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Some Issues in Tunnelling through Rock Mass and Their Possible Solutions

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ABSTRACT

There are still many issues in tunneling through rock mass, which require some solutions for the safety of tunnels during and after constructions. For example, squeezing with or without swelling and rockburst in underground excavations are major modes of failure in both short-term and long-term. To assess the real-time safety of tunnels in such grounds, the monitoring of transformations of stored mechanical energy in rock into different forms of energy involving variations of the electrical potential, magnetic field, heat release, kinetic energy during deformation and fracturing processes may be quite useful. Underground structures may be damaged by earthquakes when permanent ground movements occur in/along the underground structures. This problem is still not addressed in tunneling. The author attempts to point out some issues in tunneling through rock mass and address their possible solutions in this article.

KEYWORDS

Squeezing, rockbursting, multi-parameter monitoring, seismic damage, permanent ground deformation.

1. INTRODUCTION

Tunnels are generally long underground structures and their shape and size changes depending upon the purpose of utilization and the history of tunneling extends thousands years from present. However, there are still various issues in tunneling through rock mass, requiring some solutions for the safety of tunnels during and after constructions.

Squeezing, swelling and rock bursting problems in underground excavations are often encountered and they are major modes of failure in both short-term and long-term [1]-[5]. While squeezing and/or swelling problem is often observed in weak rocks, rockburst problem is commonly seen in underground excavations in hard rocks. Rockburst could be particularly a very severe problem during the excavation as it

involves detachment of rock fragments with high velocity. Mont Blanc tunnel in France, Gotthard tunnel in Switzerland, Dai-Shimizu tunnel and Kanetsu tunnel in Japan are some of the well-known examples of rock bursting in tunneling. Rockburst problems are also one of the common instability modes in deep mining in hard rocks and numerous examples are reported from South Africa and Canada [6],[7].

It is known that when rock starts to fail, the stored mechanical energy in rock tends to transform itself into different forms of energy according to the energy conservation law. Some of these transformations involve the electrical potential, magnetic field, heat release, kinetic energy. Recent experimental studies by the authors [8]-[11] showed that rock indicates distinct variations of multi-parameters during