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SNAP-BACK TESTING AND ESTIMATION OF PARAMETERS FOR NONLINEAR RESPONSE OF SHALLOW AND PILE FOUNDATIONS AT COHESIVE SOIL SITES

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ABSTRACT

We are working on the development of methods for analysing the earthquake response of foundations that make use of Soil-Foundation-Structure-Interaction (SFSI) as a means of incorporating nonlinear soil deformation effects and nonlinear geometrical effects into the earthquake resistant design of foundations. There are three challenges in this work. First, to incorporate adequately the nonlinear response of the soil during the earthquake. Second, to account for geometrical nonlinearity during the earthquake - that is loss of contact between various parts of the foundation and the underlying and/or adjacent soil. Examples of this are the gapping that develops between a pile shaft and the surrounding soil during cyclic lateral loading and the uplift beneath parts of a shallow foundation subject to rocking. Third, to obtain appropriate values for the soil parameters which describe the nonlinear response of the foundations.

The main thrust of this paper is to show how snap-back testing is a most effective means of evaluating nonlinear soil behaviour. It will be demonstrated that snap-back testing is more convenient than using a shaking machine which applies sinusoidal excitation. The results will show how for the rocking of a shallow foundation and the cyclic lateral loading of a single pile, the damping and the stiffness can be estimated at increasing levels of lateral loading.

Keywords: Shallow foundations, deep foundations, snap-back testing, nonlinear soil response

INTRODUCTION

We have been working on the development of methods for analysing the earthquake response of foundations that make use of Soil-Foundation-Structure-Interaction (SFSI) as a means of incorporating nonlinear soil deformation effects and nonlinear geometrical effects into the earthquake resistant design of foundations. SFSI differs from the well-known SSI (soil-structure interaction) in that SSI is confined to linear response, whereas SFSI incorporates nonlinear responses. We regard our work as a contribution to the development of performance-based design in earthquake geotechnical engineering. Our progress to date has been documented in the following papers: Pender (2007), Pender et al (2009), Wotherspoon (2009), Algie et al (2010), MSa'Don et al (2010), Toh and Pender (2010), and Wotherspoon and Pender (2010). A feature of the work has been the modelling of the foundation and the structure supported by the foundation in an integrated manner so that a single numerical model of the structure-foundation system is developed for design analysis. There are three challenges in this work. First, incorporating the nonlinear response of the soil during the earthquake. Second, accounting for geometrical nonlinearity during the earthquake - that is loss of contact between various parts of the foundation and the underlying soil.

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