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

Seismic Response and Cushioning Research of Long-span Railway Continuous Beam-arch Composite Bridge

Yu Wang, Gonglian Dai

School of civil engineering, Central South University, China

Contact:wangyu92129@qq.com

Abstract

For analyzing the seismic response and cushioning rules of long-span continuous arch-beam bridge, taking a (82+172+82)m long-span continuous beam-arch bridge on the Lanzhou-Chongqing railway as an example, the pile-pier-beam-arch finite element model considering the interaction between pile and soil was established. It was discussed that the higher modal shape, geometrical non-linearity, travelling wave effect and so on had impact on the seismic response. The results show that the largest internal forces happen on the arch feet. The sectional internal force mostly depends on lower modal shapes(the first 30 modal shapes). With the increase of travelling wave speed, internal forces of the arch bridge vary in different positions. The speed lock-up devices can significantly reduce the displacement and seismic forces of the fixed bearing piers, whose seismic damping rate can reach 18%.

Keywords: *Beam-arch bridge, Seismic response, Travelling wave effect, Speed lock-up device.*

1 Introduction

Beam-arch bridges have both the characteristics of arch and beam, which are significant structural type of railway bridges[1]. With the development of railway enterprise, beam-arch bridges have been widely applied in the railway engineering of China, such as (90+180+90)m Zhenjiang bridge on the Beijing-shanghai express railway, etc.

Domestic scholars have made extensive research on the seismic response of the long-span beam-arch composite bridge. Hao Wang analyzed half-through concrete filled steel bridge and discussed travelling wave effect on its seismic response[2]. Zhengying Li analyzed the seismic characteristics of Caiyuanba bridge[3].

Taking the (82+172+82)m long-span beam-arch bridge as the example, the pile-pier-beam-arch finite element model considering the interaction between pile and soil was established. It was discussed that higher modal shape, geometrical non-linearity, travelling wave effect and so on had impact on the seismic response. On this basis, the seismic reduction of the speed lock-up device was further discussed.

2 Model building

The (82+172+82)m beam-arch composite bridge is located in Sichuan province, with main girder of single box and variable height. The height of beam varies from 4.5m to 10m. The arch rib adopts dumbbell concrete-filled steel tube section with the design rise of 34.4m and rise-span ratio 1:5.

The pile-pier-beam-arch finite element model considering the interaction between pile and soil was established based(Fig.1)[4,5,6]. Girder and arch rib adopt spatial beam element, and spatial truss element for bridge derrick. And equivalent spring element is adopted to simulate the interaction of piles and soil.

In accordance with the requirements of seismic design calculation, the corresponding response spectrum is selected in the railway engineering

https://doi.org/10.2749/222137815818359276