

# Technical Problems of Residential Construction

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**Abstract.** Beauty, utility, durability - these are the features of good architecture and should also be the distinguishing qualities of every residential building. But do beauty and utility remain along with the passing of time? Performance characteristics are an indicator of both, the technical as well as aesthetic state of buildings. Aesthetic needs are in disagreement with the merciless aging process. The beauty of a city is formed not only by the original forms of new residential buildings, but also by existing tenement housing; thus preserving their aesthetics becomes a necessity. Time is continuously passing and along with it, aging intensifies. The aging process is a natural phenomenon for every material. The life expectancy of building materials is also limited. Along with the passing of time, the technical state of residential buildings continuously deteriorates. With the passing of time, the aesthetic values and preferences of users of flats change and the usability of the building decreases. The permanence of buildings, including residential buildings, is shaped not only by the forces of nature but also by activities of humans. A long lifespan is ensured by carrying out ongoing, systematic renovation-repair works. It is thanks to them that buildings derived from past centuries are still being used, and their market attractiveness is not decreasing.

## 1. Introduction

The results of the analysis of hazards, failures and disasters of building structures [1] shows that, of the different building technologies, the majority of them occur in masonry constructions (44%), and in terms of various types of buildings - in residential ones (41%). Building stock is a significant indicator of our standard of living and comprises an increasingly higher part of tangible national assets. Maintaining a building in good condition necessitates ensuring the technical efficiency of its elements, use value and aesthetic requirements of the building [2]. The level of intervention in the building aimed at removing irregularities may vary and be distributed differently over time as the components are characterized by various life expectancies.

One of the most important problems connected with using any building, but especially a residential building, is ensuring an adequate technical condition. The most effective type of renovation works are preventive measures based on securing the buildings against damage.

Diagnosis is the basis for properly carried out renovation works. The term "diagnostics" is derived from the Greek work "diagnosis" - identification, differentiation, evaluation. Technical diagnostics in the encyclopedic sense is a field of studies which covers the assessment of the technical conditions of a building and its ability for proper future service. The diagnosis pertains to the assessment of the technical conditions as well as predicting the development of and change in the condition, reasons behind such



development or change, as well as a combination of all of the above. The technical condition is strictly connected with the aesthetic state.

## **2. Beauty**

The architecture of a city is a continuously changing picture. New building structures, usually residential, are continuously being created. Space alongside buildings from the past is continuously being filled in with new ones. But the beauty of the city is created by all of these structures, new buildings as well as those dating further back; beauty lies in the original style of modern forms, but also in the sentimental relics of the past.

The passing of time brings about new tasks - the preservation of beauty. Maintaining residential buildings in an adequate technical condition is of utmost importance when creating the image of a city, while their aesthetic state is a reflection of their technical conditions. The renovation of buildings is inevitable. Aesthetic requirements combined with requirements in terms of the technical state of the building necessitate many actions. The scope of works in residential buildings is always of an individual nature. It may rely on the conservation of detail, or may involve the modernization of a tenement house: "beatifying, improving appearance - thus something added to the initial form for the sole purpose of decoration is commonly accepted" [3]. The needs of our civilization's development often necessitate the modernization of historic building structures or their adaptation to modern-day needs.

New elements are introduced in an environment of landmark buildings in two ways, as new architectural forms directly attached to the fabric of historical buildings or in their nearest proximity. Modern-day additions, when it comes to aesthetic value, are in harmony with buildings of the past and do not blur the differences between that which is new and that which is old. The idea behind modernization and adaptation is to combine the historical magic of relics with the language of contemporary architecture in common dialogue.

The interiors of historical objects subjected to renovation which incorporates contemporary details into the historical design one-of-a-kind. The original ceilings, columns, woodwork, balustrades or brick walls combined with bold lines and bright modern colours of modern-day solutions give the interiors a unique character. Connecting history with the contemporary ideas of a designer results in the creation of inimitable objects.

The coexistence of landmarked buildings and modern architectural forms is currently an inseparable element of the landscape. Reconstructions, expansions, and insertions of infill buildings in frontages are all being carried out.

All buildings demand attention, especially those closest to people - residential buildings. Aesthetic requirements, which stem from the passing of time, are most focused on these buildings.

## **3. Durability**

Time is continuously passing and along with it, aging intensifies. The aging process is a natural phenomenon for every material. The life expectancy of building materials is also limited [4].

Residential buildings are constructed with different building materials, which vary in terms of quality. Along with the passing of time, they age, lose their performance characteristics, and undergo natural wear and tear. Materials in the buildings are different and characterized by various, each their own, defined life expectancy periods. The processes of aging, wear and loss of performance characteristics do not take the same course in each fragment of the building. The roof cover is not as durable as the structure of the roof trusses. The life expectancy of a wooden roof truss structure is shorter than that of load-bearing walls. Passing, however, is not inevitable [5].

In the modern-day world, the protection of cultural heritage is connected with the needs of the civilization. Historical objects are used. The modernization of historical structures and their adaptation to modern needs is inevitable: "Modern-day conservation doctrine is based around changing the emphasis from instrumental to more personal treatment of a relic, the concept of which evolves over time, nowadays signifies not only an increasingly extensive scope of protection but also the multiplication of meanings which this relic is a carrier of" [6]. Dynamic changes taking place around

the world and technological advancement are completing the guidelines of the Venice Charter. General assumptions regarding the different approaches to handling relics of course remain. The rules of fully respecting the original substance or choosing solutions which do not harm the object are always current. The rule of minimal interference calls for maintaining form and substance, however it does not exclude introducing contemporary elements. These elements may not distort the historical content. A following rule regarding the clarity and distinctiveness of the insertions also allows for contemporary additions

The permanence of buildings, including residential buildings, is shaped not only by the forces of nature but also by activities of humans. A long lifespan is ensured by carrying out ongoing, systematic renovation-repair works. It is thanks to them that buildings derived from past centuries are still being used, and their market attractiveness is not decreasing.

#### **4. Usability**

Along with the passing of time, the technical state of residential buildings continuously deteriorates. With the passing of time, the aesthetic values and preferences of users of flats change and the usability of the building decreases.

The modernization and adaptation of historical objects is the result of ever-changing human needs. Adapting post-industrial objects in residential areas for modern-day uses has become something of a trend. The beauty of a historical building, however, has made it so that the changes carried out in the object are small. The introduced novelties are essentially fitted into the existing architecture.

The needs of our civilization's development continue to increase, and performance requirements of buildings are, therefore, becoming increasingly higher. Increasing performance requirements and the coexisting problems of a deteriorating technical state pose a challenge when using residential buildings. Serving as indicators of the scale of these problems are so-called performance characteristics. Seeking effective methods of preserving the beauty of the architecture of existing residential housing is strongly connected with the assessment of these very performance characteristics.

#### **5. Results and discussions**

The secret behind connecting the problems of maintaining a proper technical and aesthetic state with the problem of the passing of time results from familiarity with change processes in performance characteristics. These characteristics are a set of properties determining the technical and aesthetic state of the building.

In accordance with the recommendations of the currently binding standards regarding "planning the service period", an assessment of the performance characteristics of a building ought to be carried out, and changes in these properties over time predicted by designing methods simulating the anticipated degradation of the material over time [7]. The standards provide general guidelines on issues concerning the prediction of the service life of a building. The International Standards Organization (ISO) developed these guidelines based on the results of extensive CIB W080/RILEM 175 SLM research - "Service Life Methodologies Prediction of Service Life for Buildings and Components" [8], carried out by the International Council for Building (CIB) along with the RILEM Technical Committee (Technical Committee "International Association for Building Materials and Structures). The standards contain an introduction to the predicted performance characteristics. They emphasize the difficulties in indicating degradation even in the case of similar buildings because, in practice, there are many variables that influence their service periods. The variety of buildings, environments, surroundings, quality of construction works and future standards of upkeep result in uncertainty when predicting the service life.

Negligence in maintenance and repair is the main reason of the decline of technical value of a building. With the passing years, the repair needs are growing, and the absence of such work results in the loss of the usability value of a building. In order to maintain the existing buildings, it is necessary to solve problems associated with the prognostication of the repair needs.

The continuous degradation of buildings and the resulting high costs of repairs and renovations made the problem of optimal renovation predicting extremely important. However, in Poland, maintenance

planning is not seen as a long-term system. Repairs are approached as temporarily measure, and are carried out exclusively on the basis of period controls and inspections. Additionally, there is a series of disadvantageous tendencies as far as maintenance planning is concerned. First of all, the technical needs are not fully recognised, which is accompanied by inappropriate planning of tasks and means, which is based on finance funds resulting from the assigned limits. In order to program the repair and renovation works, the prognostic determination of the scope of work in terms of the kind and quantity is necessary. The repairs should include preventive actions aiming at assuring that no damages will occur to the building.

An adequate level of residential building reliability can be ensured by properly carried out renovation works. The accurate prediction of changes in efficiency as well as preventive renovation work will allow for the building to be exploited efficiently. In the realization of these tasks, the building is treated as a system made up of individual components. The predictive model of maintaining the technical condition of the building is based on the adaptation of principles applied in the utilization of technical equipment. Applying optimal prophylactic replacements requires a knowledge of the time span that the components of the building can be expected to work properly.

During the entire service period, the performance characteristics of a building deteriorate as a result of technical wear. An increase in performance characteristics (figure 1) may occur as a result of conservation, preventive measures, modernization, replacement of elements, or overhaul and rebuilding.

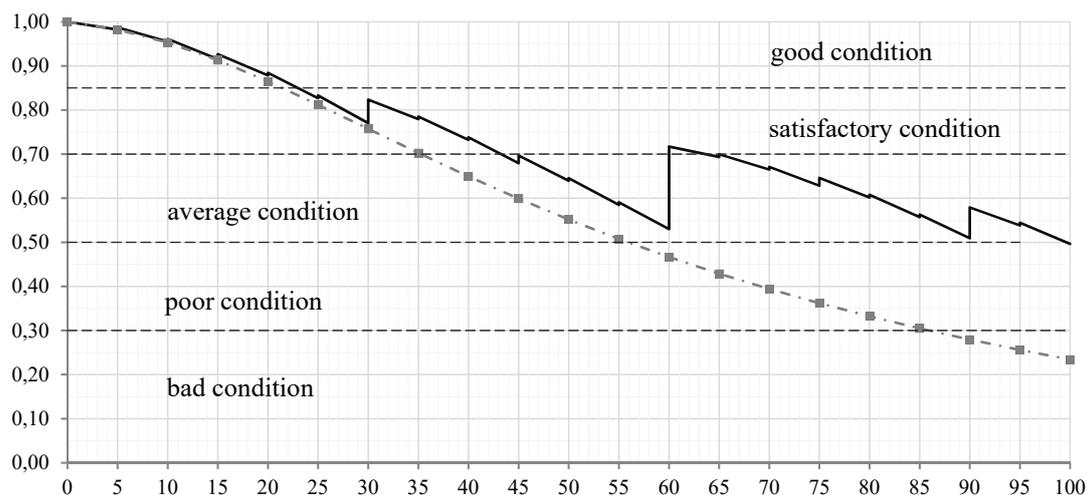


Figure 1. Prediction of changes in the technical condition of a renovated building and unrenovated building, so-called life curve

The limits of the tolerance ranges, determined by the area of technical conditions, i.e. good, satisfactory, average and poor, have been indicated in Figure 1. The limiting values of the technical conditions were assumed in accordance with values corresponding to the degrees of technical wear.

Maintaining an adequate level of operating efficiency for each technical structure requires the application of supplementary solutions which support the diagnosis of damages and optimal planning of renovation works [8]. Familiarity with changes in the performance characteristics, e.g. as in Fig. 1, is an excellent prediction of detrimental changes in the building. The prediction of changes can be the basis for assuming proper decision strategies when planning renovation activities in residential buildings [9].

Technical diagnostics seen as a procedure of predicting operational reliability allow us to conclude that the analyzed parameters of buildings constructed using traditional technology can prove to be a useful tool for those managing these objects. An approach directed at predicting when damage will occur

will facilitate the optimal planning of renovation works on buildings over the course of the entire period they are in service.

## 6. Conclusions

The world of architecture is treated as an indivisible whole, as a vast space without boundaries between the past, present and future; not limiting the territories for observation, it provides a feeling of freedom in seeking architectural forms" [10]. The coexistence of the past with the present is most felt in residential architecture. This stems from the awareness that a building in the sense of a house always has sentimental value.

Shaping the longevity of residential buildings is connected with familiarity with the technical problems of passing; however, the secret of lasting is found, above all, in the propagation of aesthetics. The features of architecture specified by Witruwiusz are always current, which also holds true for residential buildings: the magic of beauty changes use and extends durability.

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