International Journal of Mechanical Sciences
Volume 130, September 2017, Pages 487-496

An advanced continuum damage mechanics model for predicting the crack progress process based on the consideration of the influence of crack direction under quasi-static load

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https://doi.org/10.1016/j.ijmecsci.2017.05.021

Abstract

In reality the wrong crack path can be generally obtained in the case of arbitrary crack propagation by traditional continuum damage mechanics (CDM). In this paper a novel advanced continuum damage mechanics (ACDM) method is proposed, which can predict the crack propagation and fracture behavior correctly for the structures. The material property degradation method, which is usually used when simulating the structures within the framework of CDM, is advanced based on considering the influence of crack direction. The maximum tensile stress criterion is used to predict the damage initiation and crack propagation direction and the advanced CDM used to predict the damage evolution process in meso-level under the quasi-static load. It can directly evaluate the propagation process of the discrete crack and the fracture strength for structures using the continuum model as well as not using discontinuum model. The algorithm for the application of our advanced CDM theory in the numerical simulation based on finite element method (FEM) is presented. ACDM model is not only a simple and useful model which can easily be used in FEM framework but also a phenomenological model based on the concept of crack propagation. The simulation results by our ACDM are compared with the experiment results and the ones and from cohesive zone method and extended finite element method for good agreements to be achieved.

Graphical abstract