

# Back to School on Construction Blasting Rules of Thumb Revisited

by Jerry Wallace

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*(Note) This article was presented by the author at the ISEE's 27th Annual Conference on Explosives and Blasting Technique in January, 2001 in Orlando, Florida. This article has been updated from its original version. The opinions and ideas expressed are not necessarily those of the International Society of Explosives Engineers or the editorial/publishing staff of the Journal of Explosives Engineering. Your response in form of letters to editor is encouraged.*

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Construction blasting within three meters of a school with children in attendance has required this blaster to change priorities, review a current systematic approach and upgrade current rules of thumb for construction blasting.

In order to be successful when blasting under such conditions, the blaster must use a systematic approach to project investigation, design and management. Outlined in this paper is such a systematic approach, included in which are rules of thumb. The systematic approach, which I have developed, continue to modify as situations demand, and use is "Construction Blasting Problem Solving, A Structured Approach", (CBPS). The steps are:

- Identify the Goal

- Define the Problem,
- Describe the Limitations and
- Design the Solution.

Rule of thumb one, however, is not specifically mentioned in the CBPS since the rule is self-evident. It is so self-evident that it is often not mentioned and is all too frequently overlooked.

## **RULE OF THUMB ONE : There must be a Blaster-in-Charge**

This first rule of thumb is perhaps misnamed, it is not necessarily a rule of thumb but an inviolate rule for success of any blasting project.

The Blaster-in-Charge must be just that, in charge. The Blaster-In-Charge must be accountable for the safety of all involved,

responsible for blasting procedures and results and have the authority to direct and control the operations. This authority, responsibility, accountability, direction and control cannot be diffused or spread among several individuals. There must be one person only who can make the final decision to fire a blast.

Three corollaries apply to rule one, which themselves appear redundant. They are:

**Corollary:** The blaster must have both the responsibility for the blasting and the authority to make and enforce decisions. This rule must be applied rigorously when establishing the safety zone surrounding the blast site.

**Corollary:** The drilling and blasting must be designed and carried out under the direction and control of a qualified blaster.

**Corollary:** The blaster must have and use a systematic approach to blasting and project management.

This puts us back to the systematic approach. The system that I use, "Construction Blasting Problem Solving, A Structured Approach" provides just such a systematic approach. The CBPS consists of three parts which are useful only if critical avenues of communication are developed. The CBPS is doomed for failure if there is a "...failure to communicate.. ." at the beginning. That is, the project goal must be clearly identified and understood before the system can operate properly. That is the purpose

behind rule of thumb two.

***RULE OF THUMB TWO : Establishing clear and concise communications from the start of the project, that are project specific, is essential.***

**Corollary:** Blasting safety plans and procedures fit into this category. A simple one-size-fits-all blueprint rarely works. Site safety plans must be job specific.

**Corollary:** In order to safely and professionally conduct construction blasting operations the blaster must first know what finished product (*IDENTIFY THE GOAL*) is intended.

Once communications have been established and the goal properly identified the additional three steps of the structured approach can be used. The three steps, taken in order, are:

- Define the Problem,
- Describe the Limitations and
- Design the Solution.

Additional rules of thumb are contained within this structure and are highlighted as one works through the system, Taking the steps one at a time is important. First, one must DEFINE THE PROBLEM, In this system the problem is tightly defined as the rock (or concrete or whatever must be blasted) that the owner has need to have blasted.

It is important that the definition of the

problem be limited so that distractions are not introduced. Distractions can include perceived problems by others involved in the project, such as estimator errors that place the owner in a financial bind or project time-line issues because the rock was not anticipated. These distractions, which ultimately must be addressed, are excluded by definition and dealt with further along in process. After all, time and financial constraints haunt many jobs, even those without rock blasting involved. Since by definition the rock is the problem, the problem must be investigated and dealt with. Rock properties that affect blastability must be identified. This leads to rule of thumb three.

***RULE OF THUMB THREE: Geology can set absolute limits and will dictate results.***

Once the problem has been defined, that is the rock along with its characteristics that affect its blastability, then the other encumbrances, both real and arbitrary, that surround the site must be investigated. This investigation is referred to as *DESCRIBE THE LIMITATIONS* and is necessary in order to decide if the finished product desired (identify the goal) is possible in the existing geology (define the problem) at that location.

At times the goal is not possible given the native geology. For instance, a poured-to-solid foundation with critical wall

thickness usually is inadvisable if not impossible in a formation composed of massive blocks of rock that are loosely jointed. At other times joints and angles of repose of the rock mass are not accommodating to the design.

Additionally, only after listing all the limitations at the site can a drilling-and-blasting plan be devised (*DESIGN THE SOLUTION*). It is while working through the two steps that the further rules of thumb arise.

Items taken into account in describing the limitations include both real and arbitrary limits. Examples of real limits are geology, and blastability characteristics of the rock, blast site physical geometry including bench heights, trench depths, overburden amounts, distances to structures, groundwater presence and slope angles among others.

Examples of arbitrary limits are regulatory considerations that limit vibrations, noise, explosives selection (fumes are currently a big issue) storage and transportation limits and neighborhood demographics to name a few. Pre-blast surveys may uncover other arbitrary limits. Once all encumbrances affecting the project have been listed and a possible solution exists, the process of drill and blast planning begins.

It is important to remember that success in construction blasting can only be accomplished when an appropriate blast design has been implemented and carried

out in a safe and professional manner that is specific to the rock at the site and takes into full consideration all other conditions present at that jobsite at that time. Therefore several common-sense rules apply.

***RULE OF THUMB FOUR: Explosive selection and delay timing cannot correct improper drilling, therefore the blaster must make the decisions on drill patterns, hole diameters and subdrill.***

Some basic drilling guidelines that apply in most instances, but must be investigated as suitable for the specific site are:

- Spacing should never be greater than 0.50 times the hole depth, including subdrill.

- Burden should never be greater than spacing.

- Burden should tend towards 0.33 times the hole depth or less in very close quarters.

- Top stemming length should be at minimum equal to the burden.

- The length of stemming column between explosives decks should never be less than the burden, and more in wet holes, depending upon explosives type

- Subdrill, if not limited by contract

specifications, should be about 0.50 times spacing (it is easy to add a bit of backfill to bring up the bottom of the hole if overdrilled).

- Additional subdrill may be necessary or desirable if one wants to spread the drill pattern.

- Additional length of hole in rock is necessary to accommodate the charge length required to break the rock when overlain with a significant amount of overburden

- Multiply actual overburden measurement by 0.50 to convert to rock equivalent for explosives calculations.

- The drill pattern must be accurately laid out and accomplished.

In parallel with overseeing the drilling, the Blaster-in-Charge must select explosives for the job, which leads to the next rule of thumb.

***RULE OF THUMB FIVE: Geology and site conditions dictate the type of explosives and initiation system used, and blast size.***

Explosives selection parameters often include the following:

- The detonation velocity of the explosive

should meet or exceed the sonic velocity of the rock.

- The explosive must be able to reach steady state VOD in the charge diameter and length used. Be especially aware of minimum critical diameters of the different explosives when working in small diameter blastholes.

- Select an explosives that will not propagate either hole to hole or deck to deck under the conditions at the site. Wet holes increase the likelihood for propagation of shock tube initiation systems as well as explosives.

- Select an explosives that is resistant to transient pressures and therefore less likely to dead press.

- Adjust your explosives selection to reflect the amount of heave the situation or geology demands. At times an explosives mat produces more/less gas is more suitable.

- Select an initiation system that offers the greater degree of safety. Each type of initiation system, whether electric or non-electric offers certain advantages while each has its own systemic limits. After selecting the initiation system be aware of and work

within the limits of the system.

Now one can attempt to answer the production and time-constraints issue asked by the owner by estimating job timeline while being mindful of the next rule of thumb.

**RULE OF THUMB SIX: Overall project production is often a function of limits imposed on the blasting by site conditions rather than excavation equipment capacities.**

Blast size and design parameters apply.

- Start with a small blast in the area providing the most forgiveness for minor errors. Adjust the following blasts according to results.

- Overall blast size may be limited by the reach of the equipment placing the blasting mats.

- Block movement, which is distinctly different from flyrock, is more likely to cause problems than is vibration.

- Enough room should exist for the shot rock to swell into, usually twice the tight volume measure is sufficient.

- When blasting for trench line where vertical relief is not available for muck displacement, that relief to the face is limited as a function of trench-depth to center-line-length in a given blast. Often

no more length of centerline of trench can be fired per blast mat one-half the trench depth, including subdrill, without having the muck move vertically.

- Blast size may be affected by imposed blast times and work hours given the location.

During this entire process the interest of the public must be acknowledged. A separate rule of thumb applies.

***RULE OF THUMB SEVEN: Public Relations are critical.***

Corollaries to the rule, which could fill a book at Certain jobsites, include:

- Be Polite
- Be Professional
- Be Diplomatic
- Educate yourself about the demographics of the surrounding area and
- Educate the public about blasting in a positive manner whenever possible.

The final rule of thumb often comes as a surprise.

***RULE OF THUMB EIGHT: At times the decision NOT TO BLAST is the correct decision***

Although this rule should also be self-evident it is too often violated. At

times single limits, such as geology or finances, or combinations of limits preclude safe, prudent and professional blasting being a solution to the problem at the jobsite (the rock).

Remember, we are the professionals. Simply because someone wants blasting done at the site does not mean that it is reasonable or sensible to do so. If safety guidelines cannot be established or chains of command cannot be followed, then it is incumbent upon the Blaster-in-Charge to realize and to communicate to others that not all problems can be solved by blasting.

