

BUILDING CONSTRUCTION, BUILDINGS AND STRUCTURES

MONITORING AND PREDICTION OF TECHNICAL CONDITION OF STRUCTURAL UNITS OF BUILDINGS AND STRUCTURES

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Annotation. We considered the issues of analysis for existing approaches to monitoring technical condition of structural units of operated buildings and structures that are described in the normative and technical literature. We considered and analyzed different types of monitoring technical condition of buildings, features of their implementation, existing inconsistencies and difference in approaches to performing different types of monitoring. As a result we clarified the scheme of monitoring technical condition of structural units of buildings and structures. The main controlled parameters and their limit values are considered from the point of view of monitoring, as well as prediction of the technical condition of load-bearing and enclosing structural units of buildings and structures for various purposes. We carried out the analysis of the possibility of using dynamic tests of structural units provided in the current regulatory and technical documents in the absence of objective results when predicting the technical condition of structures based on the results of vibration tests of buildings. Significant discrepancies were revealed in the approaches to the procedure of monitoring technical condition of buildings and structures that are in a limited operational or emergency condition. We made an attempt to link the requirements and recommendations of the current GOST 31937-2011 for monitoring, to ensure a smooth transition in key controlled parameters from general monitoring to monitoring of buildings that are in a limited operational or emergency technical condition. The ways of predicting further development of the technical condition of structural units of buildings are considered, using generalized parameters that characterize the current technical condition of structural units, using parametric prediction and expert methods.

Keywords: monitoring; technical condition; structural units; controlled parameters; residential and public buildings; prediction.

ENGINEERING SYSTEMS AND COMMUNICATIONS

DETERMINATION OF THE COEFFICIENT OF THE DYNAMIC SHAPE OF DUST PARTICLES RELEASED IN THE AREA OF GRINDING MACHINES

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Annotation. When working on sharpening carbide tools with abrasive wheels on universal grinding machines, a significant amount of dust particles is formed. A certain part of the dust particles, depending on the size, is suspended. Prolonged

exposure to dust aerosols on the body of machine turners can lead to the development of a large number of occupational diseases of the respiratory tract. It is established that in the working area, the nature of the movement of dust particles, as well as the rate of their deposition, is affected by such a parameter as the shape of the dust particle. The material for the study, calculation and subsequent computer simulation of the dust aerosol flows in the dust collector casing was collected at the OOO Russian Tool, which is located in the village Severny, Belgorod district. The samples were taken in different zones of the grinding area. Based on the available samples of dust particles, the results of electron microscopy were obtained at the laboratory of BSTU named after V. G. Shukhov. The purpose of this work is to describe the results obtained and determine the shape coefficient of dust particles, using existing methods for determining this coefficient. The material of the work allows us to supplement the initial data for the development of a mathematical model of the processes of the flow of dust particles near the local suction.

Keywords: local exhaust ventilation; non-dust ventilation; dust extraction; dynamic shape coefficient; grinding machines; abrasive dust; electron microscopy.

USING FAN COIL UNITS TO REDUCE ELECTRIC ENERGY CONSUMPTION FOR THE FAN DRIVE

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Annotation. The volume of energy consumption, including electricity, in our country is constantly increasing. In this regard, it becomes necessary to reduce the cost of electrical energy as much as possible. The article discusses the possibility of reducing electrical energy in supply ventilation systems through the use of fans. We present the results of the aerodynamic calculation of two variants of the supply ventilation system of an industrial building. The first option is the traditional scheme with one common central fan. The second option is a scheme using fan coil units on separate branches of the system. As a result of the calculations, it is shown that the installation of fan coil units will significantly reduce the load on the central fan drive.

Keywords: supply ventilation system; pressure loss; fan coil unit; saving electrical energy; aerodynamic properties of ventilation systems.

NUMERICAL SIMULATION OF AIR DUST FLOW IN A DUST COLLECTING NOZZLE WHEN DRILLING FLAT SURFACES

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Annotation. In the process of drilling wall structures with electric drills, significant dust emissions occur, which negatively affect human health and pollute the surrounding space. Development of compact nozzles-dust collectors that reduce dust emission is urgent. We offer a new design of a dust-collecting nozzle - suction for the localization of dust when drilling flat surfaces with electric drills. To select the

required flow rate of air sucked out of the nozzle and its most rational dimensions, a computer model of the movement of the dust-air flow has been developed, taking into account the influence of the rotation of the drill. We used the software package *SolidWorks*, in the *Flow Simulation* extension where the Navier-Stokes and continuity equations were numerically solved using the $k - \varepsilon$ turbulence model. The dynamics of dust particles was determined by numerically solving the differential equation of their motion with the Henderson drag coefficient. We carried out a number of experimental measurements of the speed of the air flow activated by the rotating drill to check the adequacy and reliability of the model. By processing the obtained experimental and calculated values of the velocity according to static criteria we assessed the reliability, adequacy of the model, reproducibility of experiments and tightness of the connection. As a criterion for the efficiency of dust collection by the nozzle, the value of the maximum diameter of the captured dust particles is used. As well we revealed some regularities of the change in the value of the maximum diameter from the angular speed of rotation of the drill, the change in the radius of the suction hole and its distance from the edge of the nozzle. As a result of numerical simulation, it is shown that not taking into account the air flow created by the rotating drill leads to significant errors, reaching 68%. The developed computer model and the revealed patterns of trapping dust particles can be used to create an effective dust-collecting nozzle.

Keywords: localization of dust emissions; drilling with electric drills; dust particles; computer simulation.

ANALYSIS OF THE DANGER OF EMERGENCY SITUATIONS IN THE CONSTRUCTION AND OPERATION OF GAS BOILER HOUSES

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Annotation. The purpose of the research is to analyze possible emergency situations during depressurization of the gas pipeline adjacent to the boiler room and located in it, as well as to determine the horizontal radius of action of the key damaging factors in case of an accident. As an example, an emergency situation was calculated for a section of a medium-pressure gas pipeline. The values of the maximum overpressure, the pulse of the compression phase of the air pressure waves, and the radii of the affected areas during the explosion of the fuel-air mixture are determined. Recommendations for the prevention of an emergency are given.

Keywords: gas pipeline; accident; jet fire; radius of the affected areas; overpressure.

IMPLEMENTATION OF AQUAPONICS IN ARTIFICIAL POOLS FOR GROWING CARP AND STURGEON FISH

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Annotation. We demonstrated the relevance of the problem associated with the difficulty of fishing and plant growing in an unfavorable climate, limited territories. We described the experience of introducing aquaponics into the scheme of growing sturgeon and carp fish in artificial pools using circulating water, including purification units. In the course of the study we developed an installation, the principle of operation of which can be used as a solution to the problem of growing fish and plants in artificially created conditions. As well we identified and described the nodes of water filtration and its purification. We demonstrated indicators of water that show the operability and efficiency of the installation. We also carried out comparison of indicators of circulating water during experiments with growing carp and sturgeon fish. As well we made a comparison of the efficiency and growth rate of plants in an aquaponic installation using various substrates and water. The advantages of germination of plant seeds with the use of circulating water from the fish-breeding basin in comparison with the use of tap water have been revealed.

Keywords: aquaponics; sturgeon and carp fish farming; fish farming; modern farming methods; plant growing.

CITY. RECONSTRUCTION, RESTORATION AND LANDSCAPING

EVOLUTION OF URBAN DEVELOPMENT TAKING INTO ACCOUNT THE FEATURES OF THE APARTMENT MARKET FORMING

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Annotation. The article analyzes the characteristic risks that arise during the construction and operation of apartments. The object of the research was apartments as a type of demanded real estate and their role in the evolution of urban development. The aim of the study was to study the problems and prospects for the development of the apartment market and the possibility of their successful integration into the life of modern cities. We carried out an analytical review of publications considering main trends in sustainable urban development. We analyzed the experience of developing the Standard for the integrated development of territories prepared by the Ministry of Construction of the Russian Federation. As well we determined the dynamics of the volume of demand and supply of apartments in the primary real estate market of Moscow. We created a diagram of the root cause-effect relationships of the risks of acquiring and managing apartments. Also we compared urban planning, technical, economic and operational characteristics of apartments and apartments by an expert method. We offered some ideas for risk minimization, based on the ranking of these risks. The research results can be applied to improve the legislative framework in the field of urban planning activities.

Keywords: risks; operation; infrastructure; urban planning; taxation; housing and communal services.

ECOLOGY AND SAFETY OF THE URBAN ENVIRONMENT

ASSESSMENT OF THE ROAD NOISE IMPACT ON THE LIVING CONDITIONS IN URBAN AREAS

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Annotation. In modern cities there is a steady growth of road transport, which serves as a condition for formation of the acoustic discomfort that leads to the emergence of some environmentally caused diseases. The article describes the methodology of field experiments for measuring noise level in an urban environment under various conditions. The level of motor vehicle noise was assessed depending on the distance between the first traffic lane and residential buildings. The influence of noise on the living environment conditions in residential premises with open and closed windows, as well as in the mode of ventilation both in the day and evening time. As well we established the experimental dependence of the equivalent level of motor vehicle noise on the number of floors of residential buildings.

Keywords: motor vehicle noise; acoustic discomfort; increased noise load; equivalent noise level; monitoring control point; first traffic lane.

ROAD TRANSPORT, AGRICULTURE AND CONSTRUCTION MACHINES

EVALUATION OF TECHNOLOGICAL PARAMETERS OF ASPHALT CONCRETE MIXTURES FOR THE STREET-ROAD NETWORK IN URBAN AGGROMERATIONS USING ADDITIVES OF POLYETHYLENE WITH LOW MOLECULAR WEIGHT

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Annotation. We obtained the values of the dynamic viscosity of bitumen binder with additives of polyethylene with low molecular weight in the temperature range of 60...160 °C. When polymer additives are introduced into road bitumen, the viscosity of bitumen increases. The highest values of dynamic viscosity are observed for the polymer additive Viskodor – PV1, this is clearly pronounced at the consumption of 4 % of the additive based on the mass of bitumen and at temperatures below 130 °C. The additive of unoxidized low molecular weight polyethylene Honeyvell Titan 7205 increases the viscosity to a greater extent than the additive of oxidized polyethylene Honeyvell Titan 7686. We determined as well the permissible technological temperatures of asphalt concrete mixtures with polymer additives at the stages of structure formation of asphalt concrete.

Keywords: additives of polyethylene with low molecular weight; thermo-plastic elastomers (TPE); additives for warm asphalt concrete; permissible technological temperatures of asphalt concrete mixtures; dynamic viscosity of bituminous binder.

ECONOMICS AND ORGANIZATION OF CONSTRUCTION

COMPETITIVENESS ASSESSMENT OF THE SOLAR SYSTEM OF A HOTEL IN THE VORONEZH REGION

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Annotation. The issue of energy supply of buildings and structures in areas with poorly developed engineering infrastructure and decentralized systems can be partially solved by the use of solar heat supply systems (or hot water supply). Such systems (reliable, safe, simple and low-cost in operation) reduce the consumption of traditional energy resources and the emission of harmful emissions into the atmosphere. The possibility of mass implementation of solar plants was largely constrained by cost indicators that determined the payback period. The annual rise in prices for traditional organic fuels, the ability to manufacture solar collectors with their own strength and means can increase their attractiveness. The work assessed the profitability of the solar hot water supply system of a hotel, located in the village of Babyakovo, Voronezh Region, for two time periods (2005 and 2021), taking into account the increase in the cost of electricity, which is the main traditional energy source. The solar collectors were produced in-house. The introduction of a solar plant for the needs of hot water supply in the traditional heating system of the hotel can reduce electric energy consumption by 44 %. The paper shows that the increase in the price of electricity for the period from 2005 to 2021 did not compensate for the increase in the cost of materials for the manufacture of solar collectors. At the same time, the payback period for 2005 was 6,0 years, for 2021 was equal to 13,1 years. Efficient operation of the plants covers a period of 6,9 years. The installation of Russian and foreign manufacturers in terms of costs occupies an average position. With the cost of electricity at the level of the European market (2021) the payback period is 1,4 years.

Keywords: solar plants; solar collectors; competitiveness; payback period.

TECHNICAL AND ECONOMIC RATIONALE OF A GAS-PISTON USE IN A MEDIUM-CAPACITY BOILER HOUSE

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Annotation. The problem of reducing cost of electricity consumption by the equipment of the central boiler house of medium capacity is considered. A promising direction in solving this problem is the use of an alternative source of electricity in

the form of a gas-piston installation. Heat generating plants for district heating were designed taking into account the minimum electricity consumption and achieving reliability. We carried out the analysis of electricity consumption by the boiler house equipment with an installed capacity of 4.7 MW. The technical characteristics of the gas-piston plant selected as a new source of electricity were determined. As well we carried out technical and economic calculations of the cost of producing own electricity for the boiler house. The use of its own power source allows one to reduce the cost of electricity in comparison with the purchase from the central power grid. It is concluded that the use of its own alternative source of electricity for the boiler house is a profitable investment to reduce the financial burden on the heat supply organization and to reduce the cost of the heat energy tariff.

Keywords: alternative source; gas-piston power plant; cost of electricity; technical and economic rationale; heat supply; boiler houses.

HIGHWAY IMPACT STUDY OF THE EFFICIENCY OF COATING AND BASE COMPACTION WITH THREE-ROLLER TANDEM COMPACTORS

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Annotation. We present a highway impact study for increasing efficiency of compaction of coatings and bases through the use of three-roller tandem compactors. Calculations have been performed showing the possibility of a sequential increase in the vertical loading of the rollers of a compactor as the strength of the compacted surface increases over a wide range (up to 1.1 of the weight of a serial compactor) due to the use of an additional controlled section. The possibility of reducing the number of passes of the compactor by increasing the number of its rollers has been established. A technical and economic calculation was carried out confirming the feasibility of using such road compactors made on the basis of serial two-roller tandem compactors, which is due to an increase in productivity by 1,27...1,5 times.
Keywords: highway impact study; road bases and pavements; compaction; road compactors.