8ms CONCEPT

With the increase of environmental constrains on the levels of disturbance induce by blasting operation; the prediction of ground vibration with reliable approach will be extremely important to the blasters. However, with applying of 8ms rule will complicate the situation.

The 8ms concept was borne out of a Bureau of Mines study conducted in 1960 by Duvall, Johnson, Meyer and Devine published in 1963 as RI 6151. The study encompassed a single limestone quarry near Alden, Iowa, which consist of monitoring a series of nineteen single-row quarry blasts employing instantaneous and delayed initiation.

While the research was important and the science (though limited) was good for its time, we have to wonder whether the authors truly anticipated the significance their work would eventually take on.

Many blasters will acknowledge the shortcomings of the 8 ms rule, but often it's viewed as a harmless method of compliance. Unfortunately, it may not always be as harmless as it seems. While the 8 ms criterion is sufficient to protect most residential structures from damage, it's overly restrictive in the sense that adherence in critical locations often precipitates inefficient and ineffective blast designs. These may include unnecessary decking, smaller boreholes, tight patterns, smaller blast size, insufficient powder factors and odd timing configurations. Poor explosives distribution and blast performance is often the result with a minimal return from a cost/benefit perspective.

In 1989 at the 15th Annual Conference on "Explosives and Blasting Technique", Douglas Anderson, PhD, presented a paper entitled "The 8ms Criterion": Have We Delayed Too Long in Questioning It?' While he may have been one of the first to openly question its applicability, he has certainly not been the last. Dr. Anderson made a very compelling argument that the definition of "Scaled Distance" is inadequate. Nevertheless, this outmoded and overly simplistic formula is still being written into regulatory codes, blasting permits and project specifications around the world.

While charge weight is obviously an important component affecting vibration intensity, the relevance of the 8 millisecond separation is arbitrary at best and counter-productive at its worst.

Scaled Distance ($R/W^{1/2}$)

Customarily, Scaled Distance is described as the distance (*R*) from the hole closest to the nearest protected structure divided by the square root of the total charge weight per 8 ms delay ($W^{1/2}$). Charge weight per 8 ms delay is interpreted as the sum of all individual explosive charges designed to fire within any 8millisecond window, which is irrespective of the spatial relationships to the point of concern.

It can be demonstrated however, that as long as multiple charges fire simultaneously or within the 8ms window (whether by design or by chance) are separated by sufficient distance, they will usually contribute independently to the vibration without constructive wave re-enforcement *(Bartley et. al 2003)*.

This also becomes very evident during data collection for regression studies. Whenever multiple charges fall within the 8 ms window, an erroneous Scaled Distance is often the result. These data are usually discarded since the particle velocities are too low to contribute towards a reasonable goodness of fit.

This is understandable when we factor in the wave propagation velocities in the surrounding medium. If the velocities and the distances are known, we can estimate the wave front arrival times.

As an example, let's assume that we have a blast with two holes firing simultaneously (See Figure 1). The hole closest to the structure is 1000 feet (305 m) away while the more distant hole is 1150 feet (351m) to the structure. For the sake of simplicity we'll calculate the travel times of the primary waves (P-waves) only. In this example, let us assume they are traveling at a rate of 9000 feet (2743 m) per second.

Material	P Velocity, m/s	S Velocity, m/s
Granite	4000-6000	2000-3000
Basalt	5500	3000
Sandstone	2000-3500	1000-2500
Limestone	3000-6000	2000-3000
Schist	4000-5000	2500-3000
Soil	150-1000	100-700

With this information we can estimate the arrival time for the closest hole to be:

(9000 ft/second / 1000 *millisecond/second) = 9 ft/millisecond*

(2743 m/second / 1000 *millisecond/second) = 2.743 m/millisecond*

So

(1000 ft / 9 ft/ms) = 111 ms

(305 m / 2.743 m/ms) = 111 ms

Whereas; the second hole is:

(1150 ft / 9 ft/ms) = 128 ms

(351 m / 2.743 m/ms) = 128 ms

So in effect, even though these two holes fired at exactly the same time, the arrival times are separated by 17 milliseconds at the monitoring location. Of course, this has oversimplified the very complex nature of the event. However the calculation did show that 8ms rules may not be best the guideline.

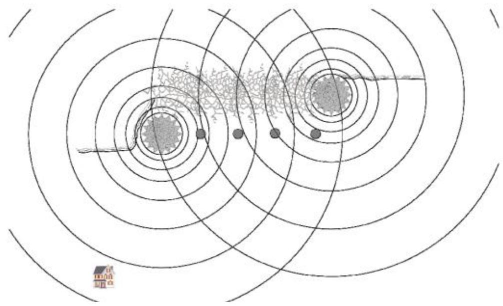

Figure 1. Simultaneous detonation- individual arrival times.

Reference

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