BUILDING CONSTRUCTION, BUILDINGS AND STRUCTURES

CALCULATION OF THE RESIDUAL LIFE OF REINFORCED CONCRETE STRUCTURES IN THE REACTOR SHAFT OF THE NPP POWER UNIT

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

Annotation. The article considers the author's approach to forecasting and calculations of the residual life of the reinforced concrete shaft of the PWR-type reactor of the 3rd power unit of the Kola NPP. The calculation method takes into account the radiation and temperature effects on the reactor concrete and on changes in the strength of it over time. As well as we consider possible accidents on design and beyond design basis. The effect of radiation exposure on the concrete of the reactor shaft is taken into account due to the neutron fluence, which is regularly monitored at the station. Based on the results of neutron fluence control, we made a forecast of neutron accumulation in the concrete of the reactor shaft and estimated the effect of neutron fluence on the concrete of the reactor shaft. Based on the data of the guidance documentation and reference literature, we developed a method for taking into account the most probable development of the aging (degradation) process of concrete in the reactor shaft. Based on the constructed predictive models, we made a forecast of the time for the reduction in the strength of concrete in the reactor shaft below the initial design values. Based on the design documentation for the reactor shaft, the most probable causes that could lead to an emergency situation with the reactor were determined. We also defined the most critical sections of the supporting structures, their dimensions, and the features of transferring the load to the concrete of the reactor shaft. We performed the corresponding verification calculations of the bearing capacity of reactor shaft concrete, taking into account the design reinforcement, in terms of the collapse resistance under the reactor support ring. On the basis of the results of the performed verification calculations, we predicted the residual life of the reactor shaft concrete, taking into account radiation exposure, as well as temperature effects during accidents of design and beyond design basis.

Keywords: method of calculation and forecasting; residual life; reactor shaft; radiation and temperature effects; concrete strength; collapse calculation.

SYNCHRONOUS THERMAL ANALYSIS OF SILICONE AND EPOXY THIN-LAYER INTUMESCENT FIRE-RETARDANT MATERIALS

E. V. Golovina, A. V. Kalach, E. V. Kalach

Annotation. The article discusses aspects of the application of the method of thermal analysis for the study of the heat resistance of fire-retardant intumescent materials for possible use at industrial facilities located in the Arctic region. We

substantiated the relevance of the use of fire protection equipment at oil and gas industry facilities located in the Arctic regions. We present the results of synchronous thermal analysis of silicone and epoxy fire retardant thin-layer thermal intumescent compositions. We evaluated the results of thermogravimetric, differential-thermogravimetric analysis and differential-scanning calorimetry. We investigated the thermoanalytical characteristics of the analyzed fire-retardant materials, allowing us to assess the heat resistance and flammability. Based on studies by thermal analysis, we made a conclusion about the higher fire-retardant properties of the fire-retardant material based on an epoxy binder compared with a silicone fire retardant.

Keywords: thermally intumescent fire retardants; synchronous thermal analysis; thermoanalytical characteristics; thermal resistance; flammability.

METAL INTENSITY OF STEEL TRUSSES WITH RODS OF VARIABLE CROSS-SECTION

S. S. Samakalev

Annotation. Reducing the metal intensity of the trusses of roofs in buildings and structures leads to cheaper manufacturing of structures, lower construction costs, simplification and facilitation of loading and unloading and installation work. Reduction the metal intensity of the trusses remains an urgent task. The article considers the possibility of replacing compressed truss rods with rods with a cross section variable in their length, provided they retain their bearing capacity. We used an approximate method for determining the critical force for a compressed rod of variable cross-section, to be able to analyze diverse variants of the geometry of a rod of variable cross-section and the effect of geometry on reduction of metal intensity. As a result, we obtained simple formulas and ratios of the geometric characteristics of the rod, allowing us to determine the geometric parameters of such a rod and its metal intensity. Based on the formulas obtained, we found the geometric parameters of rods of variable cross-section for two different structures. The first option is a rod made up of paired corners and having an insert of a flat sheet in the central part. The second option is a rod made of a bent-welded profile and reinforced in the central part with plates made of sheet steel. We established the correspondence between the rods of variable and constant cross-section for their possible replacement. Finally, we present the results of calculating the reduction of the metal capacity of the rods.

Keywords: metal trusses; stability of rods of variable cross-section; metal intensity; bearing capacity of steel trusses.

ENGINEERING SYSTEMS AND COMMUNICATIONS

JUSTIFICATION OF THE OPTIMAL ARRANGEMENT OF THE ECONOMIZER IN ACCORDANCE WITH TECHNICAL CRITERIA

D. N. Kitaev, S. G. Tulskaya

Annotation. Economizer is used to heat feed or network water, when used as an energy-saving measure in boiler rooms of the housing and communal sector and industry. The article deals with the issue of designing the optimal arrangement of the economizer according to the criterion of the minimum value of the design discrepancy, permissible value of the flue gas velocity, minimum number of blowers and possibility of placement in a boiler room with a minimum reconstruction of the gas path. We show that the accepted assumptions on the design discrepancy do not provide the optimal solution. One needs to find the optimal value for all possible options for the arrangement and assortment of the economizer pipes.

Keywords: boiler room; energy saving; economizer; feed water; arrangement; optimization.

FEATURES OF THE HEAT AND HUMIDITY CONDITIONS OF ATTIC ROOMS OF KINDERGARTENS WITH PITCHED ROOFS

D. A. Drapalyuk, N. A. Drapalyuk, A. V. Isanova, M. S. Kononova

Annotation. We consider the issue of the emergence of serious defects in the buildings of preschool educational institutions operating for less than five years from the date of construction. According to the data of field surveys, we performed an analysis of defects with a similar nature of occurrence. We considered the issues of the organization of attic rooms on typical facilities, the heat and humidity conditions of attic rooms and the influence of temperatures and relative humidity on condensation on various surfaces and layers of the attic rooms. We used for our analysis the dependences of changes in the partial pressure of water vapor and the partial pressure of saturated steam in the plane of the attic rooms. So we determined the temperature and relative humidity intervals characteristic of the construction area under consideration, at which condensation appears on the surface of the waterproofing film in the roof structure.

Keywords: heat and humidity conditions; attic rooms; condensation plane; relative humidity; saturated steam pressure; partial pressure.

IMPROVING THE DESIGN OF LOCAL SUCTION IN THE EXHAUST VENTILATION SYSTEMS OF THE GALVANIC SHOP

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Annotation. The relevance of improving the design of devices for removal of harmful substances in local exhaust ventilation systems is substantiated. There systems are designed to create standardized parameters of the air environment in the local volume of the working area of the production facility by removing polluted air

directly from the source of harmful substances (technological equipment). The construction is designed to ensure the concentration of polluting harmful substances at low flow rates of sucked (removed) air at a level permitted by the norms. At the same time the suction unit operation is interconnected with the technological process execution in such a way as to minimize pollutant emission into the room at different stages of its performance. The regulation of the local suction unit operation can be carried out in the manual or automatic modes. It is shown that the use of the described device will reduce capital (ventilation equipment, products and materials) and operating (heat and electric power) costs when organizing ventilation systems in galvanic and pickling shops of production buildings.

Keywords: local suction; device for hazardous substance removal; local exhaust ventilation; ventilation of the production building; electroplating bath; onboard suction.

THE IMPACT OF LANDSCAPE CHANGES ON STORMWATER RUNOFF

S. A. Antsiferov, N. V. Maslova, L. V. Gryzunova

Annotation. The federal law No 416 *On water supply and water disposal* regulates legal relations in the field of public utilities. On the basis of regulatory and technical documents and norms, they calculate the volume of surface runoff and sign a contract with management facilities for wastewater disposal services. The actual conditions often differ from the design ones and, when switching to commercial relations, the calculated values of the amount of runoff are often several times greater than the actual one, or sometimes there is no runoff at all. The article presents the results of the survey and calculation of the actual amount of surface wastewater entering the storm sewer, depending on the amount of precipitation (rain), taking into account the microrelief of the territory of the School No. 10, Togliatti-city. We additionally researched the object under study, especially in areas where the hard surface was repaired and where a new curb stone and tile were laid. We clearly demonstrate that additional researches, calculation and construction of the longitudinal profiles are capable to increase the reliability of directions and slopes for drains.

Keywords: urban economy; utilities; storm sewer; water disposal; surface unorganized runoff; rain and meltwater; relief of the drainage basin.

WATER DEFERRIZATION THROUGH FILTERS WITH PRESSED LOADING

A. V. Bahmetev, V. V. Pomogaeva, V. Yu. Khuzin

Annotation. The article describes the process of water deferrization through filters with pressed loading. First we indicate the problems of consumption of water

containing dissolved iron. Also we describe the principles of water deferrization during its transition from the divalent state into the trivalent state. We assessed technological indicators of filtering materials during water deferrization. As well we consider the main types of filter loading. We offer to use filtration through a neutral filter material that works without the use of reagents. We present the principle of hydroxide formation (III) during the oxidation of iron under filtration conditions. We consider in detail the processes that determine the speed of water movement in the filter material. As well we analyzed the principle of determining the linear filtration rate, taking into account the maximum number of values necessary to determine the main parameters of the filter: filter load, conditions of deferrization, temperature, iron concentration. We also determined factors influencing the degree of water purification from iron. We carried out experimental studies of water deferrization through a filter with a pressed loading. We considered two variants of water movement in the filter: through the center of the filter and from the walls of the container to the center. We present the results of experimental studies on the determination of pressure losses during filtration. Also we show the degree of water purification from iron under experimental conditions. We determined the iron-absorbing capacity of the filter depending on the direction of water movement and pressure loss. For maximum mass transfer, the most efficient mode of filter operation was identified, taking into account the regeneration of the filter material. We show the fields of application of the considered filter from a neutral load. It is offered to use a neutral load to improve the quality of water both for individual consumers and in industrial scale.

Keywords: water treatment; removal of iron from water; deferrization; hydroxide sediment.

CITY. RECONSTRUCTION, RESTORATION AND LANDSCAPING

URBAN PLANNING ASPECTS OF A MULTIFUNCTIONAL COMPLEX ARRANGEMENT IN URBAN AREA

A. V. Shutka

Annotation. The article considers a number of examples of modern practice of designing and building multifunctional complexes in the structure of a modern large city. We carried out the analysis of the location of complexes in the urban structure, which determines the patterns of architectural and planning construction. We developed a classification of arrangement of multifunctional complexes in the city. As well we offered the measures that allow to competently create the master plan of the land plot, to comprehensively approach the development of architectural and spatial solutions.

Keywords: urban planning; multifunctional complex; public spaces.

ECOLOGY AND SAFETY OF THE URBAN ENVIRONMENT

COMPUTER SIMULATION OF THE MIXING CHAMBER OF A COMBIFILTER FOR WASTEWATER TREATMENT

A. A. Shirniekh

Annotation. The task of ensuring the requirements of sanitary rules and regulations is becoming more and more difficult every year. The requirements are getting tougher, the drains are dirtier, and their volumes are increasing. To solve this problem, new methods of water purification are needed. We offer one which consists in using a combined filter. With the help of modern computer modeling technologies, we consider the camera design, and the design solution is optimized to achieve the best result. We presented the results of modeling the mixing chamber for various versions of overflow organization. We carried out a comparative analysis of two methods of dosing reagents: into the mixing chamber and into the source water pipe. We investigated the flow lines, and as a result it was revealed that vortices formed in the lower part of the mixing chamber due to the flat bottom may destroy the flakes formed. To solve this problem, we offer to add a cone insert to the lower part of the chamber for a smoother flow. The proposed design of the mixing chamber will not only increase the efficiency of water treatment, but also reduce the area occupied by the equipment.

Keywords: water treatment; filtration efficiency; coagulation; ANSYS; filtration intensification.

ECONOMICS AND ORGANIZATION OF CONSTRUCTION

COMPARISON OF TECHNICAL AND ECONOMIC INDICATORS OF HEAT-INSULATING PAINT COATINGS OF PIPELINES DURING MAJOR REPAIRS OF THE HOUSING FACILITIES

M. E. Dement'eva, I. V. Kozhevnikova, S. E. Sokolova

Annotation. The article presents an overview of the advantages and disadvantages of modern thermal insulation materials, analyzes their operational and technical characteristics. The object of the research was the thermal insulation of pipelines as a way to improve the energy efficiency of a building. The aim of the research was to study the problems and prospects for the use of innovative heat-insulating paint coatings for heating and hot water supply pipelines during the overhaul of housing stock. We analyzed the data of the governmental report on the state of energy saving and directions for increasing energy efficiency in our country. We carried out an analytical research of scientific studies on the main trends in the use of heat-insulating paint coatings, and the experience of their application. We compiled a matrix for comparing heat-insulating materials in terms of technical, economic,

technological and operational characteristics, which can be used to justify the feasibility of using heat-insulating paint coatings during major repairs of pipelines. As well we determined a list of factors preventing the introduction of heat-insulating paint coatings into operational practice.

INCREASY IN ENERGY EFFICIENCY IN THE CONTEXT OF DIGITAL TRANSFORMATION OF THE HOUSING AND COMMUNAL SERVICES SECTOR

I. A. Provotorov, I. S. Kudryavtseva, I. I. Pereslavtseva

Annotation. The article is devoted to the topic of increase in energy efficiency of the housing and communal services sector due to the introduction of digital technologies. It is noted that despite the long-term policy to ensure energy efficiency, it was not possible to achieve a significant transformation of the industry. The current stage is characterized by the active implementation of digital solutions. The stages of the energy flow are ranked as the potential for increasing energy efficiency increases. It is concluded that in the context of digital transformations, the sphere of final consumption is of the greatest potential. The digitalization of the housing and communal services sector in order to increase energy efficiency should be considered from many perspectives, including the impact on various categories of stakeholders. We identified the main stakeholders of the process of increasing energy efficiency in the housing and communal services sector through digital transformations, and determined their main roles in projects. The condition of having the main stakeholders in the project, who have a clear understanding and objective assessment of their benefits, is mandatory to ensure the feasibility of energy efficiency projects through digital transformations. Based on the proposed model, we identified 3 types of projects to improve energy efficiency through digitalization according to the degree of their feasibility. In the process of developing and structuring projects to improve energy efficiency through the introduction of digital technologies, one should clearly understand the composition of the participants and determine their effectiveness at various stages of the project life cycle. If the calculations show that the project is unprofitable for stakeholders, one should adjust its parameters, otherwise the probability of its successful implementation will be quite low. The approach presented in this article allows us to determine the potential feasibility of projects to improve energy efficiency through the introduction of digital technologies, to assess the effects for various stakeholders and to make adjustments to the initial conditions, if necessary.