Seismic Response Analysis of Hakucho Suspension Bridge from Long-term Monitoring System

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Abstract

Hakucho Suspension Bridge (HSB) located in Muroran Gulf, Hokkaido Prefecture is the longest suspension bridge in northeastern Japan with the total span length of 1380m. The bridge has permanent seismic monitoring system consisting of 27 channels of accelerometers placed on fourteen locations on the deck, tower and free-field. Since opened to public on June 13, 1998 until 2006 the monitoring system has recorded various scales of earthquakes, including the major ones such as the 2003 Tokachi and 2004 Kushiro earthquakes. To investigate dynamic characteristics during various level of seismic excitation in more detail, multi-input multi-output time-domain system identification was conducted. Vibration characteristics of structural members such as girder and tower for different amplitude of excitation are investigated and compared with previous results from ambient response analysis and finite element.

Keywords: Suspension Bridge; Seismic response; structural monitoring; bridge pylon; seismic monitoring.

1 Introduction

Many long-span bridges were constructed in Japan in the past decades. These bridges are expensive investments and have long service periods, during which they are subjected to environmental long-term loads effects such as fatigue, material deterioration and extreme loading conditions. For long-span bridges, wind-induced vibration generally considered as the most critical among various types of dynamic excitation. Determination of wind forces is a difficult task since they are sensitively influenced by the turbulence. Similarly, earthquake is also an important factor in design of long-span bridges located in seismically active regions such as Japan. Structural non-linearity, multi-support excitation and specially design aseismic devices are known to significantly influence seismic responses of the bridge.

Design for earthquake resistant structure involves many assumptions and inherent uncertainties. Therefore, understanding the real behaviour of the bridge under such excitations is very important for design verification. For this purpose, structural monitoring system through deployment of permanent instrumentation plays an important role. In addition, structural monitoring system is also useful to evaluate severity of loading effects after the occurrence of extreme events.

In this paper we describe a case study of long-term seismic monitoring system of a long-span suspension bridge. The dynamic response characteristics of the bridge have been identified and studied using both ambient vibration data and finite-element models [1,2,3]. However, this is the

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