

## Meta Model for Optimum Design Objective Function of Steel Frames Subjected to Seismic Loads

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**Abstract :** Except for simple problems of statically determinate structures, optimum design problems in structural engineering have implicit objective functions where structural analysis and design are essential within each searching loop. With these implicit functions, the structural engineer is usually enforced to write his/her own computer code for analysis, design, and searching for optimum design among many feasible candidates and cannot take advantage of available software for structural analysis, design, and searching for the optimum solution. The meta-model is a regression model used to transform an implicit objective function into objective one and leads in turn to decouple the structural analysis and design processes from the optimum searching process. With the meta-model, well-known software for structural analysis and design can be used in sequence with optimum searching software. In this paper, the meta-model has been used to develop an explicit objective function for plane steel frames subjected to dead, live, and seismic forces. Frame topology is assumed as predefined based on architectural and functional requirements. Columns and beams sections and different connections details are the main design variables in this study. Columns and beams are grouped to reduce the number of design variables and to make the problem similar to that adopted in engineering practice. Data for the implicit objective function have been generated based on analysis and assessment for many design proposals with CSI SAP software. These data have been used later in SPSS software to develop a pure quadratic nonlinear regression model for the explicit objective function. Good correlations with a coefficient,  $R^2$ , in the range from 0.88 to 0.99 have been noted between the original implicit functions and the corresponding explicit functions generated with meta-model.

**Keywords :** meta-modal, objective function, steel frames, seismic analysis, design

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