



72<sup>nd</sup> Conference of the Italian Thermal Machines Engineering Association, ATI2017, 6-8 September 2017, Lecce, Italy

## Re-interpretation of an ancient passive cooling strategy: a new system of wooden lattice openings.

Silvia Di Turi<sup>a,\*</sup>, Francesco Ruggiero<sup>b</sup>

<sup>a</sup>Construction Technologies Institute, National Research Council, via Paolo Lembo 38b, Bari, Italy

<sup>b</sup>DICAR, Department of Civil Engineering and Architecture, Polytechnic University of Bari, via Orabona 4, 70126, Bari, Italy

---

### Abstract

Traditional passive cooling strategies are a very important tool in Mediterranean architecture to face climate changes and to limit energy consumption, both in new and ancient buildings, toward sustainability and reduction of fossil fuel consumption. Starting from the traditional architectural culture, the aim of the study is to understand how using and re-interpreting ancient constructive elements that interact with the outdoor environment, in order to assure the indoor thermal-hygrometric comfort. In this regard, the paper proposes the study of a new system of wooden lattice openings to be installed in Mediterranean buildings. It originates from the Islamic architecture and it is used especially to control natural light into the buildings. Actually, it has also the function to regulate the airflow into the indoor environment, mitigating the climate conditions and ensuring the comfort of inhabitants. For this reason, the research proposes the analysis of this system through modern computational tools and demonstrates that it can guarantee better indoor summer conditions, improving wind velocity and air change rate in the room.

© 2017 The Authors. Published by Elsevier Ltd.

Peer-review under responsibility of the scientific committee of the 72<sup>nd</sup> Conference of the Italian Thermal Machines Engineering Association

*Keywords:* lattice windows ; passive cooling strategies ; natural ventilation ; re-interpretation of ancient techniques ; CFD simulations

---

### 1. Introduction

In recent years, it is very important to face climate changes and design architectures that are suitable to reduce the energy consumption from non-renewable sources.

---

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

E-mail address: [silvia.dituri@itc.cnr.it](mailto:silvia.dituri@itc.cnr.it)

The ideas of bioclimatic architecture and the recovery of traditional knowledge have been extremely popular. The traditional architecture has often a better adaptation to climate than modern architecture. That is due to the materials as well as to the passive strategies used in the buildings.

Moreover, cooling of buildings, obtained with low environmental and energy costs, is now one of the main challenges in hot climate countries.

For this reason, the study of passive cooling systems, starting from traditional architecture examples, is very important in order to reduce the energy consumptions during summer, in the point of view of sustainability.

In particular, natural ventilation is a renowned as an ancient and cost-effective technique to cool indoor environments and manage thermal comfort in buildings [1]. At this regard, different ventilation strategies have always characterized the traditional architecture in the Mediterranean area.

In this context, the “mashrabiya” is a kind of window with carved wooden latticework that controls the passage of light and air flow, reducing the temperature and increasing humidity, besides ensuring privacy. It is a traditional element of the Arabic and Hispano Islamic architecture.

Some researcher studied the window shutters as tool for heat storage [2,3] and others investigated the mashrabiya in the point of view of natural lighting control and visual comfort conditions. Ruggiero et al. [4] affirm that the typical Islamic architectural façade meets two important aspect of vision. On the one hand, there is a physiological aspect, so that light does not cause any contrast, it does not give glare and assures the discernment of details; on the other hand, there is the psychological aspect: the system of holes made on the wall allows a view of the landscape outside and, thus, improves indoor work conditions psychologically.

Nevertheless, the two problems to be solved in hot climate are, at the same time, ventilation and protection from solar radiation. Standard windows cannot provide a solution to these two aspects and, therefore, the system of mashrabiya represents an opportunity to solve both of them. Almador et al. [5] studied similar kind of windows, the “Jaranas”, and demonstrated that they contribute to reduce the indoor temperature of about 1-2°C and are good strategies as ventilation tool. Moreover, the lattice performance improves when the blocked area increases, because air speed rises in the interstice area.

However, the way in which these systems can influence natural ventilation of buildings needs more investigation.

Therefore, the paper proposes the study of natural ventilation through a wooden lattice window to be installed in Mediterranean buildings, deriving the idea from a new prototype of mashrabiya, namely “The shutter”.

It was designed by a research group of Polytechnic of Bari [6] as a system of window inspiring to the examples of modern architectures, like Institut du Mond Arab in Paris by Jean Nouvel and Architecture Studio or Al Bahr Towers in Abu Dhabi by Aedas Architects. Two wooden fixed panels with dodecagonal holes contain wooden dodecagons that can rotate in order to provide natural ventilation or natural lighting control. One of the innovative aspects of this system is the possibility to control the regulation of the openings manually, by wooden levers (Fig. 1).

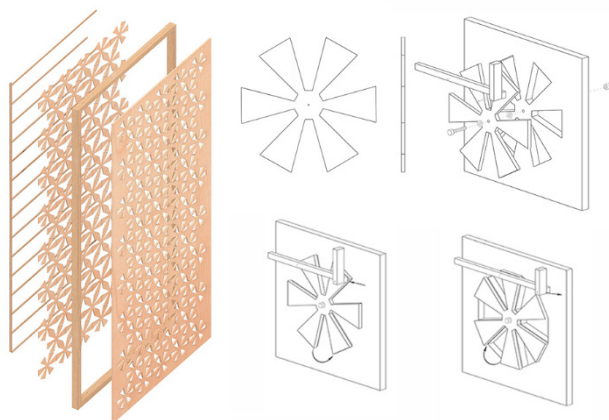


Fig. 1. The Shutter prototype: exploded view of a single module and kinematic mechanism of each mobile dodecagon. [6]

Download English Version:

<https://daneshyari.com/en/article/5444466>

Download Persian Version:

<https://daneshyari.com/article/5444466>

[Daneshyari.com](https://daneshyari.com)