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Analysis of evapotranspiration processes in the Sassi of Matera (southern Italy)

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Abstract

The Sassi of Matera (Basilicata region, southern Italy), inhabited since the Paleolithic period, has become an important tourist attraction in recent years. This interest has led to remarkable restoration of homes excavated in the tufaceous rock and suffering from severe moisture problems. To improve indoor hygiene conditions, the best way is to install HVAC systems. However, designing these systems must take into account the water coming from the walls. The awareness of the amount of water released into the environment due to evapotranspiration could be of great help in dimensioning the HVAC system. This paper illustrates the first results of a numerical analysis of the interaction between the mass of wet tuff and the internal environment of rock-clad dwellings.

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Keywords: The Sassi of Matera, historic buildings, recovery

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1. Introduction

The territory of Matera (Basilicata region, southern Italy) has been inhabited since the Paleolithic period and the earliest settlements, otherwise known as Sasso Caveoso and Sasso Barisano, were edified between two *grabiglioni*. The dwellings consisted of simple caves enclosed by a wall of excavated tuff blocks. Indoor environments were vaulted rooms built in the open space promoting further adaptations and extensions. Groups of dwellings around a common courtyard evolved into the social structure of the *vicinato* (neighborhood) sharing their facilities (e.g. tanks).

The water supply was highly organized, being collected on the plateau above and brought down by gravity for distribution to the community. As the town grew, more houses were excavated and built up on the hillside; the roofs of the houses below often acted as streets for the houses above.

This structure was left untouched until the 18th century. The continuous expansion and related interventions of the 19th and 20th centuries favoured the refusal of the ancient principle of land management based on the water supply and drainage on the plateau above. Matera and its urban fabric became the symbol of the misery of peasant life in southern Italy. Because of the concern of the Italian Government about this situation, legislation passed in 1952 led to the rehousing of the dwellers of the old quarters in new buildings and the desertion of the old town centre in the 1950s.

The Sassi is under the protection of the Italian State under the provisions of Law n. 771 of 11 November 1986, which allocated 50 M€ only for the conservative restoration and renovation of the dwellings.

The Sassi and the Park of the Rupestrian Churches of Matera have been included in the Word Heritage List since 1993, because "*The Sassi quarter of Matera is the best surviving and most complete example of continuity in the Mediterranean region of this type of settlement, which developed in close harmony with the ecosystem*".

The restoration and recovery works now in progress should follow the criteria set out by the Venice Charter for the Conservation and the Restoration of Monuments and Sites [1]. These are very important and valuable tools to achieve the goal of conservation (compatibility, minimal intervention, reversibility, distinguishability, expressive authenticity, durability and respect of the original tissue). During the past decades, The Sassi have become a very popular tourist attraction. This interest has fostered the cultural and economic revival of Matera resulting in important restoration and recovery works that caused it to be declared the European Capital of Culture 2019. Moreover, this event has accelerated the process of renovation of the old dwellings which are becoming private homes and hotel facilities. The recovery, now in progress – especially in the Sasso Barisano – is quite easy from a structural perspective, while it is challenging in terms of layout design. In particular, the retaining walls are affected by serious problems relating to dampness, which affect the indoor environmental quality in terms of thermo-hygrometric and indoor air quality. This means that to make The Sassi habitable, HVAC systems need to be installed whose design requires considerable care regarding dehumidification and ventilation issues.

The idea forming the base of the research that we are carrying out is that if we are able to find the causes responsible for the presence of water within the tuff bank and solve the problem upstream by reducing the evaporation in the various rooms with less complex systems. This paper outlines and discusses the preliminary results of a numerical analysis on the tuff bank-walls-indoor environment interaction based on the data collected via in-situ and laboratory tests.

2. The Sassi

The recovery of historic buildings starts with gaining in-depth knowledge. No work can be performed on a building artefact, which is evidence of the past, without first having investigated the construction techniques with which it was made, the work that it has been subjected to and any structural and plant modification [2, 3, 4]. This same course can be extended to a different scale from that of the building to that of the neighborhood. This is the case of The Sassi: first the long history and the particular architecture of The Sassi should be taken into consideration before even thinking of rehabilitation. If you have never been to this city, just imagine two slopes that depart from the valley of the Gravina Torrent up to the Civitas walls. These two