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## Crack Resistance of Eccentrically Compressed Reinforced Concrete Elements in Natural Conditions of the Republic of Uzbekistan

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**Abstract:** This article is devoted to the theoretical and experimental study of the crack resistance of eccentrically compressed reinforced concrete elements under dry, hot climate conditions. Methods for conducting experimental research have been developed and the nature of the increase in the deformative properties of heavy concrete under dry, hot climate conditions has been studied. Based on the research conducted, it has been established that in conditions of a dry, hot climate, the deformative properties of concrete change due to the action of temperature and humidity, which must be taken into account in the calculations.

**Keywords:** reliability, operating condition coefficients, moment of crack formation, strength, deformability, crack resistance, solar radiation, shrinkage, cracking, temperature-shrinkage deformation, rigidity, crack opening, eccentric compression, short-term loading.

### INTRODUCTION

Further development of capital construction in the Republic of Uzbekistan involves increasing the volume of production and use of prefabricated and partially monolithic reinforced concrete. The climatic conditions of the Republic of Uzbekistan are distinctly continental.

In summer, the air temperature can exceed +40°C, while the relative humidity drops to 10-15% and below. In such climatic conditions, from direct exposure to solar radiation, the surface of reinforced concrete and concrete structures heats up to 70-80°C. In this case, significant shrinkage deformations of concrete appear, leading to the formation and opening of cracks on the surface of reinforced concrete and concrete structures.

Fluctuations in temperature and air humidity during the day and season of the year (summer and winter) adversely affect the formation of the structure of concrete. Intensive dehydration of concrete at elevated temperatures and low relative humidity leads to a decrease in its strength and elastic modulus. A large daily temperature difference causes an uneven distribution of temperature stresses across concrete sections. Design and construction of reinforced concrete structures for a dry, hot climate without taking into account deformations, forces caused by changes in elevated temperature and low humidity leads to early formation of cracks in concrete, their excessive opening, as well as large deformations of the structure.

The need to take into account the impact of a dry, hot climate on reinforced concrete structures is noted in the works of many researchers. In the studies of A.F. Milovanova, A.V. Nifontova, E.A. Mazo /1,2/ notes that exposure to elevated temperature causes early formation of cracks and also reduces the rigidity of bending reinforced concrete elements.

Experimental studies have shown that the operation of reinforced concrete structures in dry, hot climates leads to an additional increase in the opening width of normal and inclined cracks. The opening width of cracks in bending reinforced concrete elements in a dry, hot climate turned out to be 1.2 times greater than under normal conditions. Experience in operating ribbed roofing slabs in dry, hot climates shows that structures unprotected from solar radiation have early cracking.

The calculated deflections of the coatings, determined according to the standards, were less than the experimental ones from 20 to 40% /6/.

With an increase in the temperature of the element and a decrease in the humidity of the outside air, the curvature and width of crack opening increases, and the rigidity of reinforced concrete beams decreases /3/.

**The purpose of the research:** to study compressive and tensile strength, temperature and humidity deformations and establish their influence on the formation and opening of cracks in eccentrically compressed reinforced concrete elements. working in dry, hot climates

Calculation of reinforced concrete elements for the formation of cracks for forces caused by the influence of temperature is recommended when the temperature of the concrete along the height of the element between the cross-section faces differs by more than 300 C in elements of statically indeterminate structures and by more than 500 C in elements of statically determinate structures. Such temperatures are unlikely in dry, hot climates.

Therefore, the calculation of temperature deformations of reinforced concrete elements in dry, hot climates can be carried out as for concrete elements.

**Object and subject of research:** The object of this scientific research is the strength and deformation characteristics of eccentrically compressed reinforced concrete elements made of heavy concrete under the influence of force factors and the unfavorable influences of dry, hot climate conditions To study the operation of eccentrically compressed reinforced concrete elements, experimental columns of rectangular cross-section measuring 16\*30 cm, which had consoles, were made.

All columns had symmetrical reinforcement of 4 rods with a diameter of 14 mm of class A-III. To measure concrete deformations, pins with a diameter of 6 mm and a length of 50 mm were installed on a base of 250 mm along the height of the elements. The samples were produced in three series. Samples of the first series were exposed to direct solar radiation to determine the temperature change across the cross section of the element. To determine the effect of direct solar radiation, one part of the experimental columns was installed at the test site. Some of the samples of the second series were protected from direct solar radiation. These samples were in workshop conditions. Another part of the samples was exposed to direct solar radiation in the open air

All columns of series 2 were in the workshop and on the test site in an unloaded state for 40-41 days in order to determine the temperature-shrinkage deformations of reinforced concrete columns. The columns were tested at the age of 40 days with a short-term eccentrically compressed force. Series III columns were loaded with a long-term load of 0.8 and 0.5 Np, were exposed to the open air for 1 year, and then were destroyed by a short-term load in order to determine the effect of direct solar radiation on the strength and crack resistance of the columns.

In order to establish the influence of directed solar radiation on the heating of concrete, the columns were positioned so that in some columns the tensile zone, in other columns the compressed zone and the side surface would be exposed to its greatest impact.

The columns were tested with two eccentricities of axial force application to determine how the eccentricity of load application affects the performance of the column in a dry, hot climate. One eccentricity is close to the core eccentricity  $e = 0.5y$  and the other eccentricity  $e = y$ , where  $y$  is the distance from the neutral axis to the most compressed face. During the tests, the appearance and opening of cracks was monitored. The width of the cracks was measured with an MBP-2 microscope.

**Results:** In unloaded columns exposed to solar radiation for 12 months, no cracks appeared. During

short-term loading of these columns, cracks formed at a load of 52.9 - 53.6 kN. This moment of crack formation was less than for columns under constant conditions by an average of 19%.

In columns subjected to long-term loading under a load of  $N = 0.8$  for 12 months under solar radiation and under constant conditions, cracks did not appear. Under short-term loading, the moment of crack formation was 55.6 kN, which is 6% less than for unloaded columns at the age of 12 months. Comparing the moments of crack formation, it can be stated that for columns exposed to solar radiation this figure is 22% less than in columns under constant conditions.

Under the influence of a long-term load of 0.8, the first cracks appeared on the heated surface after 56 days from the start of observation (with the onset of the maximum temperature in July) in the column exposed to solar radiation and after 71 days, cracks appeared in the compressed column exposed to solar radiation edge.

When determining shrinkage stresses in a column, the scale factor is taken into account; in addition, in columns, in addition to shrinkage deformations, tensile stresses arise in concrete due to the difference in the coefficient of thermal expansion of concrete and thermal deformation of concrete

## CONCLUSION

This causes additional tensile deformation of the concrete, which contributes to the early appearance of cracks. of a reinforced concrete element for the formation of cracks normal to its longitudinal axis due to the simultaneous influence of load, temperature and shrinkage of concrete in hot climates is carried out according to SNiP 2.03.01-96. equal efforts

$$N_{crc}^{(T_2)} \cdot (e_0 - Z) = M_{crc}^{(T_2)} \leq (R_{(bt,ser)} \cdot \gamma_{tt} - \sigma_{cs}) \cdot W_{pl} \quad (1)$$

tensile strength taken from experimental data

elastic-plastic moment of resistance of a reinforced concrete section along a stretched zone, assuming that there is no longitudinal force.

$\gamma_{tt}$  is the coefficient of concrete tensile operating conditions.

The values of  $\sigma_{cs}$  and  $E_b$  for concrete were taken based on experimental data, taking into account the coefficients  $\gamma_{tt}$  and  $\beta_b$  depending on the storage conditions and hardening of concrete.

During observations of the development of cracks in columns under loads of 0.8 and 0.5  $N_p$ , it was found that at a load of 0.8 s

$e = 0.5y$  and  $e = y$ , the crack opening width increases over time and after a year the crack opening width was 0.15 and 0.17 mm, respectively, for columns when exposed to solar radiation

for the stretched zone and 0.14 and 0.15 mm for the compressed zone. For columns under constant conditions, the crack opening width is 0.13 and 0.14 mm, which is 9% lower. This is apparently explained by more intensive development and increased deformations of the mustache

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