

# **Influence of delay time accuracy on the fracture process in smooth blasting**

Masaaki Yamamoto, Asahi Chemical Industry Co., Ltd.  
Keita Morooka, Nishimatsu Construction  
Yoshiharu Tanaka, Nishimatsu Construction  
Katsuhiko Kaneko, Hokkaido University

## **ABSTRACT**

Smooth blasting is the standard method for underground rock excavation, to reduce over break and remaining rock damage. We already utilized the high accuracy of the electronic delay detonator to investigate its effect on over break remaining rock damage, and surface smoothness. And we presented at 11th annual symposium on Explosives and blasting Research.

In the present study, we analyzed the effect of detonator delay time accuracy on the fracture process of smooth blasting by an numerical simulation method. This numerical simulation method is based upon a finite element method and a rock fracture mechanics. The dynamic stress field induced by explosives is determined by a finite element scheme, and initiation and propagation of cracks are represented by the remeshing procedure. Furthermore, heterogeneity of rock strength and nonlinear mechanical behavior of cracks are also taken into account in order to express propagation history of cracks as exact as possible.

Smooth blasting by complete simultaneous initiation(with no error initiation), simultaneous initiations with initiation error of an electronic delay detonator and with initiation error of a pyrotechnical delay detonator are analyzed by this numerical simulation method. The characteristics of maximum principal stresses distributions indicate that the interference of dynamic and/or quasi-static stress fields induced by blasts of adjacent holes plays important role to control the crack propagation in smooth blasting with an electronic delay detonator. And, it is confirmed that the depth of damage with an electronic delay detonator is nearly equal to that with complete simultaneous initiation.