

Walker Aggregates Inc.

Blasting and Vibration

How a blast works

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. It is wasted energy - which is wasted money.

What Walker does to minimize blasting effects:

- ✓ Designs all blasts with millisecond delays between holes to reduce vibration
- ✓ Notifies immediate residents in advance where applicable
- ✓ Watches the weather with objective to blast under least impact conditions
- ✓ Monitors vibration levels of all blasts
- ✓ Vibration levels are maintained well within the provincial guideline limits.

1

Blast design

A blast begins with the design. A plan of the drill hole pattern is developed that identifies the size, number and spacing between the holes, the size of the burden and the sequence in which the holes detonate.

2

Drilling

The drill pattern is laid out on top of the quarry bench and measured to ensure accurate spacing and depth of holes. The drill drills a column into the rock, typically slightly lower than the quarry floor (subgrade) to ensure that the bottom of the hole kicks out at a consistent level.

3

Loading explosive

The hole is loaded with a specific weight of explosive. The first thing down the hole is an electric detonator inserted into a booster, followed by the explosive. The detonator sets off the booster, which then detonates the remainder of the explosive.

5

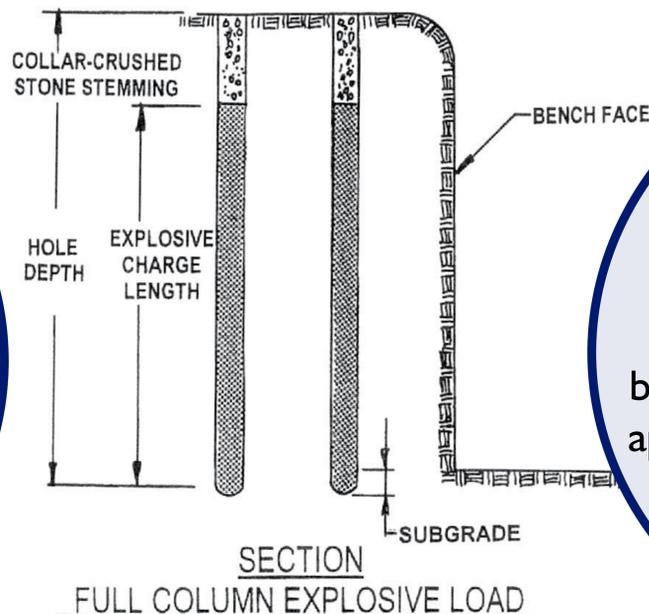
Detonation

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 a half second in duration.

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.



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How does the energy of the blast *move*?

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

Air vibrations (over pressure)

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 vibrations

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

- the type and condition of the bedrock being blasted,
- depth and composition of the overburden, and
- the general topography.

How 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 annoying because it's unexpected, unlike vibrations we regularly experience, like walking up stairs or closing doors.



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.

Blasting and the weather

Weather conditions, such as high humidity or the presence of cloud cover, can cause the levels of overpressure and noise to seem more severe than there would be on a day when the humidity is low and there is lack of cloud cover. When possible, we generally avoid blasting when weather conditions include the following:

- significant temperature inversions
- strong winds
- foggy, hazy or smoky conditions with little or no wind



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Measuring Vibration

Because there are two types of energy from blasting, blast monitors need two different instruments to measure them: one to measure seismic waves caused by ground vibration and one to measure pressure waves traveling through the air.

The Ministry of the Environment established guideline limits for both in 1978. Air overpressure is determined by measuring the peak pressure level in decibels. Ground vibration is determined by measuring the vibration velocity in millimetres per second.

Designing a blast is about balancing the need to adequately fragment the bedrock with the need to minimize environmental impacts.

Structural Response To Ground Vibrations

Peak Particle Velocity	Ground Vibration Effect
mm/s	
600	Microcracks 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
10	12.5 mm/s, Ontario limit for quarries.
0.50	0.3-0.5 mm/s, ground vibrations become perceptible to humans
mm/s = millimetres per second	

Structural Response To Air Vibrations

Overpressure		Air Blast Effect
dBL	Pa	
181	22440	Conventional structures severely damaged
171	7096	Most windows break
151	710	Some older windows may break
141	224	Some large plate glass windows may break/crack
131	71.0	129- 134 dBL, USBM interim limit
121	22.4	128 dBL, Ontario limit for Quarries
dBL = decibels, linear (different from noise)		
Pa = Pascals, measure of pressure		

