Numerical Simulation on Blasting Seismic Effect Under the Different Charge Structures

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Abstract

A finite element program LS-DYNA is applied to simulate the production and attenuation of seismic waves during rock blasting under the condition of different decked charges. The simulation signal of seismic wave is compared with results from experiment. The agreement is reasonably good. This work shows that numerical simulation is an effective method for engineering blasting.
Keywords: *dynamic finite element; rock blasting; seismic effect; numerical simulation*

1. INTRODUCTION

Study of seismic effect and its controlling is an important issue in the area of rock blasting. Rock blasting by explosive is an extreme complexity due to the rock properties of unhomogeneity and anisotropy [1-2]. With the development of computer numerical technology, computational analyses play another significant role in scientific research except experimental investigation. In recent years, a number of simulation studies on blasting and seismic wave propagation in rock have been carried out by many researchers [3].

This paper applies finite element program of LSDYNA to simulate the characteristic of production and attenuation of rock blasting seismic wave. The simulation is compared with results from experiment, the agreement is reasonably good. The results have provided a base for preventing and controlling blasting seismic effect effectively.

2. EXPERIMENTAL TEST AND COMPUTATIONAL METHOD

2.1. Experimental test

In the experiment, the diameter and the depth of the explosive column are 200mm and 14m respectively. The geometry is shown in Figure 1. 2# rock explosive is used, and its weight is175kg.

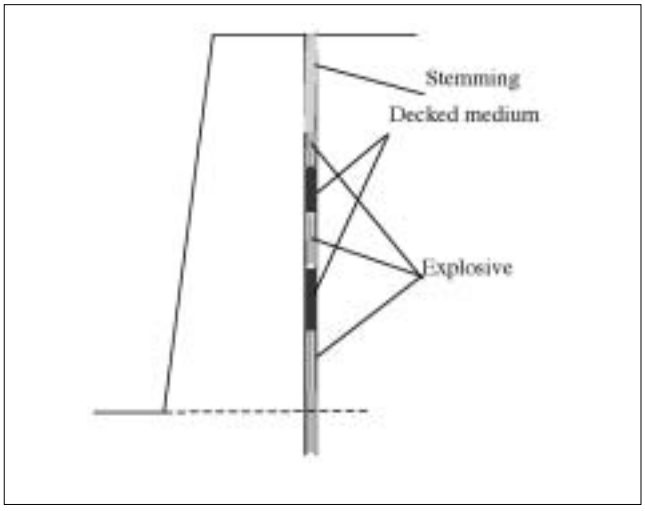

Figure 1: configuration of experiment.

The explosive is distributed in three layers with a ratio of 4:2:1. The decked mediums include air, water and sand. The length of decked media is 1.5m at bottom part and 2.0m at upper part. Strata ViewTW digital seismograph produced by an EG&G company of American is applied in the experiment.

2.2. Computational method

Simulation of the explosion, breakage and propagation of seismic wave is theoretically possible. However, a great deal of factors, involving the characteristic of medium, the difference of time step and the restriction of computer resources etc., make numerical simulation can not simulate the process from explosive blasting to seismic wave propagation. So the simulation is carried out in two steps on the basis of blasting influencing fields. 1. Where the part of explosion, due to the high stress level, large deformation and even fluid state are produced in rock media. ALE method is used to simulate fluid-solid coupled problem during explosion, and the stress data are obtained on elastic-plastic boundary. 2. Where the field of seismic wave, elastic vibration is produced with the attenuation of blasting waves. Based on equivalent theory, the stress data obtained where the part of explosion are applied to simulate the blasting seismic wave propagation.

3. SIMULATION OF EXPLOSION

3.1. Simulation model and material parameter

Figure 2 shows the geometry and the local enlarged finite element model of blasting. The radius and

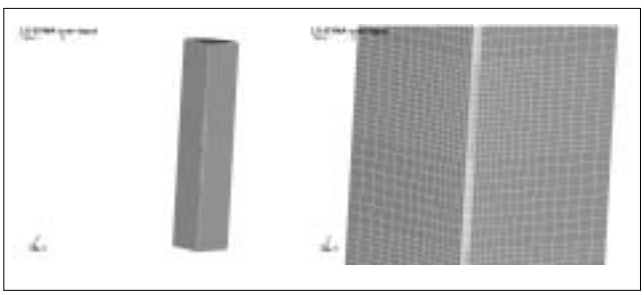

Figure 2: Geometry of the model and finite element mesh of local enlarged.