Experimental Research on an Assembled Steel Damping Device with the Large Temperature Displacement

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1 Abstract

The cylinder-shaped damper is proved reliable in mechanical performance and every single-body can simultaneously provide bi-directional damping force. In order to take advantage of these benefits in the long-span bridge, an assembled steel damping device is developed in this paper. A fluid lock-up device is connected in series with a cylinder-shaped steel damper, which can meet the requirement of girders stretch out and draw back freely for large displacements under temperature load, and can control the bi-directional seismic vibration of the structure under earthquake load. A series of quasi-static tests were carried out on the steel damper, the fluid lock-up device and the assembled device. The test results show that a low force is generated to allow unrestricted motion at low translational speeds. Yet, when a transient event occurs, the lock-up device activates, and the steel damper can exhibit good hysteretic behavior due to its plastic deformation.

Keywords: Large temperature displacement; cylinder-shaped; steel damper; fluid lock-up; quasi-static test.

2 Introduction

The bridge seismic design includes bi-directional control of vibration. In the longitudinal direction, a fluid viscous damper is often installed at deck-tower connections to reduce shear and bending demands at tower bottoms and foundations. In the transverse direction, however, steel damping devices are often adopted at deck-bent/tower connections [1]. The photographs of the typical damping devices adopted for the vibration of long-span bridges are shown in Figure 1. Metallic dampers have proved to be straightforward as far as configuration patterns are concerned and reliable in mechanical performance. Compared to other forms of energy-consuming damping devices, their control effect is more predictable, their maintenance costs are lower, and are more widely applicable. In the design of a steel damping device for a long-bridge, the gap between the damper and the connecting plate should be such that it satisfies the requirement that the main girder has the ability to slip, in case the temperature load force is generated. The slipping distance depends on how much the main girder expands and contracts under temperature load. For the long-span bridge, the distance may be in tens of centimeters or more. But this kind of solution limits the application of steel damping devices for the vibration control in the longitudinal direction.

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