

Direct fully stressed design for displacement constraints

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This paper presents a new fully stressed design method for the solution of the general weight optimization problem applicable to determinate trusses subject to displacement constraints. Fully stressed design (FSD) has been a popular method to perform structural optimization when only stress constraints are considered. It is attractive because it reaches the optimal design following a few iterations which minimizes computational effort. For this reason, it is one of the earliest optimization techniques and was used prior to the advent of computers. However, FSD needs to be modified when displacement constraints are considered. This is known as fully utilized design (FUD). FUD has been implemented with several variations, at times utilizing energy methods. In this study, it is shown how there is the possibility to apply FSD directly to determinate trusses, even in the presence of displacement constraints. The method does not require the modification of FSD to FUD, but rather it manipulates the stresses to directly account for displacement constraints. This new technique can be easily automated using structural analysis software in conjunction with a spreadsheet. Presently, it is limited to determinate structures. However, it is quite appealing for its ease of implementation. Several truss examples are presented showing how the optimal design of trusses subject to displacement constraints is attained. Results compare favorably with those presented in literature that were solved with other well-known optimization techniques as, for example, genetic algorithms.