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ScienceDirect

Energy Procedia 133 (2017) 281–289

Energy Procedia

www.elsevier.com/locate/procedia

Climamed 2017 – Mediterranean Conference of HVAC; Historical buildings retrofit in the Mediterranean area, 12-13 May 2017, Matera, Italy

Energy retrofitting of dwellings from the 40's in Borgata Trullo - Rome

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Abstract

Buildings with architectural constraints and recognized historical values entail careful design process, especially, when the aim is to improve the energy efficiency. Foreseeable interventions consist of preservation and improvement of building envelope energy performance as well as the adaptation of the built environment to modern use and its accessibility. The compatibility between the aforementioned constraints and its future more sustainable use represents the crucial challenge. In this paper, feasible interventions on the dwellings from the 40's in Borgata Trullo, Rome were designed and analyzed. Public housing asset is an interesting environment to test a sustainable holistic approach due to its homogeneity in terms of building technology solutions and typologies. Furthermore, the absence of public funding made more difficult the ordinary and extra-ordinary maintenance processes. So, the approach accounts for the age of the building along with the subsequent reduced energy performance as well as the architectural values to preserve. The proposed energy retrofitting measures are related to the building envelope, in the installation of insulation layers, the substitution of windows and improvement of HVAC systems to enhance energy efficiency. Besides the case study, design guidelines were presented to help the stakeholders in compatible and sustainable interventions. New HVAC solutions showed high gains in energy saving even if building envelope modifications were limited by the willing to preserve the cultural heritage values. Therefore, a virtuous restoration can address effectively current energy efficiency targets.

Peer-review under responsibility of the scientific committee of the Climamed 2017 – Mediterranean Conference of HVAC; Historical buildings retrofit in the Mediterranean area

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1876-6102
Peer-review under responsibility of the scientific committee of the Climamed 2017 – Mediterranean Conference of HVAC; Historical buildings retrofit in the Mediterranean area
10.1016/j.egypro.2017.09.389

Keywords: energy refurbishment; energy efficiency; public housing.

1. Introduction

Prioritizing sustainable urban regeneration can be considered the strategy to unlock urban resources towards healthy [1] and low-energy built environment [2]. Especially in highly urbanized areas, urban policy is definitely developing guidelines and best practices to address new issues such as outdoor thermal comfort [3], adaptation strategies to climate change [4] and more complex preservation measures for existing and listed buildings [5,6].

Today, the concept of urban renewal works with socio-economic regeneration and environmental impact, through appropriate energy improvement strategies and resource management but keeping in mind the preservation of historical, social and cultural values [7]. Old buildings, such as the ones built in the 60's to face the rising demand for housing, have often issues to be identified as cultural heritage rather than built environment no more suitable for modern society. Maintenance and refurbishment is the logical demand of this housing stock since many building components already reached the end of their useful life [8].

Beyond this critical issue, even where durability of materials is preserved, the design of those buildings entails high-energy consumption, spatial layout not suitable for modern society as well as neglecting many requirements obligatory according current regulations. Heading towards low or nZEB status is an achievable target if an integrated renovation is coupled with the analysis on energy production side as well as thermal management strategies [9,10].

The main lack in regulation is that the refurbishment framework from an energy point of view is the same for all building types, merging new constructions with large perspective of energy savings with listed buildings where even ordinary maintenance can negatively affect its preservation in terms of historical and architectural values. However, it is not realistic to push listed buildings to have energy performance as new buildings as well as adopting complex methods to explore energy saving potential [11]. Only, thanks to a careful and accurate planning of interventions can achieve optimal results from all points of view as already demonstrated in [12,13].

In order to assess the feasibility of urban regeneration Borgata Trullo was selected as case study. It is a public housing district built in the 40's in Rome, which is a representative example of the heterogeneity of case studies in Italy. This study is part of a comprehensive work done on public housing in Rome [14].

2. Borgata Trullo

Borgata Trullo is located in the south-west part of Rome, currently belonging to the Municipio XI, an administrative division of Rome Municipality. It takes its name from an ancient Roman tomb located on the right bank of the Tiber River. During the First World War, the Trullo area was the place chosen to locate the first industrial settlements. In 1917, Gaetano Maccaferri reclaimed land to build a barbed-wire factory for the military defence. Then, the Defence Ministry chose this area to set a branch of Genio Militare. Moreover, the area was also involved in the urban transformations for the Universal Exhibition of 1942.

In 1939, the fascist Independent Institute of public housing built up low-cost housing complexes, called borgate, composed by three villages: Torre Gaia, Quarticciolo and Trullo. The future users of those buildings were Italian settlers from France, Algeria, Egypt, Morocco and Tunisia. In detail, Borgata Trullo was designed as a complex of 336 apartments, divided into three main lots: one central plot, a southern lot and a northern one [15,16].

The Borgata was provided with roads, water and electricity services. Roberto Nicolini and Joseph Nicolosi were the designers following modern criteria and allusive architectural language to the rationalists themes. As shown in Figures 1 and 2, different kind of spaces were designed such as the balcony and staircase, kitchen gardens and private gardens were built. Great part of the buildings is composed by two or three floors with a specific focus on orientation to North-South and East-West for increasing the received solar radiation.

The buildings were conceived as the combination and series of two modules, called QE and QS. The QE contains four apartments per floor, each one consisting of three rooms and accessories, served by balcony with access from a single head-scale, as shown in Figure 3.