WARSAW UNIVERSITY OF TECHNOLOGY Index 351733
FACULTY OF CIVIL ENGINEERING
COMMITTEE FOR CIVIL AND WATER ENGINEERING
POLISH ACADEMY OF SCIENCES ISSN 1230-2945

DOI: 10.24425/ace.2025.153354
ARCHIVES OF CIVIL ENGINEERING
Vol. LXXI ISSUE 1 2025

© 2025. Adrian Jędrzejczyk, Karol Firek, Tomasz Stoch.

pp. 631 –642

This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives License (CC BY-NC-ND 4.0, https://creativecommons.org/licenses/by-nc-nd/4.0/), which permits use, distribution, and reproduction in any medium, provided that the Article is properly cited, the use is non-commercial, and no modifications or adaptations are made.

Research paper

Economic effectiveness of preventive structural protection against mining impacts in masonry buildings

Adrian Jędrzejczyk[1], Karol Firek[2], Tomasz Stoch[3]

Abstract: Buildings located in mining terrain, in addition to typical utility and environmental loads, take on the impacts in the form of ground surface deformation and mining tremors, which can adversely affect their technical condition. In these terrains, activities are carried out to prevent possible adverse impacts of mining on buildings. One of such activities is planning at the project stage for preventive protections of building structures against mining impacts and their implementation during the construction stage. The paper presents the results of an analysis of the cost of preventive structural protections performed in a group of single-family masonry residential buildings. For each building, we determined the replacement value and calculated the average share of the cost of preventive protections in the construction costs. Based on the difference in the course of technical wear between protected and unprotected buildings, a period of less than 26 years was determined during which the expenditures spent on the buildings' preventive protections are compensated by their lower technical wear. Over the subsequent useful life, owners of protected buildings receive measurable benefits in the form of lower technical wear of the buildings, and thus higher replacement value, as well as lower costs of repairs or renovations. The proposed approach can be applied to other operations concerning buildings or other fields of engineering to assess economic efficiency.

Keywords: mining impacts, masonry buildings, preventive structural protection, technical wear, technical condition, replacement value

---

[1] PhD., Eng., AGH University of Krakow, Faculty of Mining Surveying and Environmental Engineering, al. Adama Mickiewicza 30, 30-059 Kraków, Poland, e-mail: jedrzejczyk@agh.edu.pl, ORCID: 0000-0003-1969-2169

[2] DSc., PhD., Eng., AGH University of Krakow, Faculty of Mining Surveying and Environmental Engineering, al. Adama Mickiewicza 30, 30-059 Kraków, Poland, e-mail: kfirek@agh.edu.pl, ORCID: 0000-0002-0985-6003

[3] DSc., PhD., Eng., AGH University of Krakow, Faculty of Mining Surveying and Environmental Engineering, al. Adama Mickiewicza 30, 30-059 Kraków, Poland, e-mail: tomst@agh.edu.pl, ORCID: 0000-0001-6971-3488

1. Introduction

In the life cycle, buildings are subjected to various environmental and industrial impacts that can adversely affect their technical condition. One of the most dangerous phenomena of this type is seismic tremors. It is enough to recall recent incidents of this type in Morocco or Turkey to realize what consequences this can imply for buildings structures, but most of all for theirs occupants.

There are many entries in the world literature that analyse the structural solutions of buildings located in seismic terrains. These works mainly concern buildings with reinforced concrete or steel construction [1–4], and less frequently with masonry construction [5]. In some works, solutions are proposed to protect the structure from the damaging effects of ground vibration due to seismic tremors, e.g. by placing flexible isolation devices at the foundation base level [6] or by using a hybrid control system consisting of magnetorheological dampers and tuned mass dampers [7].

In Poland, there are adverse impacts of the industrial environment in the case of numerous buildings located in mining terrain. The mining exploitation interferes with the rock mass, inside of which stresses and deformations are generated, which are subsequently transmitted to the ground surface as a result of the release of potential energy. These impacts most often manifest themselves in the form of continuous deformations of ground surface [8], mining tremors [3, 4, 9, 10] and less frequently as discontinuous deformations [11]. They induce kinematic loads transmitted through the ground to the buildings, which in turn can have a negative impact on the buildings [9, 12–14] and initiate the damage proces [15].

In mining terrains in Poland, there are actions carried out to prevent the possible adverse effects of mining exploitation [16, 17]. One such activity is the planning at the building project stage of preventive protections to the structure against mining impacts and their implementation during the construction stage. This includes: determining the appropriate location of the building, selecting the dimensions and shape of the horizontal projection and building shell (in the case of larger or elongated buildings, segmentation is introduced), and also on selecting optimal constructive solutions (e.g. at the foundation level, additional longitudinal reinforcement of footings, diagonal ties, etc.).

According to Instruction [18], preventive protection of buildings in mining terrains shall be applied to ensure the safety and functioning of the objects in accordance with their intended use and to prevent excessive inconvenience of use associated with damage and deformation of the objects, which may be caused by the impacts of the mining exploitation. This paper presents a proposal for the assessment, in the long term, of the economic effectiveness of preventive structural protection against mining impacts. For this task, we carried out a comparative study of the course of technical wear of protected and unprotected buildings [19], and we used the methodology from the cost approach of the real estate valuation [20].

2. Materials and methods

2.1. Characteristics of database

The research was based on a database containing information on 106 residential buildings, up to 22 years old with masonry construction, located in the mining terrain of the Lublin Coal Basin (LCB). These buildings have not been subjected to significant construction interventions (renovations). Detailed architectural and construction inventory combined with an assessment of their technical condition was carried out. As a result, it was found that 52 buildings had been protected preventively at the project and construction stage, and in 38 cases, the owners applied to the mining plant for a refund of the costs incurred. In order to determine the compensation value, it was necessary to determine the actual extent of the protections performed (quantity survey of works) and to establish the costs of their implementation, in each case by preparing a calculation. An analysis of the technical documentation, as well as of the acceptance protocols for subsequent works, revealed that among the above-mentioned 38 buildings, all of them have protection at the foundation level, most often in the form of diagonal footings, and less often additional transverse or longitudinal footings. In only four cases were the traditional footings replaced by a foundation slab, and in two cases anchor diaphragms were additionally used. In five cases, in the foundation level, the diameter of the reinforcing bars was increased (from ϕ12 to ϕ16), and in one object the width of the footings was increased. In order to extend the protection against the direct effects of mining, in two buildings an additional reinforced concrete beam was used on the foundation walls (at ground level). In order to increase the stiffness of the building, there were reinforced concrete studs in the walls in 9 cases, and additional transverse stiffening walls were made in two cases. All buildings have continuous perimeter reinforced concrete beams in the ceilings. The beams were planned in the project before the adaptation and only in two cases was it required to increase the diameter of their reinforcement due to mining influences. In the 13 buildings where dense-rib ceilings were projected, additional reinforcement of the concrete overlay was used. In single cases, the projects envisaged replacing the wooden ceiling, with a reinforced concrete cross-reinforced ceiling, dividing the living part of the building from the garage part, or constructing drainage around the building.

2.2. Research on the course of technical wear

The starting point for the present research was the comparative analyses presented in the paper [19] of the technical wear course of the analysed buildings over time, which were realised for the above-mentioned, unrenovated buildings up to 22 years old, taking into account the division into preventive protected against mining impacts and unprotected. The results of these studies are shown in Table 1.

The obtained difference in the average degree of technical wear concerns protected and unprotected buildings up to 22 years old with similar construction and material solutions. It was concluded that the use of preventive structural protection at the design and construction stage results in an average 1.8% reduction in technical wear of buildings over 25 years of use and 3.5% over 50 years, compared with unprotected buildings.

Table 1. Summary of model parameters for unrenovated buildings up to 22 years old, accounting for preventive structural protection [19]

Unrenovated buildings	**Number of objects**	**Course of technical wear model parameter ($s_z = b \cdot t$)**	**Average wear $s_{zśr}(t)$ and absolute differences $\Delta s_{zśr}(t)$**			
			t = 25 years		**t = 50 years**	
	[number]	**b**	$s_{zśr}(t)$ [%]	$\Delta s_{zśr}(t)$ [%]	$s_{zśr}(t)$ [%]	$\Delta s_{zśr}(t)$ [%]
with preventive structural protection	52	0.68049	17.1	**1.8**	34.2	**3.5**
without preventive structural protection	64	0.7551	18.9		37.8	

For the selected groups of buildings, the obtained technical wear models also allow assessment and comparison of their durability (Fig. 1).

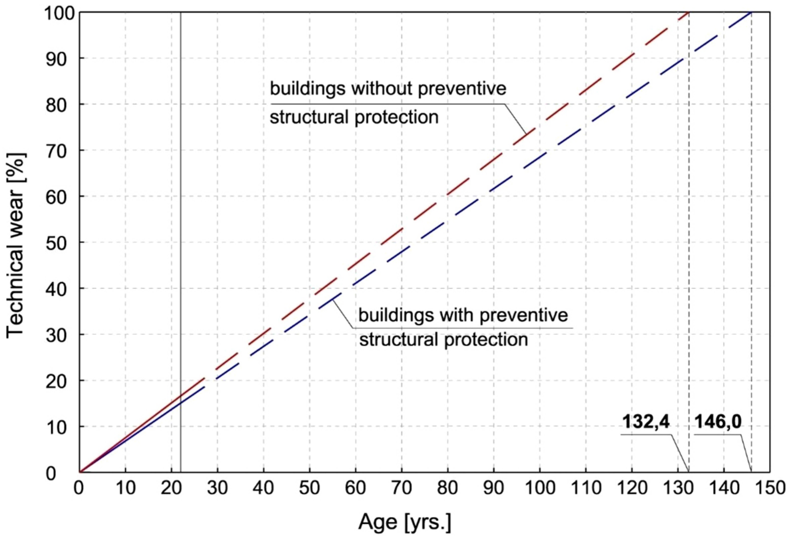

Fig. 1. Course of technical wear of unrenovated buildings with and without preventive structural protection [19]

On the basis of the analysis of the models (Table 1), which are shown in the graph (Fig. 1), it can be concluded that, in the case of the studied masonry single-family buildings, the application of preventive structural protection results in an extension of durability, by at least 13.6 years on average.

2.3. Methodology for determining the protection costs and replacement value of buildings

The realisation of the protections described in chapter 2.1 required additional expenditures related to the use of materials and the execution of works by staff and equipment. According to the Tangible Expenditure Catalogue [21] these were cost positions related primarily to the foundation reinforcement, i.e. ground work, preparation and installation of reinforcement, shoring and concreting of foundations and waterproofing of foundations. In the case of the wall reinforcement, this was mainly preparation and installation of reinforcement and boarding and concreting of the reinforced concrete studs. In the case of ceilings, it was additional work related to the preparation and installation of additional reinforcement. In all 38 cases, the mining company commissioned a cost calculation, on the basis of which a conciliation was signed with the owner and compensation was paid.

In the research, consideration was given to the net preventive structural protection cost (K_z), as determined by the cost calculations prepared at the Mine Works [22].

In order to test the economic effectiveness in the long term of the use of preventive structural protection in the analysed residential buildings, it was decided to investigate the contribution of preventive protection costs to the total construction costs. Due to the unavailability of information on the total expenditure spent on the construction of each building, these values were determined in a simplified manner, using the cost approach in property valuation. This made it possible to determine the replacement value of the buildings in new condition, which is an approximation of the building's construction cost, taking into account the individual technical and material solutions used during construction.

According to article 153. section 3. of the real estate management act [23] and the valuation standards [24], the cost approach consists in determining the value of a property, assuming that the value corresponds to its replacement cost less the value of wear. In this approach, the acquisition cost of the land and the replacement cost of its components (including the building) are determined separately. The cost approach distinguishes between two methods: Depreciated Replacement Cost (DRC) and Replacement [20]. The DRC method determines the replacement cost of the structure using the same technology and materials that were used to construct them [24, 25]. Replacement is the cost to replace a structure with a substitute structure of at least equal utility using current standards of materials and design [20]. It is used when the materials and technologies applied during construction are not currently in use. Both methods use detailed, integrated element or index techniques [20, 23, 25]:

- detailed technique, requires a precise inventory and analysis of the technical documentation of the object, from which the types and quantities of necessary construction works can be specified. The result is a quantity survey of works, which in the case of a construction cost calculation is the basis for determining the cost remuneration, while in property valuation it is the basis for determining the value of the property,
- integrated elements technique makes use of the possibility of combining homogeneous building elements and determining quantities of works for them. For the valuation, (as with the detailed technique) specialised catalogues with price indices are used here,

- index technique requires the specification, as a basis for calculation, of a technical unit (index) for the building. This can be, for example, the volume of the building, the floor or total area. The unit price for a specific technical unit is then found in the price catallogues and multiplied by the number of reference units. In this technique, some analogy can be sought with comparative models. The main problem in applying this technique is to identify those buildings that are similar to the valued building and for which the unit prices of the are known.

For the context of this consideration, the value of the building plot was not determined, only the replacement cost of the building. For this purpose, the integrated elements technique was used, intermittently (in individual cases) using the detailed technique. Among the buildings analysed, there was quite a wide age variation (from 0 to 22 years) and the security costs were determined each time in the year of construction. Therefore, in order to estimate the replacement cost of buildings in new condition, building price catalogues from 1996 to 2018 were used. This allowed the subsequent determination of the share of security costs in the cost of constructing a building in new condition. In particular, aggregate works price catalogues [e.g. [26]] were used to determine the value of older buildings (year of construction before 2004), while building price catalogues [e.g. [27] were used for buildings erected after 2004. The value of each building was determined using formula (2.1):

$$W_o = K_o \cdot (1 + W_{KD}) + K_z \tag{2.1}$$

where:
W_o – replacement value of the building, excluding VAT,
K_o – replacement costs, excluding VAT,
W_{KD} – index of additional costs (e.g. documentation, building supervision),
K_z – costs of preventive structural protection, excluding VAT.

In turn, the amount of replacement costs was determined according to formula (2.2). It was obtained the net values (excluding VAT) of the replacement costs of the K_o in new condition, that is, without taking into account degree of technical wear.

$$K_o = \sum_{n=1}^{k} I_n \cdot C_{jn} \tag{2.2}$$

where:
I_n – quantity of integrated elements (e.g. m^2 of wall),
C_{jn} – unit prices of individual integrated elements,
k – number of integrated elements into which the building is divided.

The cost approach determines the value of the property, which is the replacement value of the building less its technical wear (s_z). In European standards, this value is defined as Depreciated Replacement Cost (DRC) [24, 28]. This relation can be described by formula (2.3):

$$W = W_o \cdot (1 - s_z) \tag{2.3}$$

where:
W – building value,
W_o – replacement value of the building, excluding VAT,
s_z – the technical wear degree of the building.

Based on the above equation (2.3) and the authors' own experience, as compensation time for preventive structural protection costs, a period was assumed after which the economic benefit consisting in a lower increase over time of technical wear will exceed the expenditures made on the protections. This period can be determined using equation (2.4):

$$\Delta s_z = \Delta w_o \tag{2.4}$$

3. Assessment of the economic effectiveness of preventive structural protection

The cost of building protection (K_z) is directly related to the extent of the structural improvements and the material, work and equipment costs occurring in the building market at the time of construction. Individual buildings were constructed at different times which is reflected in the variation of prices in the building market. Therefore, as a first step, the correlation between the protection costs (K_z) and the replacement value (W_o) of the surveyed buildings was examined. As a result, a strong correlation was found with a coefficient $R = 0{,}77$

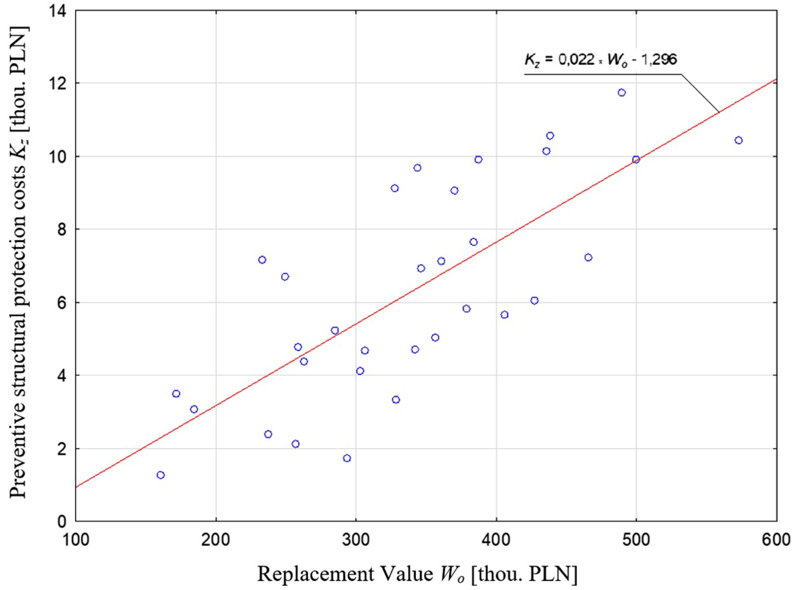

Fig. 2. Scatter diagram of preventive structural protection costs according to the replacement value of buildings

at a significance level of $p = 0{,}00$. The distribution of protection costs in relation to the replacement value of the buildings is presented in the chart (Fig. 2).

The distribution of the data in Figure 2 has an increasing trend, which is best described by the linear relationship (3.1):

$$K_z = 0{,}022 \cdot W_o - 1{,}296 \tag{3.1}$$

where:

K_z – costs of preventive structural protection, excluding VAT,

W_o – replacement value of the building, excluding VAT.

The replacement value of the building and the security costs were both determined with regard to the prices during the construction period of each building. This made it possible to determine the share of security costs in the construction costs of each building, represented by the replacement value (W_o). The percentage contribution of building protection costs (K_z) to construction costs (W_o) for the studied group of buildings averages 1,82% with a standard deviation of $\sigma = \pm 0{,}63\%$.

In the described analyses, the degree of technical wear has so far not been included in the calculation of a building's value, because values were estimated by assuming prices from the construction period and technical wear at a zero level.

From the calculation results presented in Section 2.2 (in Table 1 and Fig. 1), it was concluded that the difference between the technical wear degree (Δs_z) in time (t) determined for protected and unprotected buildings is described by the following line (3.2):

$$\Delta s_z = 0{,}0702 \cdot t \tag{3.2}$$

On the basis of the above-determined contribution of the protection costs to the replacement costs of the building in the new state (1,82%), as well as the determined difference in the degree of wear (Δs_z) between buildings protected against mining impacts and those which do not have these protections. It was found that the compensation of protection costs takes place over a period, which was determined by equation (3.3):

$$\Delta s_z = \Delta w_o = 1{,}82\% \tag{3.3}$$

The analyses of the course of the Δs_z dependence over time (Fig. 3) demonstrated that, on average, after a period of 25.9 years of use, the benefits of protection, consisting in a lower increase in technical wear over time of buildings with preventive structural protection, will overtake the expenditure incurred on protection.

In the further period of use, the owners of protected buildings will obtain tangible benefits in the form of a lower increase in the technical wear of the buildings, and thus a higher replacement value of the building, as well as lower costs for possible repairs or renovations of the buildings. Thus, the results obtained confirm the effectiveness of using preventive structural protection in newly constructed buildings in mining terrains, both technically and economically.

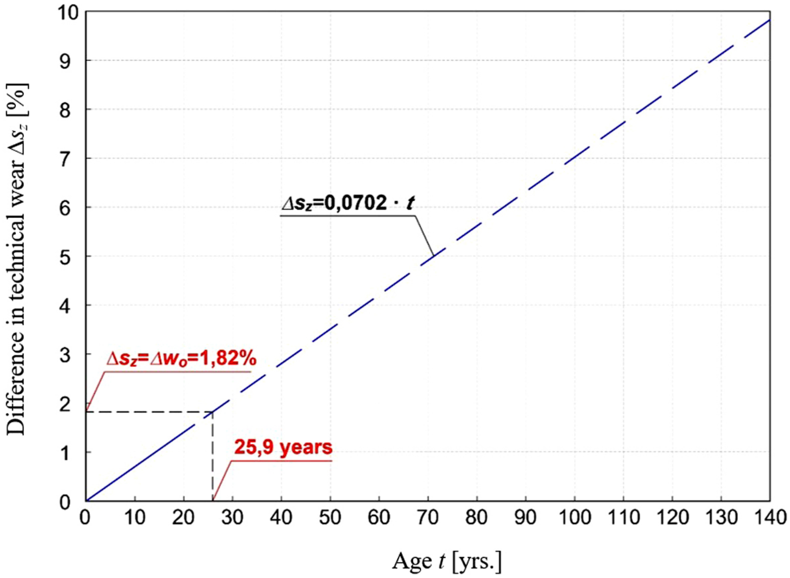

Fig. 3. Difference in the course of technical wear over time between unrenovated protected and unprotected buildings

4. Conclusions

This paper presents the results of a research on the economic effectiveness, in the long term, of the use of preventive structural protection against mining impacts. The main objective of their application to ensure the safety and functioning of the objects in accordance with their intended use and to prevent excessive inconvenience of use associated with damage and deformation of the objects. The economic effectiveness of the application of preventive safety features was analysed by determining the compensation time for the costs incurred in their implementation.

Applying the current law regulations and standards of the cost approach in property valuation [23, 24, 28], it was found that the compensation time for the protection costs can be taken as the period after which the economic benefits consisting in a lower increase in technical wear over time will exceed the expenditures made on the protections.

The basis for the study was a database containing information on 106 masonry residential buildings up to 22 years old, located in the mining area of the Lublin Coal Basin. For these buildings, a detailed architectural and construction inventory combined with an assessment of their technical condition was carried out. According to the available technical documentation, it was found that, among the analysed buildings, 52 had been protected against mining impacts preventively at the stage of construction.

A previous published paper on the aforementioned buildings [19] showed a lower rate of increase in technical wear over time for protected buildings. It was found, for example, that after 25 years of use, the average technical wear of protected buildings will be 1,8% lower than for unprotected buildings. In contrast, the durability of protected buildings will be extended by an average of 13,6 years. These results formed the basis for the study of the compensation time for preventive structural protection costs.

Based on the cost calculations of the executed preventive structural protection and the replacement value of the buildings, the share of the protection costs in the construction costs was determined, which was 1,82% on average for the protected buildings analysed. On this basis (cf. Fig. 3), it was found that, on average, after a period of 25,9 years of use, the costs incurred for preventive protection offset each other. This means that, after a period of nearly 26 years, the benefits of the protections in terms of lower growth over time of the building's technical wear of the preventive protections will exceed the expenditure made on the protections. Over the further lifetime, the owners of the protected buildings continue to obtain tangible benefits in the form of lower increase in the technical wear of the buildings and thus higher replacement value, as well as lower costs for any repairs or renovations.

The obtained results confirm the effectiveness of preventive structural protection of buildings against mining impacts, both in technical and economic terms. However, it should be noted that these are the results of an assessment on the scale of the entire population under analysis. An individual assessment is necessary to determine the compensation time for the costs of protection for individual buildings.

Acknowledgements

The research was funded by an IDUB university grant (ID: 6379) from the AGH University of Krakow.

References

[1] G.G. Penelis and G.G. Penelis, *Concrete buildings in seismic regions*. CRC Press, 2018.

[2] B. Gencturk, K. Hossain, and S. Lahourpour, "Life cycle sustainability assessment of RC buildings in seismic regions", *Engineering Structures*, vol. 110, pp. 347–362, 2016, doi: 10.1016/j.engstruct.2015.11.037.

[3] F. Pachla, A. Kowalska-Koczwara, T. Tatara, and K. Stypuła, "The influence of vibration duration on the structure of irregular RC buildings", *Bulletin of Earthquake Engineering*, vol. 17, pp. 3119–3138, 2019, doi: 10.1007/s10518-018-00546-4.

[4] T. Tatara, F. Pachla, and P. Kuboń, "Experimental and numerical analysis of an industrial RC tower", *Bulletin of Earthquake Engineering*, vol. 15, pp. 2149–2171, 2017, doi: 10.1007/s10518-016-0053-y.

[5] R. Marques and P.B. Lourenço, "Unreinforced and confined masonry buildings in seismic regions: Validation of macro-element models and cost analysis", *Engineering Structures*, vol. 64, pp. 52–67, 2014, doi: 10.1016/j.engstruct.2014.01.014.

[6] G.P. Warn and K.L. Ryan, "A review of seismic isolation for buildings: historical development and research needs", *Buildings*, vol. 2, no. 3, pp. 300–325, 2012, doi: 10.3390/buildings2030300.

[7] S.H.H. Lavassani, S. Shangapour, P. Homami, V. Gharehbaghi, E.N. Farsangi, and T.Y. Yang, "An innovative methodology for hybrid vibration control (MR+ TMD) of buildings under seismic excitations", *Soil Dynamics and Earthquake Engineering*, vol. 155, art. no. 107175, 2022, doi: 10.1016/j.soildyn.2022.107175.

[8] K. Tajduś, "Analysis of horizontal displacements measured over the mining operations in longwall No. 537 at the Girondelle 5 seam of the BW Friedrich Heinrich-Rheinland coal mine", *Archives of Mining Sciences*, vol. 61, no. 1, pp. 157–168, 2016, doi: 10.1515/amsc-2016-0012.

[9] K. Tajduś, A. Tajduś, and M. Cała, "Seismicity and rock burst hazard assessment in fault zones: a case study", *Archives of Mining Sciences*, vol. 63, no. 3, pp. 747–765, 2018, doi: 10.24425/123695.

[10] F. Pachla and T. Tatara, “Nonlinear analysis of a hoist tower for seismic loads”, *Archives of Civil Engineering*, vol. 69, no. 3, pp. 177–198, 2022, doi: 10.24425/ace.2023.146103.

[11] A.A. Malinowska, R. Misa, and K. Tajduś, “Geomechanical modeling of subsidence related strains causing earth fissures”, *Acta Geodynamica et Geomaterialia*, vol. 15, no. 2, 2018, doi: 10.13168/agg.2018.0015.

[12] R. Misa, A. Sroka, K. Tajduś, and M. Dudek, “Analytical design of selected geotechnical solutions which protect civil structures from the effects of underground mining”, *Journal of Sustainable Mining*, vol. 18, no. 1, pp. 1–7, 2019, doi: 10.1016/J.JSM.2018.10.002.

[13] A. Kwinta and R. Gradka, “Analysis of the damage influence range generated by underground mining”, *International Journal of Rock Mechanics and Mining Sciences*, vol. 128, art. no. 104263, 2020, doi: 10.1016/J.IJRMMS.2020.104263.

[14] R. Ścigała and K. Szafulera, “Linear discontinuous deformations created on the surface as an effect of underground mining and local geological conditions-case study”, *Bulletin of Engineering Geology and the Environment*, vol. 79, no. 4, pp. 2059–2068, 2020, doi: 10.1007/S10064-019-01681-1.

[15] A. Jędrzejczyk, K. Firek, and J. Rusek, “Convolutional Neural Network and Support Vector Machine for Prediction of Damage Intensity to Multi-Storey Prefabricated RC Buildings”, *Energies,*vol. 15, no. 13, art. no. 4736, 2022, doi: 10.3390/EN15134736.

[16] L. Florkowska, J. Walaszczyk, and J. Cygan, “Przepisy, odniesienia normowe oraz instrukcje dotyczące projektowania i realizacji budynków narażonych na górnicze oddziaływania deformacyjne”, *Prace Instytutu Mechaniki Górotworu PAN*, vol. 14, no. 1–4, pp. 93–102, 2012.

[17] M. Kawulok, *Projektowanie budynków na terenach górniczych*. Warszawa: Instytut Techniki Budowlanej, 2006.

[18] *Instrukcja GIG nr 12: Zasady oceny możliwości prowadzenia podziemnej eksploatacji górniczej z uwagi na ochronę obiektów budowlanych. Instrukcja nr 12*. Katowice: Główny Instytut Górnictwa, 2000.

[19] A. Jędrzejczyk, K. Firek, W. Kocot, and D. Rataj, “Effectiveness of preventive structural protection against mining impacts and Maintenance Management on technical state of masonry buildings”, *Archives of Civil Engineering*, vol. 68, no. 2, pp. 261–273, 2022, doi: 10.24425/ace.2022.140641.

[20] U. Wiśniewska, *Podejście kosztowe w wycenie nieruchomości*, wyd. 3. Warszawa: WACETOB, 2015.

[21] KNR, *Katalog Nakładów Rzeczowych nr 2-02*. Ministerstwo Gospodarki Przestrzennej i Budownictwa, 2009.

[22] “Materials on technical solutions and costs of preventive protection of buildings provided by LW Bogdanka S.A.”, 2022.

[23] *Ustawa o gospodarce nieruchomościami*. 1997, (Dz. U. z 2023 r. poz. 344).

[24] *European Valuation Standards,* 9th ed. The European Group of Valuer’s Associations TEGoVA, 2020.

[25] *Rozporządzenie Rady Ministrów w sprawie wyceny nieruchomości i sporządzania operatu szacunkowego*. 2004, (Dz.U. z 2021 r., poz. 555).

[26] *Biuletyn cen robót zagregowanych elementów i obiektów budowlanych BCO*, III. Sekocenbud, 1999.

[27] *Biuletyn cen obiektów budowlanych BCO. Część I-Obiekty kubaturowe*, III. Sekocenbud, 2018.

[28] *International Valuation Standards 104: Bases Of Value*. London: International Valuation Standards Council, 2016.

Ocena efektywności ekonomicznej stosowania zabezpieczeń profilaktycznych przeciw wpływom górniczym budynków murowanych

Słowa kluczowe: oddziaływania górnicze, budynki murowane, profilaktyczne zabezpieczenia konstrukcji, zużycie techniczne, stan techniczny, wartość odtworzeniowa

Streszczenie:

Budynki zlokalizowane na terenach górniczych, oprócz typowych obciążeń użytkowych i środowiskowych przejmują oddziaływania w postaci deformacji powierzchni terenu i wstrząsów górniczych, które mogą niekorzystnie wpływać na ich stan techniczny. Jednocześnie na terenach górniczych prowadzone są działania mające na celu przeciwdziałanie ewentualnym niekorzystnym wpływom eksploatacji na zabudowę powierzchni. Jednym z takich działań jest planowanie na etapie projektowania zabezpieczeń profilaktycznych konstrukcji budynków przeciw wpływom górniczym oraz ich wykonywanie podczas budowy. W artykule przedstawiono wyniki analizy kosztów zabezpieczeń profilaktycznych wykonanych w grupie jednorodzinnych budynków mieszkalnych o konstrukcji murowanej. Dla każdego z budynków określono wartość odtworzeniową oraz obliczono średni udziałkosztów zabezpieczeń profilaktycznych w kosztach budowy. Na podstawie różnicy w przebiegu zużycia technicznego pomiędzy budynkami zabezpieczonymi i niezabezpieczonymi, na niespełna 26 lat określono czas, w którym nakłady poniesione na zabezpieczenia profilaktyczne budynków kompensuje ich niższe zużycie techniczne. W dalszym okresie użytkowania właściciele zabezpieczonych budynków uzyskują wymierne korzyści w postaci niższego przyrostu zużycia technicznego budynków, a co za tym idzie wyższej wartości odtworzeniowej, a także niższych kosztów ewentualnych napraw lub remontów. Proponowane podejście może być stosowane w zakresie innych działań dotyczących obiektów budowlanych lub innych obszarach techniki przy rozwiązywaniu zagadnień związanych z oceną efektywności ekonomicznej.

Received: 2023-12-13, Revised: 2024-02-13