Seismic Performance Assessment of Multi-Span Continuous Railway Bridges Across a Symmetrical V-Shaped Canyon Considering the Near-Source Topographic Effect

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Abstract

Topographic features have remarkable influences on the characteristics of ground motions, which may cause the amplification of input seismic waves. The objective of this study is to numerically explore the near-source topographic effects on the seismic behaviors of an existing railway bridge crossing a symmetrical V-shaped canyon. Numerical results demonstrated that the topographic effects can noticeably amplify the seismic responses of the bridge. Compared to the bridge without crossing a canyon, the peak displacement of the girder and pier in the case of the canyon-crossing bridge increases by 15.2% and 2.9%-14.5%, respectively. The piers at the illuminated side of the canyon experience larger seismic responses compared to the piers at the shaded side of the canyon due to the unequal motion amplitudes at each support.

Keywords: railway bridges; V-shaped canyon; topographic amplification; seismic response.

1 Introduction

To improve socio-economic development, the transportation network has been extended to the mountainous areas in western China[1]. Many bridge structures have been or are being constructed across various canyons in high seismic zones. One case in point is the Sichuan-Tibet railway in China, which is being constructed in a high seismic risk region and across numerous deep canyons or valleys along the railway line [2]. Past earthquakes have demonstrated that the canyon slopes may cause the amplification of the ground motions [3-6] and as a result, the bridge structures may experience serious seismic damage. For example, the Miaoziping bridge crossing the Zipingpu canyon and the Baihua bridge crossing the Minjiang river sustained serious damages under the Wenchuan earthquake [7]. These damage examples have raised public concerns on the seismic safety of the canyon-crossing bridges near an active fault.

It has been widely recognized that the scattering of seismic waves in the presence of a V-shaped canyon may cause significant modification on earthquake ground motions. Many researches have been conducted to investigate such topographic effects through domain methods [8-

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