
Summary: The post-buckling of a clamped column made of nonlinear elastic material and subject to axial compression is investigated in this paper. The Ramberg-Osgood type constitutive relation is adopted and it is expanded by using Taylor series. Based on Euler-Bernoulli beam theory, the exact governing equations are expressed in terms of rotation angle. Because the equations contain strongly nonlinear terms that are functions of the rotation angle, analytical solutions are virtually impossible. In this respect, this paper is focused on presenting an alternative method to construct concise yet accurate analytical approximate solutions for post-buckling of the Ramberg-Osgood column that is related to large rotation amplitude. The improved harmonic balance method is used to solve the nonlinear governing equations which are simplified via the Maclaurin series expansion and orthogonal Chebyshev polynomials. In addition, numerical solutions by applying the shooting method on the governing equations are obtained for comparison. The second-order analytical approximate solutions presented in this paper show excellent accuracy by comparing with numerical solutions. The analytical approximate method and numerical result presented in this paper can be applied as design guidelines for designing engineering structures that sustain large deformation, such as slender nonlinear compression of aluminum alloy columns, rods or braces.

MSC:
74K10 Rods (beams, columns, shafts, arches, rings, etc.)

Keywords:
analytical approximate; large deformation; nonlinear elastic materials; post-buckling; Ramberg-Osgood constitutive law

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References:


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