IABSE Conference – *Structural Engineering: Providing Solutions to Global Challenges*
September 23-25 2015, Geneva, Switzerland

Earthquake-induced Collapse Simulation of a Super Long Span Cable-Stayed Bridge Based on an Open Source FE Program

Kaiqi Lin, Linlin Xie, Xinzheng Lu, Lieping Ye

Key Laboratory of Civil Engineering Safety and Durability of Ministry of Education, Tsinghua University, Beijing, China

Contact: luxz@tsinghua.edu.cn

Abstract

Currently, the seismic performance assessments of long span bridges are generally conducted using commercial finite element (FE) software packages, which to some extent limit the in-depth investigation of associated topics. A numerical model system is proposed to simulate a super long span cable-stayed bridge with a maximum span of 1500 m based on an open source FE software package (i.e., OpenSees). The seismic performance of this bridge is investigated. The simulation results of OpenSees and the commercial software MSC.Marc are compared with a good agreement. Furthermore, a collapse simulation of the bridge is also successfully performed and the corresponding collapse mechanism is revealed. The research outcome could provide a reference for further studies on the seismic performance of super long span cable-stayed bridges based on open source FE programs.

Keywords: super long span cable-stayed bridge; seismic performance; collapse simulation; OpenSees; multi-layered shell element

1 Introduction

The recent rapid development of transportation networks has promoted the construction demand of long span bridges. This makes investigations on the seismic performance of long span bridges a critical issue in civil engineering. Numerous investigations have indicated that the FE method has gradually become an effective method to investigate the seismic performance of large-scale complicated structures due to the limitation of experimental facilities for such structures [1-6]; however, most seismic analyses of large span bridges were conducted using commercial FE software packages [3-6], which to some extent restrict the further investigation of this research field.

OpenSees (Open System for Earthquake Engineering Simulation), as an open source FE program, has become one of the most influential platforms for earthquake engineering research. In comparison with conventional commercial FE software packages, there are two notable advantages for using OpenSees. First, the source code of OpenSees is available for free, which enables further research and discussion on its internal mechanisms and functionalities. Second, researchers worldwide are permitted and encouraged to share their latest research outcomes using this software, thus facilitating the reuse of previous achievements and further in-depth research.

Despite the abovementioned advantages, OpenSees is mostly used to investigate the seismic performances of small or mid span bridges [7-9]. Research on the seismic performance of large span bridges using OpenSees has rarely been reported. The primary reason for the lack of such work is that OpenSees lacks an appropriate and versatile model for bridge towers, piers and decks,

https://doi.org/10.2749/222137815818359087