Seismic Design Optimization of Steel Structures Considering Uncertainties

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ABSTRACT

Due to the inherent characteristics of nature, uncertainties appear in every real-world engineering application playing a significant role. In structural optimization problems, stochastic performance measures can be taken into account using two distinct formulations, namely Robust Design Optimization (RDO) and Reliability-Based Design Optimization (RBDO).

According to a RDO formulation it is desired to obtain optimal designs that are insensitive to the variance of the probabilistic input parameters. In the present study, the solution of a structural robust design problem formulated as a multi-objective optimization problem is addressed, where material properties, cross-sectional dimensions and earthquake loading are considered as random variables.

Additionally, a multi-objective Deterministic-Based Optimization (DBO) problem, where uncertainties are ignored, is also considered. The main objectives of this study are: (i) to compare the two-objective Deterministic-Based Optimization (DBO) formulation with the RDO one and (ii) to verify the value of the behaviour factor q that the Greek national seismic design code (EAK (2000)) suggests for the design of steel building structures [1].

The Nondominated Sorting Genetic Algorithm II (NSGA-II), where the Genetic Algorithm is replaced by mixed-discrete Evolution Strategies (ES), is used for the solution of the multi-objective optimization problem at hand while the stochastic finite element problem is solved using the Monte Carlo Simulation method.

References

[1] Lagaros, N.D., Papadrakakis, M. Robust seismic design optimization of steel structures, *Str. Mult. Opt.*, to appear, 2007.