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ON PROBABILISTIC YIELDING OF (GEO–)MATERIALS

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ABSTRACT

Uncertainty in material properties can have large effect on numerical modeling of solids and structures. This is particularly true for geomaterials which exhibit high variabilities in measured properties. We recently developed ([1],[2],[3]) second order accurate solution for probabilistic elastic–plastic problem for general elastic–plastic constitutive equation with uncertain material properties. The methodology was based on the solution of the Fokker-Planck-Kolmogorov equation (FPKE), by writing the constitutive equation in the probability density space and then solving for the probability densities of stress directly. The developed methodology was based on mean yielding criteria to make the separation between elastic and elastic–plastic regions.

In this study we develop a methodology that accounts for probabilistic yielding of elastic–plastic materials. Probability weights, based on cumulative density function of yield function (stress) are applied to the elastic and elastic-plastic regions and the the resulting FPKE is solved once to obtain the complete material response. Developed methodology is demonstrated on von Mises and Drucker–Prager material models with uncertain elastic and elastic–plastic material parameters as well as uncertain yield behavior. Results show that the most likely response (mode) is different than the mean and/or deterministic solutions. In addition to that, smooth response (mode and mean) is observed even for (bi–linear) material models featuring elastic – linear hardening elastic–plastic response.

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