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Direct plastic structural design by chance constrained programming

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In a CISM course direct plastic design of structures has been proposed with probabilistic and fuzzy modelling of uncertainties [1], [2]. Both use limit analysis which determines the plastic collapse load under monotonic loading by linear programming if the Tresca yield function is assumed. The probabilistic model can be modelled by chance constrained programming. Only a normal distribution has been assumed so that an equivalent deterministic problem could be formulated. The methods found little attention because of the numerical difficulties of chance constrained programs for realistic distributions.
We have generalized the approach to shakedown analysis for plastic design under time-variant loading and could show how it relates to the methods of structural reliability. The more realistic von Mises yield function is assumed which leads to nonlinear programming. First we have considered only uncertain material data [3], [4]. The approach has been still restricted to normal distributions which are not well suited to material strength which is non-negative.
The present contribution includes uncertain loading and a more realistic distribution for uncertain strength data. The duality of the primal and dual program is used to derive deterministic equivalents. An outlook to open problems, further developments and alternative approaches is given.

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