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Energy Dissipation Analysis of Elastic-Plastic Materials

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Abstract

Presented is an energy dissipation analysis framework for granular material that is based on thermodynamics. Theoretical formulations are derived from the second law of thermodynamics, in conjunction with a few plausible assumptions on energy transformation and dissipation. The role of plastic free energy is emphasized by a conceptual experiment showing its physical nature. Theoretical formulation is adapted in order to be applied in elastic-plastic finite element method (FEM) simulations. Developed methodology is verified through comparison of input work, stored energy, and energy dissipation of the system. Separation of plastic work into plastic free energy and energy dissipation removes a common mistake, made in a number of publications, where energy dissipation can attain negative values (energy production) which is impossible.

Keywords: Seismic energy dissipation, FEM, Computational geomechanics, Thermodynamics, Elastic-plastic materials, Plastic free energy

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