BUILDING CONSTRUCTION, BUILDINGS AND STRUCTURES

METHODS FOR ASSESSING THE MECHANICAL SAFETY OF LOAD-CARRYING BUILDING STRUCTURES

G. D. Shmelev, Y. A. Vorobieva, E. V. Sazonov

Annotation. The article considers the authors' approach to assessing the mechanical safety of building structures, which is based on the requirements and instructions of current legislation and regulatory and technical literature. Based on the analysis of the current standards, we assessed the main boundary values of technical, individual and social risk. We as well established their compliance with the categories of technical condition of building structures, based on the requirements for mechanical safety established in Article 7 of the Federal Law of December 30, 2009, No. 384-FZ *Technical Regulations on the safety of buildings and structures*. For each level of mechanical safety requirements stipulated in the *Technical Regulations on the Safety of Buildings and Structures*, we analyzed the fulfillment of these requirements and measures for their implementation, including the implementation of appropriate verification calculations. Based on the system of current state standards and our previously published works, we propose a methodology for calculating the risk of collapse of building structures. The methodology is needed to qualitatively assess the mechanical safety of a building or structure, taking into account the actual damage to the structure, as well as the individual and social risk of an accident at the facility. On the basis of the requirements set out in Article 7 of the Federal Law of December 30, 2009, No. 384-FZ *Technical Regulations on the Safety of Buildings and structures*, we proposed to carry out quantitative calculations and justification of the mechanical safety of operated buildings and structures for each level of mechanical safety requirements.

Keywords: mechanical safety; unacceptable risk; structures; categories of technical condition; risk assessment.

MONITORING TECHNICAL CONDITION OF THE STRUCTURE AND FOUNDATION OF THE BUILDING UNDER CONSTRUCTION

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Annotation. First of all, we substantiate the importance of monitoring the technical condition of a structure and foundation during construction. We assessed the foundation performance using various methods, with the feasibility of further work being identified. We conducted comprehensive in-kind studies of the technical condition of pile foundations using the example of a sports and fitness complex with a swimming pool in the town of Borisoglebsk, Voronezh Region.

We identified survey errors, their causes and remedial measures. We determined the actual ranges of pile geometric characteristics – length, based on ultrasonic (seismic) wave testing, median pile length and design length of the tested piles. Minimum pile length for driving to the design elevation was compared with the conditions and requirements of regulatory documentation. We determined that testing the bearing capacity of existing piles is impractical due to their non-compliance with regulatory requirements for the minimum pile penetration depth into the load-bearing (non-subsidence) soil layer. We assessed technical condition of the pile foundation for the study site, characterizing it as unsafe; further construction of the building on the existing pile foundation is not permitted. We made a recommendation to construct a duplicate pile field, setting it back from the existing piles by a distance that ensures the minimum regulatory requirements for the distances between piles, taking into account the technical capabilities of the contractor and the conditions of the adjoining structure to the existing building. We confirmed the possibility of increasing the information content and reliability of conclusions on the condition of pile structures based on a comprehensive survey using seismic acoustics.

Keywords: pile foundation; survey; acoustic diagnostic method; technical condition of the structure.

ENGINEERING SYSTEMS AND SERVICES

COMPARATIVE ANALYSIS OF METHODS OF AERODYNAMIC CONNECTION IN VENTILATION SYSTEMS

B. P. Novoseltsev, T. V. Shchukina, D. V. Lobanov

Annotation. The adjustment and testing of ventilation systems are quite labor-intensive production processes, so in the absence of highly professional skills, there is a possibility of poor-quality performance of work. To achieve the transportation of design air flows through sections of networks, reducing the additional costs of installing control valves, it is possible to use various technical solutions that exclude the influence of the level of training of installers. The article discusses three methods: the use of ducts with non-standard diameters if necessary; the compilation of branches with a constant air flow from sections with different cross-sectional areas; the installation of confusers to increase pressure losses. We as well describe the results of aerodynamic calculation for each of the three methods, and their effectiveness in achieving the coordination of pressure losses along the branches. In conclusion we formulated some recommendations on the scope of application of the considered methods of aerodynamic coordination.

Keywords: ventilation system; air flow rate; regulation; aerodynamic coordination.

STATE AND PROSPECTS OF HEAT SUPPLY SYSTEM MODERNIZATION IN THE CITY OF BIYSK

A. V. Rukoleev

Annotation. The presented article examines the current state and dynamics of the development of the heat supply system in the city of Biysk based on data from three heating seasons (2022…2025). The main focus is on analyzing the operational parameters of the heat supply system, including the outdoor temperature, the temperature of the supply and return heat carriers, the average hourly flow rate of the heat carrier, as well as the statistics of accidents and defect repair. This analysis has revealed the specific features of the heat supply system's functioning depending on the climatic conditions of each season. The results of the study show that the temperature schedules are generally maintained, and the difference between the supply and return temperatures remains within 15…20 °C, indicating the stability of the hydraulic and thermal processes. However, during the 2024…2025 heating season, there was an increase in the supply temperature, which can be attributed to harsher weather conditions and increased thermal loads. The analysis of the heat carrier flow confirms this trend: the highest flow values are observed during the coldest months of the last season. An important aspect of the study was the assessment of accidents: there was an increase in the number of incidents from 235 in the 2022…2023 season to 312 in the 2024…2025 season. Despite the regulatory deadlines for accident response, the increase in damage indicates the need for network modernization. We have formulated some recommendations for optimizing temperature schedules, implementing weather-dependent regulation, developing automated monitoring systems, and improving the efficiency of repair measures. The obtained results can be used for planning measures to modernize and develop the city's heating network.

Keywords: heat supply; modernization; energy efficiency; costs; temperature; wear and tear; heating season.

SIMULATION OF THE AIR TEMPERATURE DISTRIBUTION IN A ROOM WITH DISPLACEMENT VENTILATION

D. V. Lobanov, T. V. Shchukina, I. I. Zvenigorodsky, S. A. Safonov

Annotation. In the article we consider a number of designs of low-speed air distributors with different types of generated air flows. We present the results of modeling air distribution using the ProAirWeb program from Swegon for a conference room equipped with forced ventilation. It has been established that the temperature regime of the indoor air in different areas of the room is identical and does not depend on the types of similar supply air devices, all other things being equal. We show the differences in the formation of air jets in the volume of the

room, which is mainly due to the design features and location of the air distributors. We as well consider the change of the thermal regime depending on the temperature gradient at the same height of the room. Also, we demonstrate graphical dependencies and determine the parameters of the supply air temperature in the lower and upper zones of the room, ensuring the set temperature of the indoor air.

Keywords: displacing ventilation; air distribution; air exchange; thermal conditions of the room; modeling; efficiency of assimilation of heat surpluses.

EVALUATION OF WEAR AND TEAR OF PROCESS PIPELINES AND COMPRESSOR STATION STRUCTURES UNDER THE INFLUENCE OF VIBRATIONS AND VERTICAL DISPLACEMENTS

N. A. Ponyavina, V. P. Matushkin

Annotation. Modern monitoring methods, including comprehensive diagnostics and integrated data analysis, play a key role in maintaining the performance of compressor stations and trunk pipelines. These technologies make it possible to detect potentially dangerous changes in equipment operation in a timely manner, prevent sudden failures and significantly reduce the risk of emergencies. Here we present the results of measurements of vibration characteristics of pipelines that pipe gas through pumping units. In the article special attention is paid to the analysis of the impact of external factors on the structural integrity of pipeline units, in particular, the piping of gas through the pumping units and purification one.

Keywords: vibrodiagnostics; technological pipeline; vertical displacements; altitude position; vibration velocity.

DEVELOPMENT OF A DESIGN CONCEPT FOR ALTERNATIVE SOLAR ENERGY SUPPLY SYSTEMS FOR INDUSTRIAL BUILDINGS WITH CLEAN ROOMS

I. S. Kurasov, T. V. Shchukina, K. A. Ivankin

Annotation. The authors of the article consider the possibility of using solar energy for industrial buildings consisting of clean laboratory rooms with external fences consisting of double walls with an air layer. We give a schematic solution of a vertical solar collector located in the outer wall layer. We consider the design features of energy-efficient external fences with integrated solar collectors, the heat from which can be directed both to the heat supply of the facility and to the generation of cold in absorption machines. We present the results of calculations

performed using the example of a bio-factory in the Stavropol Territory in the form of graphs illustrating the estimated heating capacity. We assessed the reduction in the consumption of traditional resources when integrated solar wall collectors were installed on the southern and western facades of the building.

Keywords: solar energy; external fences; integrated solar collector; energy saving.

MANAGEMENT APPROACH TO MATHEMATICAL MODELING OF UNDERGROUND WATER INTAKE

I. Yu. Purusova

Annotation. As the management practice shows, groundwater water intakes do not fully meet the requirements of regulatory and technical documents for housing and communal services systems. The distribution of water flows is described by a system of linear equations as part of a mathematical model for managing the operation of existing water intakes, which establish a balance between water inflow and flow rate at each node for given operating conditions. The proposed equations allow for individual consideration of the parameters of each system element: water intake well – submersible pump – prefabricated water pipeline – drinking water reservoir, which are directly dependent on the measurement results and determine the system's state based on the pump operation mode. The results of constructing a mathematical model allowed me to determine the conditions for a managerial approach to mathematical modeling of groundwater intake.

Keywords: groundwater intakes; mathematical modeling; water consumption; pressure.

ANALYSIS OF THE REASONS FOR THE FAILURE OF PUMPING EQUIPMENT DURING OPEN DRAINAGE TAKING INTO ACCOUNT ITS PIPING SYSTEM

V. V. Pomogaeva, S. V. Grigoriev

Annotation. The problem of rapid failure of pumping equipment is considered using the example of an open drainage of a coal-flooded quarry. The hypothesis of incorrect selection of the pump and its piping is considered as an alleged reason. In the article we describe the principle of operation of the pump-pipeline system. We show the operating principle of the *pump-pipeline* system. We also analyzed and calculated the main characteristics of pumping equipment. We as well analyzed the decisions made on strapping the pump and carried out a hydraulic verification calculation. It is shown that the calculations performed for

the selection of pumps do not take into account all hydraulic patterns. We justified the calculation for changing the diameters of pipelines, which will help improve the operation of pumps during open drainage. In conclusion we formulate several proposals for the correct selection of design parameters of pumping equipment, which will help eliminate failures and prevent premature failure.

Keywords: pumping equipment; strapping pumps; hydraulic calculation; drainage waters; open drainage.

URBAN PLANNING. RECONSTRUCTION, RESTORATION AND LANDSCAPING

COMPREHENSIVE ASSESSMENT OF THE ROSTOV REGION FOR THE FORMATION OF SUPPORTIVE SETTLEMENTS

D. S. Vyshlova, A. A. Fedorovskaya

Annotation. The article considers the methodology of complex assessment for territories using the Rostov Region as an example. We determined some factors of relative value of settlements for their subsequent assignment of the status of supporting ones. We as well consider the main issues that need addressing during the revival of small settlements. Here we show the tables with the distribution of points for the following factors: population size, transport provision conditions, road network condition and provision with roads, engineering arrangement of the territory, engineering and geological conditions of the territory. Also we formed maps of different factors that influence relative value of the Rostov Region territory. It is shown that the choice of best possible settlements as "supportive" ones should be based not only on the analysis of the current state of the territory, but also taking into account possible changes.

Keywords: supportive settlement; comprehensive assessment of the territory; municipal district.

ECOLOGY AND SAFETY OF THE URBAN ENVIRONMENT

ANALYSIS OF THE RESULTS OF THE TESTING OF A UNIFIED METHODOLOGY FOR A COMPREHENSIVE ASSESSMENT OF THE QUALITY OF SOURCES OF DECENTRALIZED DRINKING WATER USE IN A LARGE AGRO-INDUSTRIAL REGION

S. A. Kurolap, O. V. Klepikov, T. I. Prozhorina, P. A. Sukhanov

Annotation. The research is aimed at the creation and practical implementation of a standardized methodology for a comprehensive geoecological

assessment of the state of sources of decentralized economic and drinking water use. The Voronezh Region was chosen as the key region for testing, characterized by dense population (2.285 million people) and the predominance of the industrial and agricultural sector of the economy. The developed research algorithm is based on the integration of modern scientific approaches aimed at collecting, systematizing, analyzing and then visualizing data characterizing the quality of drinking water. Probabilistic and statistical analysis of environmental and hydrogeological data is used as methodological tools, supplemented by geoinformation modeling methods to establish patterns of spatial distribution of pollutants, as well as a procedure for assessing environmental risks affecting public health. As part of field research (January 2024…June 2025), 302 water samples were taken and analyzed from various sources: wells (113 samples); wells (53 samples); water collection columns (31 samples); springs (105 samples). Laboratory tests revealed significant excess of sanitary and hygienic standards for the following indicators: nitrates (30.29 % of samples); hardness salts (28.37 %); ammonium nitrogen (12.5 %); iron (5.8 %).

Keywords: decentralized water supply; drinking water quality; environmental risks; groundwater pollution; sanitary and hygienic standards; Voronezh region; hydrochemical analysis.

ASSESSMENT OF TRENDS IN THE CHANGE OF THE THERMAL CLIMATE REGIME OF THE CITY OF VORONEZH

L. M. Akimov, E. L. Akimov

Annotation. The purpose of the study is to conduct a comprehensive assessment of the thermal regime of the climatic seasons of the city of Voronezh against the background of global temperature rise. The research materials and methods are based on the analysis of daily observation data from stationary atmospheric observation posts in the city of Voronezh. Graphoanalytical and probabilistic methods of analysis were used to assess the relationship between the meteorological parameters of the atmosphere and the comfort of the environment. The results of the study were the establishment of temporal patterns of the distribution of the thermal regime in different seasons of the year. We determined its main characteristics and revealed the dynamics and the nature of the direction of changes.

Keywords: temperature distribution; climate; thermal regime; weather; season.