



Editorial The Latest Scientific Problems Related to the Implementation and Diagnostics of Construction Objects

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1. Introduction

The construction industry is a sector of the economy that is characterized by a large variety of building structures, as well as a large variability in the conditions of their implementation. Particularly in times of rapid economic development, this great variability and diversity generates many new scientific problems that must be solved in order to further improve the quality of construction production and reduce construction costs and time. Moreover, in the construction industry, as in other sectors of the economy, great importance is attached to all environmental issues, as well as to the broadly understood sustainable development strategies. This means that new building materials, modifications of commonly known and widely used materials, new research methods, and methods of implementing and controlling construction processes are still being sought. The diagnostics of existing facilities is also gaining importance, as it determines the operational safety and durability of buildings.

This Special Issue entitled "The Latest Scientific Problems Related to the Implementation and Diagnostics of Construction Objects" aims to present and discuss the results of the latest research in the broadly understood field of construction engineering, in particular regarding: the modification of the composition of building materials with various micro and nanomaterials, by-products, or waste; modern methods of controlling construction processes; methods of planning and effective management in the construction industry; and also methods of diagnosing building structures. Articles published in this issue cover theoretical, experimental, applied, and modelling research. They are organized into several representative topics, and the main content of each article is briefly discussed.

2. Research in the Field of Building Materials

The most popular material that is used in the construction industry is concrete. Its common use is primarily influenced by its high compressive strength, its relatively high durability and resistance to various factors, the ease of forming elements, and the availability of components and their low cost. Concrete is a composite, the basic components of which are a cement matrix and aggregate. In recent years there has been a growing interest in modifying cement composites with finer materials (e.g., various types of fibres or nanoparticles) in order to improve their parameters.

Article [1] presents an assessment of the creep of the cement matrix of self-compacting concrete modified with the addition of SiO₂, TiO₂, and Al₂O₃ nanoparticles using the cavity method. Depending on the type of nanoparticles used, an increase or a decrease in the creep coefficient CIT was found when compared to the reference series. It was found that the addition of SiO₂ and Al₂O₃ nanoparticles in the amount of 4.0% of the cement matrix. In turn, the use of TiO₂ nanoparticles in the amount of 4.0% of the cement matrix. In turn, the creep coefficient CIT. The statistical analysis of the obtained



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Copyright: © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https:// creativecommons.org/licenses/by/ 4.0/). test results indicates, however, that the addition of nanoparticles does not significantly affect the creep of the cement matrix of self-compacting concrete.

Depending on the dimensions of concrete elements, aggregates of different granulation are used in building structures. The properties of the aggregate determine the strength and durability of the concrete. Taking this fact into account, the authors of article [2] examined the influence of the maximum graining of aggregate on the strength properties and modulus of elasticity of concrete. The research showed that the strength properties of the aggregate are not only proportional to the maximum size of the aggregate grain, but also to the aggregate's crushing strength. However, no analogous relationships were found in terms of the modulus of elasticity of the tested concrete.

As already mentioned, one of the main requirements for building structures is durability. In reinforced concrete structures, the direct factor that influences the durability of concrete is the corrosion of reinforcing steel. In paper [3], one of the non-destructive methods was used to assess the degree of corrosion of the reinforcement, namely the galvanostatic pulse method (GPM). It is an electrochemical method that uses the physicochemical properties of concrete and steel. Using this method, the influence of the temperature of the tested element on the results of such parameters as: corrosion current density, stationary potential of the reinforcement, and the resistivity of lagging, was investigated. The differences in the values of these parameters, which were measured on the same samples, but at different temperatures, amounted to several dozen percent in some cases. This means that measurements of actual structural elements conducted with the use of the GPM, e.g., at different times of the year, may lead to an incorrect estimation of the probability of corrosion of the reinforcement in the studied area, and also to an incorrect assessment of its corrosive activity over time. According to the authors, it is advisable to define appropriate temperature correction factors for measurements performed with the use of the GPM.

It is more and more common to use various fibrous composites that improve the technical parameters of concrete. The use of FRP (Fibre Reinforced Polymers) materials is of particular interest. Paper [4] proposes a new original mathematical formula for predicting the compressive strength of FRP-confined concrete cylinders. The formula was developed on the basis of the output data obtained from a neural network. The results of the study show that the mathematical formula proposed by the authors allows the compressive strength in concrete cylinders reinforced with FRP tapes to be estimated with greater accuracy when compared to other existing formulas. The authors emphasize that over 96% of the results obtained with the proposed formula are fully consistent with the results of experimental research. The proposed calculation method can be easily applied using a calculator, which is particularly important at the stage of preliminary engineering projects.

As a result of the growing environmental awareness of society, it has become very popular to use natural plant fibres as an addition to new thermo-insulating composite materials. Article [5] presents the results of research concerning the physical and thermomechanical properties of a new composite based on cement mortar reinforced with alpha fibres (AF) sourced from a species of grass growing in an area of the Mediterranean basin. It was shown that the addition of 5% of weight means that the composite material is lighter by about 15%, its thermal insulation properties improve by about 57%, and its heat diffusion damping coefficient increases by about 49%. Moreover, the mechanical bending and compressive strength of the composite increases by up to 10% with an AF content of 1%.

A significant proportion of building materials are capillary-porous materials that are characterized by a high degree of water absorption. In many technologies that are used in the construction industry, it is necessary to dry such materials. Paper [6] presents a mathematical model of drying a thin-layer capillary-porous material, which enables changes in the material's moisture and its drying time, depending on the drying temperature and the initial moisture content, to be forecasted. The results obtained from the model were confirmed to be in line with the experimental data known from the literature related to the drying of ceramic blocks used in the construction industry.

3. Methods of Controlling Construction Processes

The implementation of each construction project is related to the three following parameters: the scope of the project, implementation time, and budget. Changing one of these parameters causes changes to the others, and consequently affects the fourth parameter, i.e., the quality of the project. One of the key tasks of an investor and contractor at the stage of planning and implementing construction works is to measure the progress of construction works while taking into account the planned dates and costs. During the implementation of construction works, various types of disturbances often occur, which make the prepared implementation schedules obsolete. As a consequence, the original milestones identified in the project schedule are delayed. The authors of paper [7] undertook research that aimed to define the optimal set of actions of responding to schedule delays. They proposed a simulation method for selecting schedule compression measures, i.e., accelerating processes, and for determining the best moment to take such actions in the event of disruptions. The proposed method allows the costs of activities that cause schedule failure and the costs of delays to be minimized, as well as the resilience of the schedule to be increased by reducing the differences between the actual and planned start of the process. The developed model is meant to serve as a tool that supports decisionmaking by construction site managers in the event of finding disturbances in the course of construction works.

Appropriate cash flow planning is of key importance for investors and contractors. The S curve is a very helpful tool for planning, monitoring, and controlling construction projects in terms of time and costs. Knowledge of the planned and actual course of cumulative financial outlays over time, as well as the shape of the S curve and its deviations, allows rational actions to be taken in order to achieve success and the intended goal in the implementation of the investment. The aim of article [8] is to analyse the course of an exemplary construction project, to compare the costs of the planned works with the actual costs of the performed works, as well as to indicate the reasons of failure to meet the planned deadlines and the project's budget. The authors of the article analysed the financial expenditure for the implementation of a construction investment, which were incurred in 20-month cycles. On the basis of these results, charts and tables of the planned and actual calculative costs of the completed investment were prepared, the detailed analysis of which allows interesting conclusions to be drawn. The development of a methodology for planning the cumulative cost curve in construction projects will enable better planning of financial outlays.

The image of every building is shaped by its facades. Currently, traditional concrete forms have been replaced with light casings in the form of aluminium-glass facades and ventilated facades. The authors of article [9] investigated the influence of various identified factors on the costs of implementing a building's facade system. On the basis of the collected quantitative and qualitative data, which were obtained as a result of research concerning the design documentation and cost estimates of public utility buildings, as well as on the basis of interviews conducted with experts, factors that have a real impact on the costs of aluminium-glass facades and ventilated facades were identified. The indicated factors were analysed and classified using the MICMAC structural analysis method. Finally, six groups of factors that influence the cost of facade systems were determined, including: regulatory factors that do not have a very strong impact on the cost level, but show a strong correlation with other factors; determinants that have a very strong impact on costs; and the group of external factors that have the least impact on the estimation of facade costs.

An important element in the implementation of construction investments is the quality of works. Defects affecting the quality of works are common in the construction industry in all countries. Previous studies of defects in residential buildings mainly focused on the defects that occur at the stage of works acceptance. The authors of article [10] examined damage in residential buildings that was reported during the warranty period. The statistical analysis of the research results showed that more than half of it was justified. Understanding the existence of defects in buildings is a fundamental prerequisite for their prevention and elimination. Research and analysis of defects that occur during the warranty period can significantly affect the development of defect management procedures and the creation of a knowledge map that concerns the frequency of defects in individual places in a building and a building's elements. There are costs associated with repairing damage. Knowledge about defects occurring in buildings can therefore be used for better planning of an investment budget.

It has recently become common practice to use small plots of land located in dense urban developments for construction purposes. In such places, new "infill buildings" are created. In the case of revitalizing existing historic buildings, their facade walls are often used to build new buildings. In both of these cases, the implementation of the facility includes deep excavations that can cause serious damage to existing buildings in the vicinity. Article [11] focuses on the problem of interaction mechanisms between soil and the structure of buildings located near deep excavations. The authors analysed various risk factors related to the construction of new infill buildings and the revitalization of historic buildings when using only their facade walls. The reaction of buildings to deformations caused by deep excavations is influenced by the accuracy of determining the deformations and stresses caused by these excavations. Examples of current solutions for securing the walls of existing buildings, as well as the method of monitoring vertical deformations with the use of the Hydrostatic Levelling Cell (HLC) system are presented.

The construction industry is one of the most dangerous branches on the labour market. Providing safe working conditions for construction workers is the basic task of every entrepreneur. Unfortunately, a significant proportion of accidents in the construction industry are caused by reasons attributable to an employee. One of them is alcohol abuse in the workplace. The aim of the research in article [12] was to identify the main problems related to alcohol consumption at work among construction industry employees, with particular emphasis on workplaces on construction scaffolding. This study confirmed that excessive alcohol consumption is the cause of many serious and fatal accidents. Of the 219 reported accidents related to work on building scaffolding, 17.4% indicated alcohol consumed at the workplace as the cause of the accident.

4. Selected Decision-Making Problems in the Construction Process

Due to the large variety of used building materials, the possible construction solutions, and the techniques used for the construction of buildings, the problem of choosing the best solution from among many that are possible often arises. In solving such problems, multi-criteria decision analysis methods are helpful.

Article [13] proposes a methodology for selecting the best solution for the construction of retaining walls located in various environments. In the developed methodology, the authors identified various types of retaining walls and defined the selection criteria that take into account: external and construction requirements, terrain characteristics, and economic criteria. The best solution is determined by the successive application of various multi-criteria methods of decision making.

In turn, article [14] includes a concept for supporting decisions when selecting the best contractor for the project. In the developed methodology, a combination of Analytical Hierarchy Process (AHP) and PROMETHEE methods was used. The proposed management procedure enables the demands of opposing stakeholders to be taken into account; it increases the transparency of the decision-making process and its coherence; it also increases the legitimacy of the final result. It is a new scientific approach with a great potential for being applied to similar decision-making problems.

During exploitation, construction objects deteriorate and require renovation. Renovation may be needed due to the poor technical condition of a building's elements, the ending of a material's durability, a building's location, or the protection of cultural heritage. Neglecting renovation is one of the main reasons for the decline in the technical value of buildings. Article [15] proposes a new and original methodology for determining needs in the field of the rehabilitation of buildings constructed using traditional technology. The im-

plementation of the Analytical Hierarchy Process (AHP) method was used to set renovation priorities. The developed multi-criteria methodology for supporting decisions in the field of building renovation may be a tool for determining the correct sequence of renovation works while taking into account the technical condition of facilities, the preparation of work schedules, and the planning of renovation investment costs.

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

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