CASE SCHOOL OF ENGINEERING
CASE WESTERN RESERVE UNIVERSITY

Department of Civil Engineering

Case Western Reserve University
Bingham Bldg. Room 208
10900 Euclid Ave
Cleveland, OH 44106

Department of Civil Engineering Seminar

ADVANCES IN THE KNOWLEDGE OF FRACTURE PROPERTIES OF QUASIBRITTLE MATERIALS

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Friday November 8, 2019, 12:45-1:45PM @ Bingham 103
Lunch and discussion at 12:00PM at Bingham 102 (Vose Room)

Abstract

Concrete, artificial and natural stones, composites, and ceramics are considered *quasibrittle* materials. A quasibrittle material exhibits a softening response after the initial linear elastic branch when, for example, a three-point bending (TPB) fracture test is performed. The concept of quasibrittle material is deeply related to the concept of *cohesive crack* and *crack band* models. In the cohesive crack model, the crack is a zero-width line that opens by an amount w while still transferring stresses σ between the two faces of the crack until w, which is known as the *crack opening*, reaches a critical value w_c. The fracture properties of quasibrittle materials can be defined in different ways depending on the model adopted. The cohesive crack model is well accepted and widely-used in the research and engineering communities. It requires the definition of the *softening function* $\sigma=f(w)$. The area under the $f(w)$ curve is the fracture energy G_F. In addition, the shape and size of the area ahead of the initial crack tip that exhibits softening behavior, typically called *fracture process zone* (FPZ), is an important ingredient of the model because it can be used to predict to what extent structural elements made of a given quasibrittle material exhibit size effect that deviates from the one predicted by linear elastic fracture mechanics (LEFM). Experimental studies on the fracture properties of quasibrittle materials are abundant in the literature. The fracture energy can be easily determined by employing the concept of work of fracture. The experimental determination of the size of the FPZ and the value of w_c is not trivial. In recent years, digital image correlation (DIC) has been employed in attempt to gain information in this regards, although the results are questionable. This seminar explores some open issues in the determination of the fracture properties of quasibrittle materials such as the size of the FPZ, the shape of the softening function, the effect of the geometry of the specimen, and the significance of fracture energy.

BIO: CHRISTIAN CARLONI is an Associate Professor in the Department of Civil Engineering at Case Western Reserve University. Prior to joining Case Western Reserve University, Carloni was an Associate Professor at the University of Bologna (2015-2018) and University of Hartford - U.S.A. (2008-2014) and an Assistant Professor at the University of Bologna (Italy) (2004-2008). Carloni is a structural engineer with research interests in fracture mechanics, masonry structures, and composites materials. Dr. Carloni is chair of the ACI/ASCE joint committee 446 – Fracture Mechanics of Concrete. He is also member of ACI Committee 549 – Thin Reinforced Cementitious Products and Ferrocement and ASTM D30.10 Technical Committee – Composite Materials. Carloni is Member of the Editorial Board of Journal of Composites for Construction