Politechnika Łódzka
Wydział Budownictwa, Architektury i Inżynierii Środowiska

Summary of the doctoral thesis titled:
"Dynamic structural reliability index estimation of steel skeletal and cable structures"

The principle aim of this work is to establish an accurate and efficient method of dynamic reliability index assessment of chosen engineering structures. This work puts focus on steel structures specifically as their slenderness points out possible vibration issues. Three exemplary structures have been involved in this work representing different types of steel structures namely guyed steel mast, steel hall with tapered mainframes, and also steel skeletal tower. Input probabilistic parameters are Gaussian and they represent uncertain design parameters of both mechanical and environmental nature such as wind velocity, snow cover thickness, thickness of profile walls, subsoil rigidity, elastic moduli, or weight of some structural equipment. The analysis includes 1) performing static analysis of each of the investigated structures to find elements that utilize most of their admissible bearing capacity concerning Ultimate Limit State (ULS) and also nodes for which displacements and/or rotations also utilize mostly its limit in Serviceability Limit State (SLS), 2) perform stochastic dynamic analysis with some time-varying wind excitation described in a 10-minutes time interval and recover discrete values of structural responses at each time step of computations repeatedly for multiple realizations of each uncertain parameter, 3) export recovered dynamic structural responses into *comma separated value* files format (**.csv*), 4) import these recovered responses into an algorithm created in algebra system Maple 2019 in which Structural Response Functions (SRF/SRFs plural) are being created. Structural Response Functions have been approximated in polynomial form by the Weighted Least Squares Method with weight functions of triangular distribution, 5) performing the probabilistic estimation of structural responses for each discrete time step to asses and create a dynamic reliability index spectrum. The probabilistic approach utilizes the Iterative Stochastic Perturbation approach and it is contrasted with Monte-Carlo simulations and the Semi-Analytical approach which also extracts probabilistic values of structural response based on the same SRF to verify and visualize the expected accuracy of proposed here Iterative Stochastic Perturbation Technique. Probabilistic characteristics under investigation consist of expected values and coefficient of variation which directly finds its outcome in reliability index estimation introduced in guidelines for the design of structures in the European Union namely *Eurocodes*.

Rafał Grzelak

90-924 Łódź, al. Politechniki 6
tel. (+48 42) 631 35 00
e-mail: deanarch@p.lodz.pl, www.p.lodz.pl