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Challenges and recent advances in optimum design of steel structures

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Due to limitations in natural resources, optimization has always been an inseparable component of engineering design. In the recent decades, the advent of modern computing technologies has paved the way for development of efficient structural design optimization tools for optimal design of steel skeletal structures. However, except a small number of research studies, mostly the devised optimization algorithms have been tested using traditional benchmark instances with a few design variables, and the design optimization problem of steel structures with numerous discrete variables is not properly addressed in the literature of structural optimization. Furthermore, in spite of considerable research work conducted on development of new algorithms for discrete sizing optimization of steel frame and truss structures, only a few studies address non-algorithmic issues affecting the general performance of the algorithms. For instance, an important question is whether starting the design optimization from a feasible solution is fruitful or not. This paper is an attempt to outline the challenges in optimum design of real-size steel skeletal structures and present recent advances in practical structural optimization of these structures. The performance of the recently proposed algorithms as well as their sensitivity to feasibility of initial candidate designs are outlined through practical discrete sizing of real-size instances according to AISC-LRFD specification. The future research needs, which can pave the way for optimum design of large scale steel structural systems in a timely manner, are also elaborated.

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