Case Study
Reducing Vibration near Critical Structures in Development Tunnelling
Sudbury, Ontario, Canada

Site Profile
Mining Technologies International (MTI) is one of Canada’s largest manufacturers and suppliers of mining equipment, MTI has constructed its own test tunnel on the west side of Sudbury Ontario at their Magill Street property. A natural rock outcrop provided the perfect spot to build a decline that will be extended underground to test its products in an actual working environment. The decline extends at a 15-per-cent grade. It is a 5.2-by-5.2-metre tunnel, the standard dimension of most Sudbury mines.

MTI has created a high profile project for local Mining Companies and suppliers to test and showcase their newly designed mine equipment and new technologies from various suppliers including Orica in an actual underground environment.

The Situation
The portal to the underground tunnel is situated in an industrial park which is home to many businesses. The portal is situated approximately 100 meters from MTI’s own machine shop and 45 meters from Stainless Steel Technology, a business offering Laser Cutting Technology for precision cutting of Metals and expensive Alloys. The laser cutter ensures high precision cutting within 0.025mm. With such an advanced and delicate cutting system, a slight vibration can disrupt the cutting operation resulting in the possibility of ruining high priced materials. Therefore controlling vibration is MTI’s license to operate the underground project.

The other situation is there is only 5 metres of rock above the tunnel which means controlled blasting is critical to maintain stability of the heavily weathered and structured outcrop.

The use of pyrotechnic initiation results in vibration levels which exceeded the operational limit of the Stainless Steel Cutting Operation, and resulted in excessive disruption of the rock structures.

Vibration limits were not identified at the beginning of the project. However, it was understood that the Laser Cutter Equipment could not be disturbed, particularly during metal cutting operations. Loading and blasting parameters were established from blast vibration calculations.

Technical Solutions
To enable the decline to be developed required that vibration levels were tightly controlled to ensure there was no damage to nearby infrastructure and the outcrop that the portal commenced from. This required a tight control over instantaneous charge weights and the firing sequence. Orica Technical Services were engaged to develop the drill and blast methodology to enable the project to be successfully executed:

- Identification of project scope and vibration limits
- ShotPlus™ was used to design and demonstrate recommended drill patterns and delay timing
- eDev™ Electronic Initiation System was used to ensure accuracy of firing times and flexibility of timing
- Design the initiation sequence to fire slowly to create the initial void, and then shoot the production holes faster than is possible with traditional pyrotechnics. All production holes are fired individually to minimize the amount of explosives firing on each delay
- A maximum of four perimeter holes were fired together with a minimum of 25ms between groups to allow the vibration level to attenuate between events and decrease wave energy to maintain.
- This sequence also achieved a better tunnel profile.
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The Result
Firing order and sequencing adopted for this project resulted in very low vibration levels and controlled the overbreak along the back. Additional benefits that Orica Technical Services were able to deliver to MTI included:

- No delays due to vibration levels exceeding equipment limits.
- MTI were able to continue with three meter rounds avoiding the need for shorter rounds resulting in an increase in lateral advance rate.
- Reduced overbreak along the back eliminating the need to install extra ground support to pin the rock outcrop.
- Reduced disruption of the geopolitical structures in the surrounding rock.
- eDev™ fired faces flatter muckpiles and measurement of butts revealed an improvement on advance rates.
- Fragmentation with eDev™ fired headings had been recognized to be fine and uniform resulting in ease of mucking.

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