

## **The Roofs of Dubrovnik**

### **A memory of a lost dimension**

#### **Introduction**

The heritage science project RE-DU-TILE of the so-called “*fifth façade*” in the city of Dubrovnik Croatia, presents a multidisciplinary approach in documentation and research of the roofing panorama of the historical town centre.

Dubrovnik is situated on the Adriatic Sea and under the Srđ Mountain (427 m). Seen from the mountains, the colourful rooftops are a distinctive feature that can be seen from afar. In addition to being declared a UNESCO World Heritage Site in 1979, this town in fact forms a prominent example for many other cases in European historical cities and towns where modern industrial ceramic roof tiles are defying the principles of architectural heritage preservation.

While an earthquake in 1979 resulted in the destruction of 30% of the historic roof structures, the War of Independence in the 90’s caused 70% loss.

The post-war reconstruction started in 1993; the UNESCO Action plan intended the panorama of Dubrovnik to keep its identity. Following the Plan, the new roof tiles should have the same structure, colour and shape as the historic originals. The company Zagorka produced roof tiles of the two types "Dubrovnik" and “Libertas” in two colours, ochre and red. Their random mixing was intended to reduce the monotony of the modern roofing.

The reason for some notable shortcomings is that during the modernizing production processes since the 19<sup>th</sup> century, the brick industry did not follow the traditional production process and firing temperatures (which were controlled by observing the colour of the fire in the kiln). On the other hand, economic considerations led them towards fine-grained and homogeneous clay greenware, exact shaping and moulding techniques, and to high firing temperatures, leading to products of uniform colours and dimensions, sharp edges, compact texture and smooth, often glossy surfaces. All this is in agreement with modern quality standards and norms, but it strongly disregards the standards of cultural heritage conservation, which stress the importance of using compatible materials in technical and aesthetical terms.

Even from a technical viewpoint, the modern tiles, with an expected life span of 80 to 100 years, are likely to be far less durable than the historic tiles. Experience of originals, which of course reflects many individual factors, prove a much longer lifetime due to higher porosity and a wider range of micro biodiversity. Following the research of the Rheinisches Amt für Denkmalpflege in Germany, middle age roofing tiles dating from 1300 are still stable. We observed even longer durability and higher porosity in the roman *Imberexes* and *Tegulas* from the Roman Collection of the State Collections of Lower Austria and previously in the Archaeological Collection in the Museums and Galleries of Konavle in Croatia.

## **Material**

Historic roofing tiles collected by the Society of Friends of Dubrovnik Antiquities since the post-war restoration of Dubrovnik made a base for its classification system. At the University for Applied Arts Vienna, in cooperation with the University of Life Sciences in Vienna, a range of scientific analyses on historic and modern tiles, as well as on specially fabricated samples, were performed.

In-situ drone photographs of the 1996 and more recent tiles, along with historical photographs contributed by citizens and dating from between 1920 and the 1990's, together served to map the northern part of the city and helped to compare historical roofing with that currently found in 2021.

In addition, observation of the Roman Collection in the State Collections of Lower Austria provided diverse ceramic construction elements.

## **Methodology**

The presentation will provide an overview of the analytical approach and selected results in ceramic roofing tiles regarding material research. Scientific techniques, including XRF, OM and SEM microscopy of surfaces and cross-sections, as well as clay research, considers the visual and porosity impact of historic roof tiles in comparison with modern ones. Drone images from 1996 were compared with the current state of preservation in 2021.

## **Results & Conclusions**

The research resulted in a classification system for the different types of roofing tiles made from the 13th until the early 20th century, when their production in Dubrovnik ended.

Drone images of recent interventions on Dubrovnik's roof tops shows new terraces, baldachins, added house levels and a wide range of recent interventions in the form of intensive reconstructions of the roofing panorama made in the last 28 years. It seems that since 1996, every generation leaves its individual intervention as a stamp on the "*fifth façade*" which leads to an increasingly unrecognizable state.

Based on general conservation principles, which respect the tiles as a defining element for the overall impression of the roofs, it was decided that the changes made in the second half of the last century cannot be undone or reversed.

The post war restoration of Dubrovnik in the 90's reflects probably the best example of the preservation of cultural heritage in Europe concerning architectural heritage in respect of its main four facades. At the same time, through the current state of preservation it seems that the "*fifth façade*" was rushed into reconstruction (in order for the houses to become habitable again) - which led to general neglect of other considerations.

## **Discussion**

The company Wienerberger AG, together with diverse Austrian brick industry partner, is already trying through their campaign and projects with the Technical University of Vienna to give a sustainable solution with their products in response to climate change demands. In addition to the sustainability of ceramic materials, clay pits support micro biodiversity and help maintain the ecological cycle. Economic demands of recent circumstances do not correspond with actual cultural heritage preservation standards.

In general, the technology of historic ceramic material will remain a secret of the original craftsmen until invasive scientific methods sufficiently analyse the originals. In the long term, through combining heritage science project based on scientific research with technological studies of archaeological roman bricks and roofing tiles, which must include tight cooperation with industry partners, the results can be incorporated into the overall monument protection strategy.

## **References**

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