عنوان مقاله:

Minimum Stiffness and Optimal Position of an Intermediate Elastic Support to Maximize the Fundamental Frequency of a Vibrating Timoshenko Beam using Finite Element Method and Multi-Objective Genetic Algorithm

محل انتشار:

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خلاصه مقاله:

This paper explores the optimal position and minimum stiffness of two intermediate supports to maximize the fundamental natural frequency of a vibrating cantilever Timoshenko beam with tip mass using Finite Element Method (FEM) and a multi-objective genetic algorithm (GA). After validating the results by comparison to previous works, the effects of the mass ratio and the position and stiffness of intermediate elastic support on the fundamental frequency are investigated. The numerical results demonstrated that as mass ratio increases, the optimal position moves toward the tip mass, and minimum stiffness increases. In many practical applications, it is not possible to place intermediate support in the optimal position; therefore, the minimum stiffness does not exist. In order to overcome this issue, a tolerance zone is considered, and design curves are proposed. The simultaneous optimization of the first and second natural frequencies of the beam with two intermediate supports was carried out using the genetic algorithm (GA) and the multi-objective GA. It was found that the optimization of the first and second natural frequencies did not require the two supports to have the same and high stiffness. The stiffness and optimal positions of the two supports differ at different mass ratios. Moreover, to optimize the first natural frequency, the second support should be stiffer, while the optimization of the second natural frequency requires the higher stiffness of the first support.

کلمات کلیدی:

intermediate support, Multi-objective genetic algorithm (GA), optimal position and minimum stiffness, Timoshenko beam