MONITORING AND MODELLING OF PROPAGATION PATHS IN CRACKED SOLIDS

RESEARCH GROUP: Christian Carloni, Elena Ferretti, Giovanni Pascale, Erasmo Viola
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The monitoring of existing cracks can be performed by means of several non-destructive techniques. A part of the research activity has been dedicated to new techniques for SHM (structural health monitoring), with particular regard to the assessment of externally bonded FRP (fiber reinforced polymer) strengthening systems. The use of FOS (fiber optic sensors) has been taken into account, and some new applications have been developed. A ultrasonic technique has been proposed for detecting defects at the concrete-FRP interface. Defining the crack path numerically is not easy, due to several unknowns: if the direction of crack propagation can be computed by means of one of the existing criteria, it is not known whether this direction will remain constant during crack propagation. A crack initiation leads to an enhanced stress field at crack tip, which propagates into the solid during propagation, locally interacting with the pre-existing stress field. This interaction can lead to modifications of the propagation direction or crack arrest. A numerical code for use with the CM has been developed which returns accurate crack paths for brittle and non-brittle cracks. The CM code has been employed for modelling crack propagation in concrete and masonry.
The main advantage of using the CM for numerical analyses of masonry is that mortar, bricks and interfaces between mortar and bricks can be modelled without any need to use homogenization techniques.
The capability of the CM to handle domains with more than one material has been exploited to capture how the propagation direction changes when the crack overcome the joints or passes from the brick to the interface and to the mortar.
Further, an optical technique known as digital image correlation has been used to monitor the crack initiation and propagation in toughness tests of brittle materials and debonding of composite materials from concrete and masonry.

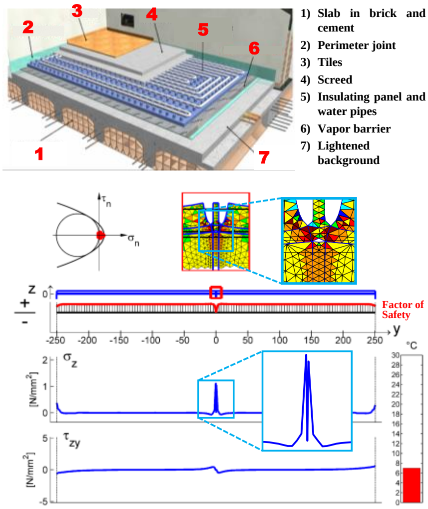

Fig. 1. Tiles separation in radiant heat floors (Ferretti).

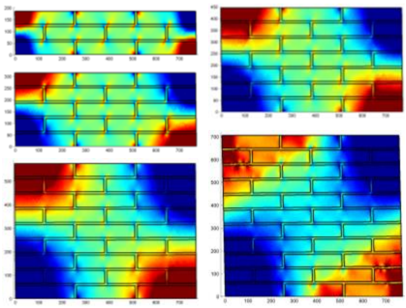

Fig. 2. Stress field for masonry wall in shear-test (Ferretti).

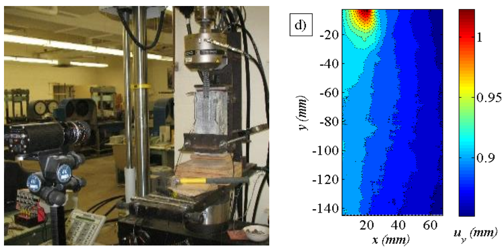

Fig. 3. Crack propagation at the interface between fiber reinforced polymer composite and concrete (Carloni).

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RESEARCH PROJECTS

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LINKS AND CONTACTS

christian.carloni@unibo.it

elena.ferretti2@unibo.it

www.dicam.unibo.it/DICAM/Risorse e strutture/Laboratori