An Inexpensive Bomb Tram for Aerial Detonations

by Karl Birkeland and Tom Leonard

Aerial detonation of explosives as a means of avalanche control is an established practice in many areas of Europe. Tramway delivered explosives protecting railroads, roads and ski areas have been used for years. (Jurgens, 1982). Limited use of trams in North America may be due to, 1) the lack of knowledge of aerial detonation effectiveness, and 2) the high expense of commercially available trams. This article will present trams as a safe and effective means of avalanche control, and will discuss simple construction of inexpensive trams for ski area use such as the ones we have been using at Snobasin, Utah for the past five seasons.

Detailed studies by the Swiss on explosives and avalanches have shown that aerial detonations impact larger areas of the snowpack with a certain minimum value of stress as compared to similar sized blasts on top of or in the snow. The area that is subjected to this stress value is called the "zone of influence". Research has shown that a detonation of 1 to 2 meters above the snow for a standard 1 kilogram charge has a zone of influence with a radius of 50 to 100 meters; the same charge detonated on top of the snow impacts an area with a radius of only 20 to 40 meters, and blasts inside the snowcover influence even smaller areas (Gubler and Armstrong, 1983). Air blasts (as used in trams) clearly impact larger areas than do surface blasts (from hand thrown charges) and thus impacts a greater percentage of weak areas within the snopack. This may increase effectiveness of control of new and light density snow. Control of very thick, hard, old or windpacked slabs, however, requires larger stresses achievable only in a small zone (less than 10 meters) around a buried charge (Gubler and Armstrong, 1983).

Use of trams in North America has been an effective avalanche control technique at some areas. Perhaps the best known example is Bridger Bowl, Montana where extensive systems of trams has been set up for a number of years (see accompanying article).

In addition in increases in effectiveness of control work, trams often enhance control team safety. Trams may be constructed so that bombs can be delivered to starting zones that are not safely approachable for accurate delivery of hand charges. Safety is also increased because slopes are more often cleared of the hazard, making travel below these slopes safer.

While trams in Europe are often elaborate, long, motor driven and expensive, trams to control the generally smaller avalanche paths found in many North American ski areas need not be any of the above. We have constructed five simple and inexpensive trams from only tricycle wheels ($5 each), Cascade alloy rescue pulleys ($20 each), carabiners, and 1/4 inch polypro ropes. Tricycle wheels obtained from a local thrift store were welded to a five foot pipe with a crap metal "V" on the bottom. These are taken up on the hill at the start of the year and anchored to a tree near where the control team will stand. Heavy duty pulleys are then put up above the starting zone and anchored to trees or to a piton pounded into the rock. Two pulleys are used in slightly different spots so that the rope is threaded through the whole apparatus and is tied off as tightly as possible. Plenty of rope is left tied in a coil taped to the main rope so that extra rope is always available. A scrap piece of rope is then tied to this knot so that a bomb hanging from it will be the proper height off the ground. The length of this scrap "pigtail" must be long enough so that the main tram rope is not damaged by the bomb going off.

Use if the tram is simple. The control team goes to the tricycle wheel, and tapes the bomb to the pigtail. First aid tape works best if it is kept warm close to the body. One member of the tram then lights the fuse (we use 180 second fuses for our trams) and the other member wheels the bomb up to the desired location. A tape marker should be put on the main tram rope at a point where the bomb is in a good general location so that the shot will be close to the proper position even if visibility is so low that the whole tram can not be seen.

Tram maintenance is not overly time consuming and is accomplished during daily morning work runs. As snow accumulates, the tricycle wheels have to be dug out and raised. The main polypro rope stretches and needs to be periodically tightened. Scrap rope that hangs off the main rope must be replaces as it is destroyed by control work and rime that accumulates on the rope should be removed.

We encourage people to experiment with tams and their effectiveness. We welcome any questions, comments, and observations at Snowbasin Ski Patrol, Box 348, Huntsville, Ut. 84317, or call (801) 399-0194.

LITERATURE CITED/ADDITIONAL READING

Gubler, H. (author) and R.L. Armstrong (translator), 1983, Artificial release of avalanches by explosives: An introduction for the field person. 31 pp., (unpublished and incomplete translation available through the Utah Avalanche Forecast Center).

Gubler, H. 1977. Artificial release of avalanches by explosives. Journal of Glaciology, Vol. 19, No. 81, p. 419-429.

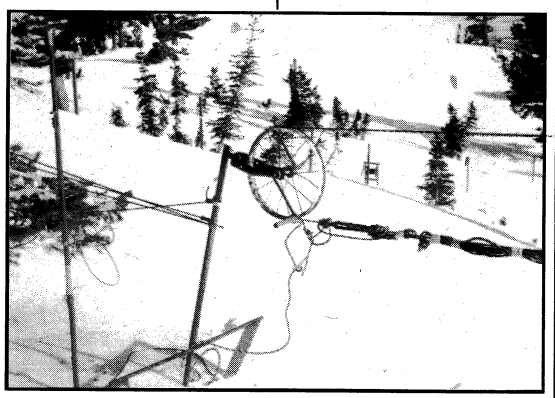

Photo of the inexpensive and easy to operate. "bicycle-type". bomb tram at Snow Basin Ski Area.

AVALANCHE HAZARD CATAGORIES

In this section, we deal with the very volitile issue of avalanche hazard catagories. Here are three viewpoints, as well as a European perspective:

Let the Hazard Begin: a short history

by Knox Williams

Avalanche forecast programs began popoing up in several western states in the early 1970s. In 1973, the U.S. Forest Service Colorado Avalanche Warning Program began operation. It was the first statewide avalanche forecast program in the United States. There were several other forecast programs operating at about this same time--one for the Jackson Hole area of Wyoming, and one for Cottonwood Canyons in the Wasatch Range in Utah. These, too, were Forest Service operations.

For many years, the Forest Service had been issuing fire danger ratings and had been using the adjectives "low, moderate, high, and extreme" to describe the relative hazards. It was logical for the Forest Service avalanche forecasters to adapt these terms to describe avalanche hazards. So, the early avalanche programs used a common terminology to relate avalanche hazaards, yet there were no written definitions of the terms "low, moderate, high, and extreme." It quickly became apparent that some national standars needed to be set, for it would be a public disservice if, for example, Colorado's "high avalanche hazard" was the same as Utah's "moderate avalanche hazard."

In the fall of 1975, the Northwest Avalanche Center was set to open in a few months, and avalanche forecasters met in Seattle to discuss common problems and goals of the various hazard categories. The goal was to define the terms simply (no jargon), briefly (20 words or less), and universally (no regional bias). They had to be useful to the forecasters, the public, and the news media. A media consultant sat in on the meeting to offer wisdom and advice from the media's point of view.

For better or worse, the following definitions came out of this meetimg and have been used now for 13 years:

low: Mostly stable snow. Avalanches are unlikely except in isolated pockets on steep snow-covered slopes and gullies.

Moderate: Areas of unstable snow. Avalanches are possible on steep, snow-covered open slopes and gullies.

High: Mostly unstable snow. Avalanches are likely on steep snow-covered open slopes and gullies.

Extreme: Widespread areas of unstable snow. Avalanches are certain on some steep snow-covered slopes and gullies. Large destructive avalanches are possible.

A controversy over the value of this system began shortly after it was introduced and continues today. Some forecasters found the system too general, and tried adding more categories such as "low-moderate" and "moderate-high". Some tried adding more detail to the definitions (and then retreated when they found themselves too restricted). Some have tried to fine-tune the definitions by separating the likelihood of natural versus triggered releases. Some use elevation, aspect, and slope angle to differentiate between hazard categories. Some hate the word "pockets". Some hate the word "moderate". Some say replace the word "hazard" with the word "instability". Some hate the system and think the public doesn't understand it, so they don't use it. Some like the system and think the public likes it, so they use it.

No doubt, the list of likes, and dislikes, tweaks, and slam-dunks goes on. What else can be expected when you try to define that which is so little understood? Certainly we in the Colorado Avalanche Information Center have been grappling with this issue for many years and have debated many of the controversial points raised above, but we have continued to use the basic definitions created in 1975. A good part of our reason for doing so was that we felt the public was making the system work.

Indeed, we surveyed our customers in the 1986 and found overwhelming support for this hazard rating system: 83 percent said that the ratings were "mostly" or "absolutely" helpful to them, while only 2 percent found them "not at all" helpful. With this level of reinforcement, we will continue to provide the public our hazard assessments...while always seeking a better mousetrap.