# 5 DEFENSIVE ARCHITECTURE OF THE MEDITERRANEAN
## XV to XVIII Centuries

Víctor ECHARRI IRIBARREN (Ed.)

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# Mapping building materials and alteration forms to diagnosis, conservation and restore: a Norman castle in Sicily

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**Abstract**

In this short paper we present the results of a diagnostic study performed on building materials of the Adrano Castle in Sicily, part of a system of watchtowers extending around the Etna Mountain. Stone materials, plasters and mortars have been studied from macroscopic point of view to produce maps of the Castle façades. The results of this study provided a fundamental contribute to the reconstruction of architectural phases interesting the Castle and the definition of relative chronology based on micro-stratigraphic data, greatly supporting also the restoration works in selecting compatible replace materials.

**Keywords**: construction materials, Norman castle, alteration mapping

## 1. Introduction

The diagnosis of construction materials and alteration patterns of ancient buildings is a fundamental moment in restoration and maintenance actions. Beside the necessary architectural and historical studies, a material science approach is of particular importance in architectural Heritages as Castles, in which the variety of construction materials (*i.e.*: stones and mortars) pose numerous questions about raw materials supply and technological chooses. Moreover, the in deep knowledge about materials can help to identify construction phases, especially when multiple socio-cultural stratifications are quite evident (Antonelli et al., 2012). Finally, specific information are required during conservation and restoration actions for the formulation of compatible repair materials (Henriques, 2004).

All the aforementioned fields of interests, *i.e.* the archeological, the scientific and the conservation fields, are reasons behind the researches performed on the construction materials of the Adrano Castle (Catania, Sicily) (Fig. 1), a watchtower whose foundation is attributed to the Norman leader Roger I, around 1070. According to the scholars, the tower was probably part of a wider system of fortification established by Normans to control the Sicilian island (Maurici et al., 2008), as testified by the geographic position of the neighboring Paternò and Motta Sant'Anastasia Castles built along the Simeto river valley.

Even if the Castle has been extensively studied from the archeological and architectural point of view, numerous questions about construction phases and technological aspects are currently opened.

The watchtower was probably remodeled several times to accommodate both housing and military requirements. The structural features clearly suggest, in fact, almost two construction phases, involving the tower itself and the later addition of fortification walls.

Fig. 1 – The Adrano Castle; courtesy of Arch. Marcellino (Superintendence for Cultural Heritage of Catania).

The recent restoration works started in 2015 offer an excellent opportunity to characterize construction materials and support restores in formulating appropriate repair and replace stone and mortars.

## 2. The Adrano Castle

The Adrano Castle was built by using the *opus incertum* technique (stone blocks, bricks and mortars). Stone materials mainly consists in volcanic blocks, employed for foundations, window's architrave and pilasters, largely available locally (Branca et al., 2011). Local raw materials seem to be used also for the manufacture of plaster and mortars; all the façades are in fact characterized by wall covering plasters with coarse grained volcanic aggregates. However, the role of volcanic ash in mortars formulations, *e.g.* technical, to manufacture hydraulic systems, and/or purely aesthetical, is not actually clear.

Diagnostic surveys and an accurate sampling of mortars and plaster from the façades of the Castle have been carried out with the aim to (i) map and characterize construction materials, and (ii) highlight the eventually changes in raw materials and mortar formulations over the building levels.

## 3. Façades maps

In Figures 2-5 we report the lithological maps describing the different stone blocks and wall covering plasters discriminated during the surveys on the Castle façades.

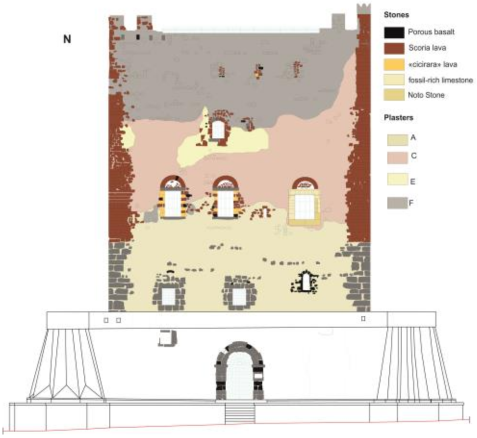


Fig. 2 – North-facing façade.

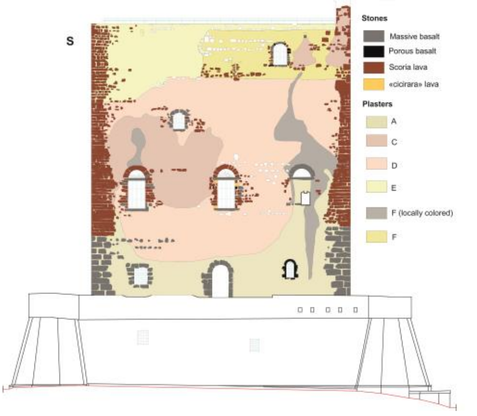


Fig. 3 – South-facing façade.

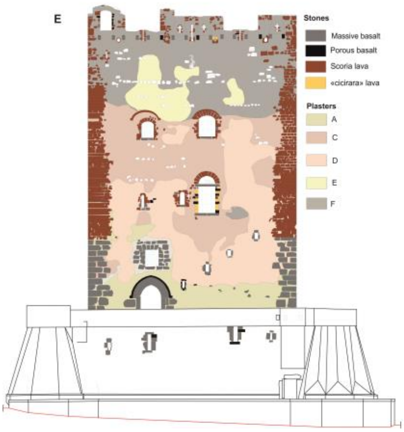


Fig. 4 – East-facing façade.

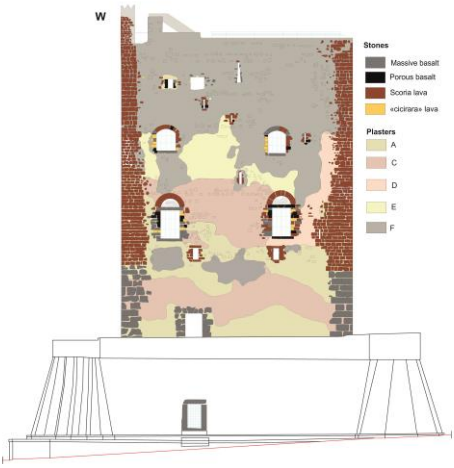


Fig. 5 – West-facing façade.

## 4. Main macroscopic features of stone materials

Stone blocks employed in foundations, walls and architraves show an interesting variability over the different levels of the tower.

As regard ground floor and first floor, architectural elements consist in lithotypes attributable to basaltic lavas quarried from Etna Volcano (Branca et al., 2011). In particular, two lithotypes can be clearly discriminated: a massive basalt, ranging from dark to dark gray in color and with naked eye olivine (Fig. 6a) and a quite porous and vesicle-rich basalt stone which employment is limited to smaller windows and decorative elements (Fig. 6b). Even if both lithotypes are widely available in the local geological context, the macroscopic examination do not allow exactly identifying their supply quarries. On the upper levels, the lithological variability of architectural elements is enriched by the occurrence of stones consisting in reddish volcanic scoria blocks (Fig. 6c) and lavas characterized by abundant white plagioclase phenocrystals (Fig. 6d), ascribable to the ancient quarries of basaltic scoria interesting the geological Mongibello Unit (in the territory of the near Bronte city) and the well known "*cicirara*" basalt lavas, respectively (Branca et al., 2011).

Noteworthy is that only in correspondence of one window at the second floor (see Figure 2) the volcanic lithotypes are associated with almost two different typology of sedimentary blocks (Figure 6e-f): a white-gray, fossil-rich carbonate stone and a creamy fine grained carbonate stone, the latter one recognizable as Pietra di Noto (Anania et al., 2012).

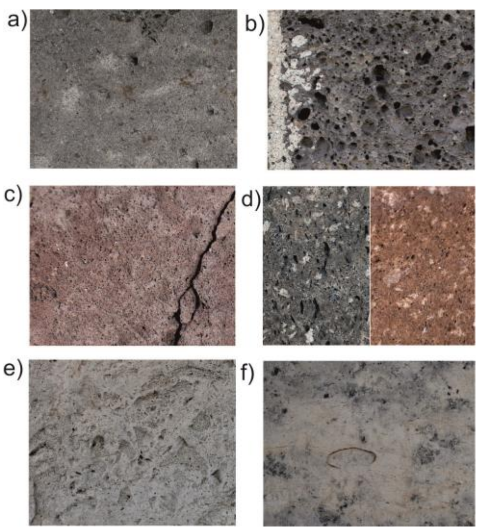


Fig. 6 – Lithotypes identified during the diagnostic survey.

## 5. Macroscopic features of mortars

The lithological mapping of the architectural elements indicates a change in raw materials supply over the different tower levels, suggesting almost two (even three) remodeling actions. Effectively, the analysis of mortars and plasters on the façades seems to confirm this hypothesis, adding further information on changes in mortars receipts over the time.

A part from a slight chromatic variability, mainly due to the presence of thin colored layers and/or chromatic alteration, the micro-stratigraphic analysis of wall plasters allow to identify almost two different stratigraphy:

- at ground floor and first floor, the outer layer (called A) is made up of whitish-gray (Munsell Index 10Y-7/1) binder, with lumps and coarse grained volcanic aggregates angular in shape; layer thickness range from 1 to 2 cm and exhibits a medium cohesion. Beneath this layer, a friable and degraded layer (called B) white in color (M.I. 10YR-8/1), with medium-fine volcanic aggregates, abundant lumps and low layer cohesion covers the walls stone blocks (layer thickness 2-4 cm) (Fig. 7a);

- up to the second floor, almost other two plaster formulations can be identified, only occasionally associated with the previous stratigraphy: (i) an outer layer (called C) characterized by white binder (M.I. 10YR-8/1), coarse grained volcanic aggregates angular in shape, with rare lumps and medium-high cohesion, 2-3 cm in thickness; (ii) an inner layer (called D) characterized by white binder, fine-grained volcanic aggregates, rare grog, medium-high cohesion and discontinuously covered by a pale-red plaster.

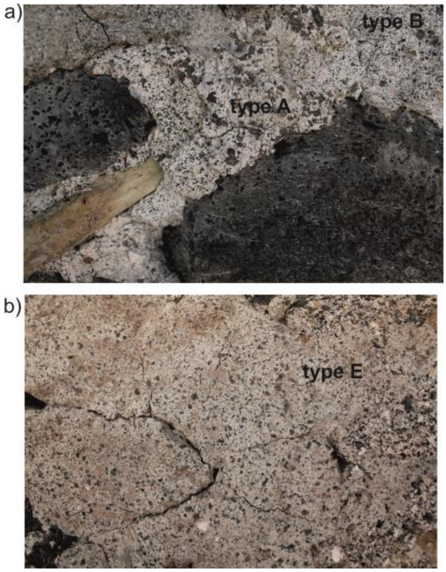


Fig. 7 – Examples of (a) type A and B plasters on first floor and (b) type E on third floor.

Without a systematic stratigraphic sequence, up to the second-third floors, two more plaster formulations can be distinguished: a white binder plaster (called E) resembling type D (Fig. 7b), and a gray (M.I. 5Y-7/1) cement binder plaster (called F) characterized by high cohesion, quartz sand aggregates and volcanic coarse-grained aggregates, not systematically covered by a pale-red colored layer.

## 6. Discussions and conclusion

The diagnostic survey performed on the Adrano Castle allow us to obtain preliminary and fundamental information on construction rules and materials employed in different phases of the watchtower lifetime, greatly useful in supporting restorers and architects.

First of all, the micro-stratigraphic data collected on plasters suggests that artisans applied almost two plaster layers on the castle façades: an outer and thin layer characterized by coarse-grained volcanic aggregates, and a inner thicker layer enriched by fine-grained volcanic ash. In spite of functionality, this sequence had credibly an aesthetical value.

Apart from the construction of fortification walls, the towers was credibly remodeled almost twice; we can speculate that materials (both stone blocks and plasters) occurring at the ground floor and first floor are related to the original building. A *cesura* is evident up to the second floor of the façades, where the occurrence of a different type of stone blocks (scoria and "cicirara" lavas) in architraves and new plaster formulations (types C and D) resembling types A and B indicate a new construction phase developed by using aesthetically compatible materials. A remarkable and subsequent remodeling, probably related to new housing requirements, can be also hypothesized by the occurrence of sedimentary stone blocks on the north-facing façade and the plaster formulation called type E.

Relatively modern rehashing are suggested by the presence of cement binder plaster, even made up assuring an aesthetical continuity with the entire building.

Of course, this work is far from its end. More and more aspects concerning the relation between aesthetical and technological choices, construction phases and historical events, raw materials supply changes and quarrying activity have to be disclosed. Nevertheless, it lays the foundation for a comprehensive knowledge of this outstanding watchtower.

**Notes**

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