World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:15, No:10, 2021

Assessing Influence of End-Boundary Conditions on Stability and Second-Order Lateral Stiffness of Beam-Column Elements Embedded in Non-Homogeneous Soil

Authors : Carlos A. Vega-Posada, Jeisson Alejandro Higuita-Villa, Julio C. Saldarriaga-Molina

Abstract : This paper presents a simplified analytical approach to conduct elastic stability and second-order lateral stiffness analyses of beam-column elements (i.e., piles) with generalized end-boundary conditions embedded on a homogeneous or non-homogeneous Pasternak foundation. The solution is derived using the well-known Differential Transformation Method (DTM), and it consists simply of solving a system of two linear algebraic equations. Using other conventional approaches to solve the governing differential equation of the proposed element can be cumbersome and the solution challenging to implement, especially when the non-homogeneity of the soil is considered. The proposed formulation includes the effects of i) any rotational or lateral transverse spring at the ends of the pile, ii) any external transverse load acting along the pile, iii) soil non-homogeneity, and iv) the second-parameter of the elastic foundation (i.e., shear layer connecting the springs at the top). A parametric study is conducted to investigate the effects of different modulus of subgrade reactions, degrees of non-homogeneities, and intermediate end-boundary conditions on the pile response. The same set of equations can be used to conduct both elastic stability and static analyses. Comprehensive examples are presented to show the simplicity and practicability of the proposed method.

Keywords : elastic stability, second-order lateral stiffness, soil-non-homogeneity, pile analysis
Conference Title : ICTAM 2021 : International Conference on Theoretical and Applied Mechanics
Conference Location : New York, United States
Conference Dates : October 07-08, 2021