

Sadeghi Tehrani, Faraz. Ph.D., Purdue University, December 2014. Study of the loading of piles using a semi-analytical method and the digital image correlation technique. Major Professors: Rodrigo Salgado and Monica Prezzi.

The response of single piles and pile groups to axial and lateral loading and the displacements induced in the soil by it are studied in this work using theoretical and experimental approaches. The theoretical solution for the loading of piles is based on idealized displacement forms, energy principles and calculus of variations. The idealized displacement field is expressed in terms of a group of unknown functions that determine both the vertical profile of the displacement along the axis of the pile, which are obtained using the eigenvalue/eigenvector method, and another that determines the displacement within the soil domain, which are obtained numerically using the finite difference method. The piles can have any cross-sectional shape, and the soil profiles can comprise as many layers as needed. The pile and soil materials are assumed linear elastic. Analysis results are in a good agreement with results from the finite element method (FEM), with the advantage that the results are obtained at a lower computational cost.

The experimental method used to study the displacement field in soil is the Digital Image Correlation (DIC) technique, used on images consists resulting from axial and lateral load tests on model piles installed in a calibration chamber. The calibration chamber is a half-section cylinder with transparent observation windows on its flat face. The soil and piles are photographed during the load tests and the response of soil is studied by analyzing the acquired images using the DIC technique. The information is combined with data from instrumentation of the piles and the load and deflection at the pile head to provide comprehensive data and insights into the response of the pile-soil system to loading.