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Abstract: Free vibration solution of a free rectangular thin plate resting on multiple point supports has been a topic of fundamental importance in mechanical engineering. It is well known that various approximate/numerical methods have been developed to solve the problems, but exact analytic solutions, as the benchmarks, are rarely reported in the literature. This is attributed to the difficulty in seeking the solutions that satisfy the governing fourth-order partial differential equation (PDE) with the completely free boundary conditions as well as the support conditions. In this paper, we present a successful endeavor to address the issue with our recently developed symplectic superposition method for free vibration problems. A general set of equations are obtained for determining the natural frequencies and mode shapes of the plates with any point supports. Seventeen typical combinations of support locations are investigated for the plates with three or four point supports. The obtained solutions are all shown by the numerical results listed for comparison with those by the well-accepted finite element method (FEM), and very good agreement is observed. This study provides some useful benchmark solutions of the point-supported free rectangular plates, and demonstrates an effective analytic approach to solving similar boundary value problems which have not been well settled by other analytic methods.

Keywords: Analytic solution; free vibration; rectangular thin plate; multiple point supports.

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