Gradient-damage theories for fracture of (i) quasi-brittle materials (ii) elastomeric materials

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A gradient-damage theory for fracture of quasi-brittle materials

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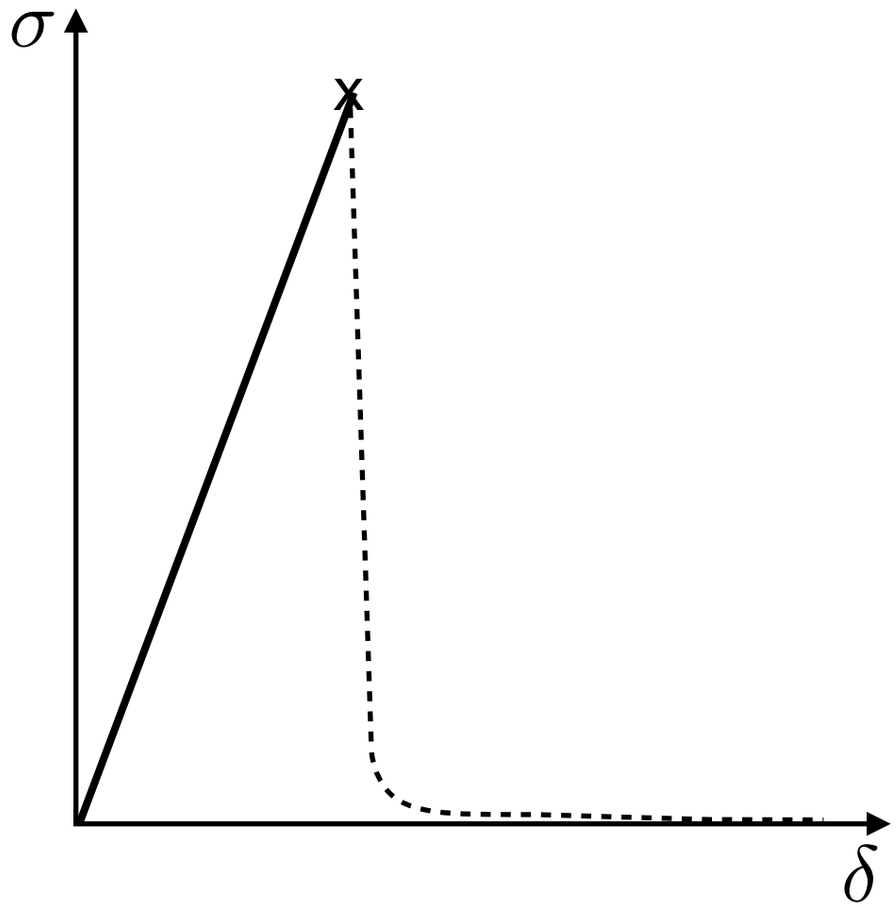
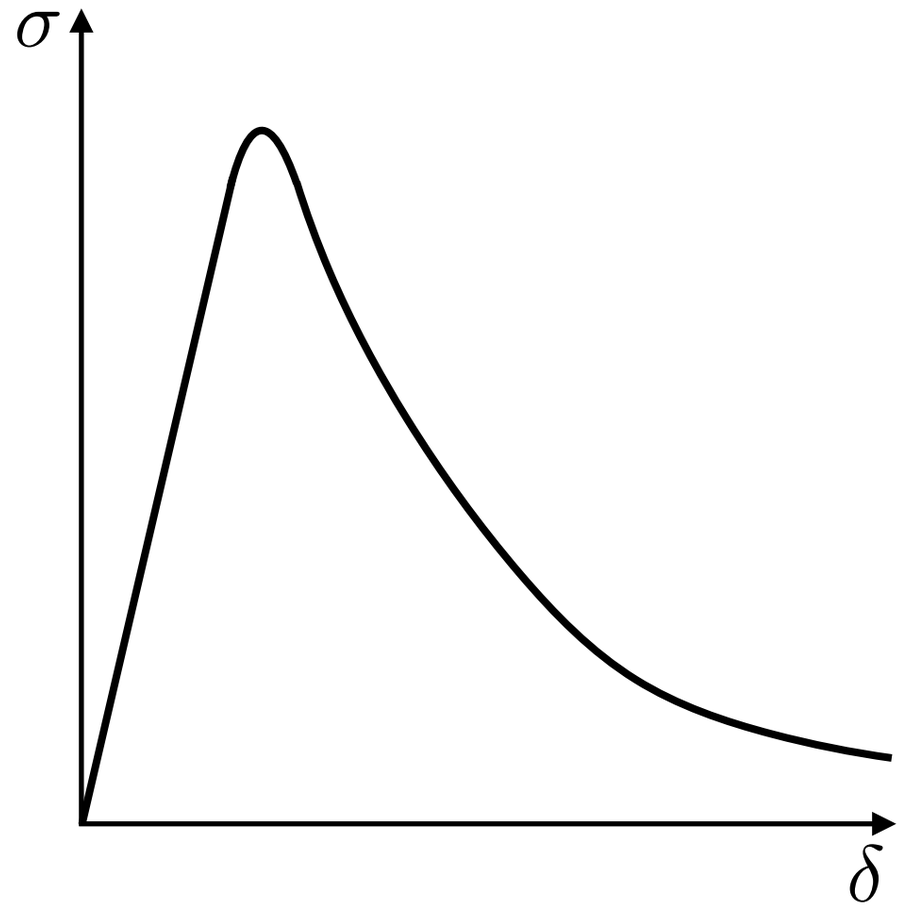
Brittle versus Quasi-brittle

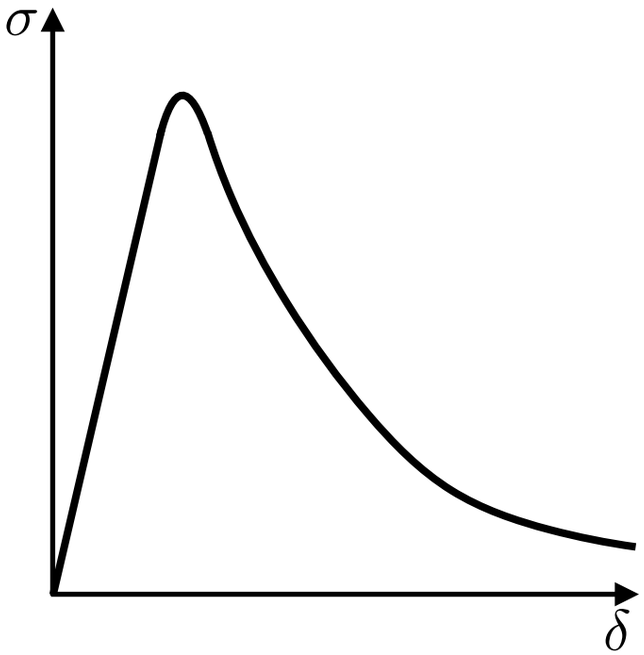


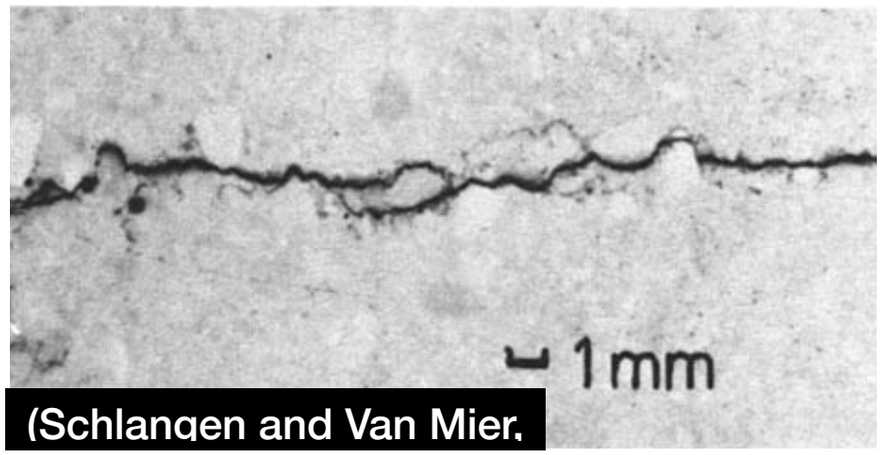
- Brittle
  - abrupt loss of stress-carrying capacity
  - very low toughness
  - e.g. soda-lime glass



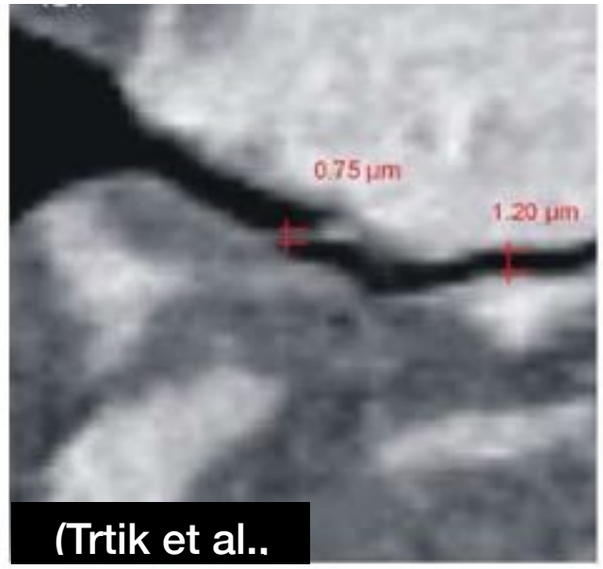
- Quasi-brittle
  - progressive damage with strain-softening
  - e.g. concrete

Crack-face bridging in concrete





(Schlangen and Van Mier,



(Trtik et al.,

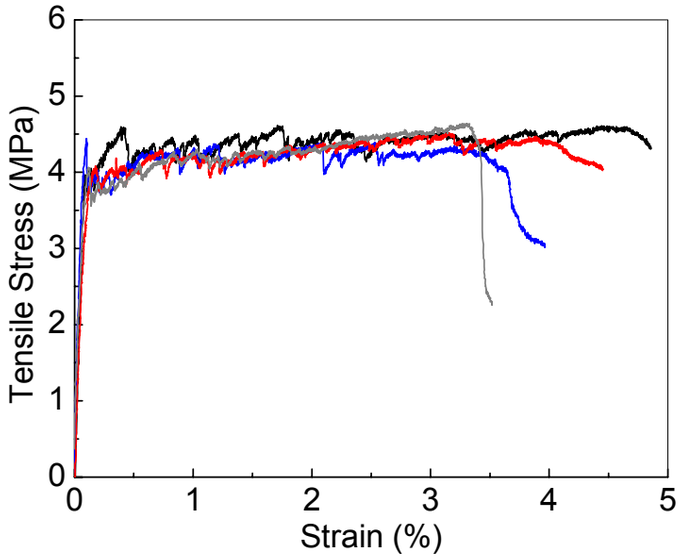
- Quasi-brittle
  - progressive damage with strain-softening
  - e.g. concrete

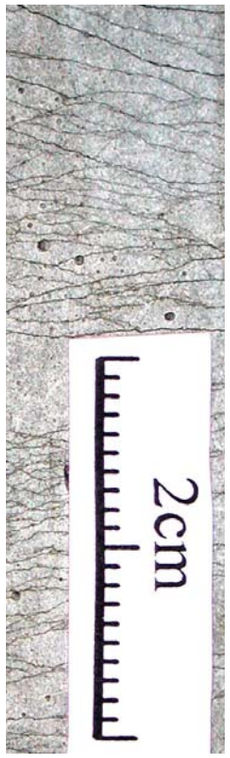
- Crack face bridging by aggregate particles in a concrete specimen observed by fluorescent-epoxy-impregnation.

- Micro-tomography studies reveal similar bridging mechanisms at a much finer length scale in micro-tension specimens of Portland cement, one of the constituents of concrete.

- The toughness of concrete is attributed to **crack-face bridging**.

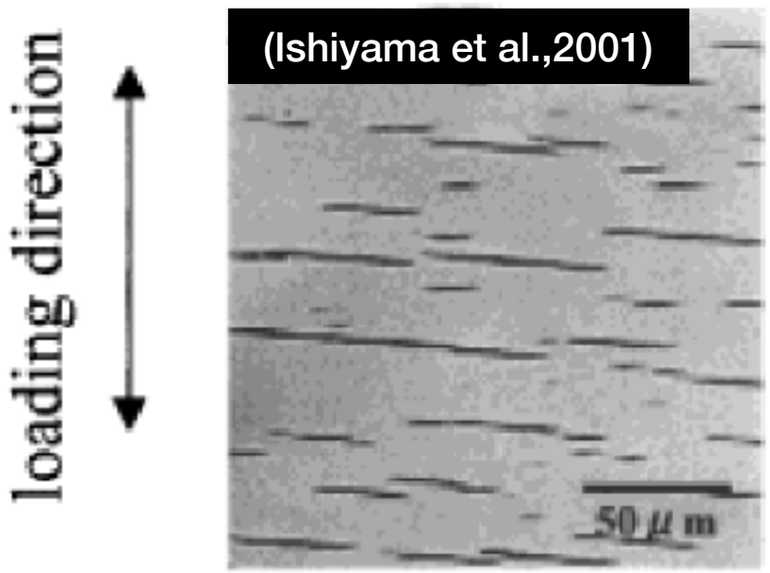
Crack-face bridging: fiber-reinforced concrete and PMMA

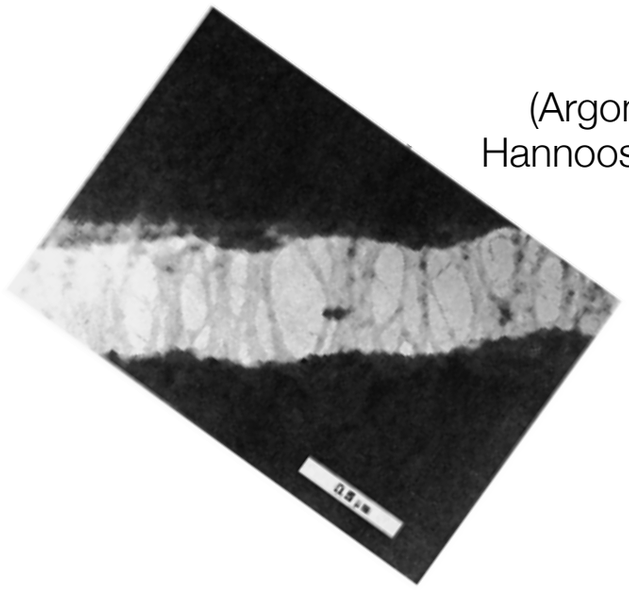




(Wang and Li, 2004)

- Fiber reinforced cementitious composite subjected to tension:
  - Engineering stress-strain curves.
  - Microcracks with bridging fibers normal to loading direction.





(Argon and Hannoosh,1977)

- Craze formation normal to the loading direction in PMMA.
- Bridging of craze faces with polymer fibrils in a polystyrene specimen.