



**POLITECNICO
DI TORINO**

Honors thesis

Master of Science in Architecture Construction City

Abstract

Adaptive Exoskeleton:

***A methodological approach for retrofitting existing
constructions***

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Architectural design has to cope with the huge leap forward of design standards and technological knowledge, the display of an achieved development: retrofit aims at adapting past buildings to this level. New parameters are now defining the built environment: carbon dioxide equivalent, vulnerability indexes, comfort variables unknown at the time of construction of the vast majority of the European and Italian building stock. Yet, to overcome the idea that retrofit operations belong to the realm of purely technical operations, we must recognize the long history of the operation of adaptation and the complexity and cultural richness proper of technological and environmental design. Adaptation means to praise the profound, yet fragile, connection with the environment, whereby this relation is, for some reason, broken or endangered. Reuse and renovation imply an ethical commitment towards the environment as a collective value, connected to a variety of externalities, boundary conditions, limitations and expectations. It must be recognised that existing assets hold an enormous material potential in terms of embodied energy and workforce, whose life needs to be extended: only in this way their importance as traces of memory and infrastructural framework will last as a backbone for the future.

Aim of this thesis is to experiment another option for “re-cycling” buildings, even when these would reach the end of their useful life: the limit state of demolition and reconstruction, an operation whose avoidance must be pursued by any technical means. A complex design challenge, seeking for a multidisciplinary and integrated design methodology: firmly based on an adequate knowledge of the weaknesses of the specific object, radically committed to the achievement of its objectives in terms of safety, functionality, liveability and marketability. The proposed Adaptive Exoskeleton methodological approach consists in an additive strategy: the existing building is enclosed in a steel cage which, rigidly connected to the main structure, is able to consistently alter its dynamic response, making up for the seismic vulnerabilities that are common to many buildings of modernity, for instance of residential reinforced concrete multi storey frames. The promising idea of retrofitting from the outside, employing lightweight and dry construction methods, is aimed at minimising the

interferences with the everyday life of the building and its inhabitants, hence the aversion and friction at transformation. Furthermore, the new envelope can drastically enhance the energy performance and allow for an upgrade of the overall degree of functionality, ultimately extending the useful life and awarding with renewed values.

The case study for this speculative design proposal is set in the southern end of Turin's outskirts, within the district of Mirafiori Nord: a mid-rise residential tower, built at beginning of the '60s as part of an INA-CASA affordable housing program. The final proposal's development is, itself, the application of a multidisciplinary approach, in fact carried out in cooperation with a master student of Civil Engineering. Following the joint experimental prototyping of a few different structural typologies and the assessment of their environmental impact, the work of this thesis aims to bring at further architectural extents these results, by physically defining the behaviour of the new envelope and energy performance of the building.
