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Structural Element Vibration Analysis with finite element method: Use of Rayleigh Quotient

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Abstract : "Various methods are typically used in the dynamic analysis of transversely vibrating beams. To achieve this, numerical methods are used to solve the general eigenvalue problem. The equations of equilibrium, which describe the motion, are derived from a fourth-order differential equation. Our study is based on the finite element method, and the results of the investigation are the vibration frequencies obtained using the Jacobi method. Two types of elementary mass matrices are considered: one representing a uniform distribution of mass along the element and the other consisting of concentrated masses located at fixed points whose number increases progressively with equal distances at each evaluation stage. The beams studied have different boundary constraints, representing several classical situations. Comparisons are made for beams where the distributed mass is replaced by n concentrated masses. As expected, the first calculation stage involves determining the lowest number of beam parts that gives a frequency comparable to that obtained from the Rayleigh formula. The obtained values are then compared to theoretical results based on the assumptions of the Bernoulli-Euler theory. These steps are repeated for the second type of mass representation in the same manner."

Keywords : finite element method, bernouilli eulertheory, structural analysis, vibration analysis, rayleigh quotient
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