Development of Innovative Foundation Systems to Optimize Seismic Behavior of Bridge Structures

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ABSTRACT: Preliminary results from a study to develop innovative bridge foundations to optimize bridge performance under earthquake events are presented. Numerical models of bridges with both flexible and stiff footings are compared to demonstrate the potential importance of soil-footing stiffness on the performance of a soil-footing-column-deck-abutment system. Detailed numerical models were developed to capture the inelastic behavior of soil-footing systems. This article summarizes two types of foundation models developed using the OpenSees computational platform. One model uses a contact interface model, soilFootingSection2D, to simulate the foundation and has been proven to be effective in analyzing the cyclic response and displacement of soil-foundation-bridge system. The other uses 2-D nonlinear Winkler foundation consisting of various constitutive springs. Although the former model is more detailed and fundamentally sound in modeling the footings, in its current state it is limited to 2-D use only. The latter model, once verified via comparison to experimental data, can be extended to 3-D. Future work will use the 3-D nonlinear footing models to more accurately simulate the 3-D response of a bridge system to 3-D ground motions.

INTRODUCTION

A research project aiming to develop a procedure for the design of innovative economical foundations funded by California Department of Transportation (Caltrans) is underway. The purpose of this research is to develop a procedure for optimizing the performance (moment capacity, stiffness, and energy dissipation) of a soil-foundation-bridge system under earthquake loading. The first phase of the study consists of an analytical part which aims to accurately model the soil-foundation-bridge system and