

POLYTECHNIC OF TORINO
FACULTY OF ARCHITECTURE
Degree in Architecture
Honors theses

**Innovative method patterns on static analysis and structural intervention
project for the rehabilitation and functional recovery of Montalenghe's Castle**

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Introduction

The main purpose of this thesis was to propose a methodology of analysis and design for the consolidation and conservative rehabilitation of the Castle of Montalenghe.

Indeed, the work tried to put into practice some diagnostic investigation techniques in order to know the construction and the intervention. The above mentioned techniques have been operatively supported by the Laboratory of Restoration and the L.A.M.S.A. of the Polytechnic of Turin, and the Tierre Group Company CEA of Turin.



View of the south side

Knowledge of the building

The cognitive phase, which represents a very delicate moment of the procedure, was articulated in several levels:

- *Historical investigation*, not to be understood as a simple set of data, but as a moment of research in which, through bibliographical sources, records and direct testimony, one attempts to reconstruct the "life" of the building.
- *Survey*, realized by means of direct and indirect methods, including the *geometric survey* and the *"defects progress report"* related to materials' deterioration and static troubles of the structures.
- *Direct visual analysis* of the building's construction systems and typology, in order to reconstruct the steps of its making.



Erosion of the brick

Diagnostic investigation

In this case investigations, whose aim was to validate, support or deny the hypothesis made beforehand, concerned the ligneous structures of the garret and the building structures in elevation.

In particular, a diagnosis protocol for the ligneous structures of the garret was realised in collaboration with the Laboratory of Restoration. The work had foreseen: *graphics-resistant analysis, endoscopic analysis, verifications by means of the hammer and humidity detection.*

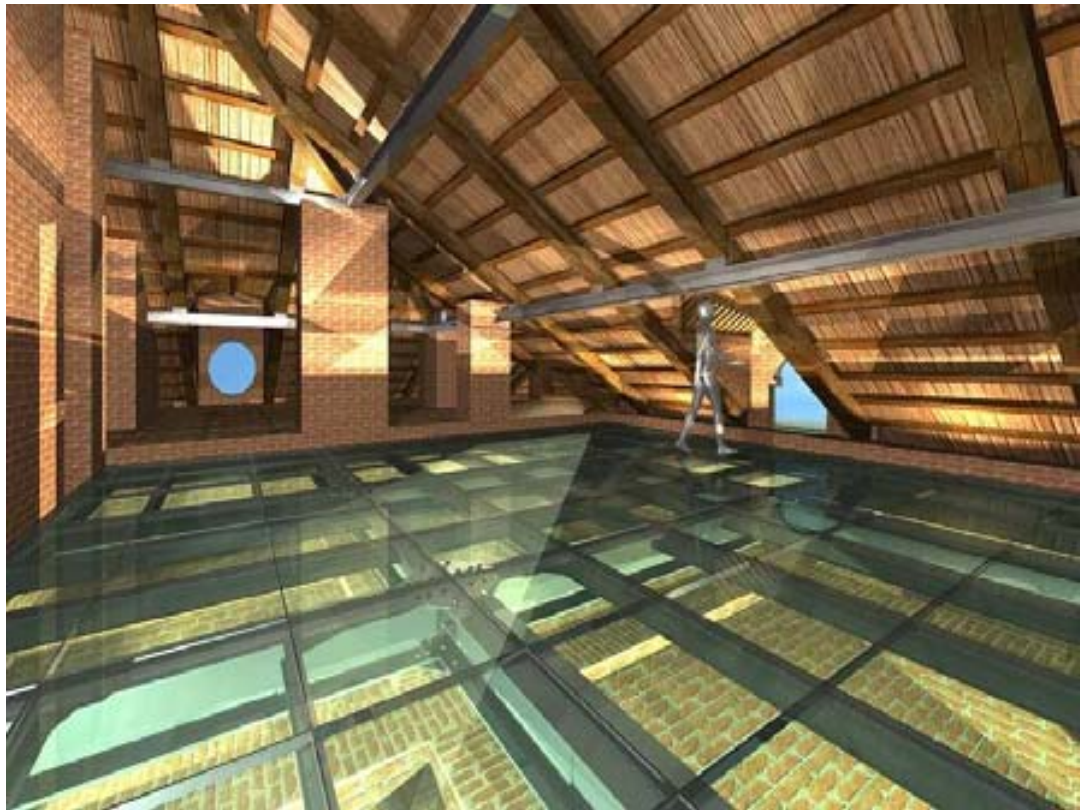
In the meanwhile, with relation to the study of materials, investigations on the *measurement of humidity level* and *determination of soluble salts* inside the building had been carried out by means of the equipment provided for by the L.A.M.S.A.. The diagnostic phase ended up with the structural inspection of each and every construction system (coverage, ligneous garrets, masonry vaults, walls and foundations) carried out following the established building methods and the Finished Elements Method (F.E.M.).

From defects analysis to consolidation and conservative rehabilitation

From the survey on cracks and trouble analysis it came out that most problems were caused by a *lack of enchainment*, *rotation* of the external walls and *decay* of the *ligneous structures*, which had inevitably led to the collapse of some garrets.

The deterioration analysis, carried out following the *Normal Recommendations 1/88*, allowed to identify the different alterations to the building walls: disjointedness, detachment and efflorescence of the plaster, brick honeycombing, mortar erosion, rust stains, biological patina and evidence of vegetation.

Thus, the reconstruction of the covering was deemed necessary, keeping the original structure pattern and reusing again the still existing ligneous elements. As regards the wooden garret at the second floor, an intervention of conservative restoration was foreseen, whereas the increase in the overloads called for the realisation of newly-made steel garrets, placed above the mentioned ones.



The attic room after recovery

As for masonry vaults needing a static consolidation intervention, it was thought to implement a covering made of reinforced concrete, linked to the vault by means of steel pickets.

The masonry, in correspondence of the crevices, would be consolidated by means of reinforced mortar injections based on slaked lime, adherence-enhanced and chemically and physically compatible with the original materials.

The frame of the building will be kept by a beam made of reinforced concrete for the linkage and placed at the level of second-floor garrets, and by the insertion of new chains (or metal tie-beams) in the upper part of the vaults at ground and first-floor level.

The renovation of the external masonry walls included the restoration of bricks and original plaster, the reshaping of mortar joints and plaster made of finish mortar which allow, like in ancient times, to figure out the building texture.

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