Improvement of Seismic Capacity of Bridges Using Seismic Isolation System in Korea

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Summary

This paper describes the state-of-the-art research activities on seismic isolation systems for improving the seismic capacities of the bridges in Korea. Optimal design methodology based on the minimum life-cycle-cost (LCC) is described for the seismically isolated bridges in areas of low-to-moderate seismicity. Experimental studies on seismically isolated bridge are introduced as well, which include pseudo-dynamic test of scaled pier and dynamic field test of full-scale. In addition, various applications of isolation devices to the new and existing bridges are summarized.

Keywords: Seismic isolation system; life cycle cost (LCC); field test; retrofit.

1. Introduction

The seismic characteristic of the Korean peninsula is widely accepted to belong to the low-to-moderate seismicity. According to the historical records, however, it has been reported that over 1900 earthquakes have occurred during the last 100 years. A noteworthy observation is that the seismic events have occurred more frequently in recent years. Accordingly, potential seismic risk in Korea is recognized to continue to grow steadily. Therefore, the development of reliable and cost-effective seismic protection system against the future earthquakes has been of great interest. In addition, since most of the infrastructures have been built during 1970's—the rapid industrialization period in Korea, the need for rehabilitating the existing structures is quite high. Moreover, over 30 long-span bridges have been planned to be constructed in the south-western coast to link about 3000 islands to the mainland. Such growing numbers of construction activities has further increased the need for providing preventive measures against catastrophic structural failure from the seismic events [1].

As the anti-seismic or anti-vibration system for civil structures, especially for the bridges, seismic isolation system has been well accepted as an effective and economical alternative for improving the seismic capacities of the new and existing bridges. Accordingly, lots of bridge designs in Korea have concentrated on the application of the efficient seismic isolation system in late 1990's. However, most of the bridges with seismic isolation system at that time have been constructed without any properly-developed seismic design code. The early seismic design code for those bridges has just borrowed the basic idea from that developed for high seismic region, without serious review and extensive investigation. However, it is self-evident that the seismic design code developed for high seismic areas may not be directly applicable to the bridges in region of low-to-moderate seismicity. For example, the seismic design of the bridges in high-intensity seismic zone is based on the assumption of ductile behaviour and large energy absorbing capacity, whereas the bridges under the moderate-intensity ground motion may remain well within elastic limit. Another critical problem of the code system was found to be lack of consistency between the performance requirements and the design principles. They are different from each other in seismic zoning,

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