

Shaking Table Test on a Super Long-span Cable-stayed Bridge Subjected to Spatially Varying Ground Motions

Wen Xie

Department of Civil Engineering, Ningbo University, Ningbo, Zhejiang Province, China

Limin Sun

Department of Bridge Engineering, Tongji University, Shanghai, China

Ye Xia

Department of Bridge Engineering, Tongji University, Shanghai, China

Contact: yxia@tongji.edu.cn

Abstract

A 1/70 scaled model of a trial designed super long-span cable-stayed bridge with a central span of 1,400 m, including group piles foundation and site soil modelled by utilizing laminar shear box, was designed, constructed and tested using a multiple shaking tables array system at Tongji University. The influences of different traveling wave velocity on the seismic response of the scale model with different structural systems, such as floating structural system, elastically constrained structural system and energy dissipation supporting pier structural system, were investigated under spatially varying ground excitations with considering traveling wave effects in the longitudinal direction. And the influence mechanism of input wavers with various traveling wave velocity on the seismic response of different structural systems are further clarified under non-uniform excitations in the longitudinal direction. The experimental results show that pile-soil-structure interaction (PSSI) has significant effect on the seismic responses of the towers and piers for three structural systems under non-uniform excitations; the seismic responses of different structural systems of the cable-stayed bridge scaled model is sensitive to the traveling wave velocity of earthquake waves, which suggests that traveling wave effects should be considered in the seismic design of the super long span cable-stayed bridges. This kind of shaking table test can help to improve understanding on dynamic performance, and is very useful for seismic design and analysis for a super long span cable-stayed bridges excited spatially varying earthquakes, especially for a super long span cable-stayed bridges considering with PSSI.

Keywords: Super-long cable-stayed bridge; shaking table test; traveling wave effects; structural system; pile-soil-structure interaction; laminar shear box.

1 Introduction

Civil infrastructures including long-span bridges have been constructed in the past in China, such as Sutong Yangtze River Bridge. Furthermore,

several sea-crossing projects are under planning in China, such as Bohai Bay and Qiongzhou channel ^[1]. Some of the projects are located in strong seismic zones. Although cable-stayed bridge is a very competitive structural type for crossing river and sea, long span bridge structures which have