POLITECNICO DI TORINO
SECOND SCHOOL OF ARCHITECTURE
Master of Science in Architecture for Sustainability
Honors theses

Building-plant system: energy requalification measures in services
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This work has been done in order to take part at the first national competition of *Schneider Electric* for the best thesis on Energy Efficiency "The improvement of Energy Efficiency in services, in the light of European and National legislation on Automation in buildings".

The thesis has been possible thanks to the availability of the banking Group Intesa San Paolo, especially of the Sector Sustainability that has proposed to analyze five branches of their "park of buildings" , used as offices and characterized by substantial consumption and considerable problems, providing technical documentation and data on energy consumption.

What has been achieved is the result of the desire to demonstrate how control systems and automation, properly studied and selected, are able to reduce the energy consumption of a building. The aim was to test and simulate, on a single case study (an office of a branch), technologies that, once proved their goodness of application, can ideally be extended to the homogeneous cluster of buildings selected: in this case are offices below 2000 m^2 of surface. The simulations, on each sector of consumption, are based on comparing control systems and automation, "in a crescendo" of optimization of the results, coming, in the final phase, to an optimal configuration.

The thesis has been then developed on the assumption of energy requalification of an entire branch, i.e. the branch in Turin Street 47 in Piossasco, acting on any item of consumption and finally coming to a process of energy certification and economic evaluation.

The elaborate, in order to achieve these results, has been structured in several phases:

- Step 1. Theoretical path of knowledge acquisition, with a particular interest in the field of offices: control systems and their energy efficiency measures in electrical plants, thermal plants and on wrapping; automation systems of the plants and the casing; depth studies on the European norm UNI EN 15232; communication networks LAN and topologies compared; standard communication protocols.

- Step 2. Branches compared: descriptions, locations, technical aspects of the building-plant system, consumption analysis, critical issues identified and possible measures.

- Step 3. Case study:

- tools assessment of electricity demand for artificial lighting of buildings and applications to different configurations (different level of control systems and automation used) of the case study (single office of the branch of Piossasco), increasing in terms of optimization of the consumption of artificial lighting: norm UNI EN 15193:2008; software *Energy Plus* and *Daysim*, with their respective algorithms for calculating (detailed).

- dynamic simulation carried out with the software *Energy Plus* (with graphic interface *Design Builder*) for the determination of requirements and energy consumption of the building-plant system, with particular interest for the summer phase and for the specific sector of the case study (Offices), i.e. services. Integration with the results of the indicators of energy consumption for lighting (LENI) previously obtained, depending on the different control systems and automation. Determination, for each configuration, of energy class and of the economic profits arising out of or less. Finally, identification of the optimal solution.

- final summary of the results of thermal and lighting compared for each technological configuration adopted in the case study of the Office, with particular interest for the optimal configuration.

- Step 4. Energy requalification of the entire branch adopting the optimal configuration, for the office analyzed, in all the offices with the same characteristics and exposure; for the other spaces: specific studies and application of technologies deemed impacting on consumption. Finally, summary of the results of thermal and lighting comparing the real data of the branch and those obtained through the configuration considered optimal.

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