Dynamic Response of Machine Foundation Resting on End Bearing Piles

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Abstract. *Machine foundations are unique, because they may be subjected to significant dynamic loads during operation in addition to normal design loads of gravity, wind, and earthquake. The magnitude and characteristics of the operating loads depend on the type, size, speed, and layout of the machine. The foundation has to guarantee smooth running during normal operation, and foundation integrity for possible accidental loading situations. Dynamic effects of the machines play a major role on sizing of the foundation where conditions, like resonance is avoided by varying the stiffness and the mass of the structure which leads to modifications in foundation sizes. For carrying out these studies, a detailed 3D finite element analysis approach is considered.*

Herein, a finite element software (ANSYS.11) is adopted which provides an efficient tool for dynamic analysis and structural design of machine foundations. As a case study, piled machine foundation in sandy soil is analyzed. Machine foundations resting on end bearing piles are introduced. Harmonic dynamic load is chosen. A parametric study is carried out to investigate the effect of several parameters including: geometry of the piled machine foundation, the amplitude of the dynamic load, frequency of the dynamic load and damping ratio. Linear elastic model is adopted for modeling the piles and their cap for machine foundation using eight node isoparametric (solid 65) element, while elastic model is adopted to model the soil behavior and eight node isoparametric elements are used to model the soil through (solid 45) element.

It is concluded that the frequency ratio decreases with increase of spacing values due to increase in natural frequency, except in the case of 3 m spacing where it increases due to decrease in natural frequency as the mass was increased obviously. The increase in spacing caused the increase of natural frequency by about 6% in the case of 1.5 m spacing more than the 1.25 m case and by about 3% for the 1.75 m spacing more than the 1.5 m reference case.

The increase in pile cap length caused the natural frequency to decrease by about 18% for the 3.75 m pile cap length as compared with the reference case and by 29% in the case of 5 m less than the reference case. In the case of increasing pile cap thickness, there was only a slight difference in the values of natural frequency.