EARTHQUAKE RESPONSE ANALYSIS OF THE HIGASHI-KOBE BRIDGE

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SUMMARY

This paper presents results of observation and analysis of the response of one of the longest cable-stayed bridges in the world to the Hyogoken-nambu (Kobe) Earthquake of January 17, 1995. It is determined that interaction of the foundations of the bridge towers with the supporting soil plays a decisive role in the overall structural behavior. The key factor governing the changes of the soil properties at this site is pore water pressure buildup, which results in liquefaction of the saturated surface soil layers under large dynamic loads. Models of the soil and structure are created and initially validated by accurately simulating the system response to a small earthquake. Soil parameters reflecting the pore-water pressure buildup in the strong earthquake are determined by an advanced nonlinear effective stress analysis, combining the Ramberg-Osgood model of stress-strain dependence with a pore pressure model based on shear work concept. They are utilized to investigate and simulate the interaction of the foundation and the supporting soil using the program SASSI with the flexible volume substructuring approach. The results show a good agreement with the observations and have useful implications to the scientific and engineering practice.

KEYWORDS: Dynamic soil-structure interaction; Hyogoken-nambu Earthquake; cable-stayed bridge; pore water pressure buildup; liquefaction analysis

1. INTRODUCTION

The Higashi-Kobe Bridge in Kobe City, Japan, is one of the longest cable-stayed bridges in the world. It is a part of one of the most important transportation arteries in Japan-The Osaka Bay Route, which is an 80-kilometer expressway stretching from the western end of Kobe to the southern end of Osaka (Figure 1). The Higashi-Kobe Bridge spans the