VIBRATIONS FROM BLASTING OVER ABANDONED UNDERGROUND MINES

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ABSTRACT

Vibration wave frequency from surface mine blasting is an important influence on the response and potential cracking of nearby structures. The Bureau of Mines studied blasting vibrations in a midwestern coal mine that occasionally produces 4-Hz surface waves in its production blasting and has received numerous complaints from neighbors. The mine and nearby town are underlain by abandoned underground coal mines 85 to 325 ft below the surface.

Blast vibration measurements at the site and analysis of mine and regulatory agency records indicated that the propagating medium was primarily responsible for the vibration wave characteristics, including low frequencies, long durations, and lower-than-normal attenuations of amplitude with distance. The observed low-frequency waves were consistent with predictive theoretical models of surface wave generation using the depths to the old mines.

Blast designs also contributed to the vibrations problem. The complex multidelayed blasts generated vibration amplitudes up to three times those of same-weight-per-delay single charges, particularly for the echelon designs. By contrast, the heavy casting blasts generated more of the unusual low frequencies. Because of these low-frequency, long-period waves, the widely adopted 8-ms minimum charge separation criterion may not apply at this site.

INTRODUCTION

The Bureau of Mines studied a site at the western Indiana town of Blanford, where surface coal mine blasting was producing unusual low-frequency, long-duration vibrations. At the request of two regulatory agencies, the Indiana Department of Natural Resources (DNR) and the U.S. Office of Surface Mining (OSM), the Bureau investigated the influence of the ground structure, which includes extensive abandoned underground workings under both the active mining and the town of Blanford. These abandoned workings are at several depths, the most significant being the extensively mined coalbed No. 5 at 225 ft and the partially mined No. 4 at 325 ft (fig. 1). The local sedimentary rocks and the coal seams are essentially horizontal.

The initial objective of the study was to determine if blasting vibrations at this site were unusual, as local homeowners claimed. Researchers noticed that some vibration records

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