VERTICAL VIBRATION OF MACHINE FOUNDATIONS

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Abstract

A perturbation technique, the method of multiple scales, is used to obtain an approximate analytical solution of the nonlinear dynamic response of foundations on soils. The analysis takes into account the nonlinearity of the soil material and both viscous and Coulomb damping. Closed form expressions are derived for the amplitude and phase of the response that show clearly the effect of the various parameters involved in soil dynamics. A closed form expression is presented for the permanent settlement of the nonlinear soil structure caused by the vibration. In addition to large responses accompanying primary or main resonances (the excitation frequency \( \hat{\nu} \) is near the natural frequency of the foundation \( \omega_0 \)), the results show that large responses can be caused by subharmonic excitations of order one-half \( \hat{\nu} = 2\omega_0 \) and superharmonic excitations of order two \( \hat{\nu} = \frac{1}{2} \omega_0 \). Consequently, the practicing design engineer cannot afford to ignore these resonances.