Towards nonlinear reliability assessment of concrete transport structures

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Abstract

Novel technique combining non-linear finite element analysis of the structural model with advanced stochastic simulation methods for realistic computer simulation and reliability assessment of civil engineering structures is presented. Elite non-linear material models are used for modelling of the structural materials within an advanced finite element computer simulation. Material properties and corresponding model parameters including their randomness and uncertainties are represented as random variables or random fields in the stochastic simulation using stratified Latin Hypercube Sampling and Simulated Annealing methods. Probabilistic evaluation of the numerical results enables to assess stochastic parameters of the model response, structural resistance, failure probability, safety index and structural reliability.

Keywords: concrete; material models; reliability; computational methods; engineering structures.

1 Introduction

The non-linear finite element analysis is nowadays used by engineers for design of new and assessment of existing engineering structures. This development is recently well supported by the new ***fib*** Model Code 2010 [1], where a rational safety assessment approach is presented. It reflects the recent developments in safety formats based on probabilistic methods. In the Chapter 4 on "Principles of structural design" the probabilistic safety format is introduced as a general and rational basis of safety evaluation. In addition to the partial factor safety concept (which remains as the main safety format for most practical cases) a global resistance format is recommended for nonlinear analysis. This concept can be applied in design and assessment of engineering structures and can offer advanced and rational solutions to modern structural technologies [2].

The fully probabilistic approach represents the most accurate method for the safety assessment

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