



Dynamic analysis of large-span suspension bridge under earthquake excitations using ANSYS-MATLAB co-simulation

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Abstract

Under strong excitations, such as earthquake, the effect of the geometric nonlinearity of the suspension bridge is significant. Traditional train-bridge interaction analysis method usually cannot simultaneously consider both geometric nonlinearity and spatial wheel-rail contact. In this paper, an ANSYS-MATLAB co-simulation method is proposed to analyze the dynamic responses of the train-suspension bridge system under earthquake excitation. The two software platforms are coupled through the interaction between track and bridge, and then the dynamic response of the whole vehicle bridge coupling system is solved. the dynamic response of the train-bridge system of a railway suspension bridge under the action of an earthquake is analysed, taking into account the effect of peak ground acceleration and characteristic period on the geometric nonlinearity of the bridge and the safety of trains running on the bridge.

Keywords: long span railway suspension bridge; co-simulation method; geometric nonlinearity; spatial rolling wheel-rail contact; seismic; running safety.

1 Introduction

With the development of high-speed railway construction, the demand for the construction of long-span railway bridges will increase day by day. Suspension bridges have become one of the structural forms considered for long-span railway bridges due to their stronger spanning capacity, more flexible side span layout and cost advantages[1], Due to the frequent occurrence of earthquake disasters in my country, the earthquake has a significant impact on the dynamic response of bridges and the safety of vehicles on the bridge[2], Therefore, studying the dynamic response of suspension bridges under earthquake action and the safety of trains on the bridge has important reference significance for engineering design.

Most of the completed suspension bridges are highway suspension bridges, therefore, there are not many studies on the safety of trains on railway suspension bridges under earthquakes.

Lei Hujun et al [3] used the virtual beam method to establish a bridge model and carried out a study on the safety of a kilometre-class high-speed railway suspension bridge under earthquake action based on a self-programmed train-track-bridge-earthquake analysis system program; Xiao et al [4] used the modified Lagrangian equation and the principle of virtual work to establish the nonlinear equations of motion of the vehicle-cable system in incremental form and, on the basis of the implicit Wilson-theta method Seung et al [5] proposed a new iterative solution algorithm based on the Newmark mean acceleration algorithm and the Newton-Raphson