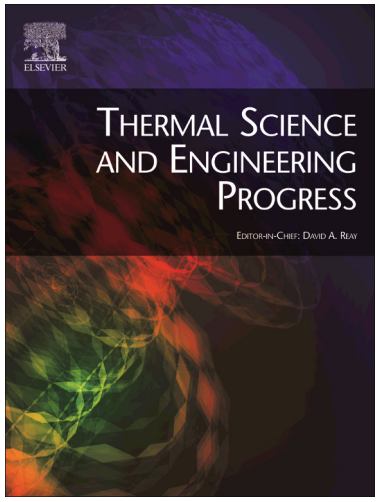


# sHourly simulations of an hospital building for assessing the thermal demand and the best retrofit strategies for consumption reduction

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# Hourly simulations of an hospital building for assessing the thermal demand and the best retrofit strategies for consumption reduction.

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**ABSTRACT**

In the framework of energy saving and environmental protection, the role of the energy consumption in buildings is crucial. For existing buildings and especially for public ones, it is mandatory to correctly select and realize suitable retrofitting interventions to reduce costs and increase the efficiency. In fact, innovative solutions for both the envelope and the plants renovation are often very expensive and the correct choice becomes critical for the sustainability from the economic point of view.
The aim of the present paper is to propose a methodology to optimize the process of selection for the retrofit interventions, here applied to a case study of the Monoblocco Pavilion at the San Martino Hospital in Genova, Italy. The building thermal behaviour is dynamically simulated by means of an Energy Plus model in order to evaluate the energy needs for both heating and cooling purposes. The base case scenario is evaluated in terms of key performance indicators (KPIs) and compared with benchmark values in order to select the more suitable intervention actions. For the analysed case study, the innovative retrofit solutions are façade void insulated panels, smart rotating windows with different emissivity glass and sunlight carrying optical-fibres coupled with dimmed LED lighting system. The technologies are combined in different intervention packages that are then compared in term of energy saving and economic sustainability by means of the estimation of hourly values of energy consumption and the assessment of the Simply Pay Back Period (SPB) of the investment.

**KEYWORDS:** Energy Saving, Buildings, Retrofitting, Energy Plus, Dynamic Simulations.

## 1. INTRODUCTION

Nowadays energy consumption in buildings is very high, reaching in Europe the value of 39% of the total energy consumption for commercial and residential buildings [1].
In this framework is very relevant the role of non-residential buildings (NR-buildings) for which the energy consumption due to space heating is coupled with a very high electrical energy consumption, constantly increasing, due to the extensive use of HVAC for cooling, electronic devices, lighting systems. This electric energy consumption was 42% of the total in 2005 and it is expected to reach more than the 50% by 2030 [1].
Thus, it is mandatory to change the approach in the building design and usage to reduce energy consumption and emissions, always keeping in mind the economic aspects of the suitability of the investment.
In this process is also important to maintain the same target of internal comfort conditions inside the building. In fact, it is not acceptable, for a building, to fulfil the near zero energy target deteriorating the indoor thermal comfort, even if the selected solutions are economically convenient [2]. On the contrary, it is better to choose more smart even if expensive solutions.
The correct approach is a comprehensive energy analysis of the whole building, considering both envelope and plants, leading to a reduction of the energy consumption up to 50% in offices [3].
To address the retrofit interventions, the first step is to analyse the present operating conditions of the building, evaluating the energy request for heating and cooling. To this aim, Aksoezen et al. [4] proposed a rough estimate of the energy consumptions based on the age of construction of the building, to allow fast and easy analyses of the existing building stock.
To calculate the energy demand of a building in an accurate way, a dynamic (transient) approach produces better results in term of accuracy because the inertia properties of the structure are taken into account. Vollaro et al. [5] presented a case study for a building located in an historical city in central Italy for which simulations are compared with in situ measurements of the thermal transmittance of the opaque walls and of the temperature field by means of a thermographic camera. In the comparison, a very good agreement is achieved only if a dynamic approach is applied.
Once evaluated the energy needs of a building, it is necessary to select proper technological solution able to fulfil energy saving. On this research topic, many studies have been developed in the recent years.
Some retrofit interventions are addressed to the envelope, to reduce the energy needs of the building also by optimizing the contribution of the solar gains. Some other technological solutions are finalized to the better use of energy, by increasing the efficiency of conversion plants.