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From the onset of damage to rupture: construction of responses with damage localization for a general class of gradient damage models. (English) Zbl 1343.74004

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Summary: We propose a construction method of non-homogeneous solutions for the traction problem of an elastic damaging bar. This bar has a softening behavior that obeys a gradient damaged model. The method is applicable for a wide range of brittle materials. For sufficiently long bars, we show that localization arises on sets whose length is proportional to the material internal length and with a profile that is also a material characteristic. From its onset until the rupture, the damage profile is obtained either in a closed form or after a simple numerical integration depending on the model. Thus, the proposed method provides definitions for the critical stress and fracture energy that can be compared with experimental results. We finally discuss some features of the global behavior of the bar such as the possibility of a snapback at the onset of damage. We point out the sensitivity of the responses to the parameters of the damage law. All these theoretical considerations are illustrated by numerical examples.

MSC:

74A45 Theories of fracture and damage
74R99 Fracture and damage

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Keywords:

damage; gradient theory; localization; variational approach

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