



Blast Load Effects On the Pier of High-speed Railway Bridge

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Abstract

Large volume of high-speed railway infrastructure have been constructed in China, which are very important to the economic development of China. However, whether these structures can stand for dynamic loading such as blast load, wind load, moving load and seismic load is very crucial to the safe operation of them. The effects on the bridges from above dynamic loads such as wind load, moving load and seismic load have been investigated, but the blast load effects have been studied very little, especially to the high-speed railway infrastructure.

Since blast load is a kind of short duration dynamic loading influencing structural response significantly, which often exhibits strong spatial and time variations, resulting in sharp stress gradients in the structures. Consequently, the analysis of bridge structures subjected to blast loading becomes a very complex issue and it is hard to analyze accurately deformation or crack conditions of bridges subjected to blast wave using equations. On the other hand, experiments on real bridge are so exhibitive that it is hardly carried out. So in recently years numerical simulation technique become very important tool to investigate such issues.

In this paper, the prestressed pier of high-speed railway bridge is selected as the research target, 3D numerical simulation models are used to analyze the dynamic response and damage mechanism of it subjected to blast loading. The numerical simulation method such as algorithm, constitutive model, failure model and contact algorithm are also discussed in the following contents.

Keywords: blast load; bridge pier; high-speed railway.

1. Introduction

Explosive phenomena is one including large energy expansion in a limit volume and a short time, which exist in modern living, such as nuclear explosion, terrorism attacking and natural gas explosion. Recently high-speed railway plays a very important role in Chinese economic development as an important infrastructure and life-line engineering project, however there are no requirement about the anti-blasting capacity in the Chinese structural code, which may generate failure of such kind of structure subjected to blast load.

Some research have been done to investigate the effects of blast load on the structures, such as steel beam column^[1], reinforced concrete beam^[2], slab^[3], reinforced concrete building^[4, 5, 6], cable-stayed bridge^[7, 8, 9], bridge components^[10] and subway structures^[11].

Although the above research has been done, the investigations about components and structural system of high-speed railway structure subjected to blast load have never been done before. So in this paper, the pier of high-speed railway bridge will be selected as the research target, the numerical model about concrete, prestressed spar, blast load and air state equation will be presented firstly, and then finite element model of bridge pier and blast load characteristics will be discussed,