Optimal passive vibration control of Timoshenko beams with arbitrary boundary conditions traversed by moving loads

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Passive control of vibration of beams subjected to moving loads is studied in which, an optimal tuned mass damper (TMD) system is utilized to suppress the undesirable beam vibration. Timoshenko beam theory is applied to the beam model having three types of boundary conditions, namely, hinged-hinged, hinged-clamped, and the clamped-clamped ends, and the governing equations of motion are solved using the Galerkin method. For every set of boundary conditions, a minimax problem is solved using the sequential quadratic programming method and the optimum values of the frequency and damping ratios for the TMD system are obtained. To show the effectiveness of the designed TMD system, simulations of an actual railway bridge traversed by the S.K.S. Japanese high-speed train are carried out and the dynamic performance of the bridge before and after the installation of the TMD system are compared.