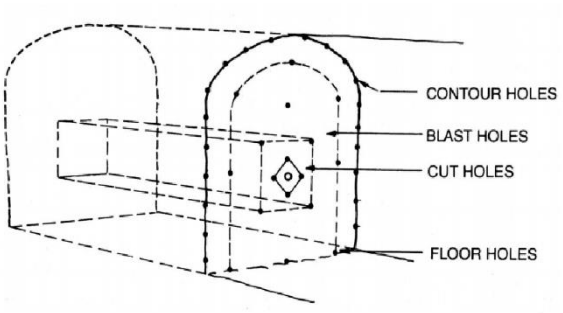
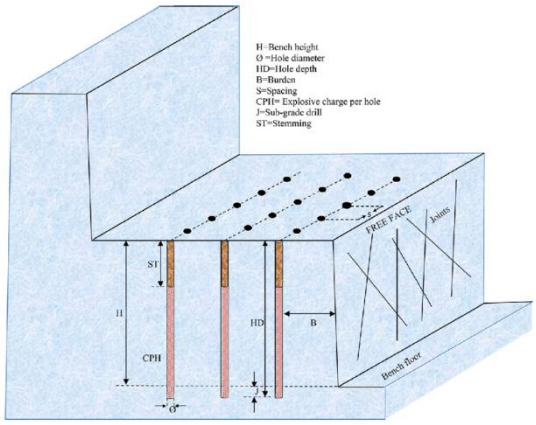
Methodologies for initial blast plan design (Part 01 of 03)

By Bruno Pimentel.





Hello my friends, I hope you are all well and of course you are enjoying our articles!

I would just like to mention here that we are always inviting some friends and specialists in the area to contribute here with us, but everyone's routine is always very demanding, so it is not always easy to find the necessary availability, so we leave the invitation here in case anyone has any knowledge or experience you want to share. Just contact us directly so we can see the best way to contribute in the best possible way.

As always, we start by leaving here the links to our Newsletter so you can check our previous articles, as well as register, so you can be automatically notified of each new article we publish (biweekly):

Português

https://www.linkedin.com/newsletters/blast-de-rocha-c-explosivo-6941709482355748864/

English

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In today's article we are going to talk briefly about a topic that is very broad and has infinite possibilities, so it is not a simple task to write about it, but we will try here to at least raise the topic and give direction to those who are wanting to specialize in area.

We are going to divide the article into 3 parts, so we will be doing a general introduction in this first article, talking a lot about the misfortune of not having a magic guide for creating a blast plan (sorry about that), then in the next article we will comment a little about the 3 main methodologies used to carry out an initial blast plan design, and finally in the last article we will make a series of comments on the choice of methodology to be used and some general observations.

But before we get directly into the topic, I would like to make a few comments that are coming to mind right now and that are part of the reason why we decided to write about this topic.

Due to the courses we provide, we always receive many questions, many of them from curious people wanting to probe about the area, but two questions always stand out:

• The first one that comes out is always related to the blaster license: people usually ask if they will receive the famous blaster license, if they can already buy and use explosives... and you can bet that it took many hours and many explanations to clarify the topic to many, many people... so at some point we're going to write an article about it. But just to record it here... kkkk... no, the process here in Brazil to obtain a blaster license is directly with the Civil Police of each state, it is necessary to be through the company where you work, and they need already have authorization from the Army... we only give specific training to obtain the blaster license, exclusive to companies that already have all the authorizations... but it will remain here in our account, owing an article about it... (Stay until the invite friends who are specialists or brokers in this type of documentation, if they want to explain the process and offer their services, it's an opportunity... and the cost of publicizing your services is just sharing the knowledge with everyone)...

• The second is related to making a blast plan: many people ask if the course teaches how to make a blast plan and if after the course they will already be able to make a plan and fire for any type of blast, that's why we decided to write this article today , which is more technical/practical knowledge that we think could be very useful for those who are starting out or want to know a little more about the area.

Before getting into the blast plan theme, related to the questions we received, here is an outburst, where most people no longer take into account the dedication and experience needed to train in some profession. A lot of people want to take a 2 or 3 day course and want to be technicians or engineers and go around earning a lot of money and carrying out works all over the world.

It is clear that today knowledge is much more available, it is much easier to take a course on the internet and we can have access to much more content, but everything takes time, and when we are talking about explosives, we are talking about a topic that is not so simple. Imagine a doctor who studies, I don't know, 10 years to be a specialist in something, and when he's going to perform a surgery, any mistake can kill one person at a time, while when we talk about explosives, a mistake can kill countless people at once, and the professional wants to be a specialist with a 2-day course and 6 months of experience.

I already think it's absurd for a blaster course to take 2 to 3 days, there are only 16 to 24 hours of class, and we say that we form or qualify a professional to go out doing blasts around. On the one hand, all the control of the Army and Civil Police are useful at this time to at least limit the people who can withdraw a blaster license, on the other hand, much more robust legislation should be developed with regard to the training of professionals.

But let's leave that aside, otherwise I'm going to write the whole article just about that, and the idea is to talk about the blast plan. So come on, after this outburst, let me highlight the name here so I can focus on the topic... kkkk...

BLAST PLAN

The rock blasting area with explosives always raises a lot of curiosity and one of the main topics is the blast plan, because as we already mentioned it is one of the first things that people want to learn to do when they relate to the area.

So, in short, we can say that a blast plan is the detailed specification of all the parameters that involve the performance of a blast, that is, it will be the plan or the guide of how and what we must do to carry out a certain blast.

As usual we won't go into details here, but we can say that a blast plan has two main parts:

1. The first is the skothersh, which we can say is like the plan of a house, that is, it is a representative drawing of how the blast will be;

2. The second would be the description of the details, which would be like the descriptive memorial of a work, that is, it would be the specification of how we are going to carry out the blast, where we have the blast data (place, person responsible, size, characteristics, others.) , the description of the materials and quantities to be used (explosives and accessories), the blast parameters (distance, spacing, loading configuration, others.), and all other details of how the blast should be carried out.

One of the most important things related to making a blast plan is that there is a huge gap between theory and practice, and as much as we can compare it to a construction, for example, that although we can build two identical houses, they can having different foundations due to terrain characteristics, or we can even make completely different houses, when we talk about the blast plan the behavior of the elements is much more unpredictable, because in two “practically equal” blasts we can have completely different results, we have much more external influences , and the most complex thing is that we “do not control the materials we use”, because unlike a column that we can design to hold a structure in a certain place, we cannot tell the explosive to break exactly that piece of rock and leave it exactly this size, because the explosive will direct most of its energy to the path that it finds least resistance. a, which can often be in the opposite direction to our need.

To justify this difference between the practice and theory of a blast plan, we can raise some points:

- Theoretical formulas with too many assumptions or too simplistic: most of the formulas we have available were based on certain scenarios and do not take into account all the variables that can affect the blast.
- Number of variables specific to each project: this is perhaps one of the most complex points, because in addition to the number of variables that affect a blast, in many cases we are not able to have all the information about them, and many are still not fully understood nor its effects on the process.
- Uncontrollable variables: in many situations we have some variables that we do not control, and we need to adapt to them, and this can be a major limiting factor.
- The explosive is “uncontrollable”: as much as we say that the explosive is under control, this is a force that we do not dominate, and the most we can do is try to direct its energy, and in most cases this is not done efficiently.
- Little scientific research: mainly due to the criticality of the subject and the difficulty of carrying out tests, there is still a lot of unknown and that it is necessary to improve the knowledge related to the dismantling of rocks, even more so that most of the studies are focused on optimizing processes of companies and does not really focus on knowledge of the subject, but only on achieving the intended results.
- Lack of training for professionals in the area: there are still many people who work in the area who only have practical knowledge or who learned it on a daily basis, due to

lack of training, time, opportunity, others, others, others, but this makes that little knowledge is transmitted and still limits the possibilities for advancement and optimization.

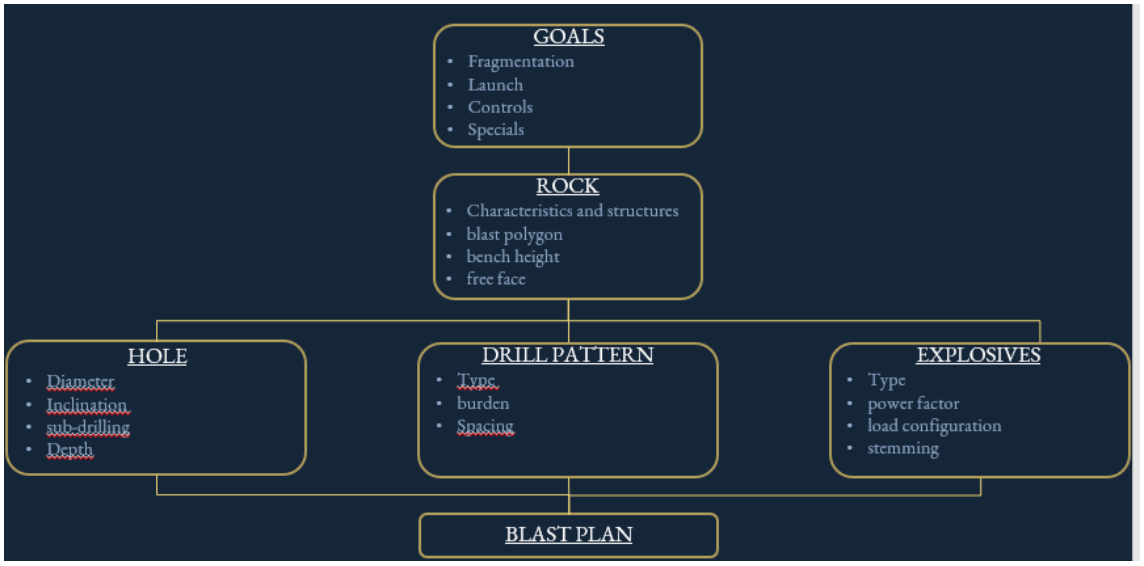
- Others.

Above all, it is important to say that when it comes to making a blast plan, there is no guide or magic formulas that can be applied in all situations, because the possibilities of scenarios and variations can be infinite, even more than the knowledge about the blasting process is still very limited, which is why numerous tests still need to be performed to determine an acceptable blast plan configuration.

We can say that making a blast plan is still an art, which must be perfected with continuous tests and improvements until we reach a standard plan that is reasonable for the needs of each operation.

There are several ways to design a blast plan and that is why there is no specific step by step for its preparation, so most literature will only explain some of the formulas used and expose some examples, but in practice to make a blast plan there is much more information that we need to evaluate and that most of the time the experience will be much more important than the use of formulas and theories.

We will see that we can use some methodologies to make an initial blast plan, but regardless of which one is used, we always first need to evaluate what information and data we have available, which will be the starting point to start our analysis, along with what we need , that is, our objectives that we need to achieve when carrying out a certain blast.

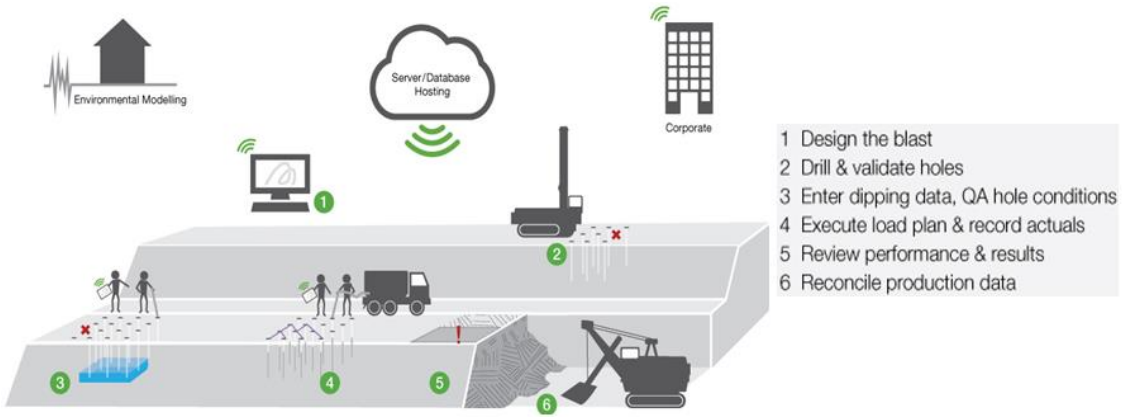


Experience and knowledge always have a great weight in the elaboration of a blast plan, requiring a careful evaluation of the available information and the blast scenario, especially when we have to evaluate the safety criteria against the objectives to be achieved.

An important observation before we proceed is that we need to understand that there are two main macro scenarios, the first is what we call punctual or initial operations or blasts, which is that scenario where we will do a new blast and it will be the only one or it will be the first, where we don't have any previous reference plan, like for example in a construction site, so we need to design an initial blast plan from scratch, or even a new mine, we need to design a plan to carry out the start of the operation. On the other hand, we have, for example, the scenario of a mine

where it detonates every day, and we already have one or a few standard fire plans and they are always the reference for making the next plan.

Most professionals will always be in the position of the second scenario, the need to create a blast plan from scratch being very rare, and even in works, it is common for professionals to use other previous works as a reference, adjusting the necessary parameters, which is why in In fact, most knowledge needs are much more focused on knowing and optimizing a blast plan, than on creating a new initial blast plan.



New operations typically hire consultants, teams of specialists or partner with explosives suppliers to develop an initial blast plan, which will be tested and improved over time. But even so, we'll leave blast plan optimization for a bit and focus on talking about creating an initial blast plan.

We can say that whenever you start creating a blast plan, the main doubt is where to start, as there are several questions or information that may seem simple and implicit in the process, but which are fundamental to determine the starting point. Some of them are:

• What kind of blast are we going to perform? (Production, blocks, controlled, finishing, others)

• Is it a single blast or will it be multiple blasts?

• Is it just for rock removal or are we going to use the rock? (Ore, overburden, crushed stone, others)

• What type of rock?

• How big is the blast?

• What is your geometry?

• What type of explosives are available?

• Which team will perform the blast? Do they have experience?

• Is loading manual or mechanized?

• Which equipment will blast and which will excavate the material?

• What is the primary crusher opening and processing steps?

• What is the location and characteristics of where we are going to carry out the blast?

• How far is the site from the nearest critical point?

• Others....

So, before starting any design, we need to evaluate all the information we have available, verify the veracity and accuracy of this information, and together with blast's objectives, decide which is the best alternative for us to design the blast plan.

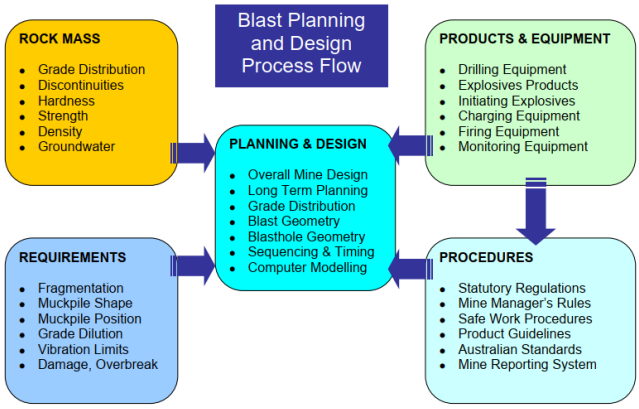
This applies both to the design of a routine plan, where what we need to do is assess whether nothing has changed and whether the scenario is equivalent to the previous blast pattern, as many operations can be very dynamic, or to an initial plan, where we need to take more extreme care so that you can verify the real conditions that can impact the design of the blast plan.

Much information may not be available or may only be estimates, and others need to be verified on site, mainly the characteristics of the rock and the safety assessment of the surroundings.

Desired fragmentation:	Rock features:	Location information:	Safety:	Equipment/Materials:
equipment size	rock types	Legislation and procedures	Risks for operation	Drilling Equipment
granulometric curve	Hard, medium or soft	isolated or urban area	safety zone	digging equipment
processing steps	Presence of structures	near critical points	nearby structures	Manual or mechanized application
Material use	Cavities, flaws, others	security limits	movement of people	types of explosives
size limitation	presence of water	remaining massif	Possible impacts	Accessories
P80, % fines, % blocks	Changes inside the polygon	Particular characteristics	failure risks	Team experience

Depending on the complexity of the blast, the scenario and the operation, we will have more or less information, and it is up to us to evaluate what is available and mainly what we are going to use as a reference or not, as part of the information may not be useful for a plan initial.

In a very summarized way, we have below a basic scheme of the steps for the elaboration of a blast plan, where we start with the need for the blast and we advance until we have our blast plan elaborated, it is important to keep in mind that each step of this can be simpler or complex according to the scenario and the available information, where in a routine blast most of the information can be easily accessed, but when starting a new operation or performing a punctual blast we can have a big job and the need to make some estimates.



We need to understand that there will be infinite scenarios and possibilities, and that in each one of them we may need different initial information and use specific considerations for each case and therefore there are no formulas or magic guides that give us the direct answer.

Drawing a blast plan can be as simple as placing a light bulb, for example as in the case of punctual detonations of blocks or rock heads where we only have one charge and the objective is just to break the rock, but they can also be as complex as building a blast plan. building with dozens of floors, where several elements have to be taken into account and

that the structure of each floor has the capacity to support all the floors that still come above it, in addition to several other external factors that will influence the project.

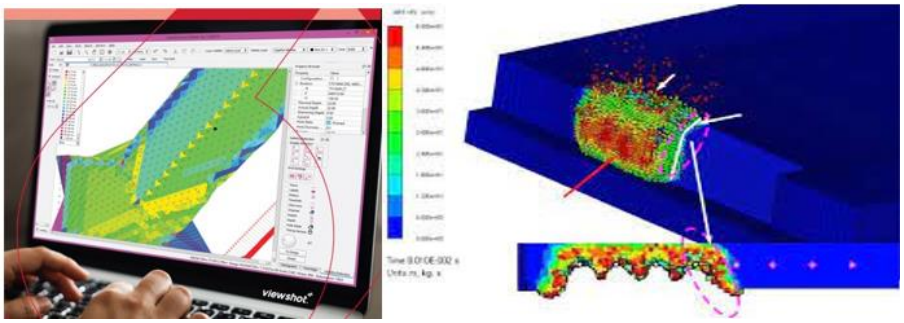
That's why whenever we talk about blast plan design, we first start by saying what we mentioned a little while ago, that there are few professionals who will need to design an initial blast plan, and the second that when we are in one of the exceptions and we need draw an initial blast plan, there is no set script and in each scenario we will have to analyze what information and resources we have available, especially the uncontrollable variables, and from there adjust the parameters to make this initial plan, and of course , if it is a continuous operation, we will have to improve this plan as we carry out the detonations.

Considering that the beginning of a blast plan depends on the scenario, objectives, information and resources that we have available, and each scenario will give us a different starting point, in summary we can say that there are 3 main methodologies that we can Use to create an initial plan:

1. **Theoretical formulas** = use of formulas and estimates to determine the controllable parameters of the blast plan starting from the uncontrollable ones or key parameters.

2. **Benchmarking evaluation or previous experience** = using references of similar operations or conditions to carry out a similar design adapted to the specific characteristics of the blast to be carried out.

3. **Specific objective** = use of a main objective as a reference for determining the blast plan parameters, where simulations are often carried out with software or approximation equations.



We will talk a little more about each of these methodologies in the next article, but it is important to keep in mind that there is no rule about which one to use, it will depend on the scenario, available resources and experience. We can even use the 3 methodologies to compare the results and they can give similar or completely different results, and this shows us the existing variability.

Another point that will greatly affect our plan is the margin or the security criteria that we are going to use, as there is no rule, so each professional can consider a higher or lower margin, and this directly affects the final result.

Well that's it folks, for today we're going to stop here, the idea of today's article was simply to raise the issue of the complexity of drawing up an initial blast plan, so that people who are not very familiar with the area know a little about the complexity of the theme, and for those more experienced professionals, reflect on whether they have already made a plan from scratch or what methodology they would use to do it.

I confess that these last few days I asked two experienced friends in the area and nobody knows how to give a direct answer, neither what you need nor how you would do it, simply because there are so many right and wrong answers that we would only know after we performed the blast... kkkk ...

In the same way, I don't have and I don't know who has the magic guide, but we have been working on preparing a short course on the subject, it has been very difficult to find and create material that is really useful, so this conversation is for me to reflect and trying to develop ideas that might be useful.

As we always ask, please comment and share, so that we have increasingly safe and quality detonations!!!

I'm going to leave here a note of apology for those who value a good academic article, because I've been writing in a scribbled way, putting what comes to mind, but the idea here is to share ideas and knowledge, so I hope I'm able to do this, leaving my point of view is open to comments and criticism from everyone, so please excuse me and if you have comments that can improve our articles they are all welcome.

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