INTEGRATED APPROACH TO PROBABILISTIC NONLINEAR ASSESSMENT OF CONCRETE BRIDGES

Drahomír Novák[1], David Lehký[1], Radomír Pukl[2], Ondřej Slowik[1], Lukáš Novák[1]

[1] Institute of Structural Mechanics, Faculty of Civil Engineering, Brno University of Technology, Veveri 95, 602 00 Brno, Czech Republic, novak.d@fce.vutbr.cz, https://www.fce.vutbr.cz/en/
[2] Cervenka Consulting, Na Hřebenkách 55, 150 00 Praha 5, Czech Republic, radomir.pukl@cervenka.cz, https://www.cervenka.cz/

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Consideration of uncertainties in bridge structural engineering is a growing topic because it provides valuable information on the reliability of bridges in time while addressing life-cycle aspects. Utilization of nonlinear finite element method (NLFEM) and Monte Carlo (MC) type simulation is essential for modelling of the concrete bridge random behaviour and its reliability assessments. Generally, a physical problem can be represented by a mathematical model, which depends on input parameters (material characteristics, geometry, etc.). The aim of the stochastic analysis is to propagate uncertainties through a mathematical model in order to gain statistical information from the output as well as information about the sensitivity of the mathematical model to uncertainties in input variables. However, in bridge engineering, the mathematical model can be quite complex and uncertainty propagation solved by classical MC approach is very difficult to perform as MC type simulation involves large number of numerical evaluations of structural response. Therefore, advanced statistical and reliability techniques have to be applied. Authors and their co-workers were active in this field combining nonlinear analysis and reliability approaches for concrete structures, e.g. [1-3]. During development an urgent need for efficient combination of several approaches and methods appeared. It includes following topics relevant to bridge assessment: Nonlinear FEM analysis, uncertainties propagation, reliability analysis, sensitivity analysis, parameters identification, model updating, surrogate modelling, material degradation aspects. Recently a node software architecture for software combination has been proposed which enables a large flexibility in both research and application [4]. The paper describes methodology of such integrated approach for a routine complex assessment utilizing developed software tools and practical application of the approach for selected case studies of concrete bridges from Czech Republic.

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