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Structural Optimization for Stabilized and Stiffened Structural System by Tension Members

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Abstract

This paper presents a numerical method for stabilized and stiffened structural system by tension members. In these structures, it is generally difficult to control a shape and prestress because of high dependency between them. Our proposal model has similar features of these systems, and we find the resisting structural form efficiently for compression occurred by prestressing. Our analytical approach is to divide a structure into two groups which are instable system and statically indeterminate system. We formulated equations of stabilizing process in each group. These shapes of structures become a unique shape under the specified prestress. In previous research [1], we analyzed two-dimensional models and verified the proposed method. In this paper, we analyzed three-dimensional models and show some results which would be available to apply for spatial structures. Next, we present the optimization method for these structures. In this method, we define the strain energy as an objective function, and magnitude of prestress as design variables. It is difficult to apply linear analysis of stress and displacement in these structural models, because it would be instable without prestress. Therefore, we apply the geometrically nonlinear analysis with prestress by FEM. We focus a form-finding analysis and optimization for these structures in this paper.

Keywords: structural optimization; stabilized and stiffened structural system; genetic algorithm.