Member sizing optimization

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MEMBER SIZING OPTIMIZATION OF STEEL SPACE TRUSSES DESIGNED BASED ON AISC 360-10 USING SYMBIOTIC ORGANISMS SEARCH ALGORITHM

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Abstract

Producing an economical truss structure that satisfies the governing design codes is a desire of structural engineers and owners. Engineers strive to meet these design requirements traditionally by trail-and-error selecting the member sizes based on the engineers' intuition and judgment. This design method, however, cannot guarantee the realization of an optimal design, especially for large and complex structures. Thus, a systematic approach of optimization is needed to achieve an optimal design of truss structures.

In the last two decades, many researchers have developed and applied various 'metaheuristic' optimization methods (i.e. a class of stochastic methods that simulates different natural phenomena to obtain a nearly optimal solution) to design of truss structures, such as the genetic algorithm, particle swarm optimization, ant colony optimization, big bang-big crunch optimization, and harmony search algorithm. Among many newly developed metaheuristic algorithms, an algorithm called *Symbiotic Organisms Search* (SOS) has drawn our attention because of its excellent performance and parameter-less nature. The SOS algorithm has been successfully used to solve different optimization problems in engineering, including truss design optimization problems. However, the truss problems considered in the previous studies are relatively small.

This paper presents applications of the SOS algorithm to optimize member sizing of relatively large steel space trusses, that is, (1) a 120-bar dome shaped truss and (2) a 160-bar pyramid shaped truss. The structural analyses are carried out using the standard finite element method. The strength design of steel members follows the 'Specification for Structural Steel Buildings', AISC 360-10. The profile of the members is circular hollow structural sections selected from a set of the American Institute of Steel Construction standard profiles. The design results are then compared to those obtained using other metaheuristic methods, namely the particle swarm optimization, differential evolution, and teaching-learning-based optimization. The comparison shows the superior performance of the SOS in optimizing member sizes of large-scale truss structures.

Keywords: size optimization, metaheuristic, symbiotic organisms search, AISC 360-10.

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