New Ways to Look at Fracture Processes in Concrete

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Abstract

The Fracture Process Zone (FPZ) is a common device for representing a variety of energy dissipation mechanisms in quasi-brittle materials. As a modeling device, it is a convenient way to represent the many different microstructure features that add toughness in the vicinity of the crack tip. In some applications it is enough for us simply to know the total contribution from all the different mechanisms. However, in other applications it could be extremely useful to better know the relative contribution of the different effects. For example, in the case of fiber reinforced concrete, it may be desirable to have quantitative information on the specific contribution of the fibers. Using x-ray computed tomography, combined with simple micro-mechanical information, we are in a position to measure specific toughening mechanisms in a way we have not been able to before. Quantitative 3D imaging techniques are allowing us to measure characteristics of fiber-crack interactions, pullout, as well as crack branching. Through these measurements, coupled with other interrogation techniques such as acoustic emission, we are able to trace the nature of damage progression through the development of a fracture process zone. Recent work is directed at validating models that are able to explicitly incorporate micro-mechanical information in such a way to enhance predictive simulation tools.

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