Methodology for the building estate knowledge: analytic tools for identifying degradation processes

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Abstract

This contribute derives from a research, which this Department is developing since five years both at teaching level and at methodology study level. The main objective for this research is aimed to define a method to analyse the state of the building envelope, with particular attention for the traditional buildings. The diagnostic phase requires the knowledge of all pathologies that can be identified on the analysed building and the existing relations with the main relevant factors, which are involved into the degradation process, in order to reach the possible causes of disease.

This study is based on a visual survey of the degradation conditions and it is carried out through the employ of the main classification systems for the degradation pathologies.

The case study is the “Real Albergo de' Poveri” in Naples, a 700th architecture, designed by Ferdinando Fuga, characterised by a very extensive and complex plan-volumetric development. The envelope of this building presents on the external wall (principal front length 354 mt.) a basement made of stone blocks (piperno) while the superior part is plastered. The facades along the internal courts are actually without plaster.

The contribute will be articulated through the following points:

1. - Degradation pathologies on the envelope of traditional buildings
   - Classification tools
2. - classification of the envelope system
   - Individuation of factors
   - Relations between pathologies
3. - Analytic card
1. Introduction

The most important activity for the approach to preservation of pre-industrial buildings consists in the process of acquiring data in order to reach a knowledge of the real estate of the building and of its consistence through the organisation of data and their relations.

Planning the survey activities becomes, of consequence, a complex phase because of the exigency to complain all required data in an organised system. From survey activities it carries out a composite information because of the heterogeneous nature of factors which have influence in degradation process.

As the building decay is recognised like a continuously developing process, its interpretation needs to be related with a synchronic view of the built system; it derives from this that it is impossible to find a direct link through the decay causes and symptoms.

The data acquiring is articulated in successively phases which are pointed to the followings actions:

- Identification of materials and their performance characteristics;
- Identification of most relevant constructive elements for the building performance;
- Identification of the relations between materials and their localisation in the constructive system;
- Identification of the risk conditions
- Identification of degradation phenomena map.

In considering the building performance it is useful to share the vertical elements of the envelope (facades) into different bands which has different roles and, of consequence, different performance requirements. It is possible to generally consider three horizontal bands and two vertical stripes:

- Base
- Elevated
- Completion
- Corner
- Spans

Our case-study, the Real Albergo de’ Poveri in Naples, is characterised from very large dimensions so that the bands and the stripes of its facades must be related not only with the environmental buildings but mainly with the urban context; this means to find, for example, the relation between the curtain wall and road system. This scale has relevant influence in the degradation processes and makes very complex to understand the genesis of phenomena and their development.
2. Methodology

Classification of the envelope system
By the time the buildings undergo a decay process of their physical characters and their performance. This process is linked up the actions of the chemical and physical agents in the air, the characters of the materials and the lack of maintenance. The deep analysis of an historic building is essential to know its constructive characters and the efficiency of its parts and becomes necessary to plan a correct diagnosis to suggest the actions for its rehabilitation and maintenance. The possibility to pick out, to collect and to draw up data assumes an important role in the information and decision process. So it is important to plan a logical process that allows us to understand the relations among all the parts of the building. The first phase of the study is articulate on the decomposition of the building envelope and on the classification of its constructive elements, on the exam of their morph-dimensional features, material characters and how they are made. We use the UNI classification system that suggests a decomposition of the building in technological system (constituted by technological units and technical elements), and environmental system (constituted by environmental units and spatial elements). In reference to the complexity and the large extension of the building chosen like a case study, we need to have a graphic reference that allows us to identify every element that make up the envelope. So we superimposed a georeferential grid on the facades analysed. The grid is based on the Cartesian system made of horizontal and vertical co-ordinates: three horizontal bands (base, hanging walls and completion of the building) and vertical bands (spans). The technical elements that belong at the considered envelope are walls, holes and frames. The degradation analysis is based on a visual remark. The identified pathologies for the technical elements have been transferred on every areas of the graphic grid. In this way we obtain a graphic map of degradation conditions starting from the glossary and the graphic representation suggested by the NORMAL instructions (1/80, 1/88, made by ICR, Central Institute of Restoration and by CNR, National Researches Committee). We need to add some other voices of this glossary to complete the identification of degradations and alterations not included into NORMAL glossary.

Individuation of factors
The methodology emphasised conditions that we defined “innate” or rather that belong to the building own. We identify two classes of “innate factors”: factors related to the context and factors related to the building construction. The elements of the sub-system envelope of the building can be considered such as a borderline between external conditions and interior environment. By the study of the degradation conditions we identify these context factors: place conditions, climatic conditions and shape of the building. Referring to the building own factors we identify three sub-classes: location factors that underline the link between the position of technical elements and the degradation estate; geomorphological factors underlie that the geometrical, dimensional and
configuration characters can promote the attack of atmospherical agents; factors related to the composition of the materials of which the elements are made.

**Relations between pathologies**
The degradation pathologies work together: in fact they present a very complex action process. The deep relationships existing among all the parts of building envelope causes the diffusion and the worsening of the building pathologies day by day. The methodology suggests a model of the degradation processes (named “degradation chains”) that emphasise the relations and the sequences of the buildings pathologies. This logical diagram is a graphic representation able to describe the course that degradation and alteration follow.

**3. Deliverable**

**Analytic Cards**
As just written, the proposed methodology localises the phases for the analysis and classification of data on the knowledge of the state of a building.
The final step in this methodology is oriented to define all links between various pathologies, their localisation and factors that have influence in degradation process (both from the building and from the environment).
Analytic Cards carry out of this phase, where the graphic representation of decay pathologies (*degradation map*), by a view survey, constitutes a landmark for recognising the phenomena’s genesis and their processes of development. By this way the degradation map can be considered the main tool to analyse the degradation estate of a building. It is not just an instrument for “reading” but it is mainly, an instrument for “knowing” the decay process genesis; as well as it allows analysing “how” and “why” certain pathologies are developed on a building.
Some other information are required to understand the degradation processes development, these are information about the constructive, geometrical and morphological characteristics and the environmental characteristics. The existing links between these characteristics (building factors and environmental factors) and the origin of pathologies are recognised in structuring the Analytic Cards.
An example, on our case-study (Real Albergo de’Poveri in Naples – *see picture*), can be that:
“Mostly degraded parts from erosion are generally located on the top of the walls and on the band above and under the median cornice: this requirements must be related with data on the exposure and on the building orientation and with data on geometrical and morphological characteristics of architectural structure, it comes from this that the lack of a proportionate structure of completion of the building together with the lack of plaster, are the probable origin of erosion process on walls; for what about the bands near the median cornice, they are so degraded because it was designed to be just a median cornice and it is not able to adequately protect the structure below, and, as the building miss the completion, it is the most attachable element form climatic agent.
This estate is worsened from the incoming of new phenomena on existing phenomena in a process that is called “degradation chain”.
By this way this methodology introduces a new approach to the study of decay pathologies, which is based on the knowledge of the decay process instead of the decay estate, it derives that the variable "time" must be absolutely considered and the organisation of degradation data in a system of Analytic Cards is an useful tool to sustain the project strategies.
Struttural Studies, Repairs and Maintenance of Historical Buildings

Fattori relativi all’edificio

Altezza ai tetti (m 7,87)
- Fissa le problematiche legate alla presenza di dislivelli nel piano superiore, che potrebbero determinare la necessità di interventi di riallacciamento.
- Capacity limitata a 30 persone.

Materiali di costruzione
- Muro in pietra laterizia (18 cm). La pietra laterizia è caratterizzata da una maggiore resistenza alla pressione e alla temperatura, consentendo una maggiore durata dell’edificio.
- Copertura in terrazzo (18 cm). La copertura in terrazzo consente di evitare l’acqua da infiltrarsi nell’edificio e di garantire una maggiore resistenza alla pressione.

Patologie di degrado rilevate a vista

Erzione
- Si verifica un fenomeno di eruzione, provocando una serie di danni alla struttura dell’edificio, come la formazione di crepe e la distorsione delle pareti.
- Si ricorre a soluzioni di rinforzo per prevenire ulteriori danni.

Manutenzione
- Si interviene periodicamente per la pulizia e lo spazzolamento delle superfici esterne, per prevenire la formazione di sporco e la corrosione delle stesse.
- Si utilizzano prodotti specializzati per la pulizia e lo spazzolamento.

Superficie esterna
- Si interviene periodicamente per la pulizia e lo spazzolamento delle superfici esterne, per prevenire la formazione di sporco e la corrosione delle stesse.
- Si utilizzano prodotti specializzati per la pulizia e lo spazzolamento.

Induzione delle relazioni tra patologie

Ripetere la manutenzione e la pulizia delle superfici esterne, per prevenire la formazione di sporco e la corrosione delle stesse.

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