Nonlinear Characteristics of Floating Piles under Rotating Machine Induced Vertical Vibration

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Abstract: This paper presents a finite element based approach to evaluate the nonlinear frequency- amplitude response of floating piles subject to rotating machine induced vertical vibrations. The variation of complex soil stiffness with frequency is also compared for a linear model and two nonlinear models considering different boundary zone parameters (shear modulus ratio, thickness ratio and damping ratio). A program was developed in Matlab to evaluate the linear and nonlinear response of a single pile with floating tip condition. A detailed investigation of stiffness and damping parameters has been done incorporating different values of soil-pile separation lengths and boundary zone parameters. Vertical vibration test was conducted in the field on a single pile of dimeter 0.114 m and length of 2.85 m with no tip resistance to verify the effectiveness of the proposed model. The frequency-amplitude response obtained from field vibration test is compared with the theoretical results for all the soil models. From the comparison results it is observed that the proposed theory can predict the nonlinear response of floating piles very efficiently with proper inclusion of boundary zone parameters and soil pile separation.

Keywords: pile foundation; vertical vibration; soil-pile interaction; dynamic response; soil-pile separation length; complex soil stiffness.