Studies on Seismic Retrofit of the Honshu-Shikoku Bridges Using Isolation and Dissipation Devices

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Summary

Seismic retrofit work for the Honshu-Shikoku Bridges has recently been launched because there is a concern that seismic risk for the bridges increases. In this paper, two examples of the investigation for seismic performance improvement using isolation and dissipation devices are described. One is the case of a viscous damper, which is adopted for a steel girder bridge. The other is the case of a seismic isolation bearing, which is adopted for a steel truss bridge.

Keywords: seismic retrofit, seismic motion level 2, viscous damper, seismic isolation.

1. Introduction

The Honshu-Shikoku Bridges are located in seismic-prone area, where plate boundaries and several inland active faults exist nearby. Occurrence of a large-scale earthquake exceeding the design seismic force has recently been predicted by the government, so there is a concern that seismic risk for the bridges increases. The bridges must undertake a role as emergency transportation routes in case of a large-scale earthquake since there is no alternative route from Honshu to Shikoku Island. Therefore, seismic upgrading for the bridges is an urgent issue. On the other hands, selection of a seismic retrofit measure for the minimum cost is another crucial issue.

In this paper, two studies on the seismic retrofit of the bridges using isolation and dissipation devices are presented. The bridges, designed by an older design code, were considered to be seismically vulnerable against a large-scale earthquake. Following the detailed seismic assessments, it becomes clear that the bridges possibly collapse, and the most efficient retrofit measures are determined in view of an entire bridge system. One is the case of a viscous damper, which is adopted for a steel girder bridge. In this bridge, the distribution of the girder inertial force is changed to increase the contribution of both abutments, which have high restraint ability against horizontal force, by installing viscous dampers at the both girder ends. The other is the case of a seismic isolation device, which is adopted for a steel truss bridge. In this bridge, existing steel bearings are replaced by high damping rubber bearings. The costs of seismic retrofit works in both bridges are extremely reduced by adopting those devices.

2. Outline of Seismic Retrofit for the Honshu-Shikoku Bridges

The Hyogo-ken Nanbu Earthquake in 1995 had brought about a great change in the Japanese seismic design. The earthquake led the Japanese seismic design code for highway bridges to be revised drastically in 1996 and to adopt the performance-based design philosophy that consider two levels of design seismic motions; seismic motion Level 1 corresponds to an earthquake with high probability of occurrence during the bridge service life, and seismic motion Level 2 corresponds to an earthquake with less probability of occurrence during the bridge service life but strong enough to cause critical damages. Furthermore, seismic motion Level 2 is classified into 2 types; one is a seismic motion corresponding to an interplate earthquake with a large magnitude (Type I); the other

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