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PRIORITISING RENOVATION USING CONSEQUENCE ANALYSIS: A CASE STUDY OF A TENEMENT HOUSE IN KOŻUCHÓW

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A b s t r a c t

Proper renovation planning requires not only an ongoing assessment of technical conditions but, above all, swift and accurate prioritization of repairs. In engineering practice, such decisions are often based on the percentage of technical wear and tear of a building's components, which is treated as a simple indicator for the order in which work should be carried out. However, this approach does not always reflect the actual urgency of intervention. A component with moderate deterioration may pose serious risks, while a more worn-out one might not present an immediate threat. Consequently, assessment methods that consider the multi-factor nature of renovation decisions are becoming increasingly important. This article presents an example of such an application in a tenement block in Kozuchow, using a method for determining priority renovation works based on an analysis of the consequences of failing to carry out repairs.

Keywords: renovation, degree of damage, urgency of repairs, technical condition

1. INTRODUCTION

The effective management of renovation works on buildings requires not only systematic monitoring of their technical condition, but above all the correct prioritization of repairs [1-3]. In engineering practice, decisions regarding the sequence of renovation works are most often based on an assessment of the degree of damage to individual building components, expressed as a percentage. This parameter serves as a basic, intuitive indicator of which components require attention first [4-6].

The process of technical condition building wear is inevitable; it can only be slowed down through renovation or modernization work. Its progression depends on a number of factors, such as: the quality of the materials used, operating conditions, service loads, environmental impacts, as well as the frequency and scope of maintenance work. The degree of technical condition describes the extent to which a building component has lost its original performance, structural or functional properties as a result of the passage of time and environmental factors [7]. It is expressed as a percentage and constitutes a key parameter for assessing the technical condition of a building, as well as the basis for making

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decisions regarding renovation [8-9]. The degree of technical condition of a building is a diagnostic parameter that enables an objective assessment of the building's condition, the planning of renovation works, and an analysis of their technical and environmental impacts. Accurately determining this parameter forms the basis for the rational management of a building throughout its entire life cycle, and also enables the formulation of renovation strategies in line with the principles of sustainable development [10-11].

However, technical deterioration alone does not always reflect the actual urgency of carrying out the work. In many cases, a component showing a moderate degree of deterioration may pose significant operational risks, whilst another, more worn component may not present any immediate danger to users or the structural integrity of the building. For this reason, increasing attention is being paid to assessment methods that take into account the multi-factorial nature of renovation decisions.

Failure to carry out repair work is one of the most significant factors leading to the progression of damage in a building. An element that is not repaired may pose a threat to the structural stability of the building and the safety of its occupants, and may cause a cascade of damage to other parts of the building. The consequences of failing to carry out repairs can be classified into four categories: (1) catastrophic, (2) serious, (3) significant, (4) minor [12].

Catastrophic consequences include the deterioration of the whole building, resulting from a lack of reinforcement of structural elements, gas pipes or the electrical system. Serious consequences include structural damage and a threat to the safety of occupants; for example, damaged roofing may lead to the deterioration of the roof truss and the ceilings on the top floor. Significant consequences relate to damage to non-structural elements, such as plumbing and drainage systems, which may cause secondary damage and have a negative impact on the environment. Minor consequences include a loss of aesthetic appeal (e.g. damaged plasterwork) and a reduction in comfort of use (e.g. damaged floors). The roof covering is a component of the building where failure to carry out repairs may result in all the aforementioned types of consequences. Unrepaired roofing reduces the building's aesthetic appeal (minor consequence), leads to damage to the roof structure, floors or plasterwork (significant consequence), causes discomfort for occupants (significant consequence), and in extreme cases poses a safety hazard (serious consequence) and may lead to the degradation of the building (catastrophic consequence) [13-15].

This article presents an approach in which the urgency of carrying out renovation works is defined as a function of two parameters: the degree of technical wear and tear of a component (Szi) and the level of risk arising from a failure to carry out renovation works (Ei). This approach allows for a more balanced and objective assessment of renovation needs, integrating both the technical aspect and the safety of the building's use.

2. METHOD FOR PRIORITISING RENOVATION WORK

Maintaining a building in a satisfactory technical condition requires the identification of those elements with the greatest need for repair. During the assessment of the technical condition, the percentage of technical wear and tear for each element Szi is determined; in practice, this constitutes the sole criterion for the urgency of undertaking repair work [16]. The method further assumes that the urgency of carrying out renovation work on a given component Mi depends not only on its degree of technical wear and tear Szi, but also on the level of risk arising from a continued failure to carry out renovation work Ei. The urgency index for carrying out renovation work is determined by the formula:

$$Mi = Ei \ \ Szi \tag{2.1}$$

where:
i – denotes the ordinal number of component i in the building,

Szi – the degree of technical deterioration of component i,
Ei – the risk index resulting from the lack of renovation of component i.

The risk indicator for risks arising from the failure to renovate element Ei is the result of an analysis of the consequences of not undertaking repair work, carried out by one of the authors [12].
The degree of technical wear and tear of the i-th element in the building, Szi, is a measure of that element's technical condition. The degree of technical wear and tear, Szi, of each element in the building is determined during the assessment of the building's technical condition as a percentage ranging from 1 to 100.

3. CHARACTERISTICS OF THE TENEMENT HOUSE IN KOŻUCHÓW

Kożuchów is one of the oldest towns in the central Odra region. In addition to its preserved defensive walls, castle and numerous towers and turrets, the Old Town area is home to many valuable historical monuments. Within the boundaries of the former fortifications, a complex of historic townhouses has been preserved, integrated into the medieval urban layout. Many of these townhouses are built on Gothic foundations, retaining a two- or three-storey layout, whilst Renaissance portals are visible on parts of the facades.

Fig. 1. Archival photograph from around 1915 [17]

The tenement house in the town centre, at 17 Rynek Street, was built in the late 19th century. It originally housed the Deutsches Haus hotel, owned by Oscar Baum. The front façade featured stucco window surrounds, decorative rustication and cornices (Fig. 1). In 1968, following renovation, the

tenement house became home to the ‘Kożuchowianka’ restaurant, well-known to local residents (Fig. 2) [17].

The building is currently disused and is listed in the register of historic monuments.

Fig. 2. Archival photograph from around 1970 [17]

An assessment of the building's technical condition was carried out by qualified building professionals. As shown in photographs 3–6, the external walls are constructed of solid brick laid in lime-cement mortar and are 0.60 m thick, while the internal walls are 35 cm thick. Numerous cracks and fissures are present above the window and door openings. The cellars and ground floor feature brick barrel vaults, whereas the first and second floors have timber floors with false ceilings. The roof is a symmetrical gable roof, covered with ceramic carp-style tiles. Its wooden truss is of the purlin-and-collar type with a single gable wall. Localized damage, including loosened carpentry joints and signs of alterations to the original roof truss structure, is evident.

4. ANALYSIS OF RENOVATION PRIORITIES

In 2025, an assessment of the building's technical condition was carried out. The results of the assessment are presented in column 3 of Table 1 and Fig. 3-7. Column 2 contains the results of earlier analyses presented in [12].

Fig. 3. The first floor space (photo J. Markowska)

Fig. 4. Damaged ceiling over the ground floor (photo J. Markowska)

Fig. 5. Damp walls (photo J. Markowska)

Fig. 6. Damage to the roof structure (photo J. Markowska)

Fig. 7. A crack in the wall (photo J. Markowska)

In accordance with equation (1), an index of the urgency of carrying out renovation works was determined. The results are presented in Table 1.

Table 1. Indicators of the urgency of carrying out renovation work

Building component	**E_i**	**S_{zi}**	**M_i**
1	**2**	**3**	**4**
Brick foundations	11.748	0.15	1,762
Masonry walls	12.164	0.35	4,257
Partition walls	12.164	0.35	4,257
Timber ceilings	6.107	0.52	3,176
Timber stairs	1.965	1.00	1,965
Roof structure	4.695	0.45	2,113
Roofing	4.695	1.00	4,695
Gutters and downpipes	1.428	1.00	1,428
Internal plasterwork	0.185	1.00	0,185
External plasterwork	0.185	1.00	0,185
Window joinery	0.603	1.00	0,603
Door joinery	0.603	1.00	0,603
Glazing	0.603	1.00	0,603
Wooden floors	0.165	0.70	0,116
Paint finishes	0.004	1.00	0,004
Paint finishes for joinery	0.185	1.00	0,185
Ceramic cookers	1.169	1.00	1,169
Tiled stoves	1.169	1.00	1,169
Central heating pipes	1.965	1.00	1,965
Central heating boilers and radiators	1.965	1.00	1,965
Water and drainage pipes	1.169	1.00	1,169
Sanitary fittings	1.169	1.00	1,169
Gas pipes	2.912	1.00	2,912

The Mi indicators in column 4 of Table 1 are also colour-coded.

The colours indicate the classification of building elements based on the consequences of failing to carry out renovation work:

- most dangerous – brown — for Ei values above 5;
- dangerous – red – for Ei values from 3 to 5;
- less dangerous – orange – for Ei values from 1 to 3;
- least dangerous – yellow – for Ei values from 0 to 1.

The urgency indices for renovation work, ranked from highest to lowest, will determine the proper sequence of renovation projects for the building's components.

The results indicate that basing the urgency of renovation work solely on the degree of technical wear and tear could lead to unfavorable decisions, resulting in the progressive deterioration of the building. Primarily focusing on the most worn-out elements, such as external or internal plasterwork, could postpone the renovation of structural elements like load-bearing walls or ceilings.

5. SUMMARY

The analyses presented unequivocally confirm that assessing the urgency of renovation work cannot be based solely on the degree of technical wear and tear of individual building components. While this parameter is an important diagnostic indicator, using it in isolation misrepresents the actual renovation needs. Research findings show that prioritizing renovation work solely on the basis of deterioration tends to focus on the most damaged components.

A multi-criteria approach, however, accounts for both technical wear and tear and the consequences of failing to carry out repairs, allowing for a more objective, engineering-based determination of the sequence of actions. Integrating risk factors—such as potential hazards to users, the possibility of damage spreading, or the impact on the structure's durability—enables the formulation of renovation decisions that genuinely support maintaining the building in a safe and functional condition.

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