BUILDING CONSTRUCTION, BUILDINGS AND STRUCTURES

THE CAUSES OF THE APPEARANCE AND GROWTH OF CRACKS IN THE STONE WALLS OF BUILDINGS

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

Annotation. The article examines the most probable causes of the appearance, development and growth of cracks of various origins in the stone walls of buildings and structures. We identified the following groups of cracks: shrinkage, temperature, force, and subsidence. We carried out analysis of the causes of their development for each group of cracks. When considering shrinkage deformations and cracks in stone structures, the following types of deformations are distinguished: contractional, humidity and carbonation. We determined limit values of relative deformations for moisture and carbonation shrinkage. It is noted that the moisture shrinkage is ten times less than the carbonation shrinkage. At the same time, it is shown that moisture shrinkage occurs in a short period of time, and carbonation develops over the course of decades, throughout the entire life of buildings and structures. We researched in detail the causes of temperature deformations of stone wall materials, and showed the causes of temperature cracking. Using a specific example, we compared the values of shrinkage and temperature deformations of stone walls made of silicate bricks. Based on calculations of temperature and shrinkage deformations, we showed and justified the beginning of the development of cracks in the exterior walls of stone buildings, proved that the opening of cracks in the cold season significantly exceeds the width of the possibility of closing the same cracks in the warm season. For cracks of a force nature, we demonstrated the stages of their development and the intensity of internal stresses in the masonry at each stage of crack development. It is shown that the development of force cracks in the stone structures of the exterior walls of the building is extremely rare. We described the main causes of subsidence cracks, and described the main characteristic outlines of the cracks. We as well described the causes of linear vertical cracks and arched cracks in the form of arches and semi-arches.

Keywords: stone structures; subsidence cracks; force cracks; vertical and inclined cracks; piers.

ANALYSIS OF COMPATIBILITY OF FORMS AND CONTENTS OF DESIGN AND OPERATIONAL DOCUMENTATION OF REAL ESTATE ASSETS

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Annotation. The safety and durability of commissioned buildings and struc-

tures depends on the quality, efficiency, and timeliness of work performed by the personnel of the operating organizations. In turn, the activities carried out for the maintenance and repair of structural elements, engineering systems and equipment of real estate assets are impossible without the use of technical documentation (drawings, diagrams, registers, instructions, passports, etc.) We analyzed regulatory legal documents in the field of construction regulating the organization and implementation of activities of design, construction, expert and operating organizations as well as executive authorities of the industry. The results of the study made it possible to formulate proposals on the need to make additions to existing regulations regarding the possibility of using executive and operational documentation at the operational stage of the life cycle of a capital construction facility. During the preparation of the article, we analyzed the compatibility of the forms and contents of the source and operational documentation transmitted by the developer to the operating organization. We as well considered the possibilities of this documentation synchronization as part of the introduction of digital information models of capital construction facilities. We describe here the advantages of using electronic documents at the operational stage of the life cycle of a capital construction facility, including the transformation of electronic documents into interactive electronic documents for more accessible forms of organizing routine maintenance by the personnel of the operating organization. In addition, we show the prospects for further use of interactive electronic documents in the educational process of educational institutions.

Keywords: building operation; technical, electronic and interactive documentation; digitalization; operational organization.

INFLUENCE OF FIBER CHARACTERISTICS ON THE STRENGTH OF STEEL FIBER-REINFORCED CONCRETE

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Annotation. Fibre reinforcement is becoming increasingly widespread. Steel fibres are most commonly used for combined reinforcement of flexural reinforced concrete structures. In the article we consider two main factors affecting the efficiency of fibre reinforcement: the bond between the fibre and the concrete matrix, and the distribution of fibres within the structural material. Here we present a methodology and results of experimental studies on fibre pull-out from the concrete matrix. We demonstrate graphs showing shear forces and pull-out forces of fibres from fine-grained concrete with different geometric characteristics. We theoretically explain fibre behaviour during pull-out from the concrete matrix.

Keywords: steel fiber concrete; metal fibers; concrete reinforcement.

ENGINEERING SYSTEMS AND SERVICES

MODELING OF PROCESSES IN INDUCTION HEATING SYSTEMS IN OIL AND GAS SUPPLY LINES IN THE FAR NORTH CONDITIONS

G. S. Serikov, I. A. Serikova, O. S. Zhilkin, A. R. Golovnya

Annotation. The article considers the possibility of using induction heating systems in oil systems located in the latitudes of the Far North. We have worked out theoretical aspects of increasing the efficiency of heating oil and gas pipelines using the induction method with a skin system. As one of the possible options for increasing the efficiency of this system, we considered physical modeling of the processes of magnetic field distribution in the skin system. To implement physical modeling, we proposed a test pulse generator of a special form for studying the induction heating system. We as well determined the main parameters of the power source, and developed a basic diagram of the magnetic-pulse system.

Keywords: skin system; oil pipelines; induction heating; pulse power source; magnetic pulse system.

ENERGY PERFORMANCE INDICES OF KE BOILERS FIRED WITH BROWN COAL

D. N. Kitaev, M. S. Khomyakov

Annotation. The use of brown coal in housing and communal services systems of the country has become widespread. The elemental composition of brown coal and its calorific value vary significantly depending on the mining area. The article presents the results of modeling the energy performance of steam boilers of KE series operating on brown coal (mined in the Russian Federation) over the entire possible range of net calorific value. Based on the calculation of the heat balance of boilers using brown coal, we established the values of changes in the main energy parameters. We determined the design values of the efficiency of brown coal boilers and their changes in comparison with hard coal boilers. We obtained the equations that allow for highly accurate calculation of fuel consumption and the temperature of combustion products at the outlet of the furnace devices of KE boilers using brown coal depending on the values of the net calorific value of the fuel and steam capacity.

Keywords: brown coal; heat generator; fuel composition; heat balance; fuel consumption; efficiency; flue gases.

PROSPECTS OF USING LIQUEFIED GAS IN AUTONOMOUS BOILER HOUSES

A. R. Gataullina, V. A. Martiashova, N. D. Torosyan

Annotation. The use of liquefied natural gas (LNG) is becoming especially relevant in the light of global climate change and the desire to switch to cleaner and more sustainable energy sources. Countries that are actively developing LNG infrastructure are reducing their dependence on traditional hydrocarbons, contributing to the formation of a more flexible and diversified energy system. The transfer of autonomous boiler houses from traditional energy resources to alternative fuels such as LNG is becoming increasingly relevant. The paper provides a technical and economic calculation of the feasibility of converting traditional autonomous low-power boilers to liquefied natural gas. It is proved that the transfer of a boiler house to LNG is economically efficient and expedient in terms of the cost of the generated thermal energy.

Keywords: natural gas; liquefied natural gas; autonomous heat supply; heating.

ANALYSIS OF THE CAUSES OF PUMPING EQUIPMENT FAILURE IN OPEN DRAINAGE

S. V. Grigoriev, V. V. Pomogaeva

Annotation. In the article we consider the problems of operating pumping equipment on the example of an open drainage of a coal-flooded quarry. We describe the principle of organization of water drainage from quarries. We analyze the most important factors influencing the process of pumping equipment operation: natural and climatic conditions, operating mode, liquid properties. It is shown that the climatic effects, that begin from the moment the pumping equipment is started up, in case of improper installation of pressure pipelines continue throughout the entire operation stage and affect the failure of operation. We have studied in detail possible reasons for the failure of the operation: defective equipment, damage by solid inclusions, installation errors, pump operation mode, lack of pipeline insulation. The article considers as well problems of operation of pumping equipment. We propose the options for improving the operation of pumping equipment, which will help eliminate failures in operation and prevent damage to pumping equipment. We also give some recommendations to improve the operation of pumps with open drainage.

Keywords: drainage water; open drainage; climatic impact; pumping equipment; pump operation.

MODELING THE OPERATION OF A MAIN OIL PRODUCT PIPELINE DURING AN UNAUTHORIZED TAPPING

N. A. Petrikeeva, I. A. Serikova, A. D. Petrikeev

Annotation. The main danger for the operational transportation of oil and oil products are leaks and unauthorized taps. According to various estimates, the total losses of oil and oil products due to accidents on main oil pipelines and leaks into the environment amount to 1 to 5 million tons annually. The article presents the results of modeling the hydraulic mode of operation of a main pipeline with a leak, which is a prototype of an unauthorized tapping. Here we present the hydraulic characteristics of the linear part without and with the tapping, as well as the total flow-pressure characteristic of the oil pumping station. The article demonstrates that the flow in the linear part after the tapping decreases, while the differential pressures of the stations increase, since the pumps develop a higher pressure at a lower feed. The hydraulic slope of the section decreases, the hydraulic slope line becomes flatter than in the design mode. It is noted that the obtained graphical dependence could be observed in the control room only on the fourteenth day of extraction from the tapping, since water can be pumped into the system during the simultaneous extraction of oil products by intruders.

Keywords: oil products; pipelines; leak; unauthorized extraction; modeling; hydraulic characteristic.

URBAN PLANNING. RECONSTRUCTION, RESTORATION AND LANDSCAPING

APPLICATION OF MODULAR GRID IN DESIGNING LANDSCAPE FACILITIES

E. V. Zolotareva

Annotation. The article analyzes the methodological approaches used in the design of various landscape facilities. The methods under consideration are based on determining the purpose of an object, identifying its functional orientation and analyzing facilities that are similar in terms of these criteria. I considered the aspects of designing environmental facilities based on the modular grid proposed by John Brooks. The use of a modular grid allows developing several options for landscaping that differ significantly from each other. Landscape projects based on a modular grid represent a holistic compositional structure, since all elements are proportional to some common value and, accordingly, proportional to each other. This method can be used on facilities of various sizes, but is most convenient when designing small areas: squares, boulevards, courtyards of individual and apartment

buildings. I give some examples of projects illustrating the possibilities of variant design based on the use of a modular grid.

Keywords: landscape design; design methodology; environmental facility; planning structure; modular grid; landscaping; improvement.

ANALYSIS OF THE EFFICIENCY OF USING PERENNIAL HERBACEOUS PLANTS IN URBAN LANDSCAPING TO CREATE SUSTAINABLE FLORAL COMPOSITIONS

E. A. Korenkova, N. A. Shiryaeva, Zh. G. Silaeva

Annotation. In the article we consider several relevant issues of ecology and design of the urban environment, and propose specific solutions to improve the quality of life of city residents through the careful selection and caring for perennial plants. We emphasize the importance of taking into account the climatic features of the region, existing traditions and difficult environmental conditions when choosing plant species for the improvement of urban zones. For the natural and climatic conditions of the forest-steppe zone of the Russian Federation, we selected perennial flower plants that are resistant to the urban environment according to the criteria of low maintenance, shade tolerance, drought resistance and undemanding to soil fertility. The choice of perennial plants for urban landscaping is based on several key criteria, among which special attention is paid to representatives of the local flora, large plant sizes and their durability in terms of preserving decorative qualities. We developed design projects that provide for the creation of modular flower beds of round, triangular, square shapes in the form of mixborders from large-sized flower plants that easily fit into any configuration of an existing flower bed and are composed of a rhythmic repetition of modules, or their combination.

Keywords: landscape architecture; urban landscaping; flower crops; urban environment, environmental friendliness; economy; sustainability.

ECOLOGY AND SAFETY OF THE URBAN ENVIRONMENT

ANALYSIS OF ENVIRONMENTAL AND FIRE SAFETY OF ELECTRIC VEHICLES THROUGHOUT THE LIFE CYCLE

E. A. Logunova, D. V. Kargashilov, N. S. Zhidkikh

Annotation. The article presents an overview and quantitative assessment of the current environmental challenges associated with the transition to electric motor transport. We analyze the entire period of electric vehicles' existence, including

issues of fire safety and the effects of fire on the environment. We as well calculated the impact of an electric vehicle fire on the environmental situation. We also investigate the environmental aspects at all stages of the electric vehicle life cycle.

Keywords: environmental safety; electric vehicle; electrification; fire safety.

MATHEMATICAL MODELING OF ZONES OF MAXIMUM NOISE AND VIBRATION EFFECTS OF RAILWAY TRANSPORT

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

Annotation. The article lays the foundations for the subsequent development of methods for constructing mathematical models for predicting zones of maximum impact of noise and vibration generated by railway transport. We propose and discuss the possibility of using second-order curves that simplify calculations while maintaining acceptable accuracy. We consider the priority of studying noise and vibration effects, mapping methods, as well as the practical application of models to optimize infrastructure and reduce environmental risks. We propose methods of visualization of the results using GIS technologies and 3D modeling. Attention is paid to the analysis of conditions under which ground vibrations and acoustic waves generated by a moving train arrive simultaneously and in phase, amplifying at the focus of the curve and forming areas of critical impact. We note the connection of the investigated phenomena with the optical properties of second-order curves. The task is to determine the ratios of key parameters, including the length of the track section, the speed of movement of the train, the eccentricity of the curve, etc., necessary for the implementation of resonant effects. We believe that the focus of the second-order curve, and especially the center of the circle, is an impact accumulation zone, which is important for designing noise protection measures and optimizing infrastructure. The development of these concepts is promising for further use in the study of nonlinear dynamic effects in transport systems.

Keywords: noise impact; vibration; mathematical modeling; railway transport; second-order curves.

ECONOMICS AND ORGANIZATION OF CONSTRUCTION

ANALYSIS OF THE FORMATION OF TARIFFS FOR COLD WATER SUPPLY AND SANITATION SERVICES USING THE EXAMPLE OF ‘RVC-VORONEZH’ LLC

A. R. Makarovskaya, D. V. Lobanov, M. S. Kononova, T. V. Stepanova

In the article the authors describe the principles and methods of tariff formation in the field of housing and communal services. We analyzed the formation of tariffs for water supply and sanitation services provided by *RVC-Voronezh* LLC for the period of 2020-2024. In the article we present the graphs illustrating the differences in the values of the wastewater tariff operating on the left and right banks of Voronezh. We revealed the trend of reducing the difference in the cost of sanitation services and the establishment of a single tariff in the territory of Voronezh. We as well analyzed dependence of tariffs on the key rate and the amount of inflation presented in the official statistics of the Central Bank of Russia.

Keywords: cold water supply; sanitation; tariff; pricing.