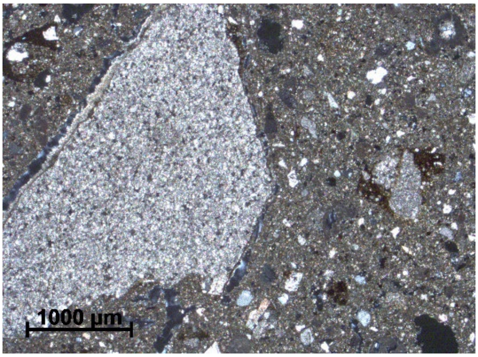

Fig. 13- bedding mortar of the oldest structures (period 0 and first phase of CF 1) (image at the optical microscope in thin section, crossed polarized light) (photo by S. Rescic)

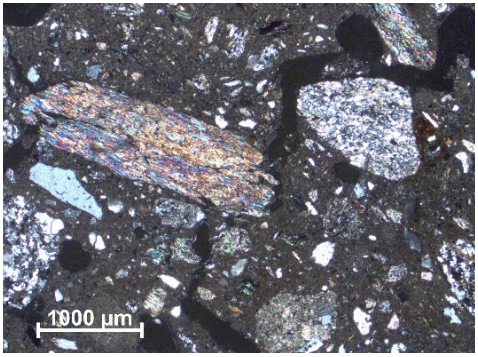

Fig. 14- bedding mortar of the second phase of CF1 (image at the optical microscope in thin section, crossed polarized light) (photo by S. Rescic)

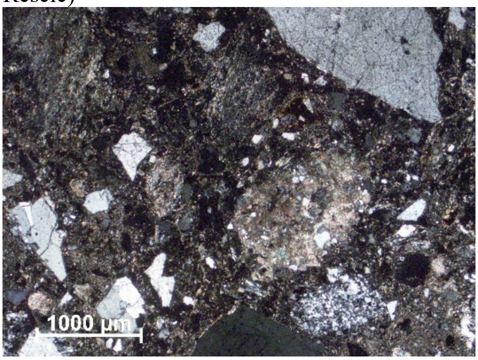

Fig. 15- bedding mortar of the CF2 and CF3 (image at the optical microscope in thin section, crossed polarized light) (photo by S. Rescic)

Thus, with regard to mortar production technologies, one can point to a particular selection of raw materials (lime and aggregate) for the second group, while the other two groups indicate a lesser attention to the production of good quality mortars [SR,FF].

3. Conclusions

The combination of the archaeological data and the mineralogical-petrographic analyses of the building materials, with particular attention to the mortars, makes it possible to propose a well-defined construction sequence of the site and the building yards that characterised it over time. In particular, from the analyses of the mortar samples, it is clear that the surrounding wall (Period 0) and the first tower (Period 1) are actually part of a single construction moment, which we could define as Period 1. The archaeological subdivision, which originated from the evident physical resting of the CF1 angle on the boundary wall, thus represents only a constructive expedient of two different construction phases carried out at the same historical moment. In addition, it is evident that a reconstruction of the wall circuit of the summit area (CF3 and CF4) occurred concurrently with the reconstruction of CF2. From the archaeological reading, these data had only been assumed on the basis of the well-defined physical relationships between the various material components and the very similar masonry techniques, but thanks to the analysis of the bedding mortars, they were confirmed. Also of interest is the clear differentiation in the composition of the binder in the masonry of the CF1 elevation with that used for the construction of CF2; these two operations had been archaeologically interpreted as belonging to the same construction phase since they featured similar masonry techniques, instead they show clear signs of their distinct time scanning.

From a building point of view, some reflections on the techniques and materials used in the different building periods can also be proposed. In this case, the analysis carried out on Castiglion Balzetti showed three very different situations ascribable to the three main building periods analysed in this contribution. Period 1 attests the construction of the site, built with a well-defined masonry technique, with well-squared angles and large ashlars. The mortars of this period were made with an aggregate taken directly from the ground on which the fortress was being built and a binder obtained by burning impure limestones. This period is followed by a reconstruction of part of CF1, carried out in Period 2, which instead presents a more irregularly laid masonry, with smaller ashlars defined by perfectly squared angles. This appears to be a punctual operation that does not change the morphology of CF1 and that portion of the settlement. The mortars of this period were made with an aggregate taken from the bed of the stream at the base of the relief of the rock and a binder obtained by burning pure limestone. The most evident change, however, occurs in Period 3 when CF2, CF3 and CF4 are realised and the space of the summit area is redefined. The use of hewn stones laid in horizontal and parallel rows and with perfectly squared angles is attested in this period. The introduction of the chisel is also attested in this period, in addition to the subbia, the use of which is also attested in earlier phases. The mortars of this period were made from an aggregate taken from the bed of the nearby stream and a binder obtained by mixing lime and earth [SR, AA, FF, MM].

Authors contributions are indicated by the initials of their names at the end of each paragraph: SR (Silvia Rescic), AA (Andrea Arrighetti); FF (Fabio Fratini); MM (Manuela Mattone)

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