EURODYN 2005, C. Soize & G.I. Schuëller (eds)

Investigation of the interaction between neighboring model structures at the Euroseis-Test site

G.C. Manos
Laboratory of Strength of Materials, Department of Civil Engineering, Aristotle University Thessaloniki, Greece
P. Renault
Chair of Structural Statics and Dynamics, RWTH Aachen University, Germany
A.G. Sextos
Structural Division, Department of Civil Engineering , Aristotle University Thessaloniki, Greece

ABSTRACT: This paper examines numerically the dynamic interaction between neighboring structures for various excitation levels, frequency content and approaches adopted. In particular, the structure-soil-structure interaction is examined for the case of a 6-storey model structure and a model bridge pier at the Volvi – Greece European Test Site for Earthquake Engineering, a well controlled built environment both in terms of soil and structure configuration and characteristics.

1 INTRODUCTION

Within the last decade the demand and interest for reliable methods to analyze the dynamic Soil-Structure Interaction (SSI) has increased considerably. The challenge to construct long bridges, high-rise buildings at unfavorable geotectonic or geotechnical environment as well as the introduction of modern seismic codes all over the world posed the necessity of a better understanding of the dynamic behavior of these structures taking into account the interaction with the underlying soil.

Towards these objectives, a model bridge pier and a 6-story building have been constructed at the Volvi - Greece European Test Site for Earthquake Engineering within the framework of the currently running (http://euroseis.civil.auth.gr) Euroseis-Risk Project. Since one of the objectives of the European project Euroseis-Risk is the numerical and experimental study of the dynamic response of the 3D reinforced concrete structures built on site, numerous in-situ low level dynamic tests have been performed which were complemented by laboratory tests.

Apart from the study of the potential effect that soil flexibility and damping can have on on the dynamic and earthquake response of structures, Euroseis-Test Site provides the opportunity to study the dynamic interaction among neighboring structures as well. This is achieved not only on the basis of the well known and controlled structural and soil properties, characteristics and configuration but also of the validation of numerical results through a set of experimental campaigns and the subsequent in-situ observations.

Within this context and in order to simulate numerically, as a first stage, the above potential interaction, various methods have been used and compared in an ascending order of complexity. In particular, simplified methods are utilized like the Winkler-Spring and the Cone-Models of Wolf, Finite Element Method (FEM), as well as a new approach that couples Boundary Element Method (BEM) and Finite Element Method formulation; the latter is implemented into a finite element software package, that essentially incorporates the advantages of both methods. Through a comparative approach that utilizes various excitation levels and frequency content, the effectiveness of the aforementioned approaches is examined and the importance of accounting for the presence and the interaction of neighboring structures.

2 DESCRIPTION OF THE STRUCTURES AND THE TEST SITE

Two model structures have been built at the Volvi test; the first is a 6-story reinforced concrete frame model building with masonry infills, initially constructed in 1994. The second model structure is a single bridge pier and its foundation block. This bridge pier model structure was recently built (2004) at the Volvi test site and is similar to corresponding bridge piers that were tested at ELSA laboratories of the European Joint Research Center (Pinto 1996), but of larger dimensions and a different cross-section detailing as will be explained below. The layout at the Test Site is depicted in Figure 1; apart from the structural models and the network of strong motion accelerographs this facility also includes a crane, a store house and a power generated hydraulic system. The geometry and material properties of the model building can be found in Manos et al. (1995). For the bridge pier the geometry and material pa-