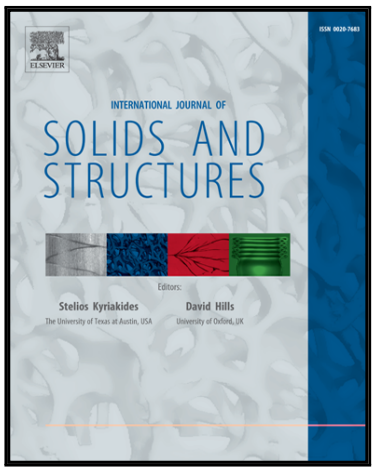

Micro-crack damage in strip of fracture process zone

Wang Limin , Li Xia , Xu Shilang , Wang Haiying , Zhang Zhaojun

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Micro-crack damage in strip of fracture process zone

Wang Limin[1)], Li Xia[1)], Xu Shilang*[2)], Wang Haiying[3)], Zhang Zhaojun[1)]

1. Science School, Qingdao University of Technology，Qingdao Shandong, 266033 China;
2. College of Civil Engineering and Architecture, Zhejiang University, Yuhangtang Road 866,Hangzhou,310058 China;
3. LNM of the Institute of Mechanics, Chinese Academy Sciences, Beijing 100190，China

*Corresponding author: Xu Shilang: 86-571-88981950，slxu@zju.edu.cn；or (Wang L)wanglimin@qut.edu.cn

Abstract：Damage and fracture of quasi-brittle materials are non-reversible processes of micro-defects and micro-cracks, often accompanied by a strip of micro-crack damage along the end of the macro-crack or gap. In this work, the micro-crack damage parameters in the strip are calculated, and a mechanics model is proposed to analyze the relation between deformation and force. The mechanics parameters are also determined using meso-mechanics homogenization of the damage zone of the micro-crack strip. Then, calculations of the deformation and stress in the damage strip are introduced, and the damage factor is estimated using a cohesive crack model. Finally, the relationship between the micro-crack and macro-fracture zone is correlated to electron microscopy data of a cast iron specimen and numerical results. For the damage factor, damage density, and geometrical factors of micro-cracks, the meso-mechanics scale is correlated to macro-mechanics in the damage fracture process zone by combining the homogenization method and cohesive crack model of nonlinear fracture.

Key Words：Quasi-brittle materials; Micro-crack；Damage factor; Fracture process zone; Multi-scale mechanics；Cohesive crack model

1.Introduction

The failure of engineering materials is affected by many factors, especially the strength and durability of the material. Therefore, evaluation of the stress and deformation, structural bearing capacity, and damage fracture are critical（Roth, Hütter, Kuna 2014; Hertzberg, 1996）. With the gradual improvement of modern characterization tools, the visual resolution of material deformation as a function of force can now be finely tuned. The meso-mechanics theories developed over the past dozens of years have laid a solid foundation for the study of material behavior（Yang and Lee,1993; Carpinteri, Cornetti, Puzzi, 2006; Zhou and Li, 2014）. With improvements of