Daveytronic, Digital Detonator Testing in a Vibration Sensitive Environment

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INTRODUCTION

The long awaited arrival of a high accuracy detonator to reach the explosives end user will
provide new opportunities the blasting community to become better equipped and able to pbastidpr ordmtnce n
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studied the use of high accuracy detonators and timing systems. These studies have concluded that accurate hole detonation would provide the explosives using industry with an increased potential to effectively minimize these adverse timing related impacts. In order to gain more data regarding the High Accuracy detonators performance an adequate test site and testing procedures was designed to quantify the performance within the following parameters:

Detonator accuracy
Vibration prediction and control
Rock fragmentation

Throughout the spring of 1997 the search was on for a testing site that would provide the environment necessary to implement the High Accuracy testing program. The pre-determined site requirements of this test location were:

Hard rock quarry with consistent horizontally bedded geology
Geology massive enough for measurable fragmentation fluctuations
Historic demonstration and adherence to modern blasting practices
High level of bench preparation, drilling and loading practices
Site with adequate documentation of chronic vibration problem
Quarry that would cooperate throughout a 2 week study

After several months of site visits to quarries located throughout the eastern United States, the preceding requirements were met by the Benchmark Materials Quarry located in Ogdensburg, NY. The town of Ogdensburg is located along the St. Lawrence Seaway in northern New York state. The drilling and blasting operations at this quarry are currently being conducted and overseen by the St. Lawrence Explosives Company of Adams Center, NY. The management at this quarry are continually contacted by neighboring home owners expressing their complaints concerning the blasting operations. This testing program was designed to derive a potential solution to the vibration problem at the quarry while simultaneously conducting field tests of the High Accuracy digital detonator.

A series of four test blasts would be detonated adjacent to one another within an active region of the stone quarry. The maintenance of a high level of field control to insure integrity of data was extremely important throughout the testing procedures. Prior to pattern layout, a laser face profile would be mapped of the highwall to insure similar burdens for each of the four test blasts.

The test blasts would be symmetrical to one another in terms of their geometry and loading parameters. They would however differ in the method and type of detonation system used. The first two blasts would be identically configured and fired using a conventional non-electric system.

The second two blasts would be fired using a high accuracy digital programmable detonator. The programmable times input into these detonators would represent the nominal firing

times of the nonelectric designs of blast one and two. The overall blast performances would then be monitored, compared and quantified using the following instrumentation and techniques.

During the detonation of each blast, two Locam high speed motion picture cameras capable of filming at a rate of 500 frames per second were used to record the following data:

Hole firing times using in hole flash indicators
Face burden velocities
Surface swell, stemming ejection and vertical rock throw

Three digital ground motion seismographs were installed at three structures adjacent to the blast site to monitor and record the blast induced ground vibrations produced by the test blasting operations. A single hole test blast was detonated prior to each set of test blasts to establish the ground vibration signature of the site. This signature wave would then be used to implement a vibration modification software technique capable of predicting synthetic waveforms for blast designers.

Following each blast, prior to any excavation, the muckpile dimensions were documented and the image of each muckpile was photographed and video taped for a optical fragmentation analysis to be performed at a later date. During the post blast excavation process video taping was also compiled of the muckpile interior to also be used in the fragmentation analysis study. The productivity of the excavator was also monitored during the excavation process and video taped for a later time study analysis comparative review.

Throughout the study and field testing procedures many precautions were taken to insure the data collected would be truly representative of the actual performance of each individual blast. These field controls will be further discussed in the following section of this document.