

## Invitation to Seminar

- **A Variational Approach to Ductile Damage**

In this presentation a variational model based on incremental energy minimization is described that captures the evolution of damage in ductile materials. The model accounts for local and gradient damage energies, and the evolution of displacement and damage fields is governed by an incremental energy minimization problem, analytically solved in a special one-dimensional case. Attention is paid to the properties that the damage energy must have in order that specific failure modes are reproduced. In particular, two failure modes are considered: *localized damage*, consisting in a stress-softening process characterized by damage localization in thin body portions and coalescing in fracture surfaces, and *diffuse damage*, which is a stress-hardening process, with damage spreading in large zones of the body. The former mechanism is typical of brittle and quasi-brittle materials, while the latter one distinguishes ductile materials.

The model is applied to the study of fiber-reinforced concrete, which exhibits a large ductility, absent in conventional concretes, which is due to the presence of fibers contributing to diffuse stresses. As a result, the material response is characterized by a quite long stress-hardening phase, in which diffuse micro-cracks appear. Afterwards, strains localize and coalesce in macro-cracks. Numerical simulations are presented, which reproduce failure modes in tensile tests and three-point bending tests.

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Prof. Giovanni Lancioni received a Master Degree in Civil Engineering in 1997 at the University of Ancona (Italy) and completed a Ph.D. in Structural Engineering in 2002 at the University of Rome "Tor Vergata" (Italy). Since 2006, he has been a researcher at Università Politecnica delle Marche of Ancona (Italy). His research interests include formulation and numerical implementation of variational theories for fracture, damage mechanics and plasticity, structural theories of plates, non-linear and non-smooth dynamics, with applications to structural problems as wave propagation in beams on unilateral substrates, assessment of the seismic vulnerability of ancient stone structures and systems with friction and impact.

**Wednesday 31 January 2018, 12.00pm-12.45pm**

**Room A401 Engineering Building**