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The influence of indoor microclimate on thermal comfort and conservation of artworks: the case study of the cathedral of Matera (South Italy)

Tiziana Cardinale, Gianluca Rospi, Nicola Cardinale, Lucia Paterino, and Ivan Persia

Università degli Studi della Basilicata, Dipartimento delle Culture Europee e del Mediterraneo, 75100 Matera, Italy (dicem@unibas.it)

The Matera Cathedral was built in Apulian-Romanesque style in the thirteenth century on the highest spur of the "Civita" that divides "Sassi" district in two parts. The constructive material is the calcareous stone of the Vaglia, extracted from quarries in the area of Matera. The interior is Baroque and presents several artworks, including: mortars covered with a golden patina, a wooden ceiling, painted canvas and painting frescoes, three minor altars and a major altar of precious white marble, a nativity scene made of local painted limestone.
The research had to evaluate the indoor microclimate during and after the restoration works, that also concern the installation of floor heating system to heat the indoor environments.
Specifically, we have analyzed the thermal comfort and the effect that the artwork and construction materials inside the Cathedral of Matera have undergone.
This evaluation was carried out in two different phases: in the first one we have investigated the state of the art (history of the site, constructive typology and artworks); in the second one we have done a systematic diagnosis and an instrumental one.
The analysis were carried out in a qualitative and quantitative way and have allowed us to test indoor microclimatic parameters (air temperature, relative humidity and indoor air velocity), surface temperatures of the envelope and also Fanger's comfort indices (PMV and PPD) according to the UNI EN ISO 7730.
The thermal mapping of the wall surface and of the artworks, carried out through thermal imaging camera, and the instrumental measurement campaigns were made both before restoration and after installation of the heating system; in addition measurements were taken with system on and off.
The analysis thus made possible to verify that the thermo-hygrometric parameters found, as a result of the recovery operations, meet the limits indicated by the regulations and international studies. In this way, we can affirm that the indoor environment of the Cathedral of Matera is suitable both from the point of view of indoor comfort (both during the summer and the winter season) and of microclimatic parameters that are in the intervals prescribed by the regulations on the conservation of artworks of art (Ministerial Decree of 10/05/2001 dictated by the Ministry for heritage and cultural activities). Moreover the energy performance of the building-plant system was evaluated according to the Italian Norm UNI TS 11300.
In particular the summer comfort is guaranteed by the huge thermal inertia of the structure that reduces the internal temperature fluctuation. Instead, the winter comfort is guaranteed by the floor heating system, which through the use of evolving fluid at low temperatures, also ensures higher efficiency and significant energy savings, as well as the protection and conservation of the artistic heritage present in the Cathedral.