9th World Congress on Computational Mechanics (WCCM)
4th Asian Pacific Congress on Computational Mechanics (APCOM)
July 19 – July 23, 2010
Sydney, Australia

MINI-SYMPOSIUM (session code: MS 7081)

UNCERTAINTY AND ROBUSTNESS IN STRUCTURAL ANALYSIS AND DESIGN

MICHAEL BEER[*], HÉCTOR A. JENSEN[†] AND GERHART I. SCHUËLLER[#]

[*] National University of Singapore, Dept. of Civil Engineering,
BLK E1A #07-03, 1 Engineering Drive 2, Singapore 117576, Singapore, cvebm@nus.edu.sg

[†] University Federico Santa Maria, Dept. of Civil Engineering,
Casilla: 110-V, Av. Los Placeres 401, Valparaiso, Chile, hector.jensen@usm.cl

[#] University of Innsbruck, Institute of Engineering Mechanics,
Technikerstrasse 13, 6020 Innsbruck, Austria, EU, Mechanik@uibk.ac.at

Key words: Robust Design, Performance-based Design, Reliability-based Design, Structural Reliability, Uncertainty Quantification, Decision-making, Numerical Efficiency

ABSTRACT

Structural design requires pivotal engineering decisions, typically, under considerable uncertainty. In early design stages the available information is quite limited. This applies not only to the structural characteristics, load parameters and boundary conditions but also to the computational model. The extent and the diverse character of the uncertainty cause severe problems in numerical modeling. A significant amount of subjectivity and experience is thus involved in the design decisions. But the numerical predictions of the structural performance are indispensible to verify all requirements on structural responses and reliability. This is fundamental to avoid severe consequences which may be fatal and later changes in design which may be costly. Developments are, thus, focused on numerical procedures to identify a structural design which is robust with respect to the entire portfolio of uncertainty. The target design is supposed to be resistant in the sense that structural performance and structural reliability are only marginally affected by fluctuations, changes and imprecision of parameters and that the numerical predictions are reliable despite uncertainty in the numerical models. Solutions developed in a stochastic environment, which are known as reliability-based design, are already quite advanced. Future challenges concern extensions and improvements in view of practical applicability to industrial problem solution.

This mini-symposium is focused on concepts and numerical methods to identify robust solutions in structural design in view of future challenges. Contributions are invited with emphasis on both theory and applications. Topics may address open problems such as the definition of robustness and the incorporation of extreme and unforeseen events in the analysis. Uncertainty models and strategies for incorporating expert knowledge may include traditional statistics and probability theory, Bayesian theory, imprecise probabilities with its various branches such as evidence theory or fuzzy probability

theory, interval analysis, fuzzy set theory, information gap theory, etc. Design strategies may be based on one-step or multi-step approaches, iterative schemes, set theory or may directly approach the inverse problem. Methods of structural health monitoring and system identification may be discussed, for example, for verification purposes. Particular attention should be paid to the numerical efficiency of the discussed approaches for robust design.