



Train-Bridge Dynamic Analysis Theory for Super Major Bridges and Its Engineering Applications

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Abstract

Subject to the running safety and riding comfort requirements of high speed railway in China, the dynamic performance of bridges and train must be evaluated through train-bridge coupling vibration analysis. Super major bridges are affected by environmental factors in service stage, such as settlement, sunshine, temperature, wind and earthquake, and their ideal states are difficult to maintain. In order to optimize structural key parameters at the design stage, it is necessary to carry out train-bridge coupling vibration analysis considering these external factors.

This article discusses separately the value range, treatment method and judging criteria of settlement, sunshine, temperature and wind. These external influences are divided into two categories, static and dynamic. The static excitations include settlement, sunshine and temperature, and they are treated as initial deformation of bridge deck. The dynamic excitations include wind, earthquake or impact caused by cars or boats, and they must be treated as additional dynamic load of bridge.

Taking an arch bridge and a cable-stayed bridge as examples, the influences on train performance caused by details of bridge construction and additional excitation sources are discussed, then the design key parameters for running safety and riding comfort are specified. These results provide technical supports for complementing design code and provide reference for similar bridges.

Keywords: long-span bridge; environmental factors; wind; static deformation; train-bridge dynamic analysis.

1 Introduction

Subject to the running safety and riding comfort requirements of high speed railway in China, the dynamic performance of bridges and train must be evaluated through train-bridge coupling vibration analysis. The ideal state of super major bridges are difficult to maintain, because these bridges are affected by environmental factors in service stage, such as settlement, sunshine, temperature, wind and earthquake. In order to optimize structure key parameters at the design stage, it is necessary to carry out train-bridge

coupling vibration analysis in considering these external factors.

At present, studies on the train-track-bridge dynamic interaction can be generally divided into two kinds – fundamental study and application study. Their corresponding contents, main points and goals are summarised as in Table 1.