

Experimental Study on Fluid Force on Bridge Beam Due to Tsunami

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ABSTRACT

Characteristics of fluid actions on beam of PC-girder bridges caused by tsunami are investigated through two dimensional experiments. In the experiments, pressure and total inline and lift forces are measured by pressure sensors and a two-component force measuring system. The measured results show that impact force of significant magnitude acts on the bridge and the maximum in-line force deeply depends on the clearance under the bridge and tsunami height. It is also found that the magnitude of the lift force is the same order of that of in-line force.

KEY WORDS: impact force, tsunami, bridge beam, in-line force, lift force

INTRODUCTION

Japan is surrounded by sea on all sides with long and complex coastlines and is highly vulnerable to earthquake-generated tsunamis. In reality, there have been severe damages caused by various tsunamis in the past, including the Meiji-Sanriku Earthquake Tsunami (1896), Nihon-kai-Chubu Earthquake (1983), and Hokkaido Nansei-oki Earthquake (1993). In addition to local tsunamis generated by earthquakes near the coast, Japan has also suffered major damages from the distant tsunamis generated by open-sea earthquakes. There are growing concerns over the occurrence of large earthquake-generated tsunamis in the southern part of Japan opening onto the Pacific Ocean. It has been pointed out with a great sense of urgency that Japan can be struck by large-scale earthquakes in the next few decades, such as the Tokai Earthquake, Tonankai and Nankai Earthquakes around the Japan. The worst scenario assumed by the Central Disaster Management Council Japan is the simultaneous occurrence of Tonankai and Nankai Earthquakes and the occurrence of the tsunami of the maximum wave height 8m. Especially in Kii Peninsula, steep mountain zone comes very close to the sea and roads have been constructed along the coastline. There are not a few bridges whose height will be lower than the envisioned tsunami height. In design of usual bridges, fluid forces caused by tsunami are out of account. There is not any significant procedure where fluid forces caused by tsunami can be evaluated. The authors carried out a series of experiments to investigate characteristics of fluid action on bridge beams due to tsunami in a two dimensional wave tank.

LOCATION AND TYPE OF TARGET BRIDGES

Locations of our target bridges are on the road along coastline of Wakayama Pref. in Kii Peninsula where the tsunami is expected to reach within a few minutes after the earthquake (Fig.1). The bridge face of about 30 bridges out of 200 will be below the envisioned tsunami height. A large part of them are PC girder type-bridges. A typical section of the bridge is shown in Fig.2.

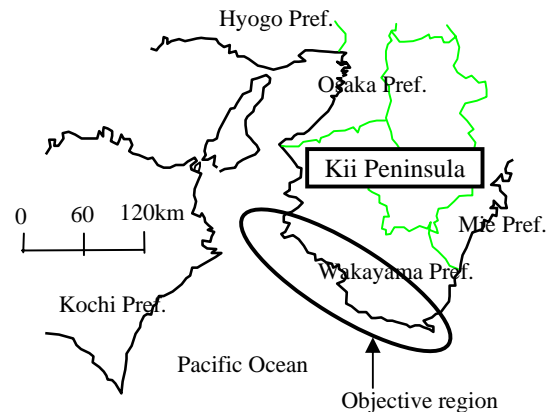


Fig. 1. Kii Peninsula and Pacific Ocean

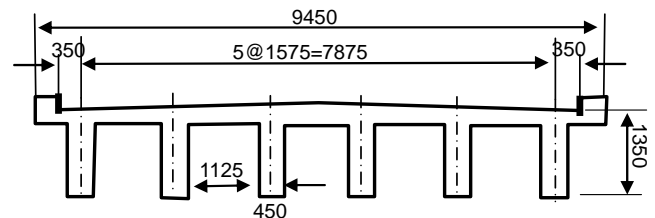


Fig. 2. Representative section of PC-girder bridge