827. Influence of concave groove on transmission of blasting vibration wave

Iau-Teh Wang[1, 2], Chin-Yu Lee[3]
[1]Graduate Institute of Disaster Prevention on Hillslopes and Water Resources Engineering
National Pingtung University of Science and Technology, Taiwan, R. O. C.
[2]Department of Civil Engineering, Chinese Military Academy, Taiwan, R. O. C.
[3]Department of Soil and Water Conservation
National Pingtung University of Science and Technology, Taiwan, R. O. C.
E-mail: [1]*wang55992002@yahoo.com.tw*, [3]*cylee@mail.npust.edu.tw*

(Received 12 July 2012; accepted 4 September 2012)

Abstract. With the extensive application of blasting techniques, the prediction and hazard control of explosion-induced vibration is an important issue which cannot be ignored in blasting engineering. A numerical approach is presented to study the explosion-induced pressure load on the surface of C-4 explosives in a semi-infinite space, in order to explore the effectiveness of concave grooves in ground vibration wave barrier. Numerical simulations are carried out by using a widely applied explicit dynamic nonlinear finite element software LS-DYNA and adopted the Arbitrary Lagrangian-Eulerian method for numerical analysis to simulate the propagation of blast waves. The analysis shows that the concave grooves have a significant effect on attenuating the propagation of detonation waves. The vibration control is related to the width and depth of the groove, and the impact of the depth is greater than that of the width. This study can be used as a reference in hazard control of explosion-induced vibration.

Keywords: blast, concave groove, wave barrier, vibration control, ground vibration.

1. Introduction

Blasting is the main construction method for rock and soil excavation. With the extensive application of blasting techniques, the prediction and hazard control of explosion-induced vibration play a very important part in engineering design and construction, and they have become important issues for experts, scholars and engineering technicians. To ensure that the vibration cannot affect the structural safety of buildings, there is an urgent demand for hazard control of explosion-induced vibration. The following are 3 general methods for the hazard control of explosion-induced vibration [1]:

(1) Control the explosive source.
(2) Control the protected object and fit it with dampers.
(3) Take measures for the propagation of seismic wave by excavating the damping groove to interrupt the propagation path.

When explosives explode on or near the ground surface, the seismic waves will be triggered by the air shock wave. Blast waves are first transmitted in the form of underground shock waves, and then transformed into elastic seismic waves, inducing the vibration of the surface mass point. In addition, the soil stress waves generated from the compression of the air shock wave on the ground surface also convert into elastic seismic waves [2]. Therefore, when there is an explosion on the ground surface, these two types of blast waves can be detected in the soil simultaneously. Near the explosive point, the velocity and intensity of the air shock waves are higher. Relatively, the velocity and intensity of the corresponding soil stress waves are also higher. These are the key parameters affecting ground vibrations [3].

The propagation of blast waves in the soil/rock medium is subject to the medium characteristics and charge parameters. But the impact of surface grooves on the propagation of blast waves is very great. Currently, the foundation for investigating the parameters of explosion-induced vibration in blasting engineering lies on the perspective of energy conversion