PROCEEDINGS OF SWBSS 2021

Fifth International Conference on
SALT WEATHERING OF BUILDINGS AND STONE SCULPTURES

22-24 September 2021
Delft, the Netherlands

EDITED BY
Barbara Lubelli
Ameya Kamat
Wido Quist

TU Delft OPEN

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WELCOME NOTE

Dear colleagues,

Welcome to the 2021 edition of the conference “Salt Weathering on Building and Stone Sculptures”!

This is the 5th edition of the conference, after Copenhagen (2008), Cyprus (2011), Brussel (2014) and Potsdam (2017), and it is the first time the conference is held in hybrid form, due to the COVID-19 pandemic. It is a challenge to organize an event in such an uncertain situation and to make it as attractive and interactive as the previous editions. We hope to meet your expectations!

I’m very glad, that despite the situation, the interest for the conference is strong: we have received more than 40 contributions from 18 countries from all over the world. This confirms the relevance of the problem of salt weathering for the built cultural heritage and stone artifacts in a wide range of environments.

Moreover, the broad spectrum of approaches to the subject presented in these proceedings highlights the importance of the interaction between different disciplines as well as between fundamental research and practice of conservation. I wish this conference to contribute to this fruitful exchange, and to generate new research ideas, whilst strengthening and broadening interdisciplinary collaborations.

On behalf of the organizing committee, I’m looking forward to welcoming as many as possible of you in Delft. We hope that, next to participation to the conference, you will find some free time to visit the city. You can stroll along the canals, enter a windmill, visit the Prinsenhof museum and the Blue Delft Factory, admire the architecture and sculptures in the Old and New Church and, if you are looking for a real Dutch experience, you can rent a bicycle and visit the surroundings!

This event would not have been possible without the collaboration of several persons. I would like to thank, on behalf of us all, the Scientific Committee for carefully reviewing the papers and contributing thereby to the high quality of the published contributions. My personal thank goes to the organizing committee who significantly contributed to the organization of this event and to the preparation of the proceedings. Last but not least, I’d like to thank the Cultural Heritage Agency of the Netherlands for co-sponsoring the event and RILEM (International Union of Laboratories and Experts in Construction Materials, Systems and Structures) for contributing to the dissemination.

I sincerely hope you will enjoy the SWBSS2021 conference,

Barbara Lubelli

Chair SWBSS2021 conference
Delft University of Technology
Faculty of Architecture and the Built Environment
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EFFECTS OF SEA-SALT AEROSOL ON THE COASTAL TOWERS OF NORTHERN PUGLIA

Cristina Tedeschi[1*], Francesco Di Benedetto[2], Giordano Montegrossi[3] and Michele Coppola[4]

KEYWORDS

Coastal towers, Northern Puglia, limestone, Gargano, sea-salt aerosol

ABSTRACT

This research aims to contribute to the understanding of the degradation mechanisms of the abandoned coastal towers of Northern Puglia. The buildings are subject to multiple deterioration processes largely due to environmental factors. The strong decay of mortars and stones evolves quickly causing a constant loss of material and partial collapses. In this case study the results of some investigations conducted on the Sfinale Tower (Figure 1 left) are presented. This tower was built on a rocky spur near the town of Peschici in 16th century, within the program of the coastal defenses of the Kingdom of Naples [1]. The objective of this research is to understand the dynamics of decay of the carbonate stone materials, trying to evaluate the contribution of individual environmental factors. The first phase of investigation addressed the historical, morphological and technological knowledge of the tower through the study of documentary sources, architectural survey and macroscopic *in-situ* observation. The second phase of the investigation focused on the effects of salts on the materials, cross-checking the available data with those obtained from lab tests (X-ray Powder Diffraction, and Mercury Intrusion Porosity,(Figure 1 right) carried out on detached fragments. The chemical and mineralogical characterization of the stone allowed the assessment of their physical and chemical alteration. Apparently, all samples consist of almost exclusively calcite, fully in line with the rock composition discussed in the literature for the Apulian calcarenites from Gargano [2]. Through the creation of analytical models of the behavior of rocks on a thermodynamic basis, the possible relationships between the

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saline component of the aerosol and the main mineralogical components of the rocks were evaluated.

This also made it possible to define the role of the marine aerosol itself in the supply of salts. The mineralogical composition of the stone was used together with reference composition of a marine aerosol/PM10 model for a thermochemical modelling of rock alteration [3]. Most of the components of the marine aerosol are non reactive, leading to the deposition of salts. Conversely, the sulphate present in the PM10 originating from sea water spray and from pollution, could start a sulfation process on the building. The presence and distribution of chlorides was evaluated in relation to the porosity and the chemical composition.

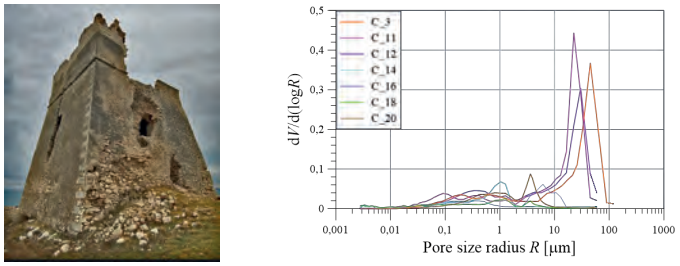

Figure 1: View of the tower from NE (left) ; Pore size distribution of stone measured by MIP (right)

It can be observed that exposure to the wind generally determines an increase in the total porosity values and the Median Pore Radius Volume. The most significant variation occurs respect to the pore distribution rather than to the total porosity. The main source of degradation of the stones of the Sfinale Tower appears mostly linked to crystallization of sodium chloride, rather than to a chemical process promoted by sulfates (in the marine spray). The degradation is characterized by erosion or pulverization due to saline crystallization, which penetrates into the porous stones damaged by the erosion of the winds. The salts growth is triggered by changes in temperature and humidity, and can occur frequently under the influence of fluctuating environmental conditions. In addition to the crystallization pressure of the salt, other mechanisms have contributed to the damage, such as the high moisture content coming from the soil due to rising damp.

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