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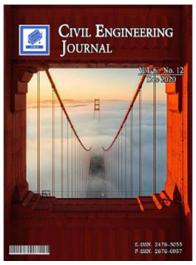

Effect of Long-Term Soil Deformations on RC Structures Including Soil-Structure Interaction

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Abstract

Lifetime service of Reinforced Concrete (RC) structures is of major interest. It depends on the action of the superstructure and the response of soil contact at the same time. Therefore, it is necessary to consider the soil-structure interaction in the safety analysis of the RC structures to ensure reliable and economical design. In this paper, a finite element model of soil-structure interaction is developed. This model addresses the effect of long-term soil deformations on the structural safety of RC structures. It is also applied to real RC structures where soil-structure interaction is considered in the function of time. The modeling of the mechanical analysis of the soil-structure system is implemented as a one-dimensional model of a spring element to simulate a real case of RC continuous beams. The finite element method is used in this model to address the nonlinear time behavior of the soil and to calculate the consolidation settlement at the support-sections and the bending moment of RC structures girders. Numerical simulation tests with different loading services were performed on three types of soft soils with several compressibility parameters. This is done for homogeneous and heterogeneous soils. The finite element model of soil-structure interaction provides a practical approach to show and to quantify; (1) the importance of the variability of the compressibility parameters, and (2) the heterogeneity soil behavior in the safety RC structures assessment. It also shows a significant impact of soil-structure interaction, especially with nonlinear soil behavior versus the time on the design rules of redundant RC structures.

Keywords: Soil-Structure Interaction; Soil Compressibility; Mechanical Analysis; RC Structures.

1. Introduction

The process of monitoring RC structures in service that includes inspections, specific measurements damages and evaluations of existing structures, is targeting the safety of the structure while begin in use. To achieve this objective, the designer must ensure the integrity of these structures throughout their lifetime. However, the performance of these structures depends in most cases on the interaction between the soil and the structure. The interaction depends on the load applied to ensure the overall stability of these structures. Various researches have been conducted on the effect of soil-structure interaction highlighting its overall importance in the prediction of the response of the coupled system [1, 2]. To simplify the actions of the structure in the analysis of soil-structure interaction, it is common to model the structure of a beam element characterized by rigidity (EI) and modelling the soil as a homogeneous and isotropic elastic medium [3]. The need to vary the contact force versus displacement has been treated with a non-linear model

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