POLITECNICO DI TORINO
FIRST SCHOOL OF ARCHITECTURE
Master of Science in Architecture (Construction)
Honors theses

The expectations of the occupant in the energy calculation. Valuation of expected environment quality by the occupants on the request for heating and cooling

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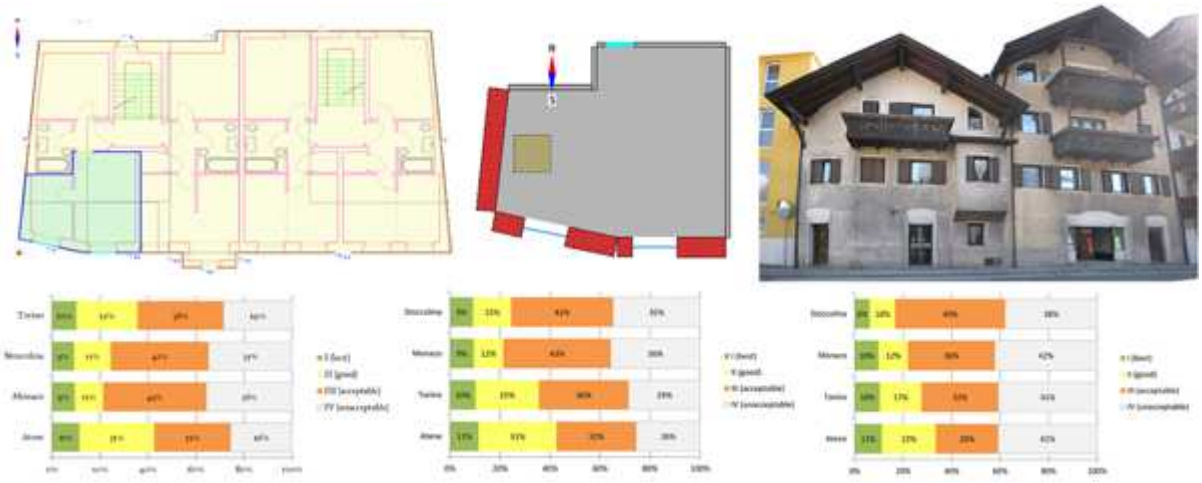
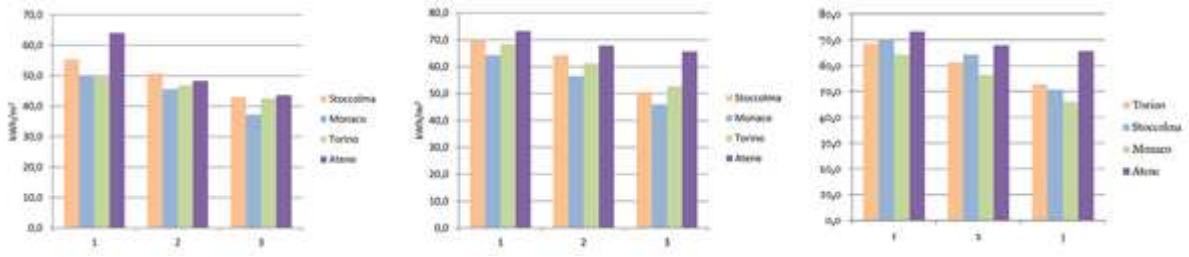
One of the aspects that highly influence environmental pollution in developed countries is the use of energy in buildings. In the case of European Union, beyond 40% of the total energy consumptions comes from buildings, and a large proportion of this energy is consumed in residential buildings. A large proportion of the world's energy consumption is spent in an effort to maintain a comfortable and healthy indoor environment. Consequently reductions in the energy consumed to climatise buildings are instrumental to the efforts of reducing energy related CO2 emissions and they are the main goal of sustainable architecture.
Building simulations programs are becoming more and more used in the design phase of the building but most of the tools are only capable of accurate simulations of the physical properties of the buildings, downplaying the importance of those variables that correlate relate human interactions with the control of the indoor environment, thus failing to give back a realistic representation of the energy consumptions.
The work described in this thesis mainly focused on the enhancement of the prediction of the energy consumptions of a building focusing on the energy needs for heating and cooling related, starting by the occupants' indoor environmental quality expectations.
In order to represent the expectations by the occupant, reference was made to EN 15251, through which it was possible to divide into three categories the occupant expectations.



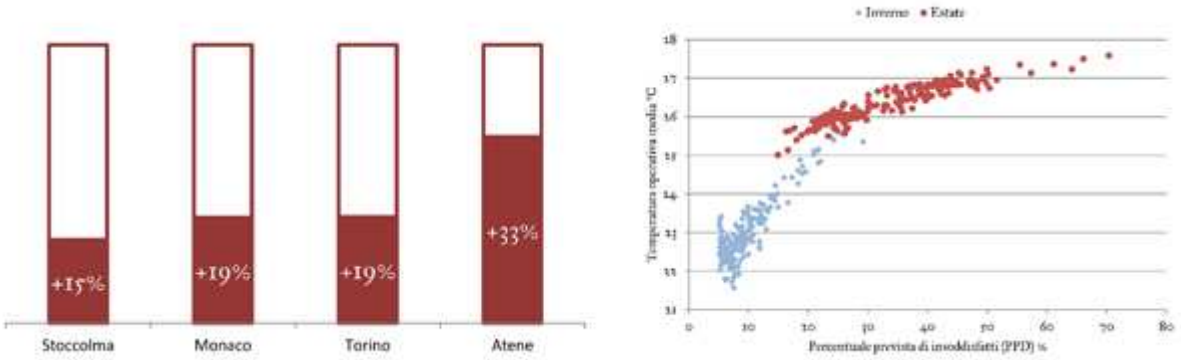
The case study and the comparison of yearly primary energy consumptions for different comfort categories according to the European Standard EN 15251

Many governments have introduced regulations to make buildings more energy-efficient. Policies and research on energy conservation in buildings are geared primarily to saving energy through technical measures relating to the building envelope and the heating and ventilation installations.
The aim of energy performance regulations is to ease the environmental burden imposed by the energy consumed in the built environment. However, the energy savings from space heating might fall short of expectations. The effectiveness of energy regulations needs to be verified in order to discern whether more energy savings will be generated by tighter regulations. It is thought that occupant behaviour, the actual quality of the construction, and rebound effects might be undermining the effect of the regulations.
The aim of this research is to provide insight into the effect of energy performance regulations on the energy consumption for space heating and to clarify the role of occupant behaviour in determining this effectiveness. This will enable us to establish whether tighter energy performance regulations are required and to identify the factors (building characteristics) that could be causing households to consume more energy.



Results of the annual energy consumption expressed in primary energy for different categories of air quality in the various case studies

Through simulations are obtained, in addition to the values on energy consumption, the results with regard to the indoor climatic conditions. From the results concerning the indoor thermal comfort, in relation to the category of IEQ and energy consumption, it was possible to make some reasoning about the potential of these results at the level of project and maintenance of the building, comparing from time to time the average indoor temperature with the expected percentage of person dissatisfied (PPD) and the predicted mean vote (PMV).
Among the most relevant results emerged from this research, we note the importance of the categories of indoor environmental quality and simulations as tools for the architectural design, but also the need to implement regulations for the summer season to remedy the discrepancy of values that is registered with the changing seasons. It also been found that Fanger's model is less effective during the cooling season for evaluation of occupant comfort, considering better the development of an adaptive model of thermal comfort. Finally, thanks to the study of literature, which has accompanied the whole thesis, we wanted to highlight the key role of the user in energy consumption.



Differences between the values recorded and an example yearly primary energy consumptions distribution of values

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