ABSTRACT

A sigmoid Timoshenko beam with and without resting on variable elastic foundation is investigated for its static and dynamic behavior. A steel-alumina functionally graded ordinary (FGO) beam with steel-rich bottom is considered for the analysis. The material properties are assumed to follow sigmoid distribution in the direction of thickness of FGM and assumed to vary as per power law and exponential law.

A Finite element method is used for simply supported end condition of the beam considering first order shear deformation theory (Timoshenko beam theory) for the analysis. The element chosen in the present case is different from the conventional elements in the sense that the shape functions of the element is obtained from the exact solution of the static part of the governing differential equation derived from Hamilton's principle. Along with this, the shape functions are dependent on length, material and cross-sectional properties ensuring better accuracy of the solution. Floquet's theory is used to establish the stability boundaries.

The influence of geometry, power index, and exponential law on the critical buckling load, natural frequencies and dynamic stability of beams is determined. It is found that the property variation as per exponential law ensures better dynamic stability than property variation as per power law and decrease in power index result a better beam as per as parametric instability is concerned.

The effect of foundation stiffness and foundation parameter on critical buckling load and dynamic stability of the beam is investigated. Various variable foundation models like linear, parabolic and sinusoidal model are considered for investigation. It is observed that parabolic foundation out of the chosen models renders better dynamic behavior for the beam.

The buckling behavior of the FGM beam is analyzed by studying the effect of geometry (slenderness parameter), power index, foundation modulus, foundation shear modulus and foundation parameter on critical buckling load under linear, parabolic and sinusoidal foundations. It is observed that the buckling load decreases sharply with increase in slenderness parameter for all the foundations considered. The variation of power index has no bearing on the buckling load. The static stability increases with increase in foundation modulus and foundation shear modulus as well. It is observed that the contribution of shear layer of beam in improving the stability behavior of beam is more significant. The comparison among various foundations as regards to their role on stability behavior of beam is done and found that the parabolic foundation renders highest stability to the beam while the sinusoidal foundation causing the lowest buckling loads of beam.

Key words: *Sigmoid distribution, foundation parameter, foundation modulus, power index, dynamic stability, static load factor, dynamic load factor.*