Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 126 (201709) 565–572

Energy Procedia

www.elsevier.com/locate/procedia

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

Architectural and energy refurbishment of the headquarter of the University of Teramo

Mattia Manni[a*], Raffaele Tecce[b], Gianluca Cavalaglio[a], Valentina Coccia[a], Andrea Nicolini[a], Alessandro Petrozzi[a]

[a]*CIRIAF-CRB, Via G. Duranti, 06125 Perugia*
[b]*Università di Perugia, Via G. Duranti 06125, Perugia*

Abstract

The recent seismic events, which distressed the population of the Central Italy, have caused the incompliance with national safety standards of several historical buildings. In particular, the headquarter of the University of Teramo revealed some structural damages which make necessary to operate a restoration of the buildings. It represents a rare opportunity for investigating possible applications of a cluster of technologies and approaches largely recognized as efficient and high-performing to such particular buildings in order to achieve an upgrading in terms of energy efficiency. The proposal includes the improvement of the exploitation of renewable energy sources through adequate systems, which do not modify the visual perception of the pavilions. In that regards, the required electricity could be produced by a PV roofing installed on the parking area, while a biomass boiler and an absorption chiller could allow supplying the thermal and cooling needs. Furthermore, the rain water recovery system permits to reduce the exploitation of potable water for uses which do not require a high quality, such as irrigation. On the other hand, the envelope energy efficiency could be enhanced by applying passive strategies for reducing the heat losses (*winter conditions*) and gains (*summer conditions*) through façades and roof. The results confirmed the reliability of those interventions and the consequent advantages from an economical and energy point of view.

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

Keywords: Energy refurbishment; historical architecture; sustainability; post-seismic reconstruction

* Corresponding author. Tel.: +39-075-585-3806 ; fax: +39-075-515-3321 .
E-mail address: manni@crbnet.it

1876-6102
Peer-review under responsibility of the scientific committee of the 72nd Conference of the Italian Thermal Machines Engineering Association
10.1016/j.egypro.2017.08.290

1. Introduction

In restoring buildings, the energy efficiency and the environmental sustainability represent two important topics which are defined in European, national and regional programming tools. In Europe, the first directive about energy savings in buildings is the 2002 EPD-Energy Performance of buildings Directive, Dir. 2002/91/CE, which has been updated in 2010 by Dir. 2010/31/UE. According to that, buildings can account for 40% of total energy consumption and for 35% of greenhouse gas emissions in EU [1].

Following the seismic events that occurred in central Italy, the building industry is currently expanding and this would probably cause the increment of its energy consumption. The reduction of energy requirements for thermal and cooling needs and the exploitation in situ of RES represent two important strategies for reducing the dependency by fossil fuels and greenhouse gas emissions [2]. Those two approaches also play an important role in promoting security of energy supply, technological developments and in creating opportunities for employment and regional development.

Regarding historical buildings, the Italian Code of Cultural Heritage and Landscape [3] obliges the landscape masterplan office to update the lists of buildings to be subjected to specific and significant constraints due to their architectural, historical and cultural value. This list includes also buildings constructed during the first postwar period such as the pavilions assessed as case study. Those constraints usually reduce the number of interventions allowed and the possibility of improving the energy level and the envelope's insulation performance. Thus, the need of operating a restoration of the University of Teramo's campus could represent an opportunity for testing the applicability to architecture with an historical value of some technologies already applied to contemporary buildings such as PV plant for producing electricity, biomass boiler and absorption chiller for supplying the thermal and cooling needs, rain water recovery system for reducing the exploitation of potable water.

In conclusion, the study aims to investigate the efficiency of passive and active strategies applied to the historical pavilion aforementioned. Starting from the actual building configuration, it was improved the envelope's insulation performance level in order to reduce the thermal transmittance. Then, dynamic simulations were conducted in winter and summer conditions for estimating the energy requirements and define the plants' size. Finally, the enhancement was evaluated in terms of building's energy consumption, carbon footprint and economic advantages.

Nomenclature

ADSU	Agency for the Study Rights
RES	Renewable Energy Sources
PV	Photovoltaics
SR	Solar Radiation

2. Case study: the campus of the University of Teramo

The headquarter of the University of Teramo was built on 1929; it is placed very close to the historical walls, near the ancient road connecting the city to the regional administrative center of L'Aquila. The campus is organized in four buildings: Pavilions A and B, the biggest, which are used for the administrative functions, and the other two, a storehouse and an annex. The whole complex is surrounded by greenery and tall trees, providing privacy and nature, if compared to the adjacent neighborhoods.

When it was realized, between the First and the Second World War, the complex was not property of the University of Teramo and it hosted a hospital supporting the medical center. Even if it should had been just a separate headquarter, it rapidly became the hospital core of the area until the last decades of the 20th century. Then, the lot was converted into an academic campus, in which the administrative offices were located. The research conducted about the case study allowed to define its architectural evolution: the original drawings showed the differences between the realized complex and the original design and its variation during its operational stage. In particular, other three pavilions should had been built in addition to the existent two for hosting adequate spaces for specialized medical sections.