BUILDING CONSTRUCTION, BUILDINGS AND STRUCTURES

THE RESULTS OF THE PRACTICAL APPLICATION OF THE METHODOLOGY FOR PREDICTING THE REMAINING SERVICE LIFE OF BUILDING STRUCTURES

G. D. Shmelev, A. N. Ishkov, I. S. Alirzaev

Annotation. This article describes the practical application of the methodology of complex integral forecasting of the remaining service life of building structures of operated buildings and structures developed by the authors' team. The methodology includes expert, parametric methods, as well as ‘load–bearing capacity’ and ‘load–strain’ methods. We present the results of a study assessing the actual load-bearing capacity and calculating the remaining service life of the swimming pool's roof structures. At the time of the survey, the building had been in operation for at least 24 years. The results of a visual inspection are presented, demonstrating significant corrosion damage to the working steel reinforcement of the reinforced concrete ribbed roof slabs, with partial or complete destruction of the concrete protective layer. Based on surveys using the author's methodology, we made some forecasts for changes in concrete strength, the depth of corrosion damage to the reinforcement, as well as the bearing capacity of the slabs (in terms of moment and shear force) and their deflections over time, taking into account the identified defects (damage). Models of continuous uniform and non-uniform ‘sickle-shaped’ corrosion were used to predict corrosion of the reinforcement. Repair measures were developed and implemented for damaged and compromised slabs. A comparison of the 2006 forecasts with the current condition of the floor slabs confirmed the validity of the original methodology.

Keywords: forecast of the remaining service life; concrete strength; reinforcement corrosion; bearing capacity; ribbed reinforced concrete slabs; deflections.

IMPROVEMENT OF FLOORING INSTALLATION METHODS IN SPORTS FACILITIES USING RESOURCE-SAVING TECHNOLOGIES

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Annotation. The increasing volume of rubber waste, primarily end-of-life tires, necessitates the development of technological solutions aimed at their integration into secondary material cycles and the reduction of environmental impact. In domestic practice, rubber crumb has long remained underutilized, the primary processing method is rubber crumb. Combining recycled rubber with epoxy systems opens up the possibility of creating more flexible and durable flooring struc-

tures. This paper presents the results of an analysis of modern approaches to the use of recycled rubber and demonstrates how changes in the composite structure affect the cushioning and performance properties of sports flooring. The obtained data confirm the potential of the proposed technology and indicate promising directions for the development of resource-efficient solutions in the construction of sports infrastructure.

Keywords: tire recycling; sports flooring; composite systems; cushioning; damping; coefficient of friction; wear resistance; environmental safety; secondary raw materials; dynamic loads; performance properties; service life.

ANALYTICAL SOLUTION AND ALGORITHM OF CALCULATION OF FIRE-RESISTANT STEEL STRUCTURES HEATING UNDER THE INFLUENCE OF HYDROCARBON FIRES

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Annotation. In the article we consider the problem of developing a methodology for calculating the heating of fire-protected steel structures under the influence of hydrocarbon fires. A mathematical problem was posed to determine the heating of the fire-resistant metal layer, taking into account that the metal layer is considered as a heat capacity, and the heating occurs from the side of the thermal insulation. An analytical solution was obtained using the Fourier method. The calculation formula for determining the temperature of metal heating was ultimately presented in the form of a nomogram. We provide as well an example of calculating the heating of a metal structure for a standard fire, as well as for a hydrocarbon fire and aviation kerosene.

Keywords: hydrocarbon fire; fire-resistant structure; calculation nomogram.

ENGINEERING SYSTEMS AND SERVICES

CLARIFICATION OF THE CALCULATION FOR THE STANDARD SEASONAL RESERVE OF SOLID FUEL FOR MUNICIPAL BOILER ROOMS

D. N. Kitaev, O. A. Kutsygina, M. S. Khomyakov

Annotation. In many populated areas of the Russian Federation coal as a fuel accounts for a significant portion of the fuel balance. Fuel reserves in boiler rooms are a crucial component of the energy security of urban housing and utilities. Solid fuel storage capacity depends on the local climate and the average temperatures maintained in heated buildings. Boiler house storage areas must be sufficient to accommodate the required fuel storage volumes under changing climate and heat

consumer conditions. This article presents the results of determining the ranges of variation in boiler output relative to the design value for one coldest month and three coldest ones of the heating season in the Russian Federation with average air temperatures in heated buildings varying from 16 to 24°C, which are necessary for calculating standard fuel reserves. We determined the minimum and maximum values of the relative temperatures for one coldest month and three coldest ones, allowing for a highly accurate determination of the possible ranges of variation in relative heat loads. We as well present the results of calculations of standard fuel reserves and coal stack area for a boiler room in the range of possible average indoor air temperatures of heated buildings.

Keywords: standard fuel reserves; coal; fuel reserves; boiler house; fuel consumption.

DEVELOPMENT OF A RADIANT-CONVECTIVE HEATING SYSTEM FOR GREENHOUSES

N. A. Kolyadin, O. N. Popov, I. V. Rogov

Annotation. Modern systems for creating a microclimate in greenhouses that are year-round operated require the development of sufficiently accurate and reliable calculation methods. The article discusses an algorithm for calculating the radiant-convective heating system of an industrial greenhouse, which takes into account the influence of mass transfer processes on the consumption of thermal energy, as well as the influence of air recirculation on resource consumption. The article presents the results of implementing the proposed algorithm for calculating the radiant-convective heating system for the *Arochnaya-12M* industrial greenhouse. The data obtained allowed us to develop a combined heating system consisting of infrared heaters that create a thermal regime for the soil, and a vortex tube used to maintain the required air temperature inside the greenhouse.

Keywords: air heating system; radiation heating system; greenhouse; thermal balance equation.

EVALUATION OF ENERGY-EFFICIENT OPERATION OF SUBMERSIBLE PUMPS AT UNDERGROUND WATER INTAKES

I. Yu. Purusova

Annotation. The main task of ensuring high-quality and safe water supply in our country is to provide drinking water according to the design data with a high efficiency of the water intake. It is necessary to improve the operation of underground water intakes to a large extent by optimizing the operation of submersible pumps installed in wells. The pumping units at existing underground water intakes

operate in energy-consuming modes, which reduces the overall capacity of the water intake. The article provides an assessment of the energy-efficient operation of the water intake based on the actual performance of the installed pumping units. The article also provides an assessment of the energy efficiency of submersible pumps in accordance with the requirements of the technical standard. We calculated the most economical operating mode of submersible pumps within the operating range based on the specific energy consumption for each well.

Keywords: groundwater water intakes; submersible pump; energy efficiency; water supply.

TREATMENT OF WASTEWATER FROM GALVANIC PRODUCTION OF INDUSTRIAL ENTERPRISES USING REAGENTS

S. I. Movchan

Annotation. This paper examines the important scientific and technical problem of ensuring the rational use of water resources through the development of resource-saving recirculating water supply systems. The article examines the issues of reagent treatment of wastewater from galvanic production through the use of spent cleaning solutions, which are chemical components of spent cleaning solutions: surfactants, caustic soda, sodium pyrophosphate, sodium metasilicate, soda ash and sodium tripolyphosphate in a certain ratio to hexavalent chromium, which ensures effective treatment of wastewater, optimizes the process of wastewater treatment in water recycling systems. I present the results of an evaluation of the proposed technology using chemical components. The main effect is a reduction in the use of reagents and the resulting sludge, as well as a reduction in the cost of treating wastewater from galvanic production. It is noted that the use of components from waste cleaning solutions increases the efficiency of wastewater treatment. I also present some recommendations for improving the efficiency of wastewater treatment, which preferably involve mixing certain types of wastewater at the pre-accumulation stage.

Keywords: wastewater; chemical components; waste cleaning solutions; surfactants, caustic soda; sodium pyrophosphate; sodium metasilicate; soda ash; sodium tripolyphosphate.

URBAN PLANNING. RECONSTRUCTION, RESTORATION AND LANDSCAPING

RUSSIAN-BYZANTINE STYLE IN ARCHITECTURE OF SAMARA-CITY

D. V. Litvinov, N. A. Orlova, N. A. Kosenkova

Annotation. The article is devoted to the study of the ‘Russian-Byzantine style’ in the architectural heritage of the Samara region. Attention is paid to the historical context of the emergence and development of the style, its connection with national architectural trends, and the influence of local urban planning features. The article briefly examines the historical aspects of the emergence of the ‘Russian-Byzantine style’ in Russian architecture. The analysis covers the St. Nicholas Church of the Samara St. Nicholas Monastery, the Church of the Presentation of the Lord in the Samara Iversky Convent, the Ascension Cathedral of the Syzran Ascension Monastery, and the Church of St. Barbara the Great Martyr in Tolyatti-city. The study is based on drawings and model church projects created by architect K. Thon and recommended as ‘models for use and imitation’. The focus is on their architectural elements as characteristic features of this style, such as the shape of the domes, the decorative design of the facades, and the layout of the buildings. The study aims to explore the Samara interpretation of the ‘Russian-Byzantine style’ and its role in shaping the architectural style and preserving the cultural identity of the region.

Keywords: ‘Russian-Byzantine style’; church construction; model church projects; monasteries and churches in thr city of Samara.

PROSPECTS FOR THE INTRODUCTION OF 3D PRINTING IN THE IMPROVEMENT OF THE TERRITORIES OF THE CITY OF VOLGOGRAD

N. V. Korosteleva, E. Yu. Kozmina

Annotation. The article is devoted to the study of the prospects for the introduction of 3D construction printing as an innovative tool for the integrated improvement of urban areas on the example of the city of Volgograd. In the context of the implementation of the national project ‘Housing and Urban Environment’, the search for technologies that can provide quick, economical and aesthetically expressive renewal of public spaces becomes relevant. By the method of system analysis, the key technologies of additive production (layer-by-layer extrusion, spraying) were evaluated, their functional specialization and complementarity were revealed to create both structural and decorative elements of improvement, including small architectural forms and unique landscape objects with precise detailing.

World and domestic experience has been systematized, demonstrating the transition of technology from the experimental stage to practical and commercial application in the urban planning context. Particular attention is paid to the analysis of specific factors of Volgograd that determine the conditions for implementation: a sharply continental climate that requires the adaptation of materials and design solutions; a unique historical and memorial heritage that acts as a semantic basis for design; socio-economic priorities for urban renewal. Based on the analysis, we developed a phased integration strategy, including the formation of a regulatory framework, the implementation of pilot demonstration projects and the subsequent scaling of the technology through its inclusion in municipal programs and the stimulation of local production. It was concluded that the deep adaptation of 3D printing to the specific conditions of the place allows us to consider it as an effective tool for creating a comfortable, stable and identical urban environment in the city of Volgograd, meeting modern challenges of urban development and forming new standards for the quality and originality of public spaces.

Keywords: 3D printing in construction; additive technologies; improvement of urban areas; comfortable urban environment; small architectural forms.

ECOLOGY AND SAFETY OF THE URBAN ENVIRONMENT

SIMULATION OF NOISE AND VIBRATION MONITORING SYSTEMS IN RAILWAY TRANSPORT: THEORETICAL ASPECTS AND AN OVERVIEW OF CURRENT TECHNOLOGICAL SOLUTIONS

E. I. Golovina, D. A. Sokolov, S. V. Artyshenko, A. A. Pilosyan

Annotation. The article presents theoretical aspects and an overview of technological solutions for monitoring noise and vibration from railway transport. It discusses the fundamentals of noise and vibration generation and propagation from railway transport. The article analyzes modern technological solutions for modeling intelligent monitoring, which are multi-level systems that include sensor networks, data transmission systems, analytics platforms, and visualization interfaces. We propose an algorithm for the operation of an intelligent system for monitoring vibroacoustic effects on railway transport. The key advantage of the algorithm is the diagnostic results, which identify the possible cause of vibroacoustic noise and indicate possible damage to components in the railway track or train. The implementation of intelligent monitoring systems for noise and vibration will reduce the costs of maintaining the track and rolling stock, and extend their service life by timely identifying the mechanisms of damage and eliminating defects.

Keywords: noise; vibration; railway transport; intelligent monitoring systems; technological solutions.

STUDY OF DUST CONTAMINATION OF THE AIR ENVIRONMENT IN ROADSIDE AREAS OF DISTRICT ROADS

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Annotation. The article presents a comprehensive study of the dustiness of the air environment in roadside areas of highways of regional significance, taking into account the effects of natural and anthropogenic factors using the example of Volgograd-city. The main attention is paid to the analysis of the concentration and distribution of suspended solids, including fine dust with an aerodynamic diameter of less than 10 microns (PM10) and less than 2.5 microns (PM2.5), which pose the greatest danger to public health and the environment. The study examined ten key factors determining the processes of dust formation, transport and deposition, including meteorological parameters (wind speed and direction, temperature and relative humidity), characteristics of the road surface, the intensity and composition of traffic flow, as well as the types of vehicles operated. Based on experimental and calculated data, we obtained adequate equations of multiple linear regression, which make it possible to establish a quantitative dependence of the concentration of solid particles on the totality of the studied factors. We analyzed the degree of influence of each factor, and identified the most significant ones of them. The results of the study can be used in assessing the environmental situation of roadside areas and developing measures to reduce dust pollution.

Keywords: dustiness of the air environment; linear city; automobile transport; pollutants; fine dust; meteorological factors.

ECONOMICS AND ORGANIZATION OF CONSTRUCTION

ANALYSIS OF THE IMPACT OF THE URBAN ENVIRONMENT COMFORT ON ECONOMIC GROWTH USING THE EXAMPLE OF THE CITY OF MOSCOW

I. K. Khasan, V. I. Prusova, M. A. Zhidkova, L. I. Artanova

Annotation. This article explores the role of a comfortable urban environment as a key driver of economic growth, using the example of the city of Moscow. It examines the transformation of the capital from a megalopolis focused on solving infrastructure problems to a city that prioritizes a human-centered approach. The article analyzes key projects in transportation, public space improvement, digitalization, and housing policy implemented between 2020 and 2025. Using statistical data, tables, and graphs, the article demonstrates a direct correlation between investments in a comfortable environment and economic indicators such as growth in the Gross Regional Product (GRP), increased tax revenues, investment inflows, the development of small and medium-sized businesses, and in-

creased labor productivity. The article proves that strategic investments in the quality of life are not an expense, but a powerful tool for economic development.

Keywords: comfortable urban environment; economic growth; Moscow-city; logistics; public spaces; GRP; investments; small and medium-sized businesses.