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OPTIMUM DESIGN OF STEEL SPACE FRAMES VIA BAT INSPIRED ALGORITHM

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Steel buildings are preferred in residential as well as commercial buildings due to their high strength and ductility particularly in regions where earthquakes mostly happen. In the past, steel buildings were designed by using trial and error strategy or designer experience. However, these strategies were not economical. After improvements in computer technology, many optimization methods have been widely used in structural design problems to obtain economical solutions while satisfying design requirements. Traditional optimization methods are inadequate to find a satisfactory solution to structural optimization problems due to complicated nature and discrete design variables of these problems. Metaheuristic techniques have become efficient tools for structural optimization problems since their emergence. These techniques try to improve the solution by using certain strategies that are generally inspired by natural phenomena. Genetic algorithms, evolutionary strategies, simulating annealing, tabu search, ant colony optimization, particle swarm optimization, firefly algorithm and harmony search are some metaheuristic search techniques that are widely used for structural optimization problems. The bat inspired algorithm is one of the recent additions to metaheuristic techniques used for structural optimization problems. This optimization algorithm has been developed by mimicking the echolocation behavior of microbats, through which the bats can find their prey and discriminate different types of insects even in complete darkness. A limited number of new applications of this technique are presented so far including benchmark problems of unconstrained optimization problems, constrained optimization problems and multi-objective optimization problems.

In this study, bat inspired based optimum design algorithm is developed for steel space frames. The sequence numbers of W steel section listed in steel profile table are treated as design variables. Design constraints are implemented according to the provisions of ASD-AISC (Allowable Stress Design Code of American Institute of Steel Institution) which includes the displacement limitations, inter-story drift restrictions, allowable strength requirements and geometric constraints. The solutions to such discrete design optimization problems are obtained by the bat inspired algorithm, number of design examples are presented to demonstrate the performance of design optimization algorithm.

Keywords: Steel Space Frames; Optimum Structural Design; Combinatorial Optimization; Metaheuristic Search Techniques; Bat Inspired Algorithm