INVESTIGATIONS ON THE INFLUENCE OF AGGREGATE GRAINING ON THE DESTRUCTION PROCESS IN COMPRESSED CONCRETE

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The paper submits the test results concerning the influence the aggregate graining evokes on the destruction process in compressed concrete. Examined were eight structures of concrete, of a similar compression strength yet differing substantially with respect to their aggregate granulometric composition. It has been pointed out that the destruction process in these structure is diverse. This diversity is proved especially by the critical stress values characteristic for the structures in question.

INTRODUCTION

As building structures more and more often employ concrete mixtures of increasing contribution of fine aggregate fractions, it is essential to determine the role aggregate graining plays in stress-evoked destruction of concrete. This issue, i.e. the influence of this technological factor on the destruction course in compressed concrete was indicated by, among others, Shah and Chandra (1) and Hoła and Moczko (2). The studies, however, were focussed on the concretes whose aggregate granulometric composition changed little. The problem seems to require a fuller experimental explanation, especially as to the assessment of the way aggregate graining affects the values of critical stresses, σ_I and σ_{II}. It seems worth noting that the studies carried out by Hsu and Slate (3), Flaga and Furtak (4), as well as (1) proved these stress values to bear a close relationship with concrete structure destruction. They distinguish between the particular stages of concrete destruction, i.e. the stage of stable initiation of cracks, the stage of stable propagation of cracks, and the stage of catastrophic destruction. The above-mentioned stresses are also referred to

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as fatigue strength and sustained strength of concrete, respectively.

TEST RESULTS

Subjected to tests were eight concrete structures, after 90 days of curing, denoted here by the letters from A to H, which displayed a similar compression strength, but varied substantially as to the granulometric composition of their natural cobble aggregate. The granulometric composition of the aggregate was diversified, in particular structures, by changing the contribution of sand in relation to the entire aggregate. Thanks to this, obtained were the structures exhibiting distinct differences in their characteristic material parameters values.
The tests employed the acoustic emission method and the method of strain measurements in a test of quasi-axial compression.

TABLE 1 - A survey of some selected values of material parameters characteristic for the concrete structures tested.

Structure denotation	Parameter: Sand Point %	Parameter: Total aggregate area in 1 m^3 of concrete, F_k m^2	Parameter: Apparent aggregate slurry-coating thickness, Z_K μm
A	20	3180	84.3
B	25	3755	68.7
C	30	4340	61.8
D	37.5	5180	54.4
E	47.5	6116	47.9
F	60	7186	42.7
G	85	8763	41.8
H	100	9768	41.7

As it was implied by the tests, there are distinct differences in the totting sum of the acoustic emission recorded during the entire destruction process in the structures under investigation.

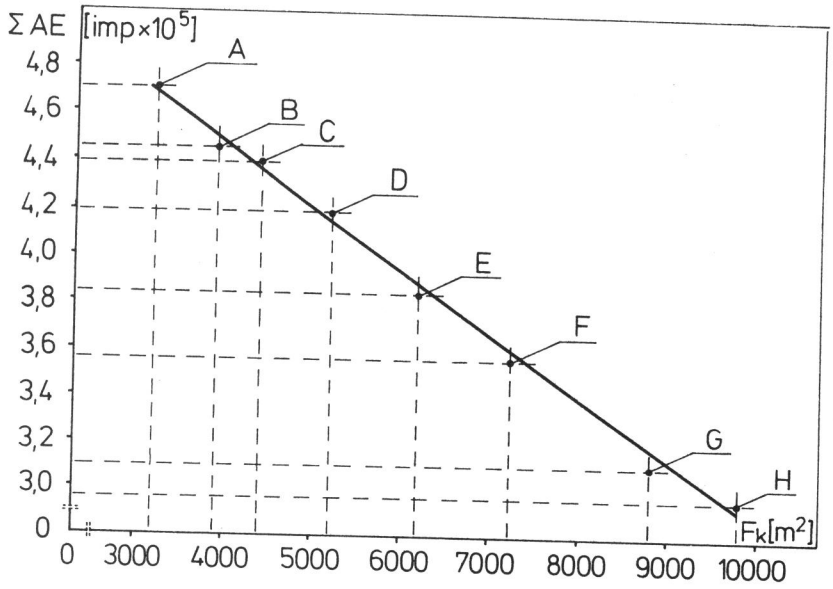

Figure 1 The relationship between the total aggregate area and the totting sum of acoustic emission

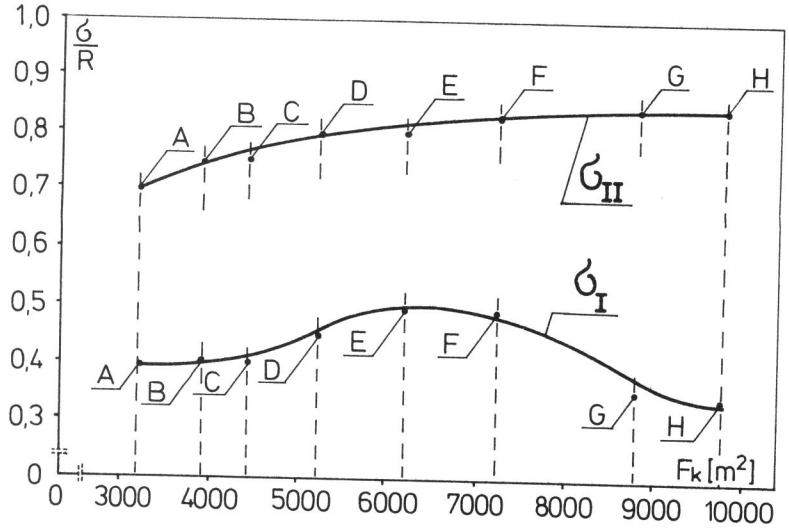

Figure 2 Variability course of the critical stress values, σ_I and σ_{II}, depending on the total aggregate area.

That fact is exemplified by the relationship plotted in Fig.1, which proves the sum to decrease together with an increase of fine aggregate fractions in the concrete. It was also stated that the concrete's deformability increases if so does fine aggregate contribution in it. These results prove a diversified character of destruction in the concrete structures tested. The differences in the course of the tested structures destruction are particularly visible concerning the values of the critical stresses σ_I and σ_{II}. They were determined according to the criteria submitted in (2), on the grounds of the recorded totting sum of acoustic emission, and also according to the ones submitted in (4), on the grounds of the measurements of longitudinal and cross-sectional strains in the tested concretes. We obtained a considerable consistence of these stress values, measurement-determined. Fig. 2 exemplifies the variability of the critical stress values, σ_I and σ_{II}, depending on the total area of the aggregate used for obtaining the structures in question.

SYMBOLS USED

ΣAE = totting sum of the acoustic emission (imp)

F_k = total aggregate area in $1m^3$ of concrete (m^2)

σ_I, σ_{II} = critical stresses in concrete

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