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CHANGES IN THE TEMPERATURE FIELD IN REINFORCED CONCRETE STRUCTURES FROM CLIMATIC FACTORS

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ABSTARCT
The introduction of new methods for calculating the temperature field of reinforced concrete structures under the influence of a dry-hot climate, as well as the objective consideration of these methods in the calculation and design of the structure are considered.

Keywords: reinforced concrete structures, effects of a dry-hot climate, operation of reinforced concrete structures, calculation and design of a structure, new calculation methods.

INTRODUCTION

The intensive development of industrial facilities and transport infrastructure of our country requires the formation and implementation of new effective methods for calculating the reliability and durability of structures, buildings and structures operated in any conditions.

It is known that the most significant influence on the durability and operational reliability of reinforced concrete structures is exerted by the temperature and climatic factors of the natural environment, especially in regions with a dry hot climate. Under these conditions, intensive dehydration of concrete, uneven distribution of temperature and humidity over the cross section of the structure lead to the occurrence of often alternating and nonlinear temperature stresses, forced deformations, micro fractures of the concrete structure and changes in the physical and mechanical properties of concrete over time and other destructive phenomena.

Experience in the design and construction of reinforced concrete buildings and structures shows that design standards do not fully take into account the above destructive phenomena, which in practice lead to an earlier than the design service life, failure of reinforced concrete structures. In turn, insufficient knowledge of the real deformation processes in the thermally stressed state of reinforced concrete structures, the lack of a deeper theoretical base that correctly simulates the occurrence of destructive processes in them, does not allow reasonably normalizing the account of the real thermally stressed state of reinforced concrete. In this regard, the relevance of this study is due to the need for a deep experimental study and theoretical substantiation of the nature of the real state of reinforced concrete under variable temperature effects, the development on this basis of methods for calculating, designing and predicting the stress-strain state of reinforced concrete structures with objective consideration of complex and ambiguous modes of temperature and climatic impacts. The purpose of these studies is an experimental and theoretical study of the influence of temperature and climatic effects on the properties of reinforced concrete with the development of reliable and objective methods for assessing the stress-strain state of concrete under the influence of external temperature, solar radiation, their seasonal and daily fluctuations.

An analysis of previous studies shows that a number of proposals have been developed for assessing the state of reinforced concrete structures when exposed to air temperature, humidity, solar radiation, wind load modes, atmospheric precipitation. However, practice clearly demonstrates that many issues related to the influence of these factors on the operational characteristics of reinforced concrete structures remain unresolved and require a broader, detailed study and study.

It should be noted that many studies were carried out under artificially created conditions that could not fully reflect natural ones. Proposals for the calculation and design of the stress-strain state of reinforced concrete elements were reduced to linear dependencies, while the influence of these factors is clearly nonlinear. At the same time, there are contradictions between the results of various studies, and also did not contribute to the creation of a unified theoretical basis for these processes.

Taking into account the above, in a previously not studied formulation, a set of laboratory and field experimental studies was carried out on the influence of various modes of temperature and climatic effects

on the properties of reinforced concrete using the results obtained in an objective assessment of their stress-strain state.

Reinforced concrete prestressed bending elements made of light and heavy concrete are taken as the object of research. In total, 4 series of beams, 8 pieces each, with dimensions 180 * 250 * 330 cm, reinforced with high-strength steel were made. T-1 and T-2 series heavy concrete for spring and summer laying. Also, standard samples of cubes and prisms were made with dimensions of 100 * 100 * 100 mm and 100 * 100 * 400 mm. The program of multifactorial experiments provided for short-term and long-term testing of prototypes in natural climatic conditions. and regulatory conditions. The experiment program also varied the residence time of the prototypes in normal and natural climatic conditions, as well as the loading levels.

As a result of experimental studies of four series of reinforced concrete beams made of light and heavy concrete reinforced with high-strength prestressed reinforcement, experimental data were obtained on the bearing capacity and deformability of elements in conditions of difficult conditions of a dry hot climate, taking into account seasonal and daily fluctuations in temperature and air humidity.

At the same time, to obtain an objective picture of changes in the temperature and moisture content of concrete over the cross-section of the structure under the influence of the environment over time, a special technique was used to record the temperature of the prototypes along the entire depth of their cross-section. For these purposes, concrete samples were made, which in shape, composition and physical and mechanical properties were twins of the experimental reinforced concrete bending elements. In these samples, special pits were made along the entire height of the cross-section of the experimental element in several longitudinal and transverse planes. The internal temperature of these elements was measured over a long test period using chromium-droplet thermocouples. According to a predetermined scheme, at certain time intervals, the internal temperature of the concrete was measured by inserting the sensing element of thermocouples into the well of the concrete element. This experimental technique made it possible to obtain with high accuracy the temperature inside the concrete element in a 3-dimensional coordinate system. Temperature measurement points were sufficient to obtain further diagrams of temperature changes, deformation and stresses from the effect of temperature.

On the basis of the results of the experimental studies, it was established that the nature of the effect of the intensity of the increase in air temperature on the temperature of concrete of the prototypes. So, there is a significant temperature difference on the surface and in the deep layers of the concrete and reinforced concrete element, characterized by the lag of heating over the section of the element from the change in external temperature during the day. Moreover, the temperature of concrete on the surface of the elements by 16 o'clock exceeds the air temperature by an average of 12-15 ° C, especially from the side exposed to solar radiation, significantly ahead of the temperature in the middle of the section.

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