LESSONS LEARNED FROM RIGID PLASTIC FAILURE ANALYSIS OF THIN LAYERS

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After a brief review of the classical theorems of Limit Load and Shakedown Analysis two model problems are examined in the light of computational plasticity based on traditional non-polar Boltzmannn and micropolar Cosserat continuum theories:
(a) the classical Prandtl problem of thin plastic layers between rough platens subject to compression and shearing which is explored from the standpoint of cohesive interface formulations of zero thickness rather than finite thickness, and
(b) the failure behavior of cylinders between rough platens which is studied from the standpoint of testing mortar specimens with different aspect ratios in axial compression and tension.
For both problems upper bound solutions are available from the theory of yield line theory in plane strain and axisymmetric geometries.
First the analytical rigid plastic solutions are revisited and compared with elastic-perfectly plastic von Mises solutions of polar and non-polar plasticity. In sequel the issue of localization is examined to address the question of critical hardening softening when discontinuous bifurcation initiates which corresponds to the formation of slip lines in rigid plasticity. The issue of failure in tension-shear vs. compression-shear is introduced by considering pressure sensitive extensions of the von Mises yield condition and the plastic flow rule. In the final stage the question of geometric shape is addressed considering test articles with different aspect ratios and different sizes in the context of degenerating the thin plastic layer to a zero-thickness cohesive interface model.

References:
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