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Influence of Property Division on the Technical Condition of a Building

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Abstract. In this article, the correlation between a technical condition of a building and property division is analyzed and assessed. In the course of the usage of a building, the process of its degradation and the increase in the demands of property occupants can be observed. There is a direct connection between the difficult technical condition of a building and the fragmentation of the ownership structure. Although not considered in the literature, it is noticeable in expert opinions and building inspections. Due to the above-mentioned connection, the renovations of the property are not very effective and justified from an economical point of view.

1. Introduction

The main aim of usage and maintenance of buildings is meeting the requirements of its owners and users. They are the direct participants of the usage process [1]. It is during the planning of building usage process that the specific requirements for each building should be fulfilled, such as complying with the regulations, usage features, aesthetic and satisfaction of the owner. The maintenance of a building involves constant problem solving, which is connected with the necessity of fulfilling the essential functions and external requirements. This does not only concern the multi-occupied buildings, but also the single-family housing [2] and even historic bridges [3]. Three basic groups of issues concerning solving problems connected with maintenance should be pondered. These are as follows:

- 1) A group of issues connected with usage of a building,
- 2) A group of issues connected with maintenance of the appropriate technical state of a building,
- 3) A group of issues connected with management and planning of usage process.

The correct course of usage process can be disturbed (discontinued) as a result of a decision of the property owners, for example division of the ground real estate. The decision, which is justified for administrative, legal and economic reasons, can have its negative consequences resulting in bad technical condition of a building, which is situated on a land that is being divided sections.

2. Literature review- types and assessment of technical wear and tear level

Having carried out literature review, the authors have not found any work dedicated to the analysis of the influence of property division on the technical condition of a building. Most of the scientific and scientific-technical publications concentrates mainly on the following four aspects:

- 1) Proper maintenance of a building



- 2) Technical assessment of a building
- 3) Selection of a research method and methodology of carrying out a research concerning the level of technical wear and tear of a building
- 4) Legal regulations applying to the division of the ground real estate.

In the paper entitled “The analysis of the usage value of a building in the time function” [4], the authors indicate that there are two types of opposing processes taking place during the usage of buildings. These are firstly, the constant decreasing of usage characteristics of a building and secondly, the increase of requirements of the building’s users. The course of these phenomena on the time line has been presented on figure 1. [4].

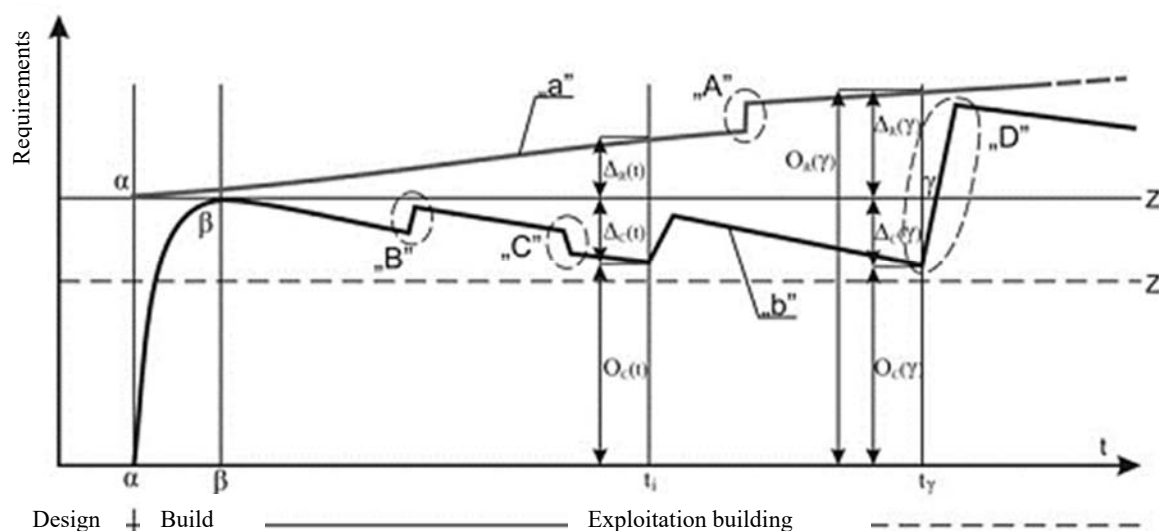


Figure 1. The phenomena relating to the assessment of the performance of the building as a function of time; and - an increase in user requirements of the object, b - changes in the performance of building [4]

Legend:

- z - assessment of the building when put to use (it is assumed that the building was designed and manufactured in accordance with applicable regulations and standards)
- z' - the minimum acceptable requirements of the utility building
- OR (t) - the value in use of the building reference time t
- OC (t) – usable value of the analysed building at the time t
- $\Delta C (t)$ - loss (loss) value in use of the building at the time t
- $\Delta R (t)$ - the difference between the value in use of the reference building and the actual use value of the analyzed object at time t [4].

Specifying, verification and process of implementation of the investor’s or owner’s goals, especially making a decision about the beginning of a building process, should arise from a detailed analysis of technical, economical and legal status of the property. This analysis should also include various scenarios of short, medium and long-term actions [5]. In the specialist literature, it has become customary to think that technical wear and tear of a building is a type of economical wear and tear, which also includes so-called social wear and tear.

As Eugenia Śleszyńska states in her book [6], division of wear and tear of a building into technical and social, has a significant meaning for the understanding of their relation to renovations and investment. Technical wear and tear has a direct connection with the duties of the property owner in

terms of maintenance of its technical condition and guaranteeing safety of building usage. This fact has ramifications in a form of maintenance, repairs and renovations.

The technical wear and tear includes:

- 1) Normal wear and tear connected with the passage of time and influence of the external factors (atmospheric),
- 2) Summary wear and tear, taking place in the case when there has been lack of sufficient maintenance and renovations,
- 3) Urgent wear and tear, caused by random incidents.

In the instance when a building is being overused at variance with guidelines or its purpose, and minor repairs and maintenance are falling behind with its technical wear and tear, a problem of devastation appears. In the situation, undertaking renovations, repairs, modernization including changing of the worn-out elements (for example change of installation, roof covering, ceiling) can restore property to its normal state [7]. These actions are justified only when they are being carried out comprehensively by all the housing cooperatives acting as one body, rather than by some residential premises' owners acting independently. The technical condition of a property construction should be examined as a whole [8] - as one system consisting of load-bearing and reinforcing elements. In order to do that, a method of inspecting the extend of wear and tear of the whole building is used, however, it does not include the division into particular housing cooperatives.

The methods are:

- 1) Time method, including:
 - a. Linear method, so-called proportion method,
 - b. Non-linear method of Ross
 - c. Non-linear method of Eytelwein
 - d. Non-linear method of Romsterfen.
- 2) Visual method, including:
 - a. Weighted- average method
 - b. Method of artificial network of neurons by Prof. Waszczyszyn's of Cracow Technical University
 - c. Method of an average by prof. Wodyński of The Academy of Mining and Smelting and other methods,
 - d. Method of technical wear and tear assessment by a real estate valuer [6].

3. Data and methods of determining and assessment of technical wear and tear of a residential building

The analysis of the impact of developed land property division on the technical state of a building is the area of interest and preliminary research of the authors. Based on the results of the completed research and the analysis, it can be stated that fragmenting of the structure results in negative impact on technical condition of the whole building and the appropriate planning of the tasks connected with modernization, renovation, repairs, reinforcement, protection and causes a problem in the appropriate assessment of technical condition of the building as a whole.

3.1. Initial data

The undermentioned discussion concerns the research area located in Gdańsk in one of its oldest districts called Wrzeszcz. A significant fragmentation of the ownership structure within a building has been observed here.

The object of study is a four-storey, multi-family residential building consisting of seven segments, with a basement and functional loft, positioned in the shape of letter "C". The location of the building and indication of particular segments is shown on figure 2, whereas the front and the backyard view of the building has been presented on figures 3,4,5 and 6. The building was constructed according to the traditional technology, with a gable roof covered with plain tiles. The residents of each segment established a separate housing cooperative. Five independent management companies undertook the

management of these housing cooperatives. Ground real estates allocated within the building in question have three types of ownership:

- 1) individuals
- 2) local authorities and intercommunal associations, if they occur in connection with leasehold
- 3) individuals in co-ownership with other individuals

The above-mentioned division has been established on the basis of the information provided by The City Council of Gdańsk (<http://mapa.gdansk.gda.pl>) [9].

There is currently no Land Development Plan for the area where the building is located.

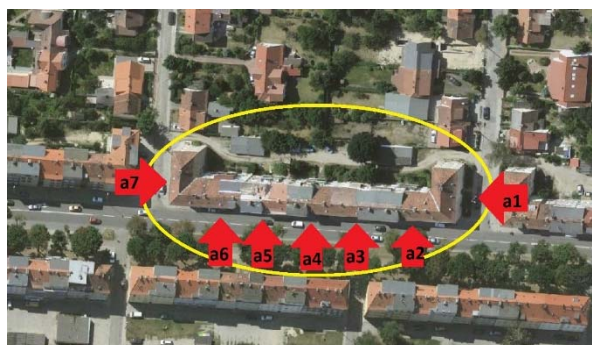


Figure 2. Fragment of the city plan with the selected segments [10] based on [9]



Figure 3. View of the building from the street [10]



Figure 4. The view from the opposite side of the street [10]



Figure 5. Back in the middle portion of the building [10]



Figure 6. View of the building from the courtyard [10]

3.2. Research methods

The research is being carried out with the use of the monographic method and includes stating the extent of technical wear and tear of different segments and the whole building as well as – the weighted-average with the use of the visual method. The subject of further research is the discussion on the problem raised in the publication, based on other methods of examining the extent of technical wear and tear of the building.

The building in question used to be self-contained whole, only during usage it has been submitted to “an artificial division” in building terms. The division was the result of the introduction of The Property Management Act of 21 August 1997 as amended [11] and had formal and legal nature.

Participation of particular elements in the construction cost and then the extent of damage of a particular element is presented in table 2. The renovation and modernization works took place only in some allocated sections (created as a result of the division of cooperatives) and in various times what was a consequence division into seven separate segments. One can clearly observe different extent of wear and tear in each of the seven segments. In consequence, it is difficult to determine the extent of wear and tear of specific elements for the whole building. Therefore, proportional division of construction costs of individual segments has been chosen.

4. Results of empirical research

Research based on direct measurements and comparing them with the building documentation has been taking place since November 2014.

4.1. Calculating the extent of technical wear and tear of a building located on the land property subjected to division

Technical wear and tear of the building in question has been calculated using the visual method-weighted- average extent of technical wear and tear of a residential building.

General formula:

$$S_z = \sum_{i=1}^n (U_i \times S_{ei}) \div 100 \quad (1)$$

S_z – weighted-average extent of technical wear and tear of a building,

U_i – the share of reconstruction cost ‘ i ’ of this element in the reconstruction cost of the building

S_{ei} – the extent of technical wear and tear ‘ i ’ of this element expressed in %,

n – the number of elements.

It can be easily noticed that applying formula 1 [6] in the direct way is not possible. It is due to the fact that as a result of the division of the land property the building is situated on, seven independent housing cooperatives have been established. The renovation works were carried out at different scope and time, which resulted in uneven extent of wear and tear of the building in relation to its individual segments. In the subsequent part of the article, the authors present fundamental stages of the established methodology of calculation and discussions carried out within the research, using the available information and documentation. The procedure of the performed research included:

- 1) determining the percentage share of particular elements (for example, flooring and floor- 10%) in the reconstruction cost of the residential building as a whole (figure 7)- U_i ,
- 2) determining the percentage share of particular segments (seven sections) in the cost of construction of residential building as a whole - from u_{i1} to u_{i7} ,
- 3) determining the share of particular element in the construction cost of a particular segment
- 4) a list of results of the above-mentioned operations has been presented in table 1,
- 5) determining in % the extent of wear and tear of a particular element - a component of a certain segment- s_{e1} to s_{e7} ,
- 6) a list of results has been presented in table 2,
- 7) calculating the extent of technical wear and tear of a particular segment - s_{z1} to s_{z7} ,

- 8) discussing the results of individual segments,
- 9) a list of final results- table 3.

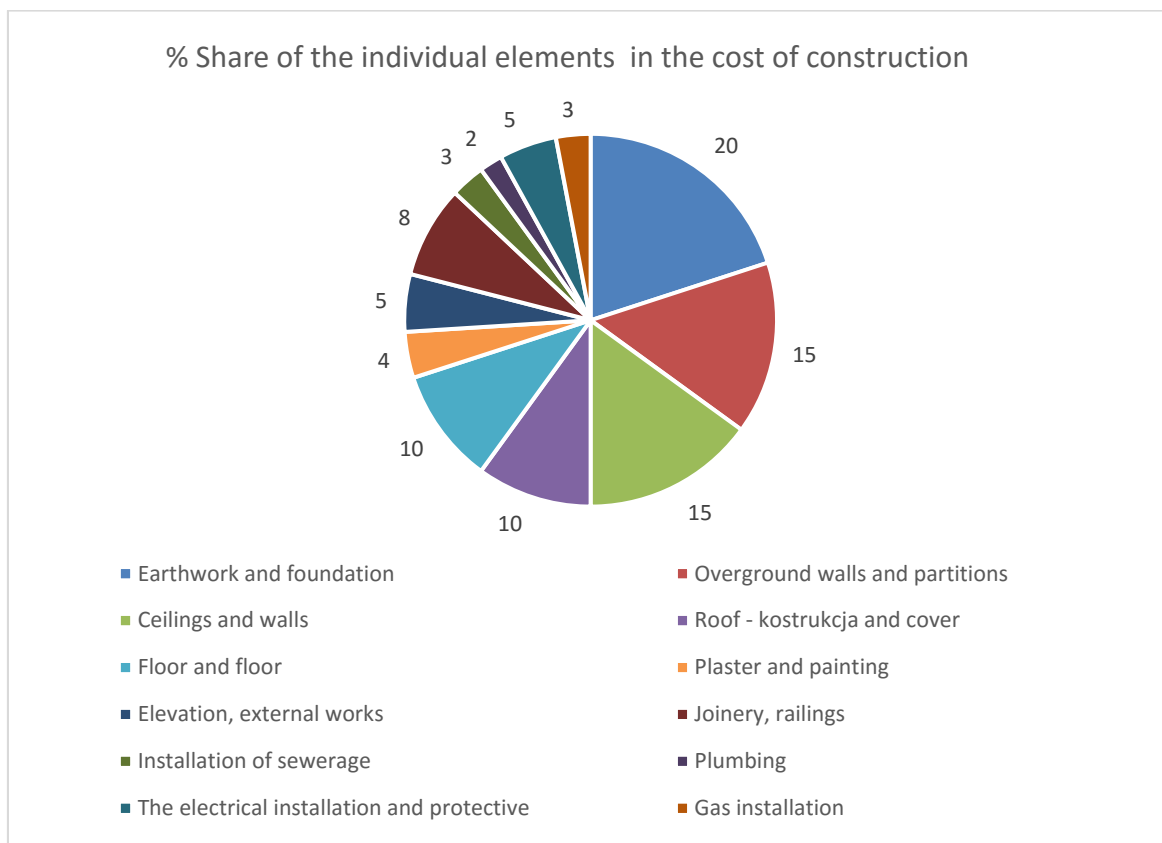


Figure 7. % Share of the individual elements in the cost of construction [10].

Table 1. % share of the item and segment in the cost of imitating the object [10]

Name of the element	The participation of an element in the cost of construction of the facility in%		Share of individual segments in the cost of construction of the entire facility in%						
	Ui		ui1	ui2	ui3	ui4	ui5	ui6	ui7
Earthwork and foundation	20.00		3.00	2.80	2.80	2.80	2.80	2.80	3.00
Overground walls and partitions	15.00		2.25	2.10	2.10	2.10	2.10	2.10	2.25
Ceilings and walls	15.00		2.25	2.10	2.10	2.10	2.10	2.10	2.25
Roof - construction and cover	10.00		1.50	1.40	1.40	1.40	1.40	1.40	1.50
Floor and floor	10.00		1.50	1.40	1.40	1.40	1.40	1.40	1.50
Plaster and painting	4.00		0.60	0.56	0.56	0.56	0.56	0.56	0.60
Elevation. external works	5.00		0.75	0.70	0.70	0.70	0.70	0.70	0.75
Joinery. railings	8.00		1.20	1.12	1.12	1.12	1.12	1.12	1.20
Installation of sewerage	3.00		0.45	0.42	0.42	0.42	0.42	0.42	0.45
Plumbing	2.00		0.30	0.28	0.28	0.28	0.28	0.28	0.30
The electrical installation and protective	5.00		0.75	0.70	0.70	0.70	0.70	0.70	0.75
Gas installation	3.00		0.45	0.42	0.42	0.42	0.42	0.42	0.45
Sum [%]	100		15	14	14	14	14	14	15

Table 2. The degree of technical wear of individual components in the following segments expressed in% [10]

Name of the element	The wear rate of the individual technical elements into successive segments in%						
	0.15	0.14	0.14	0.14	0.14	0.14	0.15
	se1	se2	se3	se4	se5	se6	se7
Earthwork and foundation	30	30	40	45	40	30	35
Overground walls and partitions	35	35	40	45	50	35	45
Ceilings and walls	45	40	35	50	45	25	40
Roof - construction and cover	70	55	5	75	5	60	65
Floor and floor	45	55	50	65	50	50	55
Plaster and painting	45	45	40	70	60	35	50
Elevation. external works	20	20	35	85	75	10	50
Joinery. railings	15	10	5	40	30	20	35
Installation of sewerage	55	55	55	60	60	50	55
Plumbing	50	55	50	55	50	55	55
The electrical installation and protective	40	45	40	55	50	45	55
Gas installation	45	40	40	45	45	45	40

Table 3. The weighted average degree of technical wear individual segments and the entire facility [10]

Name of the element	The weighted average degree of technical wear of the segments and the entire facility						
	sz1	sz2	sz3	sz4	sz5	sz6	sz7
Earthwork and foundation	0.90	0.84	1.12	1.26	1.12	0.84	1.05
Overground walls and partitions	0.79	0.74	0.84	0.95	1.05	0.74	1.01
Ceilings and walls	1.01	0.84	0.74	1.05	0.95	0.53	0.90
Roof - construction and cover	1.05	0.77	0.07	1.05	0.07	0.84	0.98
Floor and floor	0.68	0.77	0.70	0.91	0.70	0.70	0.83
Plaster and painting	0.27	0.25	0.22	0.39	0.34	0.20	0.30
Elevation. external works	0.15	0.14	0.25	0.60	0.53	0.07	0.38
Joinery. railings	0.18	0.11	0.06	0.45	0.34	0.22	0.42
Installation of sewerage	0.25	0.23	0.23	0.25	0.25	0.21	0.25
Plumbing	0.15	0.15	0.14	0.15	0.14	0.15	0.17
The electrical installation and protective	0.30	0.32	0.28	0.39	0.35	0.32	0.41
Gas installation	0.20	0.17	0.17	0.19	0.19	0.19	0.18
Sum [%]	5.70	5.19	4.81	7.21	6.01	4.72	6.56
Sum (Sz)	40.20						

4.2. The graphic representation of final results

The results shown in figure 8 present significant differences in weighted-average extent of technical wear and tear of individual segments contributing to the extent of technical wear and tear of the whole building.

The greatest difference, which amounted to 17,80% can be observed between segment a3 and a6. The average extent of technical wear and tear has been calculated and amounted to 40,20%. It must be stressed that it is a theoretical average (computational), because it is very difficult to determine their actual technical state by dividing the construction elements.

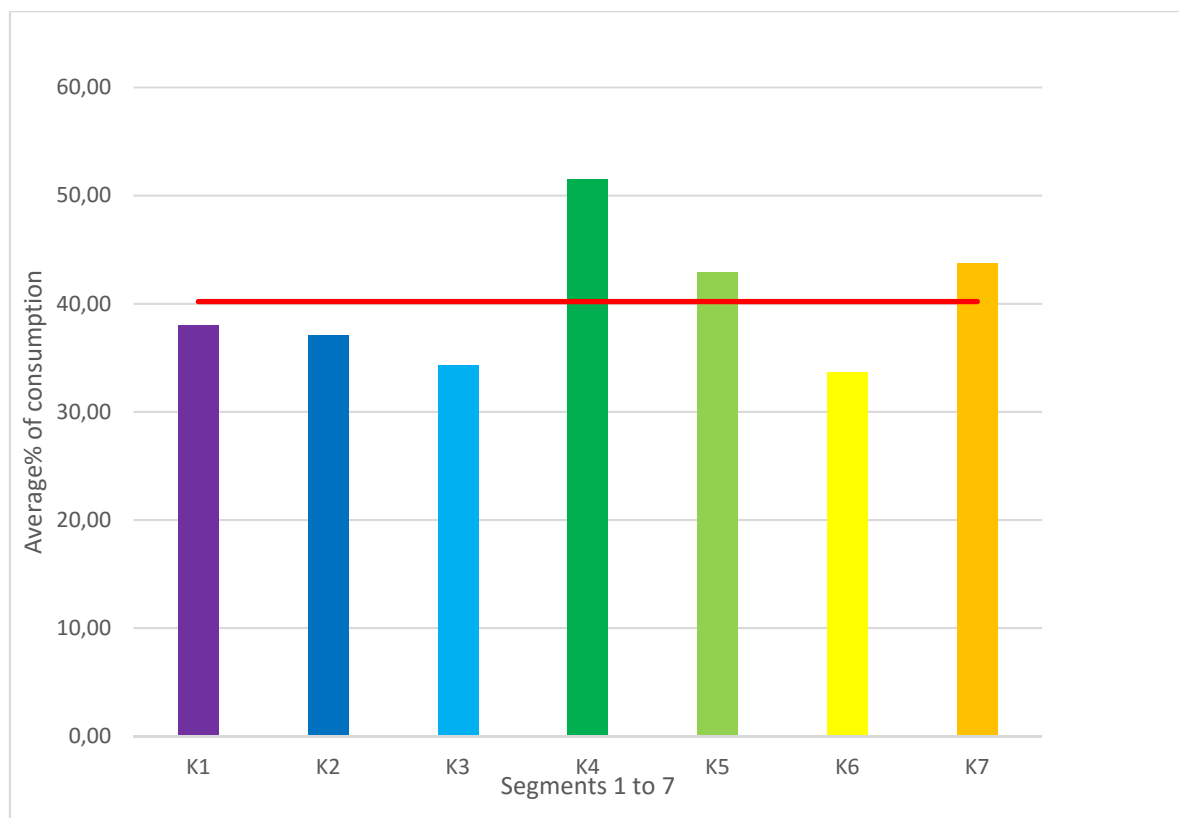


Figure 8. The weighted average degree of technical wear of the segments and the whole building% [10].

A problem of elements, which have been exposed to the effect of destruction factors (in the extreme cases it could significantly change their load-bearing capacity and stiffness), appears in the works connected with thermo-modernization or foundation repair. In order to remove the main source of damage, conservation works protecting it against further devastation should be carried out. Such an action is justified only when the works are carried out comprehensively- within the whole element, rather than in its selected fragments. It is an obvious fact that only the systematically carried out activities, connected with the technical maintenance of a property, lead to optimization of labour and financial outlays. These activities should be carried out and financed not only by the owners of the residential premises which are directly threatened, but by all members of the housing cooperative. Extensive and thorough activities generally increase the effectiveness and stability of the reinforcement, at the same time they generate lower cost (in comparison to the activities carried out independently by the owners of particular residential premises).

5. Results and discussions

The main aim of a property management constitutes conscious shaping of the scope of renovations, repairs and their optimization in time and budget. Such an attitude is justified and notably effective on condition that all the housing cooperative members are actively involved and treating the building activities as the fundamental element of life cycle of the property. In practice, it can be observed that there are some examples of arbitrary activities of some residential premises owners, or housing

cooperatives, which are the consequence of ground real estate division. They contradict the idea of coherent, organized, planned and consistent activities run by property managers.

The activities connected with the modernization, renovation, repair, enforcement, securing, replacement, addition or superstructure carried out in the construction and material sphere of a building, undertaken independently by some housing cooperative members, also have vital impact on preserving and exposing of the aesthetic qualities of a building. Carrying out independent renovations, adaptations and conversions in a building (such as adding some elements and decorations to communal areas and elevation) by individual residential premises owners, can result in the loss of the original character of a property and its aesthetic qualities. It is particularly relevant when a building represents some specific historic and semantic meaning in its form, structure, applied constructional and material solutions or details. Therefore, apart from the matters connected with the construction of a building and the consequences of arbitrary interference of residential premises owners in its scope, the vital factor which decides about the possibilities of changes introduced freely by some housing cooperative members is the character, importance of a building and its aesthetic qualities. The need to preserve the original material and construction solutions, artistic and aesthetic qualities, character of a building adjusted to the surrounding housing, should constitute an essential restriction of arbitrary interference in the building structure by the owners of its particular residential premises. It is a fact that such coherent and integrated activities should be carried out not only on behalf of some owners of chosen residential premises, but in the best interests of the whole housing cooperative.

It is believed that the issue concerning the identification and assessment of a process of wear and tear of a building that was divided in the scope of management, which was presented in the article, will become a widely analysed research subject in the future. It could be due to the fact that the number of property owners who are interested in the accurate and economically- justified usage is on the increase (for example, on account of property prices). The fundamental objective of taking up the subject discussed in this article and drawing up the presented concept has been the aspiration to fulfil the expectations of the property owners in the range of anticipating and controlling the expenses connected with the wear and tear of buildings and improving aesthetical and visual features influencing the value of a property (including a property which has been divided, like the one in the presented case). The division of a property significantly hinders undertaking activities connected with the effective management, which has been proven on the analysed case of a property located in Gdańsk-Wrzeszcz. The study, which encourages housing cooperatives to take coherent action, constitutes the aim of the research. Whereas the outcome of the identification of wear and tear condition should establish the favourable and transparent element of control of the usage and maintenance condition of a building. In this case, the flexibility of usage should increase, then the probability of ageing of a building (also its economic depreciation) will be smaller.

References

- [1] A. Kristowski, Prognosis of exploitation building in specific environment [in Polish], *Scientific Papers of Gdansk University of Technology, Civil Engineering*, vol. 61, pp. 193-201, 2007.
- [2] A. Jakubczyk-Gałczyńska, Jankowski R., Traffic-induced vibrations. The impact on buildings and people”, *Environmental Engineering. Proceedings of the International Conference on Environmental Engineering, ICEE*, vol. 9. Vilnius Gediminas Technical University, Department of Construction Economics & Property, 2014.
- [3] A. Siemaszko, Problems of construction projects regarding historic road bridges. *Technical Journal, Civil Engineering*, vol. 2-B (6) p.265, 2014.
- [4] Z. Orłowski, N. Szenlik, The analysis of building’s use value in a time funkcion [in Polish], *Technical Transactions, Civil Engineering*, vol. 1 – B, issue 2, year 107, pp. 303-212, 2010.
- [5] R. Wiśniewski, E. Miszewska-Urbańska, Management plan as an essential tool in decision related to the preparation of investment for water engineering building [in Polish], *Maritime Engineering and Geotechnics*, vol. 5, pp. 412-415, 2013.
- [6] E. Śleszyńska, Inspection, maintenance and construction work in the managed building. Law

- practice, case law [in Polish], Wolter Kluwer Polska Sp. z o.o., Warszawa, pp. 23-31, 2012.
- [7] B. Grzyl, M. Apollo, Coordination problems of construction works. Gdańsk – Letnica district Urban case study [in Polish]. *Maritime Engineering and Geotechnics*, vol. 5, pp. 345-348, 2013.
- [8] B. Grzyl, Investment project: Basic issues [in Polish], *Buses: Engineering, Operation, Transport Systems*, vol. 3, pp. 593 – 600, 2013.
- [9] Internet resource <http://mapa.gdansk.gda.pl/>, access 07.01.2016.
- [10] Authors own work.
- [11] Act of 21 August 1997 *real estate management* [in Polish], Journal of Laws, 1997, no. 115, item 741, as amended.