

## Conference Paper

# The Importance of the Directives Creation for the Evaluation of the Buildings Envelope Conditions in Condominium Regime Inserted in a Technical Management Model

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## Abstract

Currently, the importance of the condominiums technical management and the organization of their annual budgets (with an enormous preponderance of the funds reserve) is not recognized in the decision-making process regarding the maintenance and rehabilitation actions of multi-family buildings. For this reason, it is of particular interest the development of models and technical tools, some that could help to list/report pathologies/anomalies as well as the correlation between the listed pathologies/anomalies and the building, and some others that may consolidate the technical legacy, in order to understand the importance of maintenance labor in the quality and durability of buildings. In this context, the article reflects, in its essence, a proposal for guidelines elaboration for the conditions assessment of the current multi-family buildings envelope in a condominium regime, carried out within the scope of a curricular unit and an ongoing PhD thesis project. The demonstration of the methodologies and tools developed for this evaluation, with the differentiation between a preliminary evaluation and a detailed evaluation, complemented by the brief presentation of a case study, is of particular importance in this work. The work also includes the reference of the importance of this study in the future development of the thesis, as well as the schematic demonstration of other complementary works for it.

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## 1. Introduction

Currently it cannot be ignored that the majority of owners of buildings under a condominium, in the budgets related to the building expenses, are only concerned with providing the respective items with the necessary funds to meet the commitments of cleaning, insurance and current maintenance, reserving an insignificant amount (maximum 10%) for the repair work or periodic rehabilitation of the building [1].

In recent decades, it has been noted that most multi-family buildings in Portugal, present some state of degradation that results from their own aging, making it essential

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to develop processes, in the most diverse areas related to the building, in order to reverse this situation.

Since the way in which rehabilitation is carried out in most buildings is a key factor in their sustainability, it is essential to correctly interpret (or decode) anomalies, based on objective and proper/suitable diagnostic means, aiming the significant increase in quality standards and future energy efficiency of the potential buildings under intervention [2]. However, the processes of inspection and diagnosis of buildings become quite subjective, improperly influencing the subsequent decisions regarding the intervention measures to be developed [3].

In this domain, it is essential to create technical teams that work for condominium management companies. It is necessary that these agents meet the real needs of families in an efficient way, carrying out physical analyses of buildings, which may result in a financial plan with a realistic estimate to cover the needs of condominiums over time.

The methodology to carry out this study was developed based on the analysis of bibliography and various scientific papers on the subject, and was based essentially on the methodology developed in the document "Guideline for condition assessment of the building envelope" [4]. This was adapted to the case of recent condominiums, through data collected in a study carried out by the author in a condominium administration for 2 years [5].

## 2. Proposed Methodology for the Assessment of the Current Building Envelope under a Condominium Regime

For the development of the methodology, the subjects of analysis were, essentially, the "Inspection Guide" of the Instituto Valenciano de la Edificación [6], the thesis "Rehabilitation of Buildings - Diagnosis and Intervention Methodology" [1] and the methodology developed by the American Society of Civil Engineers called "Guideline for Condition Assessment of the Building Envelope" [4], the latter being adopted as the basis, since it was considered to be the most appropriate for the desired study, but it was adapted, especially in the phase of detailed assessment of the envelope's conditions.

The assessment procedure created is intended to assist an inspection technician, to be hired by the condominium, to understand the functional performance of the building envelope, analyzing its current performance and identifying any discrepancies between

the intended behavior and its actual performance. This assessment is obtained through a two-step approach that includes the following:

**1st phase:** preliminary conditions assessment to identify the main concerns of the condominium owners, the main existing elements, the main problem areas and to define the objective from the perspective of additional investigations;

**2nd phase:** detailed conditions assessment, including a detailed review of all the information collected, assessment of the condition and suitability of all the components of the respective elements, necessary tests, detailed recording of all observations and the implementation of specifications for the rehabilitation actions accomplishment.

In general, the procedures described above explain the assessment of the conditions of the envelope as shown schematically in Figures 1 and 2 below.



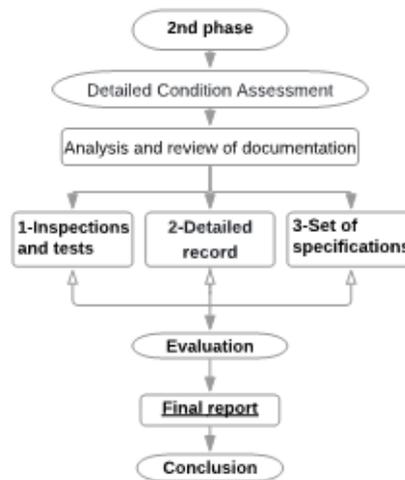
**Figure 1:** Organizational chart of the methodology of assessment of the envelope of current condominium buildings (preliminary assessment).

## 2.1. Preliminary assessment system

### 2.1.1. Contacts with condominium members/administration and definition of objectives

For a clear definition of the objectives, a survey was created for the condominium management, in order to define the client’s needs and guidelines. After defining the initial objective and concomitantly, a survey should be conducted among all the condominium members in order to provide a greater breadth to the work perception to be performed.

Sometimes it may not be possible to initially determine the objective, but it will be further developed during the preliminary assessment based on the researcher’s observations.



**Figure 2:** Organizational chart of the methodology of assessment of the envelope of current condominium buildings (detailed assessment).

### 2.1.2. Preliminary assessment of conditions

- **review of existing documentation** - this phase is limited to research, collection and review of all available documentation. In order to correctly record and compile the documentation, several registration forms have been created;

- **general observations** - the main goal of general observations is allowing the technician to carry out a rapid assessment of which elements of the environment, if any, require a more detailed assessment during future phases of the work. The depth and time required for this procedure depends on the technician’s experience with similar systems and condition assessment procedures;

Building elements – The used methodology defines 7 types of building elements: "Pitched roofs", "Flat roofs", "Exterior walls", "Exterior spans", "Protruding elements", "Structural elements" and "Underground elements".

- **pathologies/anomalies in the fractions and internal common areas** - although in the basic methodology (ASCE), visits to the fractions were only considered at the 2nd phase - Detailed evaluation of conditions, it was considered essential to be included in this phase, since it is the most efficient way to correlate pathologies and infer the necessary conclusions so that they can be exposed in the extraordinary meeting, where the necessary work will be discussed in the later phase. A research in the interior of the fractions and common areas, can be one of the most useful means to identify the problematic areas of the building envelope;

- **pathologies/anomalies in the elements of the building** - the building’s envelope elements observations

and the respective pathologies / anomalies, generally include the following: photographic and videographic surveys of the external and typical areas of all the elements; register of the pathological observations in the elements and materials; reports of the specific problems for each element; if the anomaly / pathology is significant, additional observations should be made, internal or external, close to the damage; identification of any components that evidence an immediate security risk.

### **2.1.3. Preliminary report**

The purpose of this phase is to inform the owners about the initial results and the importance of conducting future investigations. A preliminary report should be executed, describing the preliminary conclusions and recommendations of the initial conditions assessment of the building envelope.

A preliminary report should include at least the following information: framework; location and surroundings; façades and their orientation; information from existing documentation; general characterization; identified problems by management and tenants; pathologies/anomalies identified inside the building; pathologies/anomalies identified in the building envelope; conclusions and recommendations.

### **2.1.4. Final comments**

After discussion about the observed problems, one should consider the importance of each anomaly/pathology and how it relates to the overall performance of the building envelope. When there are anomalies/pathologies that were not observed in the preliminary visit, the probability of their existence and their effects should be included in the report, a comparison should be made and a hierarchical order of severity should be developed. It is also relevant a discussion about the reason why the elements of the building envelope may or may not be appropriate for its current use. After the preliminary analysis and issuing the report, an extraordinary meeting of condominium members should be held in order to adjust the objectives of the work, its conclusions and preliminary recommendations. Being defined an objective of eventual future work and if it is verified that the apparent problems are less intrusive and expensive than the proposed investigation, it must be determined with the client if an additional study is economically justified. If they are serious, replacement is inevitable and an investigation would not be economically rewarding. The costs that may be associated with the various possibilities of destructive and non-destructive testing, as well as an opinion on the

cost of rehabilitation, should be incorporated into this analysis. It is also necessary to understand whether the condominium members want a detailed record of all the observations, both inside and around the building, as well as the possible preparation of a work map and quantities with the respective specifications for future rehabilitation actions. In this sense, a detailed conditions assessment of the building envelope should be defined.

## 2.2. Detailed Valuation System

### 2.2.1. Characterization of the construction elements

In this work, sheets were developed for all the elements that compose the areas of the building envelope and that should be included in the second phase of the evaluation (Exemplification in Figure 3).

The figure displays two detailed assessment forms for external building elements. The left form, titled 'AVALIAÇÃO DETALHADA DE CONDIÇÕES' (Ficha ADPE01), focuses on external walls. It includes a header for 'Observações gerais dos elementos exteriores' (Condomínio: 2401/19) and a section for 'Condição geral da parede' with three options: 'Paredes homogêneas', 'Heterogêneas + Alvenaria', and 'Paredes em alvenaria'. Below this, there are checkboxes for 'Espessura total das paredes (cm)', 'Calha-de-azulejada', and '1.1.3 Seleção de isolamento térmico'. A table at the bottom categorizes observations by 'Local' and 'Tipo de sistema' under 'Sistemas construtivos'. The right form, also titled 'AVALIAÇÃO DETALHADA DE CONDIÇÕES' (Ficha ADCE01), focuses on pitched roofs. It includes a header for 'Observações gerais dos elementos exteriores' (Condomínio: 2401/19) and sections for '1.2.4 Ventilação da cobertura', '1.2.5 Isolamento térmico', '1.2.6 Tipos de sistemas de drenagem', '1.2.6.1 Materiais', and '1.2.7 Elementos de vedação'. It features various checkboxes for material types and drainage systems, and includes small diagrams illustrating roof construction details.

Figure 3: Example of record sheets of observations of external elements (left: external walls; right: pitched roofs).

### 2.2.2. Decision to involve other external experts

Problems can, sometimes, be identified outside the surveyor’s technical knowledge. For this reason, permission must be obtained from the owners to involve other technicians from different areas. Together with these external experts, it is necessary to establish a well-defined work objective.



### 2.2.3. Documentation review

At this stage, it is necessary to carry out a careful review of all available documentation on the building. In addition to familiarizing the technician with the elements and their components, this review helps to point in advance possible problem areas before leading a possible detailed assessment using tests. As a minimum, you should include a review of the following elements: projects; project basis; previous maintenance and rehabilitation actions and records of problems.

### 2.2.4. Detailed Valuation Strategies

#### Inspections and tests

Before starting the fieldwork for the detailed assessment, you must carefully outline the work to be carried out. Depending on the choices made by the owners, all the information collected during the preliminary evaluation and during the document review process should be gathered. After reviewing all the documentation and detailed observations of the building, it may be necessary to dismantle parts of the elements, with the help of a qualified contractor, to reveal the hidden and constructed conditions. *In situ* tests will be necessary to verify the suspicious behavior of the building elements. For example, the technician may believe that moisture stains on the interior finishes are the direct result of a defective roof waterproofing. Carefully selected and implemented field tests may validate these hypotheses or imply another unsuspected cause. In addition, they usually provide quantifiable information that may be required for the rehabilitation project.

A number of inspection and test sheets have been prepared to assist in the execution of these and in reading out the results.

In many cases, it may be necessary to evaluate individual components of a particular building element, to verify whether there are suspected problems related to strength and durability or to provide a quantified comparison with an established performance.

#### Detailed record of observations

It is part of the setting of objectives for detailed records to determine the most appropriate and efficient method(s) for recording observations. The time spent prior to the investigation to determine the most effective rating methods helps to ensure their integrity and usefulness when conducting reports and/or projects. Where possible, documentation

should be created by means of: videos; photographs; graphical representations on plans and three-dimensional graphical representations.

### **Details of observations in the affected fractions**

A detailed interior search can be one of the most useful means of identifying problem areas in the building envelope. The internal search should be used for the following: recording anomalies/pathologies; identifying the presence of humidity; recording the indoor temperature; recording relative humidity and identifying air movements. Whenever possible, during indoor surveys, all internal surfaces of building elements should be inspected. In the cases of large scale structures, where a total search may not be feasible, a random selection of internal surfaces should be visualized for each of the building elements.

### **Details of observations on the building envelope**

With regard to the detailed observations on the envelope's building, the following must be recorded: cracks, stains, material faults and other damage; violations of the elements/components; condition of the materials; configuration of the various components; conformity to the design; environmental conditions. After the surveys in the external envelope, the results should be correlated with those of the indoor surveys. It is often possible to associate areas of internal anomalies with specific conditions observed during external observations.

### **Set of specifications**

A set of specifications for maintenance and/or rehabilitation actions in a condominium building shall contain a full description of the works, the material and human resources needed to provide the respective actions, as well as the one that includes and excludes the provision of services. The document should include general clauses, special clauses and technical clauses.

#### **2.2.5. Development of the detailed evaluation report**

At the end of the process, the technician shall carry out a holistic assessment, considering all data collected, condition assessments, test results and all records made. It should

also take into account issues related to fire safety, structural safety of the building or health and hygiene with regard to accident prevention, as well as problems related to the aesthetics of the building or energy conservation. The content of the report should be consistent with the defined objectives. Unforeseen conditions revealed during the assessment shall be reported to the appropriate entities, if necessary, and included in the report. The contents and the respective order may vary according to the objective of the work, and the owners themselves may require a specific format, where it should be included, at least, the following: revision of all the information collected; the preliminary report; the characterization of the constructive elements; analysis and discussion of inspections and tests; detailed record of observations; specifications for rehabilitation actions; conclusions and recommendations.

### 3. Case Study: Conditions Assessment of the Building Envelope in a Condominium Regime

#### 3.1. General framework

The main intent of this chapter is to briefly present and describe a case study resulting from technical work carried out by the author for a condominium management company located in Viseu - Portugal. The requests of the condominium members for the hiring of a technician occurred in extraordinary meetings and concomitantly with the completion of the curricular units belonging to the PhD.

The work was developed by the author, under the guidance of Professor João Lanzinha, in the curricular unit "Inspection, Diagnosis and Intervention in the Building" [7].

#### 3.2. General description

The condominium under study is located in the center of the city of Viseu (Portugal), more specifically in the union of counties of Viseu, being located in the street "Deficientes das Forças Armadas - lote 6" (coordinates: N40°39'11"; W7°55'36").

The construction of the building took place in 1999, with a constructive typification of recent buildings, with finishing materials and construction techniques of the current type. It has 8 floors, 16 fractions of habitation and is implanted in band.

### 3.3. Objectives definition

After an initial contact with the condominium management to define the work objectives, surveys were conducted with the management company and the condominium owners. From the condominium management company, it was concluded that the technical work required was a pathology report, with a view to future interventions in roofs, façades and protruding elements such as canopies, chimneys and balconies, as these were the elements that recorded the highest number of complaints regarding anomalies / pathologies. They informed that the condominium's annual budget was 5.164,00 € and were available to supply the project, which includes written and designed pieces with the various specialties, as well as related documentation to previous rehabilitation actions.

Of the survey carried out among the 16 condominium members, only 6 responded, with 50% living in the building between 16 and 20 years old.

It should be noted that 67% of the respondents suspect that the pathologies/ anomalies, which occur in the respective fractions, are caused by external elements, justifying that there are infiltrations coming from the common areas (roof or façade). Considering it relevant to improve the comfort and salubrity of the inhabitants, 100% are in favour of changing the coverings of the façades and the roof in their entirety. The possibility of success is, however, reduced by 83% of the condominium owners not being willing to spend more than 2.500,00 € in rehabilitation actions, considering, however, that it is extremely important to visit their fraction of the surveyor engineer to analyze the anomalies and to carry out tests in the building, if deemed appropriate.

### 3.4. Preliminary assessment and report

In a documentation review phase, it was concluded that there were no maintenance records and no photographic records. With regard to previous rehabilitation interventions, it was possible to analyze a budget dated 2014, which included small works at the level of the roof, façades and rainwater drop pipes.

In the observations of pathologies/anomalies in the interiors of the common fractions/zones and external elements, the forms created for this purpose were completed. In the records of the external elements, the the pathology was named and recorded, photographic images were shown, with the following order of visualization - Surrounding area; Location; Detail of the pathology - description of the pathology, the probable

causes for its appearance, necessary inspection and testing techniques, recommendations for rehabilitation actions and scales of level of severity and urgency of intervention.

After a preliminary analysis, it was concluded that the most frequent and most severe pathologies in the interiors of the fractions were condensation, moisture stains and blistering of the coverings and pathologies in the external elements, general cracking in the ceramic coverings, detachment/discharge of ceramics in the façades, cracks and severe fractures in the roof tiles and detachment of waterproofing in vertical wall (belonging to the adjacent building) next to the roof finishing casing.

A report with all the conclusions and elements mentioned in subchapter 2.1.3 was written and given disseminated to all the condominium members.

A copy of a pathology file is shown in Figure 4.

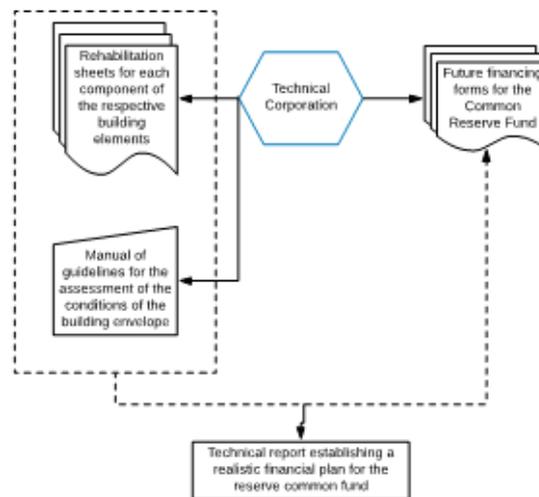


Figure 4: Constituent part of the pathology file used in the report.

### 3.5. Detailed assessment

An extraordinary meeting of condominium members was held, at which all the constituent parts of the preliminary report were clarified. In order to carry out the detailed assessment, it was decided to draw up a set of specifications, containing the respective map of works and quantities, for the rehabilitation of the building with the following solutions: replacement of all roof tiles, including all the finishing casings, application of the E.T.I.C. system on all facades, replacement of sills, sills and capping and waterproofing of all balconies.

Notwithstanding this decision to draw up a set of specifications for the rehabilitation of all elements of the building, it was also decided to carry out a more detailed assessment of all the respective elements components with the issuance of another more detailed report.



**Figure 5:** Organisation chart of the methodology for creating a technical management model for condominiums.

## 4. Conclusions and Future Works

The general objectives of performing inspections to the envelope of current residential buildings are to generate technical documentation that combines information on the conservation state of the building’s common elements, their safety, habitability and functionality aspects.

The information generated on the conservation state of the buildings will allow, besides having a greater knowledge about them, to establish the general conditions of conservation of the housing stock, and, therefore, to introduce those conditions in the management system, in order to define the best criteria for actions of maintenance and rehabilitation of the buildings themselves.

The author, in his PhD thesis, aims to create a technical management model for collective housing buildings under a condominium regime, with the objective of establishing realistic financial plans for the common reserve funds for the buildings under that regime.

The preparation of a guidelines manual for the conditions assessment of the building’s envelope, together with performance sheets for the rehabilitation of components/elements, is considered of enormous relevance in a holistic assessment system

of the behavior expected by the various building elements, ensuring a reliable financing plan over the years.

In Figure 5 it is schematized, in a simplified way, what is intended to be made.

The research work to be carried out falls within the Research Unit "C-MADE - Centre of Materials and Building Technologies".

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