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Inverse modelling for estimating an interface element properties in soil-pipe interaction. - An optimization approach

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ABSTRACT

The development of transmitted stresses onto a pipe from the backfill or in-situ soil is not well known for both static and dynamic load cases. This study was aimed at investigating the application of an inverse modelling technique to determine the material parameters of a thin interface layer which lies between the soil and buried pipe during a seismic event to assess the stress transfer. The model uses measured strain values on a pipe of an axial push test. The process of estimation is mathematically known as an inverse problem and is formulated as a non-linear least squares minimization problem coupled with a finite element model for the soil-pipe interaction. The method involves constructing an iterative procedure using an optimization routine in MATLAB and at every iteration, the finite element problem was solved using the finite element program ABAQUS. Finally, the accuracy of the parameter values are examined by using the measured strain values at various different loadings. This research helps to further the understanding of the soil-pipe load transfer system under various loadings and interface layers in finite element analysis.

Key words: Finite element modelling; Inverse problem; Soil-Pipe interaction:

Introduction

Finite element modelling of aburied pipe may be used during the design process to study the behavior of the pipe during earthquakes. By using finite element simulation, the efficient prediction of pipe deformation and pipe-soil interaction can be studied in detail. This method allows us to determine (a) stress, strain values, (b) influence of pipe dimensions, (c) effect of trench shape geometry and (d) influence of soil material parameters etc.

The performance and behavior of buried pipe is strongly influenced by soil-pipe interaction. One aspect of this involves the properties and load transfer characteristics of the soil-pipe contact surfaces. The appropriate modelling of the soil-pipe interface is important to ensure that the performance estimation is predicted as accurately as possible. Traditionally, soil-pipe interaction problems are solved for two idealized interface conditions: (a) perfect adhesion of the soil to the pipe structure (the perfectly rough, no-slip): and (b) zero adhesion (the full slip or smooth interface condition). The actual gap and slippage between pipe and soil cannot be modelled using above mentioned techniques. It is expected the actual pipe response in the field is expected to lie

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