



Reproduction of Long-span Bridge Seismic Responses Involving Tower-girder Pounding and Tower Link Failure Estimation for Large Earthquakes

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Abstract

During 2011 Great East Japan Earthquake, tower-girder transverse pounding was observed on Yokohama-Bay Bridge. Damage on the wind tongue due to pounding potentially leads to the damage of other members such as failure of the tower link. However, this pounding was not considered during design time and damage process after the damage of the wind tongue has not been clarified. In this study, a multi-scale model is constructed by combining the global frame model and the local FE model, which consists of shell and solid elements. Then, dynamic analysis of the multi-scale model is conducted to clarify the damage condition and the deformation of the wind tongue during large earthquakes. As a result, the base part of the wind tongue is yielded during the level 2 earthquakes and the tower link failure can occur due to large displacement after the damage of the wind tongue.

Keywords: Seismic response analysis; Pounding; Multi-scale model; Wind tongue; Tower link; Cable-stayed bridge

1 Introduction

Long-span bridges are often essential for the logistics networks at ordinary times and for evacuation routes and emergency vehicle transportation networks at the time of disaster. If these bridges are damaged by a disaster and the traffic function is lost, enormous economic and social losses are inevitable. After the Kobe earthquake, the seismic safety standards of bridges have been revised in Japan and the seismic risk of bridges has generally decreased.

Nonetheless, seismic damages caused by unexpected responses still take places.

At Yokohama Bay Bridge, the pounding between the wind tongue and the wind shoe, which constraint the transverse displacement of the girder, was observed for the first time during the 2011 Great East Japan Earthquake [1]. As shown in Figure 1, unexpected bolt fracture occurred at the tower link due to large transverse displacement of the girder although the wind tongue was not damaged. If the wind tongue had been damaged,