sustainability

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Renovation Management Method in Neglected Buildings

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Abstract: Renovation works to buildings are often not carried out or there are shifts in time, which causes degradation of the building. The article presents an analysis of the consequences of abandoning renovation works. The aim of this article is to present a method of preliminarily planning renovations of a MRUB (Managing Renovation in Un-renovated Buildings). This method of decision-making support is based on the consequences in the case of the omission of renovations. The omission of renovations may lead to a threat to the stability of the building's structure, threaten the lives of its users, and further damage the building by damaging further elements, or even cause a building disaster. Often, as a result of the abandonment of renovation, usually caused by the lack of the owner, improper manager, or irresponsible owners, these objects are degraded. The consequences of the failure of renovating buildings lead to irreversible processes of destruction. As a result of the research, it was found that it was not only a bad technical condition that was a prerequisite for carrying out the renovation. The consequences of the absence of renovation works, in addition to the technical condition, should be a motivating factor. The problem of the abandonment of renovations is presented using the example of the palace in Drwalewice.

Keywords: renovation needs; degradation of buildings; degree of technical condition; abandonment of renovation works; management of building; assessment of the technical condition

Citation: Nowogońska, B.; Mielczarek, M. Renovation Management Method in Neglected Buildings. *Sustainability* **2021**, *13*, 929. https://doi.org/10.3390/su13020929

Received: 23 November 2020
Accepted: 16 January 2021
Published: 18 January 2021

1. Introduction

The technical condition of the building changes as a result of the aging process. The good management of building maintenance should be based on regular renovation work. Proper management of renovations of the building maintains its technical condition at an appropriate standard level. Proper operation of buildings requires experience, interdisciplinary knowledge, and skills [1–4]. Incorrectly made decisions on behalf of the building owners or managers regarding redeployment during the implementation of renovation projects have a negative impact on the aging processes of buildings.

The consequences of wrong decisions concerning the renovation or maintenance failure of buildings lead to irreversible destruction processes [5–8]. The aging process of a building is closely related to its technical condition [9–13]. Absence of renovation work results in its acceleration. In many historic buildings, renovation activities are often abandoned. As a result, the technical condition is constantly degrading, and the functional properties reach lower and lower values [14,15]. Objects listed on the register of monuments are subject to strict conservation protection. Unfortunately, due to the higher costs of renovation and the need to supervise work in historic buildings, many valuable buildings are damaged. What will be completely destroyed as a result of negligence, omissions, and atmospheric factors can only be reconstructed to resemble historical elements in its form and material, but it will be only a reproduction, and not an original element. Therefore, regular repairs, renovations, and conservation are extremely important in order to prevent the complete degradation of the object and thus the loss of its historic value. This research concerns failure buildings. Often, these buildings are historic buildings, but failure buildings are not necessary historic objects. In the case of historic buildings, these buildings should be particularly considered. All decisions related to the renovation of historic buildings will always be made in cooperation with a conservator [16,17]. Furthermore, public awareness is of great importance here. In the pursuit of innovation and individuality, we must not forget about the monuments that testify to a past time. Souvenirs of the past show the craftsmanship, skills, and level of knowledge of those times. Historic buildings are an indispensable element of spatial development and constitute our common national good [18–22].

Research on the rational planning of renovation and modernization projects is constantly being conducted, but the impact of the level of public awareness on the efficiency of building resource management is neglected. Buildings often degrade due to a lack of any renovation operations and minor repairs, not to mention ongoing maintenance. After decades of occupancy, the housing stock shows signs of rapid deterioration and devaluation due to neglected maintenance [23]. Common for many buildings is that neglected maintenance has led to technical shortcomings such as high energy use and low thermal comfort due to bad insulation, unsatisfactory air tightness and leaky windows, inefficient heating systems, insufficient ventilation, and moisture damage due to a leaking building envelope and leaking pipes [24]. It is often difficult to obtain the residents' consent to renovate the building. In Norway, research has been conducted on the factors influencing the residents' belief in sustainable energy-efficient renovation. The results of the research of the low awareness of the people are presented in [25]. In Sweden, an analysis of factors influencing the spending of investment funds for renovation purposes related to the improvement of energy efficiency was also carried out [26]. The awareness of housing security is one of the most important aspects of housing security management. Therefore, in order to examine the residents' awareness, surveys were carried out using consultation questionnaires and statistical software. Problems also exist in the case of rented apartments [27]. The results of the research presented in [28] show that in Shanghai, residents do not understand the law on housing management, policy, and security awareness. Studies have also been conducted on the social risks associated with apartment demolition from a stakeholder perspective [29]. Risks related to stakeholders and their interrelationships have been investigated on the basis of interviews. Guides for building owners and authorities have been developed (e.g., [30]) to help ensure the safety of our aging building infrastructure. Ensuring the proper technical condition is one of the most important problems during the operation of each technical facility (e.g., [31–38]).

Renovation needs are a popular research topic. Methods of planning renovation works, renovation methods, methods of building modernization, or methods of making decisions in renovation strategy have been the subject of many studies. The methods of renovation needs assessment are being worked out, for example, the Assessment Method for Building's Rehabilitation Needs (MANR) [39], Architectural and Psycho-environmental Retrofitting Assessment Method (APRAM) [40], BuildingsLife: a building management system (BdMS) [41], survival analysis methodology for service live prediction and building maintenance [42], Determining the Rehabilitation Needs of Buildings (DRNB) [43], a model integrating the genetic algorithm, and simulations [44].

However, the problem of the effects of abandoning renovations remains unrecognized. The aim of this research was to identify and classify the consequences of a lack of renovation works. The analysis of the consequences of the abandonment of renovation works is one of the issues concerning building management. The presentation of the consequences of the abandonment of renovation works may help in making decisions to start renovation projects of various buildings. All buildings where renovations are not carried out on an ongoing basis are poorly managed. The indirect aim of this research was to make building owners aware of the consequences of abandoning renovation work.

Renovation planning studies have been carried out, the result of which is the sequence of renovation of each building element. This article presents a slightly different approach. The method of consequences of the lack of renovation work on each building element is presented. This method can be used to plan renovation works on the principle that the greater the consequences, the more necessary the renovation. Abandoning renovation works always brings with it many consequences. The most dangerous effect is building degradation.

2. Materials and Methods

The good management of building maintenance should be based on predictive and preventive maintenance renovation works. Knowledge of the consequences of abandoning renovation works can help to minimize the occurrence of construction failures in the future. No renovation work on individual elements in a building should cause a threat to the stability of the building structure, risk the lives of users, continue to damage the building by damaging further elements, or even a building disaster.

The method of the preliminary planning of renovation works of a MRUB (Managing Renovation in Un-renovated Buildings) consists of the following sequence of actions:

1. establish the most important effects of the lack of renovations;
2. determine the weights for each consequence of the abandonment of renovation works using the analytic hierarchy process (AHP) method;
3. determine the mathematical equation determining the importance of renovation needs; and
4. determine the level of the consequences of abandonment of renovation works for each element of the building.

The proposed method consists of identifying the most urgent repairs needed. The MRUB method is based on the premise that the higher the consequence of the lack of renovation works, the more important the renovation.

For this purpose, the consequences of the lack of renovation works were determined as well as the measures and weights of these consequences.

The proposed method is for buildings made using traditional technology. The material solutions for individual elements of the building were adopted and are presented in Table 2. It was assumed that the walls were made of brick, and the ceilings and stairs were wooden. The rafter framing structure is wooden covered with ceramic tiles.

The proposed method is not a method of planning conservation work. Historical buildings are especially important, and the preservation of souvenirs of the past should be taken care of. In Poland, the conservation officer often determines the conservation methods for each building individually, but not always. The proposed method is only a preliminary plan of building renovation and can be applied to historic buildings only on the condition that there is the conservator's acceptance. In the case of historic buildings, the conservator's guidelines should be taken into account.

2.1. Determination of the Most Important Effects of the Lack of Overhaul

The abandonment of renovation works is an extremely important factor causing degradation of the building. The effects of failure to repair the individual building elements presented in Table 1 can be divided into catastrophic, serious, significant, and insignificant.

Table 1. The consequences of abandoning renovation works.

Effects	Consequences
Catastrophic	Building degradation
Serious	Building structure damage
	Lack of user safety
Significant	Effect on damage of other elements
	Lack of comfort in use
	Negative impact on the environment
Insignificant	Lack of aesthetics

The catastrophic effect is defined as degradation of the building, which may be caused by the lack of renovation to damaged structural elements and gas pipes, pipes, and electrical installation accessories. The consequences of the serious omission of renovations include damage to the building's structure and the lack of safety to users. For example, a damaged roof covering may cause damage to the rafter framing and ceiling. Failure to carry out repairs involving the roofing has catastrophic, serious, significant, and irrelevant consequences. Destroyed and not renovated roofing is the cause of the lack of aesthetics of the object (insignificant effect). Lack of renovation to the roofing causes damage to other elements of the building such as the roof truss structure, floors, and plaster (significant effect). As a result of abandoning the renovation of the roofing, there is a lack of comfort in using the object (significant effect) and even a lack of safety to the users (serious effect). Destroyed and not repaired roofing may be the cause of damage to other structural elements (serious effect) or even further degradation of the building (catastrophic effect).

The building was divided into components. For each component, the consequences of abandoning renovation work on that component were determined. Criteria for the consequences of abandoning renovation works were defined as follows:

C1—building degradation
C2—building structure damage
C3—lack of user safety
C4—negative impact on the environment
C5—lack of comfort in use
C6—effect on damage of other elements
C7—lack of aesthetics

2.2. Determination of Weights for Each Effect Using the Analytic Hierarchy Process (AHP) Method

In the proposed method, decision-making processes in the form of a hierarchical structure have been applied. Many techniques supporting the choice are known. The simplest of these is the AHP technique, which has been used in the method of consequences of the lack of renovation works. There are many techniques supporting choices. The decision-making process with the use of the AHP technique is one of many, and it is flexible and universal. In the method proposed in this article, the AHP technique was used.

The assessment of the consequences of the abandonment of renovation works was carried out by means of a multi-criteria analysis. The weights of each consequence of abandonment of renovation works were determined using the AHP. The data were obtained on the basis of consultations with persons involved in the renovation of buildings including building managers, university research workers, appraisers, conservators, employees of design offices, and contractors. Over 50 experts were consulted. The task of all experts was to determine the weighting of the consequences of the lack of repair works: C1—building degradation, C2—building structure damage, C3—lack of user safety, C4—negative impact on the environment, C5—lack of comfort in use, C6—effect on damage of other elements, and C7—lack of aesthetics.

The consequences of C1, C2, C3, C4, C5, C6, and C7 were then compared in pairs in terms of relevance for each criterion. After summing up the scores obtained in each of the criteria for each variant, the final assessment of the variant was obtained. In this way, a ranking of options for the consequences of the lack of renovation work is created, determining the relative advantage of one over another. The obtained results of consultations are presented in Table 3. The obtained results of the AHP method are presented in the diagram in Figure 1. The numerical values obtained are the weights of the individual consequences. The numerical values are not physical quantities: they are without units and they are unchanged numbers.

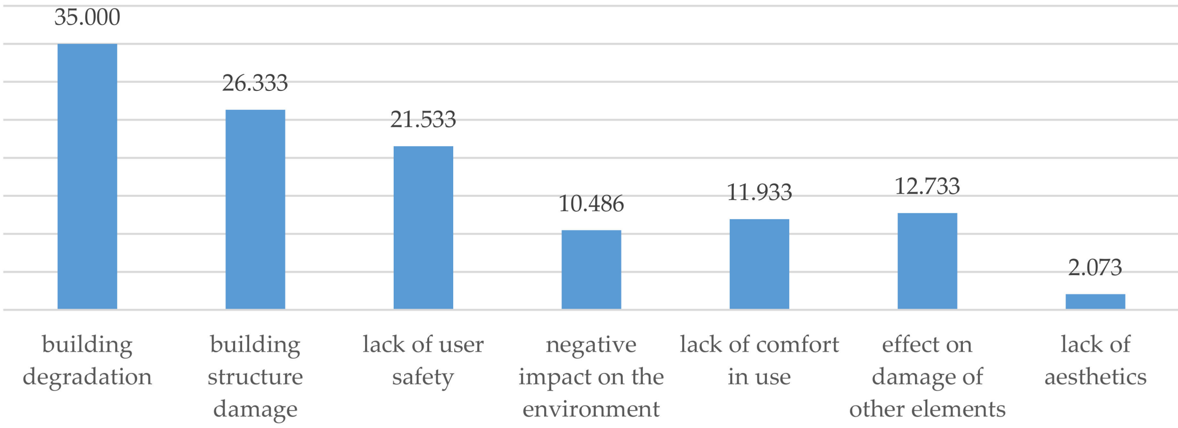

Figure 1. Obtained results of the analytic hierarchy process (AHP) method.

The numerical values obtained are the weights of the individual consequences. The numerical values are not physical quantities, they are without units, and they are unchanged numbers.

2.3. Determination of the Mathematical Equation Determining the Importance of Renovation Needs

Each element of the building was inspected for its technical condition, a result of which the percentage of its technical condition was determined. Thanks to the dependence of the degree of technical condition of the element on the aspect of the consequences of abandonment of renovation works, it is possible to obtain the renovation coefficient for each building element. Indicators ranked from the largest to the lowest size will determine the urgency of renovation of the elements in the building.

By using the solution of Equation (1), we obtained the values assigned to each investigated element in a building. The numerical values, which are the results of the study, are the indicators of the order in which the renovations are performed, Mi. The higher the indicator, the more necessary the renovation of the *i*-th element. However, the indicator does not mean any physical size of the renovated elements, and is only used to rank the building's elements due to the proposed order of performing the renovations.

$$\mathrm{M_i} = E_i Sz_i \tag{1}$$

where:

- $\mathrm{M_i}$—the renovation sequence indicator;
- E_i—coefficient of the consequences of abandonment of renovation works;
- Sz_i—degree of technical condition;
- i—denotes an ordinal number of an element in a building, i = 1, 2, 3, . . . , n;

Old buildings were very often built over several periods. In different periods, other building materials were used. Each building material wears out differently and has its own period of durability. During periodical inspections of a building, the technical condition of each element is determined, expressed by the degree of technical condition.

The degree of technical condition, Sz_i, is determined visually. In this building, for each i-element, an authorized building expert in Poland will determine the degree of technical condition. The greater the damage, the higher the degree of technical condition. This indicator is determined in percentages from 0 to 100. The degree of technical condition changes over time and is determined each time during periodic inspections of the building.

The coefficient E_i of the consequences of the abandonment of renovation works is defined as the sum of the weights for each element:

$$E_i = A_i \sum_{j=1}^{7} C_{ij} \tag{2}$$

where:

- E_i—coefficient of the consequences of abandonment of renovation works;
- A_i—importance of *i*-element;
- C_{ij}—importance of consequences *j* for the *i*-th element;
- *i*—denotes an ordinal number of an element in a building, $i = 1, 2, 3, \ldots, n$;
- *j*—denotes consequences, $j = 1, 2, \ldots, 7$.

The C_{ij} coefficient refers to the consequences of the lack of renovation work on individual building elements. If the consequence exists ("plus" according to Table 2), then the coefficient occurs. For each consequence, the coefficient is different and its value is given in Table 3.

Table 2. The consequences of abandoning renovation works for every element of the building.

Damaged Component	**Consequences**						
	Building Degradation	**Building Structure Damage**	**Lack of User Safety**	**Negative Impact on the Environment**	**Lack of Comfort in Use**	**Effect on Damage of Other Elements**	**Lack of Aesthetics**
Brick foundations	+	+	+	+	+	+	
Masonry brick walls	+	+	+	+	+	+	+
Masonry partition walls	+	+	+	+	+	+	+
Wooden beam ceilings		+	+	+	+	+	+
Wooden stairs			+		+	+	+
Roof rafter		+	+		+	+	+
Tail caver		+	+		+	+	+
Gutters and drainpipes		+				+	+
Internal plasters						+	+
External plasters						+	+
Windows					+	+	+
Doors					+	+	+
Glazing					+	+	+
Wooden floor					+		+
Wall coatings					+		+
Woodwork oil coatings					+	+	+
Cores of ceramic cookers				+	+	+	+
Tiled stove				+	+	+	+
Central heating pipes			+		+	+	+
Boilers and heaters for c.h.			+		+	+	+
Water supply and sewage pipes				+	+	+	+
Water supply and sanitation fittings				+	+	+	+
Gas pipes			+	+	+	+	+
Electrical installations			+	+	+	+	+

Table 3. The assessment of the consequences of the abandonment of renovation works [39].

Aim	C1	C2	C3	C4	C5	C6	C7
C1	1.000	0.333	0.200	0.143	0.200	0.200	0.111
C2	3.000	1.000	0.333	0.143	0.200	0.333	0.143
C3	5.000	3.000	1.000	0.200	0.333	1.000	0.143
C4	7.000	7.000	5.000	1.000	3.000	0.200	0.333
C5	5.000	5.000	3.000	1.000	1.000	5.000	0.143
C6	5.000	3.000	5.000	5.000	0.200	1.000	0.200
C7	9.000	7.000	7.000	3.000	7.000	5.000	1.000
Cj	35.000	26.333	21.533	10.486	11.933	12.733	2.073

The building was divided into n-elements (Table 2). Each *i*-th element in the building has its own purpose and has a different function [31,34]. Weights of A_i elements are assigned for each element. The values of the weights are included in Table 4.

Table 4. The consequences of abandoning renovation works.

Damaged Component	Consequences								
	Importance of i-Element; A_i	Building Degradation	Building Structure Damage	Lack of User Safety	Negative Impact on the Environment	Lack of Comfort in Use	Effect on Damage of Other Elements	Lack of Aesthetics	E_i
Brick foundations	0.127	35.000	26.333	21.533	10.486	11.933	12.733	0.000	14.988
Masonry brick walls	0.190	35.000	26.333	21.533	10.486	11.933	12.733	2.073	22.817
Masonry partition walls	0.051	35.000	26.333	21.533	10.486	11.933	12.733	2.073	6.125
Wooden beam ceilings	0.076	0.000	26.333	21.533	10.486	11.933	12.733	2.073	6.467
Wooden stairs	0.062	0.000	0.000	21.533	0.000	11.933	12.733	2.073	2.993
Roof rafter	0.070	0.000	26.333	21.533	0.000	11.933	12.733	2.073	5.222
Tail caver	0.068	0.000	26.333	21.533	0.000	11.933	12.733	2.073	5.073
Gutters and drainpipes	0.022	0.000	26.333	0.000	0.000	0.000	12.733	2.073	0.905
Internal plasters	0.010	0.000	0.000	0.000	0.000	0.000	12.733	2.073	0.148
External plasters	0.021	0.000	0.000	0.000	0.000	0.000	12.733	2.073	0.311
Windows	0.044	0.000	0.000	0.000	0.000	11.933	12.733	2.073	1.177
Doors	0.032	0.000	0.000	0.000	0.000	11.933	12.733	2.073	0.856
Glazing	0.019	0.000	0.000	0.000	0.000	11.933	12.733	2.073	0.508
Wooden floor	0.013	0.000	0.000	0.000	0.000	11.933	0.000	2.073	0.182
Wall coatings	0.006	0.000	0.000	0.000	0.000	0.000	0.000	2.073	0.012
Woodwork oil coatings	0.006	0.000	0.000	0.000	0.000	0.000	12.733	2.073	0.089
Cores of ceramic cookers	0.006	0.000	0.000	0.000	10.486	11.933	12.733	2.073	0.223
Tiled stove	0.006	0.000	0.000	0.000	10.486	11.933	12.733	2.073	0.223
Central heating pipes	0.019	0.000	0.000	21.533	0.000	11.933	12.733	2.073	0.917
Boilers and heaters for c.h.	0.025	0.000	0.000	21.533	0.000	11.933	12.733	2.073	1.207
Water supply, sewage pipes	0.038	0.000	0.000	0.000	10.486	11.933	12.733	2.073	1.415
Water supply sanitation fittings	0.019	0.000	0.000	0.000	10.486	11.933	12.733	2.073	0.707
Gas pipes	0.019	0.000	0.000	21.533	10.486	11.933	12.733	2.073	1.116
Electrical installations	0.051	0.000	0.000	21.533	10.486	11.933	12.733	2.073	2.997

The assessment of the technical condition of the building can be carried out visually. An experienced expert assesses the technical condition of each building element on a scale from 0 to 100. This method gives the degree of technical condition. The greater the degree of technical condition, the more damaged is the building element. In the case of historic buildings, not every experienced expert can assess the technical condition. In addition, the conservator must accept the expert.

2.4. Determination of the Level of Consequences of Abandonment of Renovation Works for Each Component of the Building

The results of the E_i are the determinants of the order of performance of renovation works for individual elements of all tested buildings. The E_i indicators do not represent any physical quantity and are only a comparative scale.

The E_i indicators should be ranked from the highest to the lowest value. Indicators indicate the order in which all building elements should be renovated. The higher the indicator, the more it needs to be renovated. The highest values were shown by the building's structural elements, and above all by the walls.

The proposed method does not include costs. It was assumed that the consequences of the lack of renovation works are most important to save the building. The costs are inevitable and will still be necessary.

In the case of historic buildings, the conservation guidelines should also be considered. If the conservator recommends the renovation of one of the elements in the first place, then this element must be excluded from the method. The E_i value for such an element must be considered as the maximum, and the proposed method should be applied to the remaining building elements. It should also be remembered that in historic buildings, there may be a change in the scale of the A_i weights of the elements due to preserved historical details.

3. Results and Discussion

The aim of the article was to identify and classify the consequences of a lack of renovation works. The indirect aim of the research was to make building owners aware of the consequences of abandoning renovation works. Knowledge of the consequences of abandoning renovation works could help to minimize the occurrence of construction failures in the future.

It would seem that the more worn out the element, the faster it should be repaired. However, this is a mistaken concept as not only does the technical wear and tear of a building element, but also the consequences of not renovating this element, influence the order of renovation works.

Provided that all elements are in a similar technical condition, the order of renovation works can be determined. This is based on the fact that the degree of technical wear and tear in this building was 50% for each element. According to the method, the value of the M_i factor was determined for each building element (Table 5). M_i-factors sorted from the highest to the lowest value indicate the order of renovation works for the building.

In Table 5, the building elements were ranked according to the size of M_i. In this method, the sequence of renovation works of the building elements was created and it was assumed that all elements were similarly used.

The results indicate what the most needed renovation of the structural elements is. Structural elements are made of building materials with a longer durability than other building elements. The longer the durability period, the slower the degree of the technical condition increases. In fact, the degree of the technical condition of these elements will be lower than other elements.

The minimum possible value of the renovation sequence indicator M_i results from the technical condition of the building element. If the degree of technical condition of any building element is defined as $Sz = 0$, then the M_i factor is also $M_i = 0$.

The highest possible value of the M_i renovation sequence index is possible for 100 percent of the technical condition of a building element. The maximum value of M_i is possible for masonry walls, which can be maximum of 2281.748. Maximum values of the renovation sequence index M_i for all building elements are presented in Table 6.

Table 5. Values of the order indicators of elements renovation for the average (50%) degree of technical wear of elements.

Damaged Component	E_i	Sz_i	M_i
Masonry brick walls	22.81748	50	1140.8740
Brick foundations	14.988413	50	749.4207
Wooden beam ceilings	6.466992	50	323.3496
Masonry partition walls	6.124692	50	306.2346
Roof rafter	5.22242	50	261.1210
Tail caver	5.073208	50	253.6604
Electrical installations	2.996709	50	149.8355
Wooden stairs	2.992926	50	149.6463
Water supply, sewage pipes	1.41455	50	70.7275
Boilers and heaters for c.h.	1.206825	50	60.3413
Windows	1.17656	50	58.8280
Gas pipes	1.116421	50	55.8211
Central heating pipes	0.917187	50	45.8594
Gutters and drainpipes	0.90508	50	45.2540
Doors	0.85568	50	42.7840
Water supply sanitation fittings	0.707275	50	35.3638
Glazing	0.50806	50	25.4030
External plasters	0.310926	50	15.5463
Cores of ceramic cookers	0.22335	50	11.1675
Tiled stove	0.22335	50	11.1675
Wooden floor	0.182078	50	9.1039
Internal plasters	0.14806	50	7.4030
Woodwork oil coatings	0.088836	50	4.4418
Wall coatings	0.012438	50	0.6219

Table 6. Maximum values of the renovation sequence index M_i for all building elements.

Damaged Component	M_i Max
Brick foundations	1498.841
Masonry brick walls	2281.748
Masonry partition walls	612.469
Wooden beam ceilings	646.699
Wooden stairs	299.293
Roof rafter	522.242
Tail caver	507.321
Gutters and drainpipes	90.508
Internal plasters	14.806
External plasters	31.093
Windows	117.656
Doors	85.568
Glazing	50.806
Wooden floor	18.208
Wall coatings	1.244
Woodwork oil coatings	8.884
Cores of ceramic cookers	22.335
Tiled stove	22.335
Central heating pipes	91.719
Boilers and heaters for c.h.	120.683
Water supply, sewage pipes	141.455
Water supply sanitation fittings	70.728
Gas pipes	111.642
Electrical installations	299.671

4. Case Study: A Neo-Gothic Palace

The Palace in Drwalewice is an example of one of many similar failure buildings in western Poland. The palaces in Poland survived the warfare, but were often unfortunately abandoned later on. The palaces were not used for a long time and had not been renovated. Today, the buildings already have owners. However, the buildings are so badly damaged that the owners do not know where to start with the renovations. As such, the proposed method may be helpful.

The palace and grange complex is located in the western part of the village. The entranceway leads from the south side onto a vast yard, around which outbuildings are located. The palace, situated with the facade facing the west, is located in the eastern part of the yard. Behind the palace, in the eastern and southern part, is a landscape park. The body of the building was created by various extensions added to the main body of the building.

The earliest mention of the village of Drwalewice (Driwalowitz 1295 r., Wallwitz 1791 r.) dates back to the 13th century, as an emolument of the parish in Solniki [40,41]. From the middle of the 14th century, the village belonged to the von Unruh family. The building of the renaissance residence—a fortified manor—is connected with Hans Wolf von Unruh. The village changed owners a number of times. Near the end of the EVIII century, the estate was bought by P.G. Strempel, who rebuilt the manor house. Since 1872, the owners of Drwalewice have been the von Eichmann family, and, in 1875, another reconstruction of the building took place [45–48].

The palace, erected from stone and brick, is a plastered, two-story structure with a finished attic and basement, and covered by a flat roof hidden behind crenellation (Figure 2). The majority of the basements are covered by a brick cross-barrel vault; the rooms in the southwest corner were constructed as a segmented ceramic vault on steel beams. Over the ground floor and first floor, there is a wood ceiling with sound boarding, with only a room on the ground floor situated in the eastern central part or the building, being covered by a groin vault. In an upstairs room, located in the south part of the building, the moldings have been partially maintained. The ceiling covering the stairwell is decorated with a rosette. In the hall on the ground floor and first floor, there are arcades supported by four columns and eight half-columns covered by a wooden ceiling. The window openings are covered with dripstones—rectangular on the lower floor, and narrow, and ogee-arched on the upper one. A decorative element of the facade is a portal with a balcony, with supports in the shape of griffins. The balustrade is ceramic openwork with an oak leaf motif. Above the balcony, a cartouche is laid in masonry.

Figure 2. Front elevation. View from the southwestern side. Body of the building is an irregular rectangle enriched with additions: towers in the corners, a balcony on the front elevation, terraces on the side elevations, and the roof is a multi-hipped flat roof hidden behind the attic in the form of a crenellation.

The current form of the palace was shaped as a result of three building phases. In the basements, the relics of a renaissance manor have been maintained. From the reconstruction in 1791 are the rooms of the main body. The towers in the corners, terraces in side elevations, and a balcony in the front elevation were added in the 19th century. The building was originally founded on a square plan; in the second phase, it was extended to a rectangle; and in the third, enriched with numerous extensions.

Before the building was profoundly rebuilt into a Neo-Gothic palace, it had been subjected to earlier modernization in 1791. The function of the building changed from defensive to residential. The reconstruction in the 19th century was not limited to introducing the new Neo-Gothic décor; it also covered enriching the bodies of the building with numerous annexes. The main body of the palace was coped with an attic crenellation. The tri-axial center of the façade and remaining elevations were raised and surrounded by pinnacles. The ogives main entrance was accented by a balcony placed above it, with a ceramic balustrade and griffins. The body of the building was decorated with annexes. On the north side, a tower was added on, which was four-sided in the lower part, with the upper transitioning into an octagon. A loggia was added to the tower on the north side. The east (garden) elevation was enriched by a protrusion with a balcony, the south elevation by two annexes lower than the body of the palace. The inside also received a new Neo-Gothic decor. The hall was divided into a front part covered by a wooden ceiling as well as a two-bay vaulted cloister supported by square columns and pilasters with decorative caps located further in. In the tower, in the south part of the building, in the basement, and on the ground floor, a colonnade running along the southern and western walls can be found. The arcades are supported by slender iron columns with caps covered by stylized floral ornamentation (Figure 3). The doors are decorated by a motive of ogives recesses, a stylized rosette, and crenellated lintels. The staircase leading to the upstairs is decorated by a forged balustrade (Figure 4).

Figure 3. Ground floor. View onto the arcades in the central part. Preserved decorative caps. Plasters of the columns are original, arcades are secondary.

Figure 4. Stairwell fragment. Preserved cast-iron balustrade with floral ornamentation.

The results of the carried out assessment of the technical conditions [48] indicate that there is a need for a complete renovation of the building (Appendix A).

In the analysis, all elements of the palace building in Drwalewice were taken into account. The obtained results are presented in Table 8.

Tables 7 and 8 contain the same building elements, but in Table 7, the elements are ranked. In Table 8, the building components have been ranked in value of M_i factor from the highest to the lowest. The obtained order is an indicator of the urgency of renovation works. Based on the results obtained, it can be concluded that the value of technical wear and tear is not the same as the necessity of carrying out renovation works.

Table 7. The results of the assessment of the technical conditions.

Damaged Component	Sz_i [%]
Brick foundations	60
Masonry brick walls	40
Masonry partition walls	80
Wooden beam ceilings	70
Wooden stairs	20
Roof rafter	60
Tail caver	40
Gutters and drainpipes	80
Internal plasters	30
External plasters	30
Windows	20
Doors	70
Glazing	10
Wooden floor	100
Wall coatings	100
Woodwork oil coatings	80
Cores of ceramic cookers	80
Tiled stove	100
Central heating pipes	100
Boilers and heaters for c.h.	100
Water supply and sewage pipes	100
Water supply and sanitation fittings	100
Gas pipes	100
Electrical installations	100

Table 8. Maintenance management in the palace in Drwalewice.

Damaged Component	Sz_i	M_i
Brick foundations	60	1369.049
Masonry brick walls	40	599.537
Masonry partition walls	80	489.975
Wooden beam ceilings	70	452.689
Wall coatings	100	299.671
Tail caver	40	208.897
Roof rafter	60	179.576
Electrical installations	100	149.835
Central heating pipes	100	117.656
Woodwork oil coatings	80	113.164
Water supply, sewage pipes	100	90.508
Cores of ceramic cookers	80	73.375
Gutters and drainpipes	80	68.454
Water supply sanitation fittings	100	50.806
External plasters	30	36.205
Internal plasters	30	33.493

Table 8. *Cont.*

Damaged Component	Sz_i	M_i
Gas pipes	100	31.093
Tiled stove	100	22.335
Wooden floor	100	22.335
Boilers and heaters for c.h.	100	14.806
Doors	70	12.745
Glazing	10	7.073
Windows	20	1.777
Wooden stairs	20	0.249

Figure 5 shows the results of the renovation sequence indicators for all elements of the palace in Drwalewice. Additionally, the diagram contains the maximum and average values that are possible for the building elements.

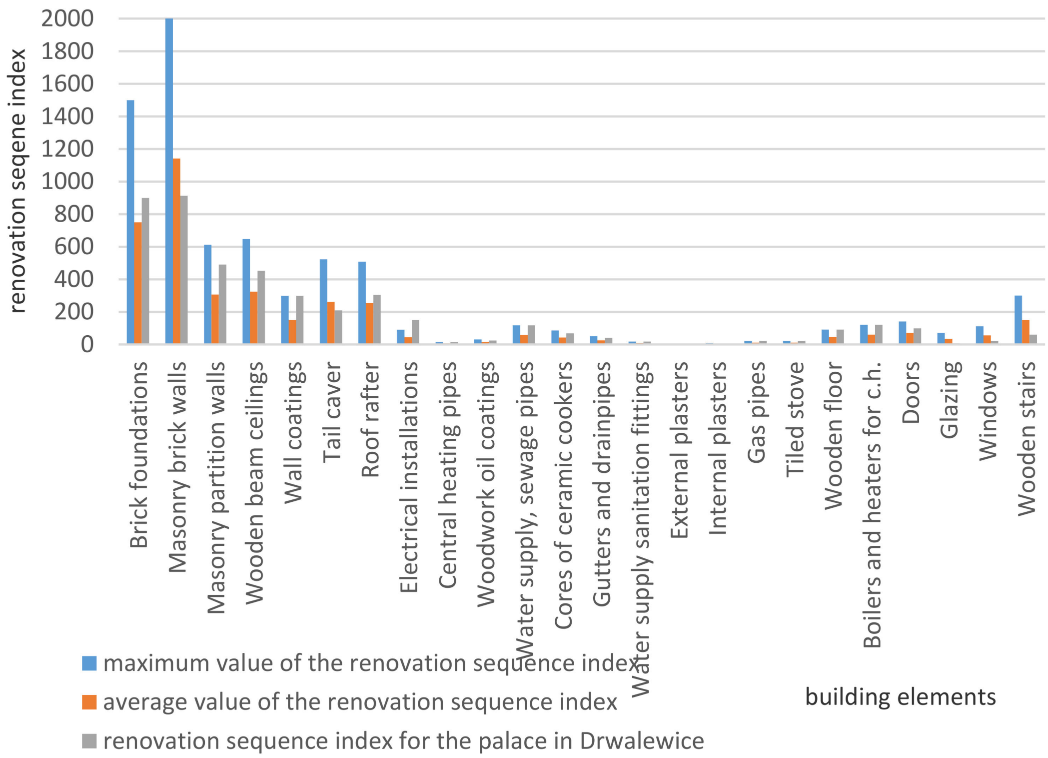

Figure 5. Values of the renovation sequence indicators for all elements of the palace in Drwalewice.

5. Conclusions

The proposed method is a new approach to determining the urgency of renovation works. In planning methods, the effect of renovation works is always taken into account, and in the MRUB method, differently, the effect of failure to complete renovation works.

Based on the results obtained, it can be concluded that:

- the value of technical wear and tear is not the same as the necessity of carrying out renovation works, and
- the most urgent renovation works are the renovation of the foundations and walls.

As a result of the research, it was found that bad technical condition was not only a prerequisite for carrying out the renovation. The consequences of the absence of renovation works, in addition with bad technical condition, should be a motivating factor.

In the area of Middle Odra, there are over a hundred manors and palaces that remain. The majority of them, however, are not in use, so their technical conditions are undergoing continuous deterioration. The presented palace in Drwalewice is among such buildings. Adaptions to the current service needs, as will be the case with Drwalewice palace, will allow for these buildings to be saved from further destruction. The palace in Drwalewice is not in use as of today. Aside from the natural wear of materials and the destructive influence of atmospheric and biological factors, the bad technical condition is the result of the object not being in use. The lack of carried out repairs has caused the progressing deterioration of the building to accelerate. Planned renovation works will stop this process.

Author Contributions: Conceptualization, B.N.; Methodology, B.N.; Validation, B.N.; Formal analysis, B.N.; Investigation, B.N.; Resources, B.N. and M.M.; Data curation, B.N.; Writing—original draft preparation, M.M. and B.N.; Writing—review and editing, M.M. and B.N. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: Data sharing is not applicable to this article.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

A technical assessment of the palace was carried out.

The assessment of the technical condition of individual building components was prepared on the basis of carried out inspections (Figures A1 and A2), periodic uncovering, and test measurements [48].

Figure A1. Fragment of the northern elevation. Numerous damp stains on the terrace, destroyed steps, and missing areas of plaster. Destroyed column caps.

Figure A2. Southern elevation. View from the southwestern side. Walls covered by a cement-lime plaster applied in the 1980s. Note the lack of balustrade on the tower terrace and the lack of plaster on the foundation plinth.

The foundation of the building is composed of a strip foundation of various dimensions with an offset of 15 cm, made from boulders on lime mortar with an addition of clay; the average diameter of the boulders is approx. 60–70 cm. The depth of the strip foundation is approximately 80–120 cm below the level of the basement floors. Uncovering of the foundations in the northeastern and southwestern part of the building has been carried out. Severe damp from the groundwater on surfaces was determined (Figures A3 and A4). The soil in areas of the foundation uncovered is loamy sand. The level of groundwater is above the level of the foundation and there is a lack of vertical and horizontal damp insulation.

Figure A3. Basement in the middle part of the building (fragment). Foundation uncovered. High level of groundwater means a severely damp wall.

Figure A4. Wall of northern elevation (fragment). Foundation uncovered. Foundation from boulders and visible groundwater table.

The walls of the basement are made from boulders and class 7.5–10 fired, solid brick, with a cement–lime mortar (composition of mortar lime:cement:sand = 3:1:5), and plastered on both sides. The thickness of the walls ranges from 65 cm to 210 cm. The middle, and oldest part, is on laid in lime mortar with the addition of clay. The outside walls of the ground floor (thickness ranging from 70 to 82 cm), first floor (thickness from 42 to 82 cm), and attic (thickness from 20 cm to 54 cm) are made from fired, class 7.5–10, solid brick on lime–cement mortar (composition of mortar lime:cement:sand = 3:1:5), and are plastered on both sides.

Slight cracks and scratches, 1–2 mm in width, are present (e.g., a crack on the western wall running between the window openings at the level of the ceiling above the ground floor). The cracks were caused by external factors (moisture, temperature, etc.). Cracks are the results of slight shifts over a period of many decades. Such shifts do not currently occur.

The walls of the basements are severely damp. From the outside, large amounts of efflorescence including salt efflorescence and discolorations are visible from the inside on the plasters. In the east part of the building, on the ground floor, the walls are severely damp due to water entering from the ground by capillary rise. The walls of the room under the terraces are damp from rainwater.

The inside walls of the ground floor and first floor (ranging in thickness from 12 to 78 cm) are made from class 7.5–10 fired, solid brick laid in lime–cement mortar (composition of mortar lime:cement:sand = 3:1:5), and plastered on both sides. Some of the inside walls of the attic are studwork walls (12 cm thickness) made from pine posts and beams covered by boards and reed.

Cracking is not present on the inside masonry walls. The walls do not require repairs and protection. Only on one wall in the room covered by the groin vault, on the wall from the direction of the hall, is a vertical structural crack visible.

Wooden elements in the studwork walls are heavily dampened, with the walls needing to be replaced by new ones. The majority of the basements are covered by a brick barrel vault (group 1 of brick). Two rooms in the southwest corner were made as ceramic segmental vaults on I 2000 steel beams, with 1.5 m spread. Over the ground floor and the first floor, there is a wooden ceiling with sound boarding. The ceiling beams measure 18 × 23 cm or 20 × 25 cm, with 80–100 cm spread.

The room of the hall on the ground flood is covered by a decorative wooden ceiling made from profiled beams and coffers. The room of the ground floor, situated in the eastern, middle part, is covered by a vault made from brick on lime mortar (group 1 of brick). In the room in the northeastern part of the building, there is a ceiling on I 200 steel beams, on the underneath finished by fake beams (profiles from boards), creating a coffered ceiling.

In a room upstairs, in the south part of the building, partially preserved moldings are found. The ceiling covering the stairwell is decorated with a rosette.

In the upstairs rooms, in the northwestern part of the building, there is a ceiling made of prefabricated concrete ceiling slabs from I 200, with a spread of 1.2 m.

In the room upstairs, in the northern part of the building, the floor slab deflection is approximately 15 cm. The floor requires additional support. Upstairs, the ceiling beams are significantly damp. The wooden construction of the ceilings requires general repairs, partial strengthening, and the partial replacement of elements (Figures A5 and A6). Additionally, it is recommended that the wood be impregnated with insecticides and fungicides.

In the hall on the ground floor and upstairs, there are arcades supported by four columns and eight half columns covered by a wooden ceiling. In the tower in the south side of the building, in the basement, and on the ground floor, a colonnade running along the south and west walls can be found. The arcades are supported by slim iron columns with column heads covered by stylized floral ornamentation.

Cracking is present in the arcades in the hall: a vertical crack running along the arch of the arcades on the ground floor and first floor (located on the south side), 5 mm wide as well as horizontal cracks, 2 mm in width, between the central wall and the arcade covering. Arcades in the south tower are heavily damp due to the leaking terrace.

The construction of inside stairs in the northern part of the building is brick arched, supported by a steel beam with wooden treads and risers. The cast-iron balustrade contains a floral motive. Stairs in the south side of the building—reinforced concrete—were built in the 1980s. The outside stairs are concrete.

The construction of the roof framework is of the rafter-purlin type from pine, comprising a few parts: central, pitched, with the roof ridge perpendicular to the front elevation, and two pitched side parts; the layout of the roof ridges is parallel to the front elevation as well as rafter frameworks over the towers. The roof is covered with roofing felt, with the end walls coped with an attic imitating a crenellation.

The technical condition of the roof framework is varied. Bending and severe dampening of elements occurs locally. Thermal insulation is 5–10 cm thick Styrofoam. The Styrofoam has undergone oxidation. The roof covering of the roofing felt on tar is in bad condition and the boards need to be replaced. The chimneys are in good condition.

The gutters, downpipes, and flashing are of galvanized steel. Missing parts of the gutters and downpipes allow rainwater to penetrate inside, leading to the destruction of outside plasters and the dampening of the walls.

The floor in the rooms of the basements is concrete. On the ground floor and first floor, there are wooden or concrete floors, missing in some of the rooms. In the hall on the ground floor, there is terracotta flooring 17 × 17 cm in size. There is no flooring in the attic. The floors in the basement are damp and cracked. Concrete flooring in the basements requires repairs and patching.

On the ground floor, first floor, and attic, the windows are double-paned, casement, folding with a fanlight, with wooden frames and wooden windowsills. In the basements, the wooden windows are single-pane loom windows. The window openings closed with weather molding on the lower floors are rectangular; on the upper floors they are narrow and ogival. The window frames are from the 1980s. The doors on the ground floor are two-winged; the ones on the first floor and in the attic have not been retained. The front opening has an ogival profile. At the entrance to the balcony are double-winged glazed box doors. Some of the doors on the ground floors are original from the reconstruction that took place in the 19th century. The preserved doors and door frames are partially infested with wood-destroying pests and mechanical damage is visible. The doors require repairs and conservation.

The original plasters were stripped. Currently, the walls are covered by a cement–lime mortar with a thickness of approximately 2 cm, which was laid in the 1980s.

A decorative element on the front elevation (west) is the balcony on supports in the shape of griffins with an openwork balustrade with an oak leaf motif. The structure of the balcony is a flat light masonry slab on steel beams. The architectural details are ceramic. An arms cartouche can be found over the balcony.

Window openings are closed with dripstones. At the level of the ceiling over the ground floor, the elevation is decorated with an inter-story cornice. The windows of the tower are enriched with a kinked profile that is adjacent to the higher part of the frame of the window opening.

In rooms at the level of the basements and ground floor, the walls are covered with a lime-cement and cement–lime mortar (applied in the 1980s), 1.5 cm in thickness. Original cement plaster and polychromes are present on the walls of the stairwell. In wet rooms, the walls are partially covered with ceramic tiles. Damp, numerous cracks, and missing plaster all occur in the rooms of the basements.

The inside walls are not painted. On the walls of the stairwell and arcade columns in the central part of the building are the remains of Neo-Gothic polychromes.

The building contains the remains of a water and sewage service system as well as a very inadequate heating system. The wiring system is damaged, with makeshift connections to the light sources posing a fire hazard.

The wooden ceilings over the ground floor and first floor do not fulfill the specified ultimate limit states of load-bearing capacity, and the immediate renovation of the ceilings in a manner that allows for preserving as much of the historic substance as possible in an unchanged form is recommended.

Missing pieces of ceiling decorations of the decorative coffered ceiling in the entrance hall as well as in the northeast room on the ground floor ought to be completed and impregnation with wood preservative agents carried out. Renovation of the moldings, polychromes, and staircase balustrades inside the building is recommended. The moldings in the room in the southeast corner are in good condition and do not require repairs, whereas moldings over the room of the stairwell are in a bad state; moreover, the ceiling beams and the ceiling need to be replaced. The moldings are prefabricated plaster elements (made according to an architectural template and installed on spot) that ought to be taken down, and put back up after a new ceiling has been constructed. Photographic documentation should be carried out prior to commencing the works. The taken down wood paneling should be subjected to conservation work to fill in the missing elements and put back up in its original place.

The bad technical condition of the roof structure indicates the necessity of immediate repairs to the framework. A new roof cover and thermal insulation of the roof ought to be carried out, replacing all flashing, gutters, and downpipes. The foundation needs to be dried and the building equipped with drainage.

There is vertical and horizontal cracking in the arcades in the hall: a structural crack runs vertically on the arcade parallel to the east wall as well as a horizontal crack between the arcade covering and the southern wall. In an effort to establish the reason behind the existing cracks and scratches, non-destructive tests were carried out. The monitoring of the cracking allowed us to assess the stabilization of the cracks. Control strips were placed on the arcades. The observation of the strips did not reveal shirting. The cracks therefore originate from an earlier period and are currently not expanding, therefore, these can be considered as stabilized.

From the analysis of the building structure, it was determined that the reason behind the cracking is the shifting between the hall and the room covered by the vault. A change in the geometry of the wall is connected with excessive bending of the ceiling and overloading of the pillars on the vault. The emerging cracks in the arcades do not threaten the safety of the structure.

Vertical structural cracks running through the third, fifth, and seventh axis were also observed on the west outside wall. Here too, control strips were placed to determine the dynamics of the cracking. Observation of the strips did not reveal shifting; the cracking therefore originated from an earlier period and is currently not expanding and is stabilized. The structural walls of the building do not reveal any deformation and damage that could threaten the structural safety or the safety of use, disqualifying the building from further service functions.

Renovation of the inside and outside stairs ought to be carried out, and floors and flooring replaced with new ones with the exception of the flooring in the entrance hall; outside plasters need to be repaired to fill in the missing areas. There is also a need to install heating, water and sewage, electrical and lighting protection systems.

The windows should be replaced with new ones, with their designs similar to the original ones. The doors (doors and doorframes) should be subjected to renovation and conservation. Missing doors ought be made according to designs reflecting those of the original doors.

The structure of the balcony slab over the main entrance ought to be reinforced and completed with the preservation of details and cleaned. Sandstone and ceramic elements present in the front elevation (i.e., the arms cartouche, balcony balustrade, stairs, porch column caps, griffins supporting the balcony slab, and terrace balustrade in the southern elevation) should all be subjected to conservation and renovation. The details should be recreated based on the remaining elements. Insulation of the terraces needs to be carried out, the original balustrades restored and missing areas patched up, with the entirety of the balcony subjected to conservation. On the elevations, missing parts of the molding and outside plasters should be patched up.

Figure A5. Upstairs fragment of ceiling above the room in the eastern part. Bad condition of the ceiling. Ceiling temporarily shored.

Figure A6. Attic fragment of the floor in the central part. Corroded ends of floor beams. Lack of flooring and ceiling.

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