11th. World Congress on Computational Mechanics (WCCM XI)
5th. European Conference on Computational Mechanics (ECCM V)
6th. European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

MIXED STRUCTURAL OPTIMIZATION OF LATTICED STEEL TRANSMISSION TOWERS IN A USER-FRIENDLY INTERFACE.

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Key Words: *Structural Optimization, Simulated Annealing, Transmission Towers.*

Power transmission towers are mostly metallic latticed structures formed by a large group of galvanized Steel-rolled bars, where these bars have generally equal leg angle sections. Additionally, these towers are usually built by a combination of predetermined modular blocks with a fixed connectivity. In this work we present a methodology for weight optimization of these structures based on the Simulated Annealing algorithm. This methodology is also implemented in a user-friendly interface that allows to quickly build any tower configuration (with the available modular blocks), define its particular parameters and obtain its optimal minimum weight design.

In this optimization method, two kinds of variables are used together: continuous and discrete variables. Continuous variables define each block sizes, and discrete variables determine the bars cross-sections. Thus, this use of discrete and continuous variables together leads us to a mixed optimization problem. In addition, a compatibility process is developed to deal with the objective function behaviour when different kinds of variables are modified. Due to the large number of structural analysis needed in this case for the Simulated Annealing, a first order sensitivity analysis has been included to reduce CPU cost.

The proposed algorithm allows to reach weight reductions up to 30% in real power transmission structures in acceptable CPU time. Generally, the algorithm modifies both, continuum (block sizes) and discrete (cross sections) design variables producing slim designs.

The user application provides a short guided sequence of steps to: select material's properties, describe tower's geometry, apply load cases, assign a specific cross-section to every bar in the model, automatically with a sizing tool or manually by selecting them individually, and perform the optimization process. Finally, the optimization output data can be displayed on the GUI itself or exported to standard format files like data sheets or CAD.

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