

# **BUILDING CONSTRUCTION, BUILDINGS AND STRUCTURES**

## **FEATURES OF VERIFICATION CALCULATIONS OF REINFORCED CONCRETE PLATES AND BEAMS**

**G. D. Shmelev, A. N. Ishkov, P. E. Avdeev**

**Annotation.** The article considers the author's non-traditional approach to performing verification calculations of the actual bearing capacity of bent reinforced concrete structures that have been in real operation for a long time. The fundamental difference from the traditional approach lies in taking into account the uneven strength of concrete along the height of the cross section of the verified structural element. The essence of the method proposed in this article lies in the simultaneous control of the strength of concrete in the compressed and tensile zones of the structure under study, for which it is planned to perform a verification calculation. Based on the measurement results, we constructed a «diagram» of the concrete strength distribution, according to the height of the cross section of the element under study. Subsequently, using the iteration method, the actual height of the compressed zone of concrete is calculated, taking into account the «diagram» of the actual strength of the concrete structure constructed at the previous stage. On the example of specific structures (monolithic floor slabs), we checked their real load-bearing capacity along the normal section for the action of a bending moment. The obtained result was compared with the results of verification calculations performed by the traditional method without taking into account the uneven distribution of the actual strength of concrete over the height of the element's cross section. Based on the results of the comparison, we draw conclusions about the features of our calculation method.

**Keywords:** flexible building structures; variability of concrete strength; cross section of the structure; verification calculation; bending moment; iteration method; compression and tension zone of concrete.

## **OPTIMIZATION OF PARAMETERS OF THE CROSS-SECTION OF TWO-LAYER BENDING REINFORCED CONCRETE ELEMENTS WITH HIGH-STRENGTH B90 CONCRETE IN THE COMPRESSED ZONE**

**Yu. F. Rogatnev, J. Minani, O. O. Sokolov, A. Yu. Rogatnev**

**Annotation.** We carried out a numerical study of two-layer bending reinforced concrete elements with top layer of high-strength B90 concrete and bottom layer of B35 concrete with varying reinforcement classes and reinforcement percentages with the aim of optimizing the relative height of the top layer. As a result we determined the influence of the relative height of the high-strength concrete layer on the stress-strain state of the element. We developed recommendations for calculating the bearing capacity of two-layer elements in accordance with the requirements of

SP 63.13330.2018 Concrete and reinforced concrete structures. The optimal relative height of the layer of high-strength concrete for double-layer bending reinforced concrete elements with an upper layer of high-strength concrete was numerically determined.

**Keywords:** two-layer element; high-strength concrete; percentage of reinforcement; optimal relative height of a layer of high-strength concrete.

## **ENGINEERING SYSTEMS AND COMMUNICATIONS**

### **STUDY OF THE INFLUENCE OF NON-NORMATIVE INTERIOR ROOM TEMPERATURE ON THERMAL COMFORT IN THE TRANSITION PERIOD USING *PMV* AND *PPD* INDICES**

**M. V. Svirin**

**Annotation.** The article considers existing methods for assessing individual sensitivity to temperature, and studies the influence of clothing, metabolism and physical activity of a resident on the comfortable perception of the environment. Here I describe the dependence of the indicator of Predicted Percentage of Dissatisfied (PPD) on the Predicted Mean Vote (PMV). We carried out experimental studies to determine the outside air temperature, the temperature of the inner surface of the wall and the inside air temperature of an apartment in a residential apartment building using an AKTAKOM ATE-2036 multichannel temperature meter. As well we carried out the analysis of the level of comfort in a room for a person using the methodology for determining the PMV and PPD indices and the assessment of the internal microclimate of the room in accordance with GOST 30494-2011. As a result I revealed a discrepancy between the internal air temperature and the optimal or permissible temperature ranges for the warm year season. The technique developed by P.O. Fanger, in conjunction with the use of modern calculation methods, can make it possible to select the most preferable microclimate parameters for a particular building, considering its purpose, climatic conditions, design features, etc. Continued research in this area will make it possible to develop recommendations on the use of methods for determining thermal comfort in the design and reconstruction of apartment buildings.

**Keywords:** thermal comfort; microclimate; thermal regime; comfort level; Predicted Mean Vote; Predicted Percentage of Dissatisfied.

### **METERING OF CONSUMED RESOURCES AND ADJUSTMENT OF THE HOT WATER SUPPLY FEES IN AN APARTMENT BUILDING**

**N. V. Maslova, S. A. Antsiferov**

**Annotation.** The article discusses a controversial situation between the owners of an apartment building and a homeowners' association related to the recalculation of fees for a poorly provided hot water supply service during the repair of outdoor heating networks. A similar situation is typical for many apartment buildings and is quite common in practice, especially in summer, as well as in closed heating systems. The residents are mostly uneducated in legal sphere or in construction sector. They don't have a legal representative in court for defending their interests. There are no individual heat meters of hot water supply in apartment buildings. These facts lead to material losses in owners and unreasonable profits of resource-supplying and operating organizations. Based on a comprehensive, technical and economic survey of the apartment building, we present here the results of an analysis of the problems and causes that lead to a decrease in the temperature of hot water at water collection points and towel rails. At the same time, we determine local features of houses with a large number of entrances, on which two or more general-purpose heat metering devices are installed. As the result of the work, conclusions were drawn about incorrect calculations of fees to homeowners in the apartment building. Erroneous receipts were issued during repairs on outdoor heating networks and disruptions in heat supply were not taken into account. We propose a method of adjusting the hot water supply fees in an apartment building, which allows one to more accurately calculate the amount of heat. That may as well regulate fees for the energy resources consumed in practice, and may create scheduled legal relations between all interested parties.

**Keywords:** housing and communal services; hot water supply; heat carrier metering; metering devices; energy fees.

## **EXPERIMENTAL STUDY OF CHANGES IN THE VALUES OF INDOOR AIR PARAMETERS IN THE WORKING AREA OF THE PREMISES OF MENTAL LABOR**

**D. V. Lobanov, I. I. Zvenigorodsky, S. A. Safonov**

**Annotation.** We performed the experimental study of changes in the air parameters in the room of mental labor during the 8-hour working day in the absence (inactivity) of ventilation systems. We plotted graphs of parameter changes, revealed their regularities in these changes, which are approximated by various functions with the highest determination value: logarithmic, power, linear. As well we determined values of percentage changes of air parameters during a working shift of a brainworker. Also we determined the conformity between the character of changes in the carbon dioxide concentration obtained experimentally with the theoretical data presented in the reference technical literature. In the end we show the importance of developing effective systems of organizing a comfortable microclimate in premises.

**Keywords:** indoor air parameters; mental labor; carbon dioxide concentration; microclimate.

## OPTIMAL PROJECT TEMPERATURE SCHEDULE OF THE HEAT NETWORK IN A RESIDENTIAL AREA

D. N. Kitaev, S. G. Tulskaya, A. V. Gorlova

**Annotation.** The article deals with the question of an expedient project temperature schedule for a heat network. On the example of a promising residential area, consisting of 15 residential buildings of 12...20 storeys and one shopping center, we carried out a hydraulic calculation of the heat network, using 95/70, 110/70, 130/70 and 150/70 project schedules. We established that when the temperature changes from 95 to 150 °C, the flow rate decreases by 2.26 times, the diameter of the outlet pipeline decreases by 1.72 times, the material characteristic – by 1.45 times, and the heat loss increases by 2,28 times. The value of the power of the network pump is determined depending on the project water temperature, taking into account the connection of consumers through the independent scheme, changes in the density of water and pressure of the pump, which ensures the regulatory requirements for the operation of the network. Having found the value of the estimated cost of the heat network and the cost of transporting the heat carrying agent, depending on the planned service life of the network and the temperature control schedule, we determined the optimal values of the project water temperatures in the network.

**Keywords:** heat network; temperature chart; material characteristic; heat loss; estimated cost; temperature of the heat carrying agent.

## RESEARCH OF THE OXIDIZING ABILITY OF JET AERATORS

V. V. Pomogaeva

**Annotation.** The article discusses jet aerators designed to saturate water with oxygen in the air. I identified the problems of eutrophication of reservoirs and found a solution to this problem. I as well carried out an assessment of some technological indicators of aeration. I considered the main types of nozzles designed for jet aeration of water with atmospheric oxygen, working without the use of technical oxygen. A diagram of the movement of individual elements during jet aeration is given to determine mass transfer. I considered in detail the processes determining the velocity of jets and air bubbles during jet aeration. I established the factors influencing the saturation of water with oxygen. Experimental studies have been carried out with conical, cylindrical and slit nozzles installed on the pressure pipe of the pump. As well I estimated the size and depth of penetration of air bubbles into the water formed by jet aeration with different nozzles. I presented the results of experimental studies to determine the oxygen content in water. Also I show the rate of oxygen saturation of water during jet aeration with various nozzles. A method is given for determining the efficiency of aeration, during the experiment, depending on the oxidizing ability of the aerator and the electricity consumed, taking into account the volumetric mass transfer coefficient. The oxidizing abilities of aerators were determined depending

on the type of nozzles. For maximum mass transfer, the most effective type of nozzle has been identified: cylindrical with twelve cylindrical holes arranged around the circumference and one conical in the center. I show the areas of application of the considered nozzles in the system of water treatment and improvement of water quality of low-flow reservoirs. The use of artificial aeration of water, which allows us to saturate water with atmospheric oxygen, is proposed to improve the quality of water and the habitat of aquatic microorganisms.

**Keywords:** jet aeration; oxygen saturation of water; eutrophication; mass transfer.

## **EXPERIMENTAL ASSESSEMENT OF METHODS FOR WASTE PRODUCTS TREATMENT OF INDUSTRIAL WASTEWATER PURIFICATION IN THE ENTERPRISES FOR SILICATE AND AERATED CONCRETE PRODUCTS**

**M. V. Obukhova, O. V. Sidorenko, E. I. Vyalkova**

**Annotation.** The article considers relevant problem of waste generation in the treatment of industrial wastewater in construction industry enterprises, which are mostly neither treated nor recycled. The effectiveness of compaction and dewatering has been experimentally proven to reduce precipitation volumes and reduce their humidity without reagents addition. We evaluated the properties of water resulted after sediment compaction and of filtrate after dehydration. We propose the technological scheme of industrial wastewater treatment with a block of precipitation treatment and water disposal after compaction and dehydration. The results obtained in the course of the work confirm the effectiveness of the use of methods of compaction and dehydration of sediments of the enterprise for the production of silicate and aerated concrete products, and can be used for the reconstruction of existing treatment plants and for the design of new ones.

**Keywords:** sediment in industrial wastewater; compaction; dehydration; technological treatment scheme; waste recycling; disposal.

## **CITY. RECONSTRUCTION, RESTORATION AND LANDSCAPING**

### **METHOD OF REGULATION OF VISUAL COMBINATION OF BUILDINGS IN THE HISTORIC DEVELOPMENT**

**A. Yu. Semenikhina, O. A. Sotnikova, A. N. Goikalov, T. V. Makarova**

**Annotation.** The article considers a number of examples of multi-storey development in the city of Voronezh. We illustrate various assessments of perception of these building and authenticity of the environment. We also analyze identified architectural and town-planning properties of modern multi-storey buildings, which determine the sence of dissonance. To solve the existing problem of disharmony

between modern and historic buildings we developed a classification of combination of the building being designed with the surrounding development. We assessed the qualimetric point of view of new buildings in the historical center of the city of Voronezh. As well we offered some measures to regulate the visual perception of architecture-and-spatial environment.

**Keywords:** historical development; disharmony; classification of buildings; qualimetry; conformity assessment.

## **ECOLOGY AND SAFETY OF THE URBAN ENVIRONMENT**

### **METHOD FOR CONTINUOUS MONITORING AND DETERMINATION OF PRESENCE AND CONCENTRATION OF PETROLEUM PRODUCTS IN THE SEWAGE WATER OF INDUSTRIAL ENTERPRISES**

**F. G. Tarasevsky, V. L. Badenko**

**Annotation.** In the article we substantiate the relevance of continuous monitoring of pollution with oil products of wastewater discharged into water bodies from the direct-flow cooling systems of CHP equipment. We offer a form of organization of the system for continuous monitoring of the concentration of dissolved oil products and oil films in the wastewater of the cooling system. As well we propose the substantiation of the instrumentation choice. The operation of the proposed system is based on the use of a dissolved oil analyzer and an oil film recorder. Also we describe the composition and principle of operation of the proposed system. This system is based on fixing the presence of oil products and determining the numerical value of the concentration of dissolved oil products. This value is found through an indirect parameter, taking into account the presence of background concentrations in the reservoir.

**Keywords:** control of oil products; environmental monitoring; polycyclic aromatic hydrocarbons; CHP.

## **ECONOMICS AND ORGANIZATION OF CONSTRUCTION**

### **COMPREHENSIVE ASSESSMENT OF THE QUALITY OF BUSINESS PROCESS NAMED *ACCOMPLISHMENT* *OF CONSTRUCTION AND INSTALLATION WORK ON THE EXAM- PLE OF A CONSTRUCTION COMPANY***

**N. N. Aleksandrova**

**Annotation.** The article substantiates the relevance of a comprehensive assessment of the quality of construction and installation work, which makes it possible to make a conclusion about the situation as a whole. It helps identify or correct the

main problems as well as develop preventive measures aimed at managing the quality of construction products. Based on the principles of quality management, within the framework of the process approach, I consider a system of indicators characterizing incoming resources, production activities and process results. Using the evidence of the N construction company of the city of Tyumen, the integral indicator was calculated and the quality of the business process named accomplishment of construction and installation work was evaluated. Based on the identified level of quality of the business process I identified the weak points of the analyzed construction company in the field of quality management. In order to improve the quality of construction and installation work I recommended several corrective and preventive measures to be applied in this construction company.

**Keywords:** quality of construction and installation work; business process; construction company; assessment of quality of construction and installation work; integral indicator.

## **ANALYSIS OF THE COMPETITIVE ENVIRONMENT IN THE MARKET OF SERVICES FOR THE MANAGEMENT OF APARTMENT BUILDINGS IN THE HOUSING AND UTILITIES SECTOR OF THE CITY OF TYUMEN**

**N. N. Aleksandrova, N. V. Meller, I. Y. Nekrasova**

**Annotation.** We considered the financial, economic and organizational aspects in the competitive environment of homeowners' associations in the housing and utilities sector of the city of Tyumen. Using desk research tools we presented the results of the financial condition, rating and competitiveness assessment of 13 homeowners' associations in the housing and utilities sector. The assessment was carried out according to two criteria: the level of financial and economic stability of homeowners' associations (the return on equity was calculated as the resulting indicator) and the assessments of the quality of housing and utilities sector by the homeowners (the consumer rating was used as the resulting indicator). As well we present a positioning matrix as the characteristic of the level of competitiveness of homeowners' associations in Tyumen-city. It was determined that reliable assessments will provide objective information about the quality of work of homeowners' associations, which will help consumers in choosing an organization to manage an apartment building.

**Keywords:** homeowners' association; housing and utilities sector; competitiveness; positioning matrix; competitiveness level.