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Vibration Analysis of Stepped Nanoarches with Defects

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Abstract : A numerical solution is developed for simply supported nanoarches based on the non-local theory of elasticity. The nanoarch under consideration has a step-wise variable cross-section and is weakened by crack-like defects. It is assumed that the cracks are stationary and the mechanical behaviour of the nanoarch can be modeled by Eringen's non-local theory of elasticity. The physical and thermal properties are sensitive with respect to changes of dimensions in the nano level. The classical theory of elasticity is unable to describe such changes in material properties. This is because, during the development of the classical theory of elasticity, the speculation of molecular objects was avoided. Therefore, the non-local theory of elasticity is applied to study the vibration of nanostructures and it has been accepted by many researchers. In the non-local theory of elasticity, it is assumed that the stress state of the body at a given point depends on the stress state of each point of the structure. However, within the classical theory of elasticity, the stress state of the body depends only on the given point. The system of main equations consists of equilibrium equations, geometrical relations and constitutive equations with boundary and intermediate conditions. The system of equations is solved by using the method of separation of variables. Consequently, the governing differential equations are converted into a system of algebraic equations whose solution exists if the determinant of the coefficients of the matrix vanishes. The influence of cracks and steps on the natural vibration of the nanoarches is prescribed with the aid of additional local compliance at the weakened cross-section. An algorithm to determine the eigenfrequencies of the nanoarches is developed with the help of computer software. The effects of various physical and geometrical parameters are recorded and drawn graphically.

Keywords : crack, nanoarches, natural frequency, step
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