عنوان مقاله:

Optimization of Location and Stiffness of an Intermediate Support to Maximize the First Natural Frequency of a Beam with Tip Mass-With Application

محل انتشار:

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خلاصه مقاله:

The optimal position and minimum stiffness of an intermediate support is implemented to maximize the fundamental natural frequency of a vibrating cantilever Euler-Bernoulli beam with tip mass. According to Courant's maximum-minimum theorem, maximum value of the first natural frequency of a beam with a single additional rigid internal support, is equal to the second natural frequency of the unsupported beam. In literature, for a cantilever beam without tip mass, the optimum position of intermediate support was reported as ۰.۷۸۳۴L and minimum dimensionless stuffiness as ۲۶۶.۹. In this paper, the effect of tip mass ratio on optimum location and minimum stiffness is investigated. The Finite element method is employed. Cross sectional area is uniform and material is homogeneous and isotropic. Numerical results demonstrate that as tip mass ratio increases the optimal position moves toward the tip mass and minimum stiffness increases. For instance, for tip mass ratio ۰.۵, optimal position is ۰.۹۲L and minimum dimensionless stiffness is ۲۸۴. Optimal position and minimum stiffness are presented for various range of mass ratio. In many applications, it is not possible to place intermediate support at optimal position; therefore, the minimum stiffness does not exist. In these cases, a tolerances zone is considered and related design curves are proposed. As a practical example, an agitator shaft is considered and end impeller is modeled as tip mass. The effectiveness of the proposed design curves in order to maximize natural frequency is shown. A design of an intermediate support is presented; in this example the fundamental frequency has increased as much as ۳۰۰ percent without any change in shaft diameter.

کلمات کلیدی:

Euler-Bernoulli, intermediate support, optimal position and minimum stiffness