ID 237

ANALYSIS OF CRACKING EVOLUTION AND FRACTURE ENERGY CHANGE OF STEEL FIBER-REINFORCED CONCRETE

Iwona Pokorska[1], Mariusz Poński[2], Wojciech Kubissa[3], Tomasz Libura[1], Adam Borecki[1], Zbigniew Kowalewski[1]

[1] Institute of Fundamental Technological Research Polish Academy of Sciences, Poland
[2] Desigma Engineering (civil engineering company), Poland
[3] Civil Engineering, Warsaw University of Technology, Faculty of Civil Engineering, Mechanics and Petrochemistry, Poland

ipokorsk@ippt.pan.pl

The fracture mechanics defines concrete as a quasi-brittle material. Concrete cracking process is a common problem, because a period to the first micro-cracks may occur even before it is loaded. This is due to the loss of moisture from the concrete. The production method, admixtures, porosity, hardening conditions, maximum aggregate size, etc., as well as its inherent disadvantages are the main reasons that the process of cracks formation in concrete and their subsequent growth up to failure is complex. The usage of fracture mechanics helps to better understand this process.

Probabilistic fracture mechanics (PFM) is becoming more and more popular for realistic assessment of the fracture response and reliability of structures. However, the application of stochastic nonlinear computational mechanics to real world applications faces a major impediment as detailed information is lacking on the stochastic properties of the material parameters related to the problem.

The paper presents the results of analysis concerning an evolution of the fracture process developing in the fibro-concrete specimens subjected to several types of mechanical tests. The results elaborated in the form of probability distributions and force - CMOD curves enabled to check suitability of the stochastic constitutive models with special emphasis of taking into account the random nature of the parameters describing the material tested and the analysis of cross-correlation of these parameters.

For experimental research mixture of 380 kg/m3 cement by 0.44 w/c ratio was prepared. Fraction of river sand of 0-2 mm and natural gravel fraction of 2-8 mm were used. The sand point was established to be SP=37% that allowed the aggregate grading curves to fit between the boundary curves. Superplasticizer Atlas Duruflow PE-220 and VMA admixture Atlas Duruflow VM-500 were used according to PN-EN 934-2. Steel fibers of 0.8 mm diameter and 40 mm length were used. The compressive strength tests were conducted on 100 mm cubic specimens after either 28 or 134 days of hardening. The tests were carried out in accordance with PN-EN 12390-3 by using a ToniTechnik instrument of 3000 kN compression force capacity. The flexural strength tests were conducted on the beams with dimensions of 500x100x100 mm after 134 days of hardening. The tests were carried out in accordance with PN-EN 12390-5 by using a Matest instrument of 300 kN compression force capacity. The rate of loading was maintained at 0.5 MPa/s for compressive strength tests and at 0.05 MPa/s for tensile splitting strength tests.