Localization of Plastic Deformation and Size Effects

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ABSTRACT

Localization, in the sense of a deformation pattern involving one or more intense deformation bands, is observed in a wide variety of solids and under a wide variety of loading conditions. Such localizations can be of significance as a precursor to fracture as well as being a mechanism of plastic deformation. Although the deformation bands are sharp, they do have a finite thickness and this thickness plays a key role in setting the associated energy dissipation. Hence, computational modeling of localization and its implications for fracture needs to contain a length scale. Such length scales are inherent to a mesoscale modeling framework such as dislocation dynamics. On the other hand, in a continuum analysis, a length scale needs to be introduced, through the constitutive relation and/or through a material or geometric heterogeneity. A variety of frameworks for introducing a length scale into continuum analyses have been proposed, but not all adequately model the size effects associated with localization of plastic deformation. Some examples of analyses, using both mesoscale and continuum modeling frameworks, of deformation and fracture processes where localization of plastic deformation plays an important role will be discussed, e.g. [1, 2, 3]. Both quasi-static and dynamic loading conditions will be considered. Needs and opportunities for improved computational modeling of localization of plastic deformation will be mentioned.

REFERENCES

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