Control of the Dynamic Response of Cable-stayed Bridge with Highway and Railway under Multiple Loading by a Viscous Damper

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Abstract

In China, a fluid viscous damper (FVD) is often used at deck-tower connections for a cable stayed bridge as a passive supplemental energy dissipation device to mitigate the structure seismic response. This presentation discusses the effect of a fluid viscous damper on a cable stayed bridge with highway and railway subject to seismic, train braking and running loads. The rational parameters of viscous dampers were firstly determined by the sensitivity analysis of parameters based on the structural seismic response. Then, the mitigation effect of viscous dampers on longitudinal vibration of the main beam induced by train braking and running was investigated. The results show that structural seismic responses are reduced effectively by a viscous damper; the longitudinal vibration of the main beam induced by train braking and train running are controlled and dynamic responses of towers are improved.

Keywords: highway and railway cable-stayed bridge; nonlinear dynamic time history analyses; seismic action; braking force of train; moving loads; viscous dampers.

1 Introduction

The construction of cable-stayed bridges has become popular worldwide in recent years, largely due to the rapid progress in design methodology and construction technologies. A lot of investigations have been shown that static and dynamic performance of cable-stayed bridges is affected by the type of deck-tower connection. A rigid connention, sliding, elastic or damper connetion between the deck and the tower are the common types of deck-tower connection[1-4]. Reasonable type of deck-tower connection longitudinally is important to reduce the longitudinal dynamic response of the bridge under seismic, vehicle braking and running loads.

For long span highway and railway cable-stayed bridge, reasonable type of deck-tower connection should meet the following requirements: (1) The constraint effect between the deck and the tower is weak to reduce the response of the tower as the floating system under temperature action. (2) The constraint effect between the deck and the tower which is to increase the stiffness of the bridge is strong enough to withstand moving vehicle. (3) The constraint effect between the deck and the tower can increase damping to reduce the response of the tower under vehicle braking and seismic action. In order to meet the above requirements, a rigid or sliding deck-tower connection is not the reasonable type of connection. Viscous damper is a common dissipation device to reduce seismic response

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