

BUILDING CONSTRUCTION, BUILDINGS AND STRUCTURES

A METHOD FOR PREDICTING REMAINING SERVICE LIFE ACCORDING TO THE PROBABLE DECREASE IN THE BEARING CAPACITY OF THE OPERATED BUILDING STRUCTURES

G. D. Shmelev, A. N. Ishkov, D. A. Drapalyuk

Annotation. In this article we consider the issue of predicting changes in the load-bearing capacity of building structures of buildings and structures located in operating conditions for a long period of time that affect the reduction of the load-bearing capacity of the studied building structures. Referring to the previously published works and methods studied in them for making predictions of changes in various parameters of the technical condition of building structures, we offer to use another parameter – a probable decrease in load-bearing capacity, based on previously published works of other authors. To make a prediction, linear and nonlinear models of the development of changes in the load-bearing capacity of the structure were used; certain assumptions were made that significantly simplify the prediction process. Based on the offered models, we considered examples of constructing predictive models, including those to use a graphical method that provides visibility of the predicting process. The authors of the article have developed a diagram of the procedure for assessing the residual service life of building structures based on the most likely change in load-bearing capacity using linear and nonlinear predicting models. When making predictions, the authors used an interval method, taking into account all possible boundary conditions of operation of structures and changes in controlled parameters of structures.

Keywords: prediction; residual service life; bearing capacity; building structures; operation; technical condition; building and structure.

ANALYSIS OF MODERN MEANS OF FIRE PROTECTION APPLICATION OF STEEL STRUCTURES IN THE OIL AND GAS COMPLEX IN THE ARCTIC CLIMATIC CONDITIONS

E. V. Golovina, A. V. Kalach, E. V. Kalach, A. Yu. Akulov

Annotation. In this article we present an overview of fire protection means in relation to oil and gas industry facilities in the Arctic climate. We consider features of the climatic conditions in the Arctic regions and criteria for determining type and method of fire protection. We analyze existing fire retardants and make a conclusion about the priority of using intumescent fire protection coatings for oil and gas facilities. We evaluated thermally expanding materials of domestic and foreign manufacturers. Based on the analysis, we concluded that intumescent flame retardants based on epoxy resins are the most effective for fire protection of metal structures of the oil and gas complex in the Arctic climatic conditions.

Keywords: structural fire protection; intumescent fire protection composition; fire resistance limit; hydrocarbon burning; open industrial atmosphere.

PREDICTION OF THE ACCIDENT RISK IN LOAD-BEARING STRUCTURES BASED ON THE CALCULATION OF THE LOAD-BEARING CAPACITY REDUCTION

M. I. Fedotova, G. D. Shmelev

Annotation. In the article we consider the issue of making a risk prediction for a collapse in structures based on monitoring change in the bearing capacity of buildings and structures that have been under operating conditions for a long period of time. These conditions decrease the bearing capacity of the studied structures. We studied the possibility of calculating the risk of an accident associated with the probability of a collapse due to a decrease in bearing capacity. Based on the previously published works of the authors and the methods outlined in them for making predictions for changes in the bearing capacity of structures, it is proposed to use the prediction of a decrease in bearing capacity to assess the risk of an accident caused by the collapse of a damaged structure. When assessing the risk of an accident of a damaged structure, we used the methodology described in GOST 31937-2011 *Buildings and structures. Rules for the inspection and monitoring of the technical condition*. We used non-linear models of the development of changes in the strength of individual design sections of bending structures to predict the change in the bearing capacity: normal section in the moment, inclined section in terms of transverse force, concrete strength along an inclined strip between inclined cracks.

Keywords: prediction; accident risk; bearing capacity; structures, design sections; operation; building and structure.

ENGINEERING SYSTEMS AND COMMUNICATIONS

CLARIFICATION OF HEAT AND GAS EMISSIONS FROM CHILDREN IN THE DESIGN OF MICROCLIMATE SYSTEMS

D. V. Lobanov, M. S. Kononova, Yu. A. Vorob'eva, A. A. Mershchiev

Annotation. In this article we substantiate the relevance of taking into account a set of physical parameters and physiological characteristics of children in determining the energy expenditure and associated carbon dioxide emissions in various types of activity. These data are required for determining the amount of heat inputs and gas emissions when designing ventilation systems in the rooms of preschool and secondary educational organizations and other buildings where children of different ages. We evaluated the anthropometric indicators of children and their influence on the amount of harmful emissions with division into age groups, taking into account

gender and the degree of the workload. As well we give graphs illustrating dependence of the studied parameters on the age of children. Finally we calculated the specified values of heat and gas emissions from children, which are recommended to take into account when designing microclimate systems.

Keywords: heat emissions; carbon dioxide emissions; mental work; physical activity; ventilation of preschools institutions; ventilation of secondary educational institutions.

APPROBATION OF THE ADAPTIVE VENTILATION SYSTEM IN SPACIOUS PREMISES

V. V. Shichkin, M. N. Zherlykina, K. V. Garmonov, S. A. Solovyov

Annotation. We analyzed the relevance of construction of multifunctional public buildings with spacious premises. We describe the adaptive ventilation system and the distinctive features of its functioning. Using the example of a real multi-purpose concert hall in the city of Voronezh, we designed a ventilation system for multi-zone general exchange air ventilation with blocking air conditioners for interchangeability. We determined the cost of the ventilation equipment for the adaptive ventilation system. We compared the adaptive and traditional ventilation systems technically and economically. As well, we described operating modes and the electricity costs for their implementation in the summer period. Based on the maximum levels of unregulated prices for electricity, we determined the electricity costs in the summer months of 2019...2021. We noticed electricity savings during the operation of the new system, which amounted to up to 50 % during the operation of the adaptive ventilation system compared to traditional systems at outdoor temperatures of above 35 °C. With normalized outdoor air parameters, energy savings rose to more than 15 % when using the new system.

Keywords: ventilation system; adaptive ventilation; recuperation; spacious premises; multi-purpose premises; equipment; air temperature.

THE SPREAD OF HEAT FLOW IN THE THICKNESS OF THE ENCLOSING STRUCTURE MADE OF SOLID WOOD

A. A. Mershchiev, R. A. Sheps, M. S. Kononova, S. A. Yaremenko

Annotation. I consider a variant of the mathematical model of heat transfer in a wooden enclosure of a building. I give the parameters on which the heat transfer depends. As well I consider a variant of a three-dimensional task based on the combination of solution of a two-dimensional dependence and homogeneity equation. When solving the problem I obtained the temperature spread in a flat homogeneous panel and the dependence of the heat flow density on the temperature spot as a function of the coordinate along the cold surface of the panel. The obtained results allow

us to ignore certain parameters when carrying out engineering and technical calculations of enclosing wooden structures.

Keywords: heat transfer; thermal conductivity; heat flow; thermal physics; energy efficiency.

IMPLEMENTATION OF THE CALCULATION PROGRAM TO OPTIMIZE HEAT NETWORKS ROUTING

E. A. Kopytina, N. A. Petrikeva, D. M. Chudinov

Annotation. For optimal tracing of heat networks during reconstruction and new construction, various methods and main optimization criteria are offered. It is possible to significantly reduce labor-intensive calculations at the design stage through the use of various software and computer systems. We consider the interface of the calculation program for optimizing the route of heating networks. The program is designed to select an option or options for routing a heat network using expert assessments and partial optimization. The program has the following functionality: selection of the method for heat network routing option; choice of optimization criteria; input of initial data; input of heat transfer thermal resistance for each pipe diameter; choice of end consumer temperatures; viewing selected calculated optimization criteria for each scheme; performing comparison of schemes according to the aggregated values of the optimization criteria with the selected partial optimization; performing comparison of schemes according to the aggregated values of the optimization criteria after entering the weights of the criteria with the selected method of expert assessments; constructing a radar diagram. The implementation of the software part of the work was carried out in the high-level free object-oriented programming language Python.

Keywords: heat networks; routing; optimization; method of expert assessments; application program.

STUDY OF SOME CHEMICAL AND MICROBIOLOGICAL CHARACTERISTICS OF WATER SPRINGS IN THE VORONEZH REGION

A. G. Baskakova, E. Yu. Ivanova

Annotation. We present the results of laboratory studies of samples of natural water from springs in the Voronezh region. The study is based on field measurements in autumn 2021. The article presents the results of laboratory studies based on data on pollution of springs in the Voronezh region with various pollutants. We applied methods of chemical and microbiological analysis of water quality, including the determination of general hardness, mineralization, total iron and nitrates, as well as microbial count and coli index. The main chemical pollutant of drinking water is nitrates. Most of the samples in the study on the content of E. coli (*Escherichia Coli*)

are classified as highly contaminated. We established an excess of the total microbial number in most samples according to the standards for surface non-potable waters. We identified the most polluted springs, as well as the connection with anthropogenic sources of pollution. The study showed that 80% of springs do not meet microbial safety requirements.

Keywords: natural water quality; microbiological indicators; springs; Escherichia Coli.

CITY. RECONSTRUCTION, RESTORATION AND LANDSCAPING

FUNCTIONAL ZONING OF THE CITY PHYSICAL BOUNDARIES BASED ON REMOTE SENSING MATERIALS

B. A. Popov, N. B. Khakhulina, N. A. Drapalyuk

Annotation. The article considers an integrated approach to the analysis and assessment of urban territory from the point of view of functional zoning of cities using remote sensing methods. We defined the principles of monitoring urban areas and outlined the tasks that need to be solved to collect complex remote information about urban areas. As well we have identified the most promising methods of collecting complex information about the urban environment. We give some examples of the results of data collection by modern remote sensing methods. The advantages of using the presented technologies for complex analysis and assessment of built-up areas are outlined. Also we have been made some proposals to develop a methodology for integrated zoning of urban areas based on joint ground and remote sensing materials. We listed the conditions that need to be provided for the effective use of complex information obtained using remote sensing tools. Finally we substantiated the necessity of an integrated approach to the collection and analysis of information when making a number of urban management and urban planning decisions.

Keywords: urban environment; functional zoning; remote sensing; space survey systems; infrared shooting; laser scanning; georadar shooting.

ECOLOGY AND SAFETY OF THE URBAN ENVIRONMENT

JUSTIFICATION OF MEASURES TO IMPROVE ENVIRONMENTAL SAFETY OF CITY GAS STATIONS

K. V. Garmonov, M. N. Zherlykina, A. R. Makarov, A. S. Zherlitsina

Annotation. In the article, we substantiate the relevance of the study of the gas stations influence on the environment in urban development. We analyzed the normative literature regulating gas stations construction and operation as well as ensuring environmental safety during the emission of harmful substances. Based on theoretical, experimental and numerical studies, we offer a methodology for assessing

environmental safety of urban gas stations. This methodology is based on a multi-criteria analysis of factors affecting the harmful substances spread from all sources of atmospheric pollution located on the territory of the gas station, taking into account the adjacent urban development. We developed several measures to improve the environmental safety. The measures are divided into some groups: structural and technical, organizational and legal, and urban planning. We calculated the implementation of the measures. We analyzed the annual payment for the negative impact on the environment from the gas stations. We economically assessed the environmental safety provision and justified the need of applying measures for reducing the level of negative impact of gas stations emissions.

Keywords: environmental safety; gas stations; environment; harmful substances; wind flows.

ECONOMICS AND ORGANIZATION OF CONSTRUCTION

IMPROVING ENERGY EFFICIENCY OF APARTMENT BUILDINGS DURING MAJOR REPAIRS

S. A. Yaremenko, R. A. Sheps, S. S. Sokhranov, E. V. Silina

Annotation. In this article we consider the main problems associated with the introduction of energy efficient technologies during major repairs of apartment buildings. We analyze reasons of the request of the apartment buildings owners to improve energy efficiency. As well we describe the main problems faced by the owners at the stage of major repairs and offer possible solutions. The conclusions are based on the results of a survey conducted by the National Center for Public Control in the Housing and Utilities Sector *Zh K KH Control* in February 2022. We also took into account the studies of industry experts who took part in the implementation of projects to improve the energy efficiency of apartment buildings as part of the major repairs of common property in the regions of Russia during 2019...2022. Finally we offer some measures to improve the regulatory and legislative framework governing the major repairs.

Keywords: major repairs; housing and communal services; energy efficiency.

RESEARCH OF THE PARTICIPATION RISKS IN INNOVATIVE ECOSYSTEMS

I. I. Pereslavytseva

Annotation. I conducted a study of the risks arising from the participation of companies in innovative ecosystems. I considered the categories of the concept of risk worked out by domestic scientists. As well I analyzed the studies considering additional risks when creating joint innovation environment. The main identified risk groups of collaborative participation in the innovation ecosystem are: risks of

interdependence, risks of integration, initiative risks, risks of opportunistic behavior, as well as risks of power imbalance. I offered a three-layer model of risks of collaborative participation in the digital ecosystem arising from joint cooperation. I also considered features of participation in innovation ecosystems of large and small companies. I made the conclusion about the need to use network forms of business organization to increase the presence of companies in the markets in the context of global competition.

Keywords: innovation; ecosystem; risk; innovation activity; digital economy; innovation environment.