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DYNAMIC RESPONSE OF A BRIDGE PIER MODEL AT THE VOLVI – GREECE EUROPEAN TEST SITE INCLUDING THE SOIL FLEXIBILITY

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SUMMARY

This paper presents results of the measured and predicted response of a bridge pier model structure which has been erected at the Volvi-Greece European Test Site. After an initial laboratory testing of the bridge pier model under cyclic horizontal loads and the study of its cyclic post-elastic behaviour, a series of low-to medium intensity excitations were performed at the test site for a period of two years. The deck acceleration response was recorded and was studied in the frequency domain in order to extract the most significant eigen-modes and eigen-frequencies for the various configurations of this pier bridge model. Moreover, an extensive numerical simulation of the response was also performed, including the flexibility of the foundation. The numerical simulation was also extended to include a volume of soil under the foundation in order to study the soil response when the pier was subjected to low intensity man-made excitations. Four pressure cells were placed in the soil under the foundation and measurements were obtained from these pressure sensors during the man made excitations, which were then correlated to the numerical predictions. A summary of the in-situ measurements of the bridge pier model response are presented and compared with the corresponding numerical predictions from a variety of numerical simulations that attempt either in a relatively simple or a relatively complex way to address the influence on the response that arises from the flexible foundation conditions.

1. INTRODUCTION

Although the effect of soil-structure interaction on the dynamic response of typical residential or commercial structures and infrastructure (i.e. bridges, Kawashima 2000) has long attracted scientific attention, it is widely recognized that there is an urgent need for further experimental support and validation. This need is far more crucial in cases where the structure responds in-elastically and/or the soil conditions favour the appearance of SSI phenomena. Towards this objective significant effort has been undertaken within the context of a number of projects that has been continuously funded by the European Union for the last decade [Manos 2004, Pitilakis 1999, http://euroseis.civil.auth.gr]. These projects were carried out mainly at a large "natural" laboratory (Volvi Euro-Test Site, located 30 km from Thessaloniki-Greece), which is unique in Europe and one of the few such Test Sites worldwide [Manos 2004]. The main objectives of this paper are to: a) define soil flexibility and damping properties. b) use model structures in-situ to investigate the beneficial or detrimental role that the soil-foundation flexibility (SSI) has on the overall dynamic response c) introduce structural yielding on the model structures and investigate the coupling between the structural yielding and the SSI effects d) examine the nature and the effect of the waves transmitted by the oscillation of the superstructure to the foundation level and the surrounding soil. e) use the Aristotle University Laboratory facilities to verify post-elastic behavior of model bridge piers as well as effectiveness of repair techniques. f) use the in-situ measurements to validate empirical, analytical or numerical simulations of this soil-foundation-structural flexibility and damping on the dynamic and seismic structural response

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