ABSTRACT

DEVELOPMENT OF MULTIOBJECTIVE OPTIMIZATION PROCEDURES FOR SEISMIC DESIGN OF STEEL MOMENT FRAME STRUCTURES

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Design of seismic-resistant civil structural systems necessitates a balanced minimization of two general competing objectives: the present capital investment and the future seismic risk. Many of the existing seismic design optimization procedures use single objective functions of either the traditional minimum material usage (weight or cost) or the recent minimum expected life cycle cost criterion while imposing constraints from relevant code specifications as well as additional seismic performance concerns. The resulting single optimized structural design may not always perform satisfactorily in terms of other important but conflicting merit objectives; the designer's individual risk-acceptance level is not conveniently integrated into the design process.

Genetic algorithm based automated seismic design procedures are developed in the present study for member sizing optimization of code-compliant regular plane steel special moment resisting frame structures with simultaneous as well as separate treatment of multiple objective functions that reflect steel material usage, initial expenses, degree of design complexity, seismic structural performance indices, and lifetime seismic damage cost, respectively. A wide distribution of valid alternative designs is obtained that establishes optimized tradeoff among all relevant conflicting merit objectives. Therefore, structural engineers have much broader view of the entire optimized design space and thus more flexibility to select, through an explicit tradeoff decision-making process with valuable engineering experiences, the most desirable cost-effective design solution that balances different merit aspects in a preferred manner.

To Mother, Father, and Baoxia

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES