World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:10, No:06, 2016

Investigation of Crack Formation in Ordinary Reinforced Concrete Beams and in Beams Strengthened with Carbon Fiber Sheet: Theory and Experiment

Authors : Anton A. Bykov, Irina O. Glot, Igor N. Shardakov, Alexey P. Shestakov

Abstract : This paper presents the results of experimental and theoretical investigations of the mechanisms of crack formation in reinforced concrete beams subjected to quasi-static bending. The boundary-value problem has been formulated in the framework of brittle fracture mechanics and has been solved by using the finite-element method. Numerical simulation of the vibrations of an uncracked beam and a beam with cracks of different size serves to determine the pattern of changes in the spectrum of eigenfrequencies observed during crack evolution. Experiments were performed on the sequential quasistatic four-point bending of the beam leading to the formation of cracks in concrete. At each loading stage, the beam was subjected to an impulse load to induce vibrations. Two stages of cracking were detected. At the first stage the conservative process of deformation is realized. The second stage is an active cracking, which is marked by a sharp change in eingenfrequencies. The boundary of a transition from one stage to another is well registered. The vibration behavior was examined for the beams strengthened by carbon-fiber sheet before loading and at the intermediate stage of loading after the grouting of initial cracks. The obtained results show that the vibrodiagnostic approach is an effective tool for monitoring of cracking and for assessing the quality of measures aimed at strengthening concrete structures.

Keywords : crack formation, experiment, mathematical modeling, reinforced concrete, vibrodiagnostics
Conference Title : ICSM 2016 : International Conference on Solid Mechanics
Conference Location : Toronto, Canada
Conference Dates : June 13-14, 2016