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The color in the vernacular bioclimatic architecture in Mediterranean region

Fabiana Convertino^a, Silvia Di Turi^{b,*}, Pietro Stefanizzi^a

^a*Polytechnic University of Bari, via Orabona 4, 70126, Bari, Italy*

^b*Construction Technologies Institute, National Research Council, via Paolo Lembo 38b, 70124, Bari, Italy*

Abstract

The building sector plays a crucial role in relation to energy and environmental issues. For this reason, today, it pays great attention to the need of a bioclimatic architecture closely related to environment, history and traditions of the various places. In this context, the guidelines for careful planning of environmental issues can be traced precisely in vernacular architecture, the result of a close link with the territories and a great sensitivity towards nature.

This study focuses on an example of vernacular Mediterranean architecture, represented by the old town of Ostuni (Puglia, Italy). The objective is to analyze the peculiarities of the building and urban layout, with particular attention to the external coating with white lime base, showing in detail the influence of the staining on microclimatic conditions. The results of the carried out analysis highlight the benefits and weaknesses of studied constructive solutions. Thus, it is supported the view that it is necessary to rediscover and be inspired by the vernacular architecture, not representing them as anachronistic, but always drawing on the contributions of technical and scientific progress. The research points out the influence of exterior finishing surfaces on the energy performance of buildings as well as on the outdoor thermal and visual comfort of the inhabitants.

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* Corresponding author. Tel.: +39-349-073-6698

E-mail address: silvia.dituri@itc.cnr.it

1. Introduction

In the last decades, there have been intense internationalization in architectural style, indifference toward local climatic conditions and tendency to mechanical control of hygrothermal parameters. However, the energy crisis and the environmental question have shown up the need of a renewed approach.

Thus, a new sensibility towards bioclimatic architecture has developed and has given rise to the definition of “passive-house”: in order to guarantee environmental comfort, it uses natural climatic resources and has a close connection to places’ and climates’ characteristics.

Manzano-Agugliaro et al. [1] show that bioclimatic architecture and passive strategies are, nowadays, studied a lot: such techniques are an integral part of contemporary design [2] and bioclimatic principles allow to cut down energy consumption and CO₂ emissions in the building sector [3].

In this regard, vernacular architectures are the result of an adaptation to climate and surrounding context, achieved thanks to experience and traditions [4]. Passive strategies in vernacular architectures contribute to create satisfactory microclimatic conditions and a certain indoor comfort. This is evident in Mediterranean architectures [5-8], characterized by great attention to orientation, limitation of openings, shading systems, great thermal inertia of envelope, light colored external coatings, exploitation of natural ventilation.

One of their most typical feature, but also one of the least studied, is the white color of the external finishing layer.

It is known that solar radiation affects thermal loads and energy needs of buildings [9] and the use of cool materials, with high solar reflection, is spreading in building envelopes to cut down energy requirements for cooling and CO₂ emissions [10-13]. However, very few authors dealt with the analysis of the influence of outer finishing’ colors in buildings [14,15]. This is due to lack of data on optical properties of materials. Such characteristic affects indoor microclimate and buildings’ energy need and it is an important aspect in vernacular Mediterranean architectures. Numerical analysis showed also that light, reflective and highly emissive external surfaces cut down the phenomenon of urban heat islands [16]. Besides, their high reflectance influences outdoor visual comfort: in some cases, visual performance decreases because of high levels of luminance that can reach 20.000-30.000 cd/m² [17] and glare problem; in other cases, such levels are lower and improve comfort thanks to better controlled lighting’s conditions, in particular urban configurations. It happens in old towns: dense urban fabric and high shading level, which influences lighting’s conditions along the streets and whose effects on buildings’ surfaces are a dynamic and complex problem [18], are made up for light and reflective surfaces that increase outdoor and indoor comfort. Visual comfort is, then, an added quality in an open space, which adapts itself to “luminous climate” of place [19].

This work results from these considerations and analyzes a typical case of Mediterranean vernacular architecture in the old town of Ostuni. The aim of the study is to investigate its chromatic feature and to know the effects on thermo-physical indoor behavior and on outdoor visual comfort.

2. Case study

2.1. Description of the context

Ostuni (Puglia, Italy) is a town characterized by a thousand-year history, which covers, with its small white houses, three hills of the Murgia, at an altitude of about 230 m above sea level. It is known as “the white town”, due to the white limestone that is the main building material in the old town, and the lime-wash finishing. The medieval old town of Ostuni has, from the urban point of view, an elliptic shape, with small closely assembled houses, separated by narrow and twisted streets that turn along the walls of the town and twine concentrically. Clearly, this scheme is not planned but spontaneous, due to people’s adaptation to topographic features (Fig. 1).

From the building point of view, here there are three typical features of the traditional Mediterranean architecture: thick walls with high thermal inertia; few, small and deep window openings; the white color of the lime-wash. The building typologies of the so-called “white houses”, in the old town of Ostuni, are: row houses (arranged on single or double line), block houses and mixed building units.

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