Blasting and Vibration

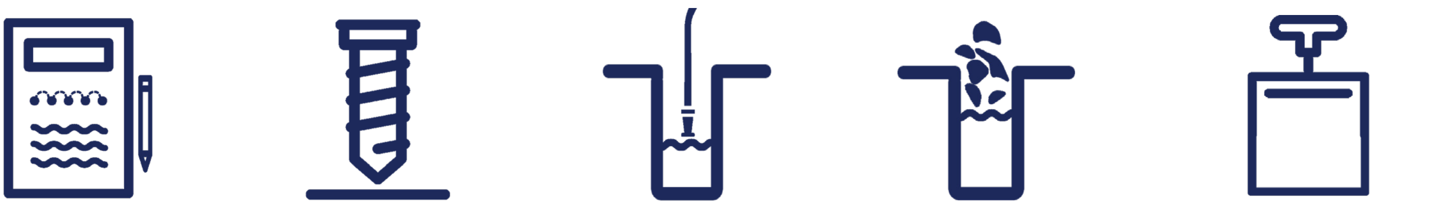
What does Walker do to minimize blasting effects?

At Walker, we operate within limits prescribed by The Ministry of the Environment, Conservation and Parks (MECP) and continually look for ways to reduce effects from blasting on our neighbouring communities. Things we do at various sites include:

- Design all blasts with millisecond delays between holes to reduce vibration
- Design all blasts to use enough energy to adequately fragment the bedrock without excess energy to minimize noise and vibration and control flyrock on site.
- Notify immediate neighbours in advance where applicable
- Monitor weather conditions to ensure minimal impact from blasting
- Monitor vibration levels of all blasts at the quarry property line to ensure levels are maintained well within the provincial guideline limits

How does a blast work?

A blast places a designed amount of energy into rock to fragment it. Noise and vibration from a blast are energy not consumed in the fragmentation.



Step 1 Blast design
A plan outlining the drill hole pattern is developed that identifies the number, diameter and depth of the holes; spacing between the holes; the size of the burden and the sequence in which the holes detonate.

Step 2 Drilling
The drill pattern is laid out on top of the rock and measured to ensure accurate spacing and depth of holes. A column is drilled into the rock, typically slightly lower than the quarry floor (subgrade), to ensure to ensure a consistent level of extraction.

Step 3 Loading explosive
The hole is loaded with an electric detonator inserted into a booster and a specific weight of explosive. The explosive emulsion is mixed at the time of insertion. The detonator sets off the booster, which then detonates the explosive.

Step 4 Loading collar
The hole is not filled to the top with explosives; space is left at the top, referred to as the collar. The emulsion is gassed to sensitize the explosive. The collar at the top of each bore hole is filled with crushed stone stemming to contain the explosive energy during detonation.

Step 5 Detonation
A blast is actually a series of small detonations. Each hole is detonated with at least an 8 millisecond delay between them. A typical blast would be approximately half a second in duration.

Weather conditions, such as high humidity or the presence of cloud cover, can cause the levels of overpressure and noise to seem more severe. When possible, we generally avoid blasting when the weather conditions include the following:

- Significant temperature inversions
- Strong winds
- Foggy, hazy conditions with little or no wind

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How does the energy of the blast move?

There are two types of energy produced from a blast: air overpressure and ground vibration.

Air Vibration (overpressure)
Air vibration effects are influenced by prevailing weather conditions. On a still day, air overpressure travels in the opposite direction of ground vibration. However, wind can focus it in one direction. Weather conditions do not change the intensity of the air concussion, weather only influences how that energy is distributed.

Ground Vibration
The rate at which ground vibrations decrease with distance from a blast depends on a variety of conditions, including:

- The type and conditions of the bedrock being blasted
- Depth and composition of the overburden
- The general topography

How do we feel vibration?

- The human body can detect vibration at very low levels. Humans can start to feel vibrations at levels of 0.3 to 0.5 mm/s
- How people perceive vibration depends on what they are doing. People sitting or lying down will be more perceptive to vibration than those doing activity.
- Vibration from blasting can seem disruptive because it's unexpected, unlike vibrations we regularly experience like walking up stairs or closing doors.

On a simple scale, quarry operations can be compared to normal household noises:
Slamming a door can produce vibrations up to 12 mm/s.
Footfalls register at 8 mm/s.
Ontario's limit for quarries is 12.5 mm/s.

How is vibration measured?

Blast monitors use two different instruments to measure vibration. One to measure seismic waves caused by ground vibration and one to measure pressure waves traveling through the air (overpressure).
The MECP established guideline limits for both. Air overpressure is determined by measuring peak pressure level in decibels. Ground vibration is determined by measuring the vibration velocity in millimeters per second.

Structural Response to Ground Vibrations	
Peak Particle Velocity mm/s	**Ground Vibration Effect**
600	Micro-cracks start developing in rock
150	150 – 250 mm/s limit often set for concrete
75	Cracks start developing in plaster
50	50 mm/s limit often set for construction blasting
25	19-32 mm/s, OSM frequency dependent limit
12.5	12.5 mm/s Ontario limit for quarries
0.50	0.3-0.5 mm/s ground vibrations become perceptible to humans
Mm/s = millimeters per second	

Structural Response to Air Vibrations	
Overpressure dBL	**Air Vibration Effect**
181	Conventional structures severely damaged
171	Most windows break
151	Some older windows may break
141	Some large plate glass windows may break/crack
131	129 – 134 dBL USBM interim limit
128	128 dBL, Ontario limit for Quarries
dBL = Decibels, linear (different from noise)	