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MICROCRACKING OF CLAYDITE

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The use of structural lightweight aggregate concrete becomes increasingly in demand because ensuring the energy performance of buildings is one of the key directions in the construction at the present time.

In view of the increase of structural lightweight aggregate concrete importance the studies of the lightweight concretes under static loading (single and low-cycle) are conducted within the framework of the state program of scientific research «Building Materials and Technologies» on the basis of the Belarusian-Russian University.

When this concrete is subjected to applied stresses, then stress concentration occurs at the interface of weak aggregate-cement paste. It leads to the microcracks formation. In case of claydite the boundary between the porous aggregate and the cement mortar is difficult to identify and two fractions are quite similar.

Significant characteristics of strength and deformability of concrete (in particular, claydite concrete) include the upper and lower limits of microcracks formation. When the lower limit of microcracks formation is exceeded, the number of microcracks, their length and opening width substantially increase and the combined microcracks appear. When the upper limit of microcracks formation is reached it leads to the irreversible destructive processes resulting in concrete. Thus, a risk of fatigue failure during prolonged loading arises.

Based on experimental data, it is established that there is a linear relationship between the values of relative loads for the upper and lower limits of microcracks formation.

The ratio of the values of the lower limit of the microcracks formation η^0_{crc} to the upper limit η^V_{crc} remains constant. The value of ratio $\eta^0_{crc}/\eta^V_{crc}$ can be taken for normal weigth concrete as 0.67 and for claydite as 0.60.

To determine the relative values of loads corresponding to the upper and lower limits of microcracks formation, the dependences are proposed

$$\eta^0_{crc} = 0.33k_{crc} \cdot \ln\frac{f_{cm}}{f_{cm,0}} - 0.15, \tag{1}$$

$$\eta^v_{crc} = 0.33k_{crc} \cdot \ln\frac{f_{cm}}{f_{cm,0}} + 0.1, \tag{2}$$

where f_{cm} is a mean value of concrete cylinder compressive strength, MPa;

$f_{cm,0}$ is a single value of a concrete average strength, $f_{cm,0}$ = 1 MPa;
k_{crc} is the empirical coefficient

$$k_{crc} = k_{c1} \cdot \frac{\eta_{crc}^{0}}{\eta_{crc}^{V}}; \quad (3)$$

where k_{c1} is the coefficient taking into account the change of the lightweight concrete E-modulus as compared to the normal concrete: for claydite concrete is $k_{c1} \approx 1.2$, for normal weight concrete and some other types of concrete $k_{c1} = 1.0$. Lightweight aggregate concrete has a lower coefficient of expansion and a lower elastic modulus than normal weight concrete. It reduces the tendency for the formation of microcracks.

The natural logarithm use in formulas instead of the decimal one allows to calculate $\eta^{v}{}_{crc}$ and $\eta^{0}{}_{crc}$ in a wider range of strengths, and the introduction of the empirical coefficient k_{crc} makes the proposed dependences universal and applicable for concretes of various types.

The higher the value of the coefficient k_{crc} is, the more stable will be the work of concrete under the action of a variable static load, since the upper limit of microcracks formation will be higher (for the same strength characteristics).

Thereby, the advantages of lightweight aggregate concrete in comparison with other traditional types of concretes are not only a low value of specific weight, low thermal conductivity and sound permeability. High values of relative loads corresponding to the upper and lower limits of microcracks formation make it reasonable to use structural lightweight aggregate concretes for the manufacture of structures subject to low-cycle static loads.

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