Strain gradient approach for quasi-brittle failure

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Quasi-brittle failure is characterised by the evolution of damage prior to final collapse, and exhibits strong size effects. Hence, a continuum approach for describing quasi-brittle failure must capture deterministic size effects, it must account for damage evolution, and last but not least, softening induced by the evolution of damage must not lead to spurious results. These requirements can be accomplished only by models derived from a generalised continuum theory.

We discuss particular aspects of a methodology for deriving such model, which can be summarised as follows:

- The strain energy density for the effective generalised continuum has to be provided for the pure elastic response, preferably by some homogenisation scheme.
- Based on the elastic strain energy density, a damage potential can be derived using the standard continuum thermodynamics scheme with internal variables.
- The evolution equations for the internal variables have to be specified.

Here, we focus on generalized continua derived from a strain gradient approach. The methodology is illustrated for porous elastic solids, i.e., materials, the micro-structure of which consists of voids surrounded by an elastic matrix.