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A homotopy analysis solution to large deformation of beams under static arbitrary distributed load. (English) Zbl 1427.74180


Summary: In this article, homotopy analysis method (HAM) is employed to investigate non-linear large deformation of Euler-Bernoulli beams subjected to an arbitrary distributed load. Constitutive equations of the problem are obtained. It is assumed that the length of the beam remains constant after applying external loads. Different auxiliary parameters and functions of the HAM and the extra auxiliary parameter, which is applied to initial guess of the solution, are employed to procure better convergence rate of the solution. The results of the solution are obtained for two different examples including constant cross sectional beam subjected to constant distributed load and periodic distributed load. Special base functions, orthogonal polynomials e.g. Chebyshev expansion, are employed as a tool to improve the convergence of the solution. The general solution, presented in this paper, can be used to attain the solution of the beam under arbitrary distributed load and flexural stiffness. Ultimately, it is shown that small deformation theory overestimates different quantities such as bending moment, shear force, etc. for large deflection of the beams in comparison with large deformation theory. Finally, it is concluded that solution of small deformation theory is far from reality for large deflection of straight Euler-Bernoulli beams.

MSC:

74S99 Numerical and other methods in solid mechanics
74K10 Rods (beams, columns, shafts, arches, rings, etc.)
74B10 Linear elasticity with initial stresses

Keywords: homotopy analysis method; beam; large deformation; arbitrary distributed load; Chebyshev expansion

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