Blasting Ledge

New methods and materials make blasting a more precise and safer technology.

by Edward Akerley

On Cape Ann, on the north shore of Massachusetts where we do much of our work, blasting for house foundations is standard procedure—ledge is everywhere.

The demand for blasting is increasing in the rest of the Northeast as well, as prime building sites become more scarce and as improved materials and techniques make blasting a more versatile tool. On some sites, the best earth must go to the septic system and the house must go on the ledge.

The cost of blasting is often recouped by the value a full foundation adds to the house. In other cases, blasting is required for utility connections, swimming pools, or additions. There may be a single knob of ledge to remove or a bed of solid ledge the size of the house. We have even blasted inside existing homes to expand a crawl space into a full basement.

Regardless of the job, find a blasting contractor with a good reputation and experience with the type of rock—and type of job—you are facing. It's not a good place to cut corners.

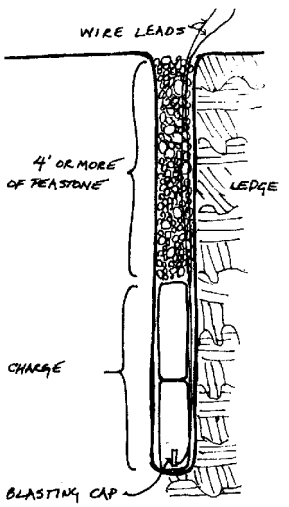
Designing a Blast

Every blast must be custom-tailored. There is no "cookbook" method to specify the job as there are too many variables; it takes experience and judgment. This is particularly true in New England, where the type and quality of the rock vary greatly.

In designing a blast, there are two major objectives: to develop a great enough compressive force to break up the rock, and to keep that force from damaging neighboring property.

In general, the harder the rock—and the more seams in it—the more explosives will be required. Seams interfere with blasting because they dissipate compressive energy that would otherwise break up the rock. The granites common in our area are among the most difficult types of rock to remove because they are both hard and seamy.

Neighboring structures can be anything from an antique house with fragile plaster moldings, 200 feet away, to a well casing that is 12 inches from the blast site. The more delicate the situation is, the smaller the explosive charges we use per hole, and the more holes we drill. This type of blast will have a smaller peak vibration—but it will cost more money.



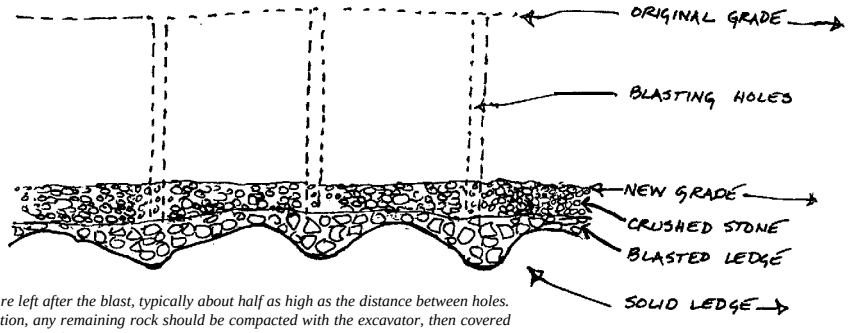
After the site is stripped, holes are drilled to about 2 feet below the desired finish grade. The charge and cap are tamped in place with a wooded loading pole and the hole filled with at least 4 feet of pea stone to contain the energy of the blast.

A Controlled Explosion

To keep the explosion contained and directed, several techniques are regularly used.

First, each hole is filled with at least four feet of pea gravel, called "stemming" (see illustration). The upward force of the explosion is contained by the stemming in the same way a stone arch resists downward forces.

Second, blasting mats are used to prevent stone from flying away. "Fly rock" can travel up to *half a mile* and cause serious damage. The mats are made of steel mesh, are typically 10x12 feet, and weigh a ton each. Depending on the job, mats may be used to cover all or just parts of the blast area. Typically, they cover at least the "front" of a blast—the part where the first charges explode.



High spots are left after the blast, typically about half as high as the distance between holes. After excavation, any remaining rock should be compacted with the excavator, then covered with several inches of compacted, crushed stone—if a structure is to be built on it.

A third technique that controls the force of the blast is the use of delays. Almost all blasting contractors today use delay caps. Delays separate one set of charges from the next by intervals of 25 milliseconds (.0025 second). The entire blast, which might contain as many as 100 holes for a full foundation in solid stone, is engineered to take place in less than one second.

By staggering the explosion, delays reduce the peak vibration, which could crack the neighbors' plaster or foundation. Delays also control the *direction* of the explosion, steering it away from vulnerable objects such as an abutting house or well casing (see sidebar).

New, improved delays are available that give the blaster accuracy to ±10 percent—much more accurate than standard delays. These are often used in conjunction with another new device called a sequential timer, which lets the blaster vary the intervals between blasts from the standard 25 milliseconds. This can cut the peak vibration way down outside the blast area, and at the same time give better breakage for the same poundage of dynamite.

The Neighbors

Successful blasting takes as much public-relations skill as it does technical know-how. Mention blasting in a neighborhood and it can become a three-ring circus—with expectations of excitement and fears of rampant destruction. A professional job should produce neither. The explosion itself usually produces no more than a muted thud and a puff of dust.

To keep order and to protect everyone involved, the contractor must conduct a neighborhood educational campaign. All neighbors must be informed of the upcoming work. We explain the scope of the blasting to be done, and the precautions they should take—keep animals and children indoors, stay away from windows, etc. A series of loud air-horn blasts signal the coming blast and its completion.

As standard procedure, we take a pre-blast survey of properties within about 200 feet of the blast. We photograph or videotape any age or stress cracks in the neighbors' houses, swimming pools, or paved areas. If people refuse to be surveyed, which happens occasionally, we have them sign a refusal form, or we send them a registered letter.

We also take seismic readings between the blast site and any abutting houses *during* the blast. If a claim is later filed, we have plenty of documentation

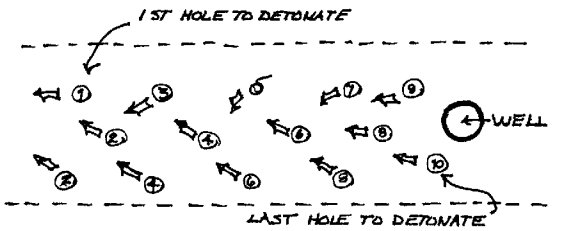
CUTTING IT CLOSE

The use of delays and small charges allows us to blast within inches of a foundation or well casing without causing damage to the existing structure. The key is in reducing the pounds of explosive per delay and creating the right pattern of holes.

In the pattern above, the blast will create a trench to run a water line from the well to the house. The blast starts at the end farthest from the well—the "front" of the blast—which is usually protected with a blasting mat. Each successive charge will dissipate its compressive force in the direction of the previous charge—away from the well.

Delays create good breakage and reduce the overall peak vibration. In general, shorter delays give better breakage. Too much delay between shots increases the likelihood of "fly rock"—stones that are sent airborne.

The total explosion of up to 100 holes or more takes less than one second. ■



Designing a blast next to a well casing. The numbers indicate the order of succession. Arrows indicate the direction of the blast.

to determine who is at fault. After a blast, people are prone to discover foundation cracks that went unnoticed for years—and to blame them on the blasting.

We have had very few claims over the years. Nonetheless, our liability insurance rose 500 percent last year alone due to the current trend in liability insurance.

Excavation

Once the rock is broken up, it must be removed. Make sure you have equipment on the site large enough to handle the mats and the blasted ledge—an excavator with a ¾-yard bucket is often the minimum. If the equipment is too small, you'll waste time and money.

You can often use the blasted rock to fill a low part of the site. You should determine this when you first consider developing a site. If you can't use the stone, you will need to give it away or sell it. Occasionally, you may have to pay to have it removed.

Blasting contractors must photograph all age or stress cracks in neighboring houses to protect themselves from liability.

Typically, we blast a few feet below the final grade—usually by half the distance between blasting holes (see illustration). After excavation, the remaining stone should be compacted by running over it with the excavator to prevent settling. Six inches or so of crushed stone should then be placed before the slab or footings are poured. Uneven settling is mainly a problem when half of a building is supported by blasted rock, and half is built on a slab at grade.

Safety

I know of one case where a blasting contractor stored dynamite in a truck with a compressor running. The compressor caught fire and set off the explosives. The truck was demolished, but fortunately no one was injured.

Explosives, needless to say, are inherently dangerous and must be stored and handled with extreme care. A single stick of dynamite that is exploded accidentally can be fatal.

Until the dynamite is primed by adding a blasting cap, it is relatively safe. But it can be set off if it is hit hard enough, or burned where the fumes are confined.

To guard against mishaps, explosives should always be stored in approved magazines. The storage facility should be locked. And only the blasting crew should handle explosives and be on the blast site.

There's another safety issue: the risk of a blasting cap detonating the explosives prematurely. This is extremely rare, but it can happen if an electrical charge in the earth induces a current in the blasting cap. A single volt can set it off. This risk is greatest when operating near high-tension power lines, or during a lightning storm. Electric equipment in the ground, such as pumps, can also set up an electrical potential in the earth.

Where this is a risk, the blasting contractor should measure for ground currents, or use nonelectric blasting caps. Nonelectric caps are set off by a small charge that runs through thin tubing dusted with explosive powder.

Finding a Contractor

All blasting contractors must be bonded, insured, and licensed to operate legally. Permits are generally granted by a town's fire inspector or public-safety official. When in doubt about a contractor's credentials, check with the fire inspector, who can usually tell you who is legitimate and who has been unlicensed. The inspector may also know the reputation of the company.

At a minimum, you should ask to see a blaster's certificate of insurance, which should have at least a million dollars in liability coverage. Any claims against an uninsured or underinsured blasting contractor will fall on the general contractor or property owner.

It is possible for contractors to lose their insurance and still obtain a permit based on a copy of the bond. If you have reason to suspect this, check with the state treasury department to see if the bond is still in effect. The local fire inspector will have access to this information.

Costs

We typically give a fixed bid based on the complexity and the size of the job. Usually, the stone must be stripped of earth before we can give a fixed bid. Costs vary a great deal, but in residential work costs vary from about $7 to $25 per yard. Blasting for a full foundation in solid ledge can cost from $2,000 to $10,000. Much of that is for drilling the holes, which can take four days for a full basement. Small jobs—removing a single knob of stone or breaking up a large boulder—can cost as little as $500.

Some jobs are best handled with techniques other than blasting. Small jobs, for example, are sometimes best handled with a rock splitter, a pneumatic device that inserts two steel "feathers" between the rocks and then forces them apart with 350 tons per square inch of pressure. Expansion grout is another option. It splits apart stone after the grout is poured into drill holes. These techniques are typically used to clean up any high spots after the main blast.

In densely settled urban areas, where risks to abutters are greater, it may be cheaper in the long run to use non-blasting techniques entirely on small jobs.

Whatever route you take, find a blasting contractor with experience in the type of work you need done. Make sure he or she has the necessary bonding, licensing and insurance. And look for a contractor who has recommendations from other tradesmen. ■

Edward Akerley is a blasting contractor from Gloucester, Mass.