A Method for Site-Specific Prediction and Control of Ground Vibration from Blasting

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ABSTRACT

We have developed a method for predicting and controlling ground vibration from blasting using a rigorous scientific approach. The method is based upon the superposition of seismic waveforms generated by a single-hole free-face shot, recorded at seismographs deployed in an array that includes environmentally sensitlve locations. Waveforms generated by single-hole shots are shown to be reproducible. The waveforms for each of the sites are used to construct synthetic seismograms for delayed shots based upon linear superposition. A computer code systematically constructs the seismograms for the delayed shots, with incremental delays between holes of 1, 2, or 3 milliseconds (ms). A Fourier amplitude specs-rum is calculated for each synthetic seismogram and the spectra are plotted on a map in delay-frequency space, i.e., each row of the map represents the Fourier spectrum for a blast with a particular delay interval. For single-row shots, the delay between holes in a row is used; for multiple-row shots, the delay between holes In a row is kept constant and the delay between rows is incremented.

Predicted vibration varies strongly as a function of delay and has been shown to match quite well the actual vibration observed in field tests with accurate delays. The optimum delay interval may then be chosen on the basis of these plots, in accordance with proper blasting practice. The delay interval that shows the lowest amplitudes at 5 to 20 Hertz (Hz) for the critical sites is chosen to delay the blest. The usefulness of the program to predict the ground vibration is directly related to the accuracy of the initiators; small deviations from nominal times, If known, may be incorporated into the program, but increased cap scatter makes the vibration less predictable.

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