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Seismic Evaluation of Optimal Performance-Based Design of Steel Moment Frames with Metaheuristic Algorithms

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Optimal use of materials in constructing structures is one of the main goals of any design. Construction of structural systems is costly for their builders, so structures and buildings that are economically justifiable, appropriate, and meet the requirements of the criteria are more welcomed. In contrast, maintaining the structural performance in earthquakes is vital to ensuring safety and reducing damage during earthquakes. As a result of optimizing frames sections, the stiffness and strength of components are reduced, and these frames' performance against earthquakes is in question. In this research, the performance level of optimized steel moment frames with metaheuristic algorithms has been evaluated. For this purpose, the seismic performance of five-story steel moment frames with different geometric characteristics has been optimized and seismically evaluated using Particle Swarm Optimization (PSO), Charged System Search (CSS) Ant Colony Algorithm (ACO) and Genetic Algorithm (GA). Study results show that the optimized frame based on the Charged System Search algorithm has lighter sections and lower weight, while the seismic behavior responses of the structures are obtained faster. Furthermore, in terms of performance levels, the total number of collapse plastic joints in the Particle Swarm Optimization (PSO) was higher than other methods. Therefore, this algorithm can also be proposed as a suitable proposal method for the optimal design of similar frames.

Keywords: Seismic Evaluation, Performance-based, Steel Moment Frame, Optimization, Metaheuristic Algorithms.

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