

## **Italian guidelines for energy performance of cultural heritage and historical buildings: the case study of the Sassi of Matera.**

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The Sassi of Matera are a unique example in the world of rock settlement, developed from natural caves carved into the rock and then molded into increasingly complex structures inside two large natural amphitheatres: the Sasso Caveoso and the Sasso Barisano. Thanks also to this aspects Matera is an UNESCO world heritage site and was elected European Capital of Culture in 2019.

Our research focuses on the compatibility of the energy efficiency measures applied in of Sassi buildings with the recent MiBACT (Italian Ministry of Cultural Heritage) guidelines on “Energy efficiency improvements in the cultural heritage” and AiCARR (Italian Association of Air Conditioning) guidelines on “Energy efficiency of historical building”.

One of the essential measures highlighted by Mibact guidelines is ensure the Indoor Environmental Quality improvement of the historical architecture in order to preserve their identity and cultural heritage. These paper aims to analyze energy and environmental performance of different buildings typology and monuments present in the Sassi site.

The energy performance and microclimate measures conducted on different type of building by non-destructive measurements and laboratory tests in situ are useful to verify and quantify the thermal characteristics of the envelopes of the Mediterranean tradition and also to demonstrate their capacity to ensure internal comfort conditions. The calcarenite walls of vernacular building of Sassi show the excellent energy behavior of these constructions. But these material often present high moisture content which negatively influence the room microclimate in particular in presence of mural frescos and rocky churches.

However these structures, once restored and in a condition of normal use, give indoor comfort within the limits of thermo-hygrometrics standards established by indices as the predicted mean vote (PMV) and predicted percentage of dissatisfied (PPD).

Another interesting consideration stated from our researches is that these buildings are able to reduce the temperature oscillations of the external environment as a result of their high thermal mass. These traditional settlements are typical of the Mediterranean area that has summers with high temperature and daily thermal oscillations. So we can conclude that these buildings could be considered as bioclimatic.

Regarding the monuments, as the Matera Cathedral, the evaluation of the indoor microclimate during and after the restoration works shows excellent results and ensures the optimal preservation of artistic heritage from the thermo hygrometric point of view. The plant solution adopted (installation of floor heating system) is in line with the Italian guidelines because this type of system at low temperature allows high energy savings as it enables the use of combustion systems with high-efficiency (condensing boilers) and/or renewable energy installations (heat pumps, solar thermal collectors).

A complete knowledge of historical heritage and energy performance of Sassi building is a strategy indicated by Italian guidelines in order to preserve the identity of their inhabitants. So it is necessary to conduct a complete mapping of the entire heritage of this city and develop specific guidelines which combine technical and economic feasibility, appropriate landscaping and architectural integration and environmental sustainability within a proper building lifecycle.