Non-linear programming in shakedown analysis with plasticity and friction

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Non-linear programming in shakedown analysis with plasticity and friction

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Abstract

Complete frictional contacts, when subjected to cyclic loading, may sometimes develop a favourable situation where slip ceases after a few cycles, an occurrence commonly known as *frictional shakedown*. Its resemblance to shakedown in plasticity has prompted scholars to apply direct methods, derived from the classical theorems of limit analysis, in order to assess a safe limit to the external loads applied on the system. In circumstances where zones of plastic deformation develop in the material (e.g., because of the large stress concentrations near the sharp edges of a complete contact), it is reasonable to expect an effect of mutual interaction of frictional slip and plastic strains on the load limit below which the global behaviour is non dissipative, i.e., both slip and plastic strains go to zero after some dissipative load cycles. In this paper, shakedown of general two-dimensional discrete systems, involving both friction and plasticity, is discussed and the shakedown limit load is calculated using a non-linear programming algorithm based on the static theorem of limit analysis. An illustrative example related to an elastic-plastic solid containing a frictional crack is provided.

Keywords: limit analysis, shakedown, complete contact, friction, non-linear programming

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