Finite Element Reliability of Two Dimensional Continua with Geometrical Nonlinearity

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**Abstract:**

First and second-order reliability methods and the finite-element method are combined into a general methodology for reliability analysis of complex structures with uncertain characteristics and subjected to random loads. Application of the methodology to geometrically nonlinear, elastic 2D continua with random field properties and static loads is presented. The formulation employs newly derived analytical expressions for the response gradient of geometrically nonlinear continua. Example results for a plate with random field properties and geometry are presented, which illustrate the influence of correlation lengths on the plate reliability, and the sensitivities of the reliability with respect to various parameters.

**Subject Headings:** Finite element method | Geometrics | Sensitivity analysis | Plates | Two-dimensional analysis | Structural reliability | Structural members | Nonlinear analysis

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Material and geometrical nonlinear analysis of a circular concrete-filled steel tube is performed with a three-dimensional degenerated beam element, which can efficiently obtain the structural nonlinear responses. Through the combination of first order reliability method and nonlinear finite element analysis, the reliability about ultimate resistance capacity of the concrete-filled steel tube is investigated. Some conclusions obtained from reliability analysis may be beneficial for rational analysis and design of the concrete-filled steel tube in practical engineering structures.