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Kinetics of the strength of concrete in constructions

Elena A. Korol[a], Mikhail V. Berlinov[a], Marina N. Berlinova[a,]*

[a]Moscow State University of Civil Engineering (National Research University), 26 Yaroslavskoye Shosse, Moscow, 129337, Russia

Abstract

In this article the question of the influence of the kinetics of hardening concrete on its strength in building structures through the stress function. Determined a direct correlation between the optimal structure of concrete and a guarantee of high strength and durability of building structures that ensured a coincidence given the amounts and extreme properties. A method for predicting the elastic properties of concrete based on known theory of strength of concrete model. It is shown by way of example, that in certain specific strength characteristics of concrete, properties of its components (cement stone and aggregates), the maximum value of the short-term strain, creep deformation and modulus of elasticity of concrete depends on its strength at the time of loading. The proposed method is the most convenient for practical approximation to obtain the equations of mechanical state to determine the total deformation of concrete.

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Keywords: concrete, short-term strength , creep rupture strength , creep, stress, strain , modulus of elasticity , kinetics.

Introduction

Deformation properties of concrete depends on its structural characteristics, resulting dosage and quality components, but the intensity of deformations in concrete constructions cannot be reliably predicted depends only on the strength of the composite, while retaining all other conditions equal to [4]. In practice, this implies that the findings on the relationship between deformation and concrete strength to do is useless, if not provided in advance some of the boundary conditions and additional factors characterizing features of the concrete structure, which vary

* Corresponding author. Tel.: +7-910-480-44-94.
E-mail address: berlinov2010@mail.ru

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(or remain constant) simultaneously with the change in strength [1]. This fact is proved by the authors under different operating conditions and loadings [2, 3].

Under the long-term strength (durability) understand the stress that causes the destruction of the material in a given time. Obtaining high quality concrete in advanced technology conglomerate materials today becomes a major factor both in science and in practice, the production of artificial materials and products. It is known that the favorable construction and performance of the concrete consist of: the largest - the strength and elasticity; least - creep, porosity and defects in the structure. According to the law "alignment" I.A.Rybiev, which reflects a high quality performance products, provided that the specific values of the properties are at specified values, you must use the following principle: a comparison of materials in the research and practical developments are not as often made - equal to or under the same conditions (which can result in large errors) but only when the respective conditions, i.e. under optimal - similar to each other, structures.

Method

This assumption establishes a direct connection between the properties and the optimal structure parameters. In other words, the guarantee of high (if not higher) quality products to accepted technology of its production is given a coincidence and extreme properties of the amounts, which is possible only when the optimal structure.

In particular, to improve the reliability of the valuation of deformation characteristics of concrete, along with the strength necessary for the long-term deformation (creep and shrinkage) to take into account the specific (by volume) amount of water in the mixing of concrete, which is closely correlated with the initial moisture content of the concrete; for short-term deformation (initial elastic modulus and ultimate strains) to take into account the specific (by weight) of cement paste content in the concrete mix, which determines the ratio of cement paste and aggregate in the hardened concrete.

Prediction of the elastic properties of concrete can be made using methods known in the theory of strength of concrete models:

linear -

$$\frac{1}{E_b(\tau)} = b_0 + b_1 P_z + b_2 \frac{P_z}{R_b(\tau)} + b_3 \frac{1 - P_z}{E_a} \qquad (1)$$

and nonlinear -

$$\frac{1}{E_b(\tau)} = b_0 + b_1 P_z + b_2 \frac{P_z^{\varphi}}{[R_b(\tau)]^{\psi}} + b_3 \frac{1 - P_z}{E_a}. \qquad (2)$$

Where $R_b(\tau)$- the strength of concrete loaded at a time τ, $E_b(\tau)$ - initial modulus of elasticity of concrete loaded on the age τ; P_z - Specific (by weight) content of cement paste in compacted concrete mix; E_a - modulus of elasticity of the filler; b_0, b_1, b_2 and b_3- deformability parameters taken from experimental data.

Results

Summarizing, we can write:

$$\frac{1}{E_b(\tau)} = a + \frac{b}{R_b(\tau)^m} = \frac{1}{R_b(\tau)^m}\left[aR_b(\tau)^m + b\right], \qquad (3)$$

where $a = a(P_z, E_a); b = b(P_z)$; $m = 1$ and or 0,75.

Maximum short-term strain on the concrete «$\sigma - \varepsilon$» curve: