World Academy of Science, Engineering and Technology
International Journal of Energy and Environmental Engineering
Vol:12, No:06, 2018

Energy Refurbishment of University Building in Cold Italian Climate: Energy Audit and Performance Optimization

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Abstract : The Directive 2010/31/EC 'Directive of the European Parliament and of the Council of 19 may 2010 on the energy performance of buildings' moved the targets of the previous version toward more ambitious targets, for instance by establishing that, by 31 December 2020, all new buildings should demand nearly zero-energy. Moreover, the demonstrative role of public buildings is strongly affirmed so that also the target nearly zero-energy buildings is anticipated, in January 2019. On the other hand, given the very low turn-over rate of buildings (in Europe, it ranges between 1-3%/yearly), each policy that does not consider the renovation of the existing building stock cannot be effective in the short and medium periods. According to this proposal, the study provides a novel, holistic approach to design the refurbishment of educational buildings in colder cities of Mediterranean regions enabling stakeholders to understand the uncertainty to use numerical modelling and the real environmental and economic impacts of adopting some energy efficiency technologies. The case study is a university building of Molise region in the centre of Italy. The proposed approach is based on the application of the cost-optimal methodology as it is shown in the Delegate Regulation 244/2012 and Guidelines of the European Commission, for evaluating the cost-optimal level of energy performance with a macroeconomic approach. This means that the refurbishment scenario should correspond to the configuration that leads to lowest global cost during the estimated economic life-cycle, taking into account not only the investment cost but also the operational costs, linked to energy consumption and polluting emissions. The definition of the reference building has been supported by various in-situ surveys, investigations, evaluations of the indoor comfort. Data collection can be divided into five categories: 1) geometrical features; 2) building envelope audit; 3) technical system and equipment characterization; 4) building use and thermal zones definition; 5) energy building data. For each category, the required measures have been indicated with some suggestions for the identifications of spatial distribution and timing of the measurements. With reference to the case study, the collected data, together with a comparison with energy bills, allowed a proper calibration of a numerical model suitable for the hourly energy simulation by means of EnergyPlus. Around 30 measures/packages of energy, efficiency measure has been taken into account both on the envelope than regarding plant systems. Starting from results, two-point will be examined exhaustively: (i) the importance to use validated models to simulate the present performance of building under investigation; (ii) the environmental benefits and the economic implications of a deep energy refurbishment of the educational building in cold climates.

Keywords : energy simulation, modelling calibration, cost-optimal retrofit, university building
Conference Title : ICEEB 2018 : International Conference on Energy Efficiency in Buildings
Conference Location : Vienna, Austria
Conference Dates : June 14-15, 2018