Seismic Analysis of a Concrete-Filled Steel Tubular Truss Bridge

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Summary

During the recent construction activity in China, concrete filled steel tubes (CFST) typology is innovatively applied in beam bridges with CFST composite truss girders and CFST lattice piers. The subject is Ganhaizi Bridge, one of the most unusual viaducts, has a total length of 1811m and is an experimental truss bridge that uses steel tubes for nearly the entire structure. This paper presents the study on nonlinear seismic performance of Ganhaizi Bridge. Seismic response characteristics, piers yielding order and internal force redistribution effect in plastic scope are investigated through a simplified fiber finite element model based on the second unit of this bridge. Take extreme edge strain of CFST columns as criterion, the horizontal most adverse seismic input direction for this curved bridge is perpendicular to the bearing connection on both ends, the influence of vertical ground motion should be simultaneously considered. After turn into plastic stage with increasing peak ground acceleration (PGA), the main stress direction of lattice piers and composite piers are both in plane, axial forces increase less than seismic, while displacements increase greater. Bending moments of high piers increase greater than short piers, which is expected to facilitate seismic performance of the whole bridge.

Keywords: CFST composite truss girder; CFST lattice pier; Ganhaizi Bridge; nonlinear seismic performance, plastic hinge.

1. Introduction

Concrete filled steel tubular (CFST) are becoming increasingly popular and used in various structures throughout the world due to the excellent composite interaction between the steel tube and concrete. Meanwhile, the trusses have been widely used due to the effective force transferring mechanism [1]. Therefore, CFST truss typology has been increasingly used in large-span spatial structures and long-span bridge structures, such as roof structures, sports stadiums and arch bridges, not only for economical reasons but also for aesthetic appeals [2]. CFST truss is used to build multi-storey frame building with excellent seismic resistance, expected to work as a vertically continuous shear wall, prevent the building from collapsing, and this system may be practical [3]. For bridges, CFST truss is mostly adopted for long-span arch bridge. When the span is greater than 200m, truss section is adopted among 97% of arch bridges in China [4]. During the recent construction activity in China, CFST truss typology is innovatively applied in beam bridges with CFST composite truss girders and CFST lattice piers. Significant advantage of this type is that, the tedious process of framework preparation and steel fixing in the RC construction is absent. Moreover, with the favourable ductility of CFST materials and lightweight truss structure, the earthquake resistant properties of high pier bridge is expected to promote. This type of bridge is a new exploration in the bridge selection when used in the high mountains and deep valleys area, especially in seismic zones.

The Ganhaizi Bridge is studied in this pater, one of the most unusual viaducts to be built in China, is an experimental truss bridge that uses steel tubes for nearly the entire structure. It is located in

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