POLITECNICO DI TORINO

Honors thesis

COURSE OF ARCHITECTURE FOR THE SUSTAINABILITY DESIGN

Abstract

In the aftermath of the Second World War, the subject of reconstruction became central throughout Europe and the significant demand for buildings generated mostly low-cost and low-quality structures. For this reason, the real estate constructions between the beginning of the 1950s and the 1980s turned out to be ancient and with great deficiencies from the structural point of view, especially in Italy. In fact, the buildings do not have the adequate construction requirements for a correct structural behavior in case of an earthquake, they are energy-intensive and their architectural image is more than obsolete.

In Europe, the most common solution to the problem of the oldness of the real estate is usually linked to the concept of demolition and reconstruction. On the other hand, in Italy the methodological approach is very different, both for cultural and regulatory reasons: it is therefore necessary to find a sustainable solution, capable of giving a second life to existing buildings. Moreover, leaving aside the problem of demolition from a social and administrative point of view, it represents a solution that has a significant impact both on waste production and release of CO2 emissions into the atmosphere. Therefore, the re-use of buildings is a necessity, as it is a more sensitive solution to the economic, environmental and social problems of contemporary living.

The aim of this thesis is to propose and evaluate an intervention methodology called exoskeleton. This design solution consists of joining self-supporting structure to an existing one that allows an improvement in the structural response to be achieved both in the static and dynamic fields. This technology, which is also linked to the function of biomedical exoskeletons, supports the existing structure and takes on horizontal actions during the earthquake phase.

Exoskeleton technology was applied to a real case, Giovanni Ruffini's Secondary School located in Bordighera, Italy. Following dynamic linear analyzes and push-over analysis of the current situation, to date it emerged that the school structure to date does not meet the structural safety requirements expressed by the legislation (NTC2018). Because of this, an exoskeleton capable of elongating the service life of the existing building was introduced in order to improve its performance against seismic actions.
In view of an integrated design solution, the exoskeleton has also been optimized according to the technological, energetic and architectural implications that have been pursued during the thesis work: the result is a complete renovation of the building, which is functional both from a structural point of view and in terms of energy efficiency.
Therefore, the design approach of the exoskeleton is an extremely interesting solution, as it can be "packaged" according to real needs by combining structural safety requirements with the functions related to the energetic, technological/performance and architectural/urban improvements of the building.

The exoskeleton as an integrative approach for seismic and energetic retrofitting of existing buildings

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