

# **EVALUATION OF THE EFFECTS OF SURFACE BLASTING ON ADJACENT UNDERGROUND MINE WORKINGS**

## **ABSTRACT**

Several underground coal mines are being worked at a depth of 30-150 m from operating surface mines. Under such conditions, ground vibration from surface blasting may be a potential threat to the stability of adjacent underground mines. In this study, field and laboratory investigations were conducted to address this problem.

Ground vibrations were monitored with three seismographs simultaneously in the roof, floor and pillar at various locations of two underground coal mines adjacent to respective opencast coal mines. As a result, 127 vibration data along with maximum charge per delay and travel distances were generated. Visual assessment of damage to underground structures was conducted thoroughly after each blast and the observed damage was classified into 'Severe', 'Moderate' and 'No damage'. The impact of heavy surface blasting was also monitored at one mine by installing convergence recorders between roof and floor, strain bars in coal pillars and multi-point borehole extensometers in the roof. The recorded peak particle velocity correlates well with the degree of damage to underground structures.

Predictor equations have been developed for the selected sites to estimate ground vibration accurately and reliably. The advantages of the site-specific scaling law over the popular square root or cube root scaling laws are discussed. The prediction efficacy of statistical tool has been compared with that of artificial network techniques.

In order to understand the impact of surface blasting on underground structures in detail, 144 finite element models were developed by varying the material properties of transmitting media, travel distance, number of blast holes, mode of initiation/priming and size of underground mine workings. The models were developed and analysed using ANSYS-ANSA-LS\_DYNA combined software. The results of this study show that a good correlation exists between model outputs and field measurements.

A new approach is proposed to classify blasting damage into three groups using the concept of 'Blast Damage Factor' and linear discriminant functions. Site-specific charts between weight and distance have been developed so that blasting at a surface mine can be conducted without causing damage to the adjacent underground mine.