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DEFORMABILITY OF REINFORCED CONCRETE COLUMNS MADE OF HEAVY CONCRETE IN NATURAL CONDITIONS OF THE REPUBLIC OF UZBEKISTAN

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Annotation: *This article discusses the stressed deformed state of reinforced concrete columns operated in the natural climate of the Republic of Uzbekistan, scientific experiments and theoretical studies. On the basis of experimental and theoretical studies, deformations of elements under the action of various eccentricities of short-term and continuous longitudinal forces are studied.*

Key words: *ry hot climate, air humidity, reinforced concrete structures, strength, deformability, crack resistance, heavy concrete, tensile reinforcement deformations, concrete fibers, stretched concrete, compressed reinforced concrete elements.*

In a dry, hot climate, fluctuations in temperature and humidity during the day and the season of the year (summer and winter) adversely affect the formation of the concrete structure. Intensive dewatering of concrete at elevated temperatures and low relative humidity of the environment leads to a decrease in its strength and modulus of elasticity.

A large daily temperature drop causes an uneven distribution of temperature stresses over concrete sections. The design and construction of reinforced concrete structures for a dry hot climate without taking into account the deformations of the forces caused by changes in high temperature and low humidity lead to early formation of cracks in concrete, their excessive opening, as well as to large deformations of the structure[1,2,3,4].

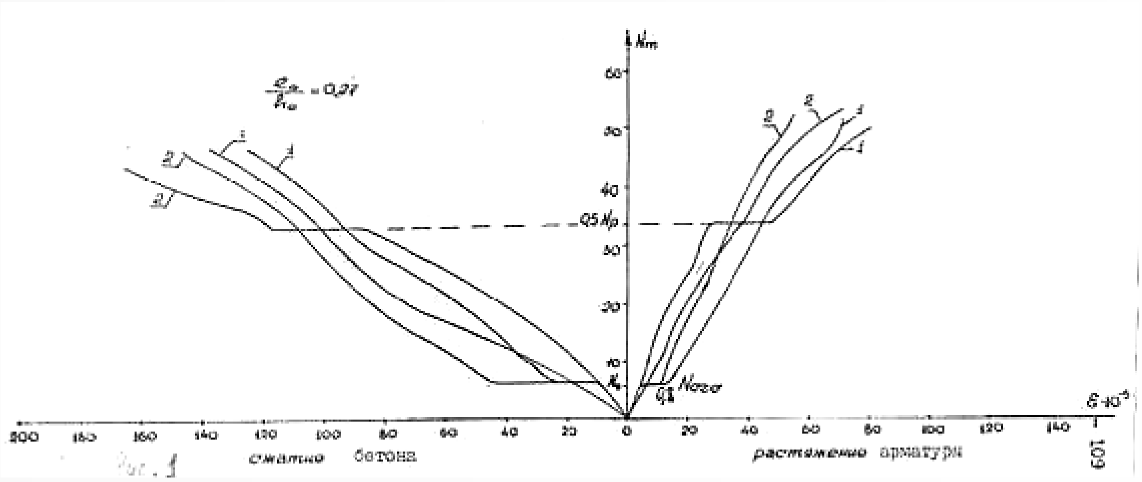
One of the most important factors in increasing the reliability and durability of buildings and structures, especially for the Republic of Uzbekistan, is the further improvement of methods for their calculation, taking into account real operating conditions. In this regard, an urgent task is to conduct experimental theoretical studies of the strength, deformability and crack resistance of eccentrically compressed reinforced concrete elements made of hard concrete under the influence of force factors and the unfavorable effects of a dry hot climate [5,6,7,8,9].

To identify the influence of a dry hot climate on the strength and crack resistance of eccentrically compressed reinforced concrete elements, experimental rectangular columns with dimensions of 16 × 30 cm and a height of 100 cm, which had consoles, were made from heavy concrete. The columns had a symmetrical reinforcement of 4 rods with a diameter of 14 mm, class A - III. After concreting, all columns were in the formwork under wet sawdust for 7 days, and then they were decomposed [10,11,12,13,14,15].

In a hot climate, 8 columns were tested, 4 columns were loaded with a longitudinal force equal to 0.8 Ncrc, the remaining 4 columns were loaded with a force equal to 0.5 Np with an eccentricity equal to e = 0.5y = 7cm, and e = y = 15cm. To measure the deformation of reinforcement and concrete during long-term holding of samples under load, portable indicators based on 250 mm were used. The readings of the devices in the first two months were taken three times a day, in the following months, once a week for a year[16,17,18,19,20].

Loading of columns with a long-term load was carried out on the stand site using lever installations. Cast iron weights weighing 20-25 kg and concrete blocks weighing 20 kg were used. To establish the effect of solar radiation on the deformations of the stretched and compressed zone, some columns were installed so that at noon solar radiation would act from the side of the stretched zone and in other columns from the side of the compressed concrete zone. The expected breaking load and the appearance of cracks were obtained from the result of testing the column with a short-term load. The columns, after being under prolonged loading and solar radiation for one year, were unloaded and brought to destruction by short-term loading on the press in order to establish how the dry hot climate affects the strength, deformation and crack resistance of the columns[21,22,23,24,25,26].

The appearance of cracks in the columns causes an increase in the average relative deformations of the stretched reinforcement and the extreme compressed concrete fiber. Until the moment of cracking, the growth of deformations of tensile reinforcement and concrete in the compressed zone is approximately the same. With further increase in the load and, especially after the appearance of cracks in the tensioned zone, the intensity of the increase in deformations of tensioned reinforcement, as well as compressed concrete, increases.



The deformation of the stretched reinforcement of the column, which during the year were in a dry hot climate under a prolonged load of 0.8 Ncrc, was 10.5.10-5 under the action of solar radiation on the stretched zone, and 4.9.10-5 on the compressed zone. After the action of solar radiation on the extended zone for one year in a dry hot climate under a long-term load of 0.8 Ncrc, the deformation of the extreme compressed fiber was 148.5.10-5 under the action of solar radiation on the compressed zone -84.5.10-5 (Fig.1).

Fig. 1. Average deformations of compressed concrete fibers and tensile deformations of the reinforcement of columns under a load of 0.5 Np and 0.8 Ncrc for a long time in a dry hot climate.

1- after the action of solar radiation on the extended zone

2- after the action of solar radiation on the compressed zone

Dry, hot climates increase the relative deformation of the reinforcement. In the columns under the influence of solar radiation during one year, the deformations of the reinforcement were more by 13-14% than in the columns that were in the workshop. The increased temperature and low relative humidity of the air in a dry hot climate also increase the deformation of the extreme fiber of the compressed zone of concrete. When the columns were in the shop for 1 year, the relative deformation of the extreme compressed fiber was Ebc = 65.10-5. The relative deformations of the extreme compressed concrete fiber in the columns that were under the influence of solar radiation for 1 year (at 0.5 Np) increased by 35-60% in comparison with the deformations of concrete at a short-term load at the age of 40 days. An increase in the deformation of reinforcement and concrete from prolonged loading in a dry hot climate occurs due to a change in the elastic-plastic properties of concrete. The theoretical deformations of tensile reinforcement and compressed extreme concrete fiber, taking into account changes in the strength and deformation properties of concrete, are determined as follows. Average deformations of tensile reinforcement under eccentric compression were calculated by the formula.

$$\varepsilon = \frac{N \cdot e_s}{E_s A h_o Z} - \frac{N}{h_o} \cdot \frac{\Psi_s}{E_s A_s}; \qquad (1)$$

Here is coefficient taking into account the work of tensile concrete in the area with cracks, determined by the formula

$$\psi_s = 1.25 - \varphi_{es}\varphi_m - \frac{1-\delta_m^2}{(3.5-1.8\varphi_m)\cdot \frac{e_s}{h_o}} \qquad (2)$$

The average deformations of the extreme concrete fiber in the compressed zone are determined by the formula:

$$\varepsilon_b = \frac{N \cdot e\psi_b}{(\varphi_f + \xi) b h_o E_b \beta_b V} - \frac{N}{h_o} \cdot \frac{\psi_s}{E_s A_s} \qquad (3)$$

Ψ_b - the coefficient taking into account the uneven distribution of deformations of the extreme compressed fiber of concrete along the length of the section with cracks, taken for heavy concrete equal to -0.9.

The theoretical deformations of the stretched reinforcement and the extreme compressed fiber of concrete determined by the formula (1) and (3), taking into account the recommendations of SNiP 2.03.01-84, were less than the experimental ones (Fig. 2-Fig. 3)

The theoretical values of the deformation of the stretched reinforcement and the extreme compressed fiber of concrete, determined by formulas (1) and (3), taking into account the influence of a hot climate, R_b, Y_{b7}, $R_{bt,Ser}$, Y_{tt}, E_b, B_b - have satisfactory convergence with the experimental values of deformations (Fig-2,Fig-3).

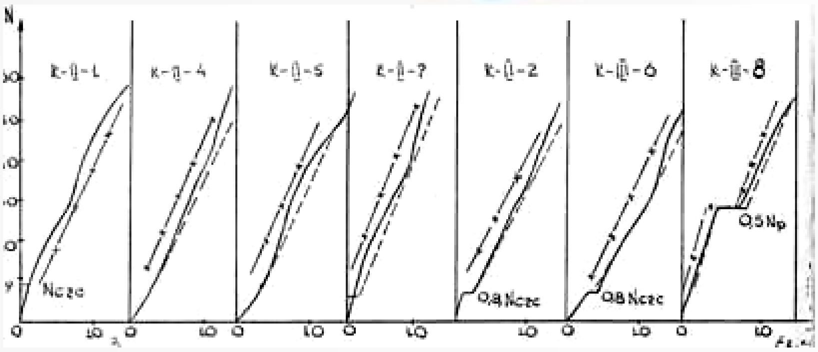


Fig. 2 Regarding the deformation of reinforcement in a dry hot climate with an eccentricity of the load e=0,5y

___________ - experienced

___x____x___ - theoretical according to the formula (1)

----------------- - the same taking into account the influence of a dry hot climate

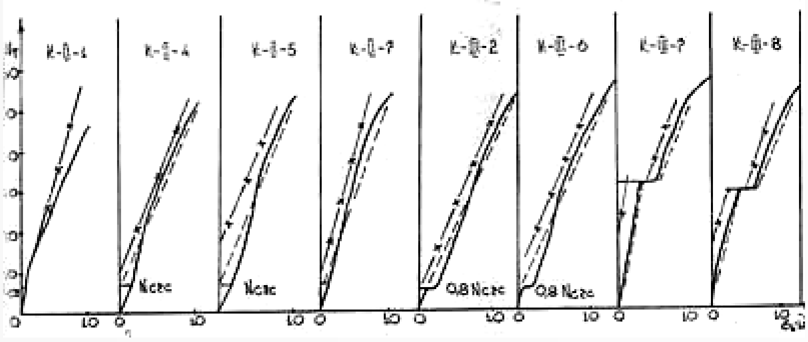


Fig. 3 Average relative deformations of the extreme fiber of the compressed zone of concrete in a dry hot climate at eccentricity of the load e=0,5y

___________ - experienced

___x____x___ - theoretical

------------------ - also taking into account the influence of a dry hot climate

According to the results of experimental and theoretical studies, the calculation of reinforced concrete eccentrically compressed elements operated in a dry hot climate should be performed according to the method Building codes and regulations 2.03.01-96 taking into account changes in the strength and deformative properties of concrete from the effects of temperature, humidity, shrinkage and swelling of concrete.

When calculating the deformations of eccentrically compressed reinforced concrete elements operated in a dry hot climate, the values of the coefficient φв1 taking into account the development of short-term creep of concrete, for a dry hot climate should be taken as 0.75, the coefficient φв2-taking into account the effect of long-term creep of concrete, for reinforced concrete elements unprotected from the effects of solar radiation for a dry hot climate, according to the first design stage of work, it is 3.0, and according to the second design stage, 3.5.

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