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Performance of Non-Deterministic Structural Optimization Algorithms Applied to a Steel Truss Structure

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Abstract : The efficient solution that satisfies the optimal condition is an important issue in the structural engineering design problem. The new codes of structural design consist in design methodology that looks after the exploitation of the total resources of the construction material. In recent years some non-deterministic or meta-heuristic structural optimization algorithms have been developed widely in the research community. These methods search the optimum condition starting from the simulation of a natural phenomenon, such as survival of the fittest, the immune system, swarm intelligence or the cooling process of molten metal through annealing. Among these techniques the most known are: the genetic algorithms, simulated annealing, evolution strategies, particle swarm optimization, tabu search, ant colony optimization, harmony search and big bang crunch optimization. In this study, five of these algorithms are applied for the optimum weight design of a steel truss structure with variable geometry but fixed topology. The design process selects optimum distances and size sections from a set of commercial steel profiles. In the formulation of the design problem are considered deflection limitations, buckling and allowable stress constraints. The approach is repeated starting from different initial populations. The design problem topology is taken from an existing steel structure. The optimization process helps the engineer to achieve good final solutions, avoiding the repetitive evaluation of alternative designs in a time consuming process. The algorithms used for the application, the results of the optimal solutions, the number of iterations and the minimal weight designs, will be reported in the paper. Based on these results, it would be estimated, the amount of the steel that could be saved by applying structural analysis combined with non-deterministic optimization methods.

Keywords : structural optimization, non-deterministic methods, truss structures, steel truss
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