World Academy of Science, Engineering and Technology
International Journal of Architectural and Environmental Engineering
Vol:16, No:09, 2022

The Rayleigh Quotient for Structural Element Vibration Analysis with Finite Element Method

Authors : Falek Kamel

Abstract : Various approaches are usually used in the dynamic analysis of beams vibrating transversally. For this, numerical methods allowing the solving of the general eigenvalue problem are utilized. The equilibrium equations describe the movement resulting from the solution of a fourth-order differential equation. Our investigation is based on the finite element method. The findings of these investigations are the vibration frequencies obtained by the Jacobi method. Two types of the elementary mass matrix are considered, representing a uniform distribution of the mass along with the element and concentrated ones located at fixed points whose number is increased progressively separated by equal distances at each evaluation stage. The studied beams 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 calculus stage is to obtain the lowest number of beam parts that gives a frequency comparable to that issued 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 used for the second type of mass representation in the same manner.

Keywords : structural elements, beams vibrating, dynamic analysis, finite element method, Jacobi method
Conference Title : ICAAE 2022 : International Conference on Architecture and Architectural Engineering
Conference Location : Paris, France
Conference Dates : September 20-21, 2022