

Possibility of using building structures maintenance planning

Ing. Martin Hanko, PhD.^{1*}

¹ Slovak University of Technology, Faculty of Civil Engineering, Department of Building Technology, Radlinskeho 11, Bratislava, 810 05, Slovakia

* corresponding author: martin.hanko@stuba.sk

ORIGINAL SCIENTIFIC ARTICLE

ABSTRACT

Maintenance of building structures in the use phase of a building is an important part of its life cycle. Planning the maintenance of buildings is not only about ensuring their technical condition, but also about efficient management of financial resources. A proactive approach to maintenance allows you to prevent costly emergency repairs, extend the lifetime of building structures, optimize energy consumption and preserve the value of the property. Regular maintenance helps in the early detection of potential problems, reduces the need for extensive repairs and keeps buildings energy efficient. The article highlights the importance of facility management, especially in the context of rising costs and economic challenges in Slovakia, while emphasizing the need for strategic planning to maintain efficiency and reduce operating costs and ensure sustainability. The article describes a proposal for a methodology that could be helpful for designers and investors when deciding on the material solution of a building. The methodology addresses the impact of the material solution on the future costs of maintenance and operation of the facility and suggests involving facility managers during the building design phase in order to optimize the costs of the operational phase of the life cycle.

Key words: *Building Maintenance; Costs; Sustainability.*

1 INTRODUCTION

Planning the maintenance of building structures is not only about ensuring their technical condition, but also about efficient management of funds. A proactive approach to maintenance makes it possible to prevent costly emergency repairs, extend the life of structures, optimize energy consumption and preserve the value of the property. Investing in planned maintenance will thus prove to be a cost-effective solution in the long term.

Planned maintenance of building structures brings a number of financial benefits, which are reflected in cost savings and property appreciation. A systematic approach to maintenance makes it possible to avoid unforeseen expenses and optimize the management of funds. It is the **financial aspect** that is most significant according to research on maintenance performance in Malaysia. [1]

The benefits of planned maintenance include: minimizing the cost of emergency repairs, extending the life of structures and reducing the cost of their replacement, optimizing energy consumption, reducing the cost of downtime and loss of income, preserving the value of the property, preventing litigation and sanctions.

Building maintenance is a continuous process and part of the technical building management that ensures the maintenance of building structures and the maintenance of the technical installations installed in the building. Wear and change of functionality is compensated just by the maintenance of building structures of buildings, which leads to the maintenance of the desired properties of buildings. [2]

Unplanned breakdowns require immediate intervention, which is associated with higher labor, material and transport costs. Scheduled maintenance allows for the early identification of potential problems and thus prevents extensive and costly emergency repairs. Early diagnostics and preventive measures are much more effective from an economic point of view than extinguishing the consequences of an accident. Regular maintenance slows down the aging process and wear of materials, thereby extending the lifetime of building structures. Delaying the need to replace structural elements significantly saves money that would otherwise be needed to replace them. Maintenance aimed at improving thermal insulation, sealing windows and doors, and inspecting heating and cooling systems contributes to reducing energy losses and, consequently, saving energy costs. The energy efficiency of buildings is currently crucial not only from an environmental point of view, but also from an economic point of view. Structural failures and failures can cause a building to be disrupted, leading to financial losses from lost profits or the cost of replacement space. Scheduled maintenance minimizes the risk of such downtime and ensures smooth operation. A regularly maintained building retains its market value and attractiveness to potential buyers or tenants. Thus, investments in maintenance are appreciated and contribute to maintaining or even increasing the value of the property. Neglecting maintenance can lead to accidents and personal injury, which can result in lawsuits and financial damages. Compliance with regulations and standards through scheduled maintenance prevents such risks and the associated financial losses.

Integration between sustainability and effectiveness of maintenance is essential and is expected to be welcomed and adopted by maintenance stakeholders, specifically maintenance organisations, as they are focusing on achieving sustainability practices that meet effectiveness criteria. [3]

2 STRATEGIES FOR EFFICIENT MAINTENANCE PLANNING IN ITS CURRENT STATE

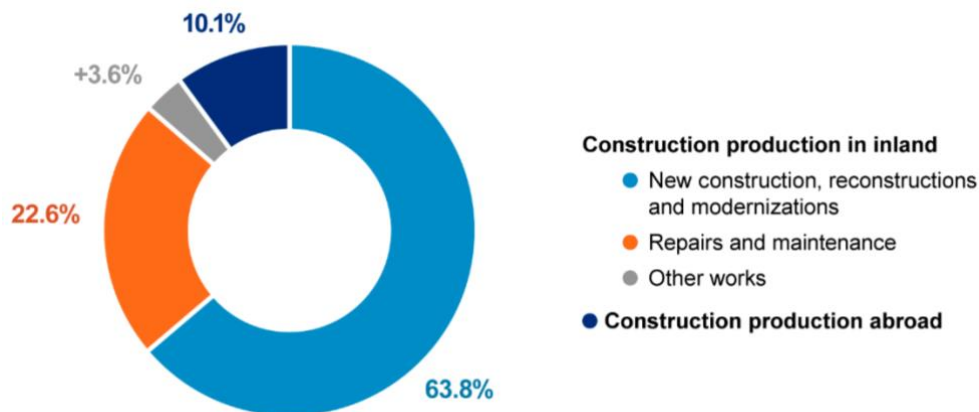
One strategy for ensuring effective maintenance planning is to focus on the maintenance of critical structural elements that have the greatest impact on the safety, functionality and lifetime of the building. Effective prioritization allows to optimize the distribution of funds and focus on the most important aspects. Another strategy is to invest in preventive measures that are more cost-effective in the long run than reactive repairs. Prevention is always cheaper than dealing with the consequences. Early detection of potential problems through regular inspections and diagnostic methods makes it possible to prevent extensive damage and reduce repair costs. Modern diagnostic methods allow for accurate and timely detection of hidden defects. Thorough documentation of the maintenance performed and the condition of the structures enables efficient planning of future maintenance work and cost optimization. Clear documentation is the basis for effective maintenance management. Choose reliable and qualified maintenance contractors who will ensure quality and efficient execution of work. High-quality execution of work minimizes the risk of repeated repairs and reduces overall costs. The implementation of modern technologies, such as monitoring systems and predictive maintenance, makes it possible to optimize maintenance processes and reduce costs. Modern technologies bring greater efficiency and precision in maintenance.

The current state in the economy of the Slovak Republic is in a difficult situation. The field of facility management (FM) is no exception. By implementing facility management, organizations can significantly improve their efficiency and reduce operating costs. Standard ISO 41011 defines facility management as integrating processes within the organization, with the help of which agreed services are secured and developed, which help and make the basic activities of the organization more efficient. [4] The task of FM is to make correct decisions and manage all supporting activities of companies and organizations. At a time of rising energy prices, inflation, operating costs, wages, or increasing all inputs, the involvement of facility management is essential.

The current situation is significantly influenced by the situation in Ukraine, international sanctions, and the related measures of state authorities. Providers of facility management services as well as clients must solve and propose several measures.

The overall price increase has also affected the prices of construction materials. There is a shortage of qualified workers in the construction industry, which leads to higher wage demands. Increased requirements for occupational health and safety increase the costs of operating construction sites. Requirements for energy efficiency and environmentally friendly materials increase construction costs. Complicated permits and administrative processes extend construction times and increase costs. Growing demand for new apartments, office space and infrastructure is increasing pressure on prices. Construction production includes work on the construction, reconstruction, expansion, restoration, repair, and **maintenance** of construction objects. The definition of construction production also includes the assembly work of building structures and the value of the built-in material. In addition to supplier construction companies, there are also non-construction companies.

Construction production (graph 1) in the Slovakia for the year 2023 was made up of 22,6% by **repairs and maintenance**, it represents a high proportion of maintenance and repair costs, which is due to the lack of attention to maintenance itself.



Graph 1 Structure of the Construction Production in 2023 in Slovakia (in % of the total) [5]

3 CONSIDERATION OF MAINTENANCE COSTS IN THE DESIGN OF BUILDINGS

The energy and operational requirements of the building are best suited to its material, spatial design, and technical equipment. These elements directly influence most future operational expenses of the building. The investment process's efficiency is determined by the **optimal life cycle cost** of the LCC building, including both **investment and operational expenses**. [6] To evaluate the maintenance

[10.51704/cjce.2024.vol10.iss1.pp43-48](https://doi.org/10.51704/cjce.2024.vol10.iss1.pp43-48)

ISSN (online) 2336-7148

www.cjce.cz

efficiency of building structures, economic efficiency is assessed throughout the building's life cycle. The material choice for building structures plays a crucial role in **determining future maintenance costs** during the building's usage phase. Heating expenses account for a significant percentage of the total future operating costs of a building, and they notably affect the material-construction choices. Involving the facility manager in the building design phase can help reduce future operating and maintenance costs of the building.

An effective tool for deciding on building materials can be the proposed methodology, which would be used in a simple and quick way to determine the selected life cycle costs.

Facility managers possess valuable tracking information from various building types, which enables them to set parameters for future maintenance of building structures. Facility managers define requirements for:

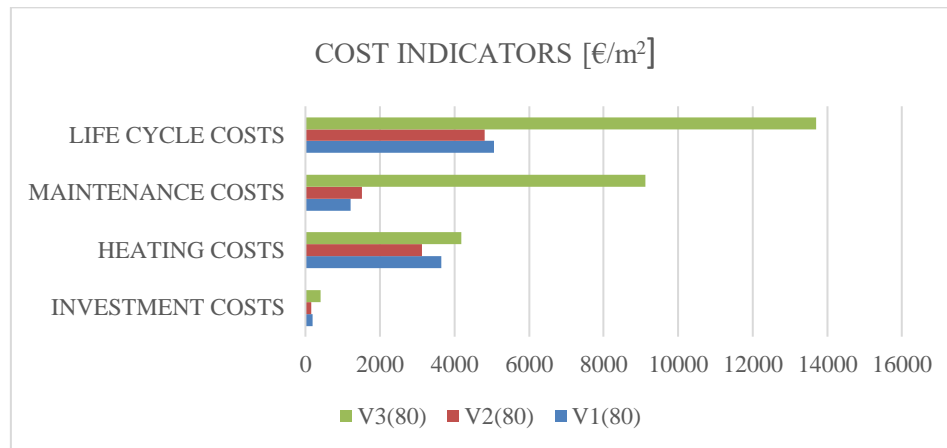
- material solution of building structures, priority resistance and maintenance of exterior and interior surface treatments,
- maintenance of the building,
- variability of spatial solution,
- the technical equipment of the building, its standard and type,
- technical equipment, coordination of distribution in the area, maintenance and control.

The designer during the design phase will design a material solution for building structures. For individual constructions, individual life cycle costs will be processed according to the methodology. Based on the minimum LCC, the investor will choose a suitable solution. The determined costs, after reference to the unit area $lcci$ [€/m²], can serve as a starting point for the design.

Determining conditions were set during the creation of the methodology:

1. The building will be designed in an environment with standard weather conditions.
2. During the construction of the building structures of the building, the relevant technological regulations will be observed, the necessary quality of the implemented structure will be ensured.
3. The methodology was developed for selected building structures: external wall.
4. The filling constructions of the openings in all variants will be identical, they will have the same thermal technical properties and the same area of the opening parts. [7]

The methodology was incorporated for three variants of external wall on the administrative building. V1 was considered as a masonry wall made of ceramic blocks, V2 was considered as a reinforced concrete wall with insulation, V3 was considered as an all-glass facade. The highest operating costs were achieved during the specified period by V3, which was caused mainly by high maintenance costs of the structure. The V2 material solution has the lowest investment and future selected operating costs during the life cycle. The indicators of the individual life-cycle costs over 80 years processed according to the proposed methodology are shown in Graph 2. The information gathered through the design methodology would provide the necessary input data for addressing maintenance issues utilizing BIM technology.



Graf 2 Overview of Lcc Cost Indicators per m² in Terms of 80-Year Level

4 CONCLUSION

This paper emphasizes the importance of planned maintenance for building structures, highlighting both technical and financial benefits. It argues that proactive maintenance prevents costly emergency repairs, extends the lifetime of structures, optimizes energy consumption, and preserves property value. The financial benefits are significant, including cost savings and property appreciation, particularly highlighted by research from Malaysia. Regular maintenance helps in early detection of potential problems, reducing extensive repair needs and keeping buildings energy efficient. The paper also discusses facility management, especially in the context of rising costs and economic challenges in Slovakia, emphasizing the need for strategic planning to maintain efficiency and reduce operating expenses. Additionally, it addresses the influence of material choices on future maintenance costs and suggests involving facility managers in the design phase to optimize long-term costs. The article concludes by comparing the life cycle costs of different building materials, demonstrating how choices affect future maintenance and operating costs.

References

- [1] SARBINI, Noor Nabilah, et al. (2021). Review on maintenance issues toward building maintenance management best practices. *Journal of Building Engineering*. Iss. 44. 102985. doi: <https://doi.org/10.1016/j.jobe.2021.102985>
- [2] SOMOROVÁ, Viera. (2010). *Údržba budov. Facility management*. Bratislava: Publishing House of STU. ISBN 978-80-227-3372-4.
- [3] HAUASHDH, Ali, et al. (2022). Strategic approaches towards achieving sustainable and effective building maintenance practices in maintenance-managed buildings: A combination of expert interviews and a literature review. *Journal of Building Engineering*. Iss. 45. Art. No. 103490. doi: <https://doi.org/10.1016/j.jobe.2021.103490>
- [4] STN EN ISO 41011: (2024) *Facility management. Vocabulary*. Bratislava: Úrad pre normalizáciu, metrológiu a skúšobníctvo Slovenskej republiky.
- [5] STATISTICAL OFFICE OF THE SR. (2024). *Construction production in October 2024*. Available from: <https://slovak.statistics.sk>
- [6] SOMOROVÁ, Viera. (2014). Determination of the Optimum Variant of the Material Solution of Building Construction from the Aspect of Effectiveness of the Real Estate Development. In *Advanced Materials Research: selected, peer reviewed papers from the 2014 3rd Global* [10.51704/cjce.2024.vol10.iss1.pp43-48](https://doi.org/10.51704/cjce.2024.vol10.iss1.pp43-48)

Conference on Civil, Structural and Environmental Engineering (GCCSEE 2014). Chengdu, China, 21.-22.10.2014. pp. 2454-2458.

- [7] HANKO, Martin, et al. (2021). *Maintenance of Building Structures. Facility Management I*. Brno: Tribun EU s.r.o. 2021. ISBN 978-80-570-3662-3.