AVALANCHE CONTROL ON HIGHWAYS

By

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The protection of a highway is the most difficult task an avalanche control engineer can undertake. The reasons are simple. A single structure, or even a group of structures such as a town, is compact. As in the case of a medieval castle, the defenses can be concentrated in a relatively small area. A ski area is a more difficult problem. Structures are dispersed and the hazard is compounded by people moving about in the open. Nevertheless, a winter sports development can still be regarded as a compact. Communications are good. Modern ski area design exploits the lift system as quick, safe transportation for avalanche control crews and their equipment. During the Olympic Winter Games in Squaw Valley, for instance, our task on any given day was to knock out over thirty avalanches distributed among five different mountains in less than two hours. A necessary ingredient for success was, as the military would say, the isolation of the battlefield and our excellent lines of communication behind the front.

A highway is neither compact nor favorable for maneuver. The hazard is generally strung out for miles with long and time-consuming dead spaces between each nest of avalanches. The avalanche release points are remote and inaccessible. They represent every combination of grade, length and exposure. The avalanche control leader can have little of the current information on what is taking or has taken place in the avalanche-breeding zones, information which is available to him as a matter of routine in a ski area.

I do not mean to draw a pessimistic picture of controlling avalanche hazard on highways. I do mean to face the facts: that it is neither cheap nor easy. It never was or ever will be, anywhere. But it is feasible, economically and technically, if we employ the means available today.

Our first and most important weapon against the avalanche is, of course, research. The snow avalanche is a great, destructive natural force, akin to flood, fire, earthquake and tempest, inferior to none of them. Without accurate information on the nature of this enemy any attempt to combat it is mere gambling, with life and property as chips. The losses can be staggering as they learned on the Austro-Italian front in World War I, or more recently in Peru. Formal research began in 1931 with the foundation of the Avalanche Institute at Davos, Switzerland. The first avalanche research center in the western hemisphere was established at Alta, Utah in 1948, by the United States Forest Service. Currently we operate three centers, at Alta, Berthoud Pass, Colorado, and Squaw Valley, California.

Avalanche research has twin objectives: to understand the nature of the beast; to develop means of combatting it. In the first category perhaps our most important discovery is the fact that alone among the destructive natural forces the avalanche can be triggered prematurely at times and places of our choosing. In the second category, our European colleagues have done outstanding work on the engineering of avalanche defense structures. On our part we have concentrated on hazard forecasting and the use of explosives to make the snow commit itself. The Europeans seek to protect fixed installations. We seek to protect people. But the dividing line between our parallel lines of research becomes more shadowy each year. The skier is now an important factor in the economy of the Alpine countries. On our side of the water skiers are no more than the advance guard of a rising tide of activity in the mountains: housing, recreation, logging, mining, transmission lines for everything from oil to microwaves.

And so we come back to highways, without which none of these activities in the mountains in winter can exist, and how to protect them from avalanches. I can only summarize here the work that is and has been going on. Colorado, with what is probably

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the toughest problem in the United States, has been actively fighting avalanches since 1952. In more recent years Idaho has set up the most comprehensive avalanche research and control program of any state highway department. To the north, Canada's Rogers Pass highway was the subject of several years of intensive research before it was opened to traffic for the first time this winter. To my knowledge, the latest comer is California which this winter firmly committed itself to reducing avalanche closures on two major transcontinental highways from days and even weeks to hours.

An avalanche control program on a highway consists of the following elements:

1. Identification of the hazard by location, frequency and severity.

2. Observation, for timely anticipation of hazardous conditions.

3. Selective use of structures to eliminate the hazard wherever economically feasible.

4. Aggressive use of explosives to force the hazard to commit itself at times and places of our choosing.

5. Finally, recognition of the fact that on occasion the only sensible thing man can do is stay out of there; i.e., traffic control.

Actually, this old and knotty problem of whether or not a highway should be closed at some point before an avalanche does it is one of the better arguments for an avalanche control program. If you're in position to shoot up the avalanches along said highway, the argument is quickly over, one way or the other.

To these five elements of avalanche control on a highway I would add a sixth: advance planning. It is seldom possible to by-pass all the avalanche paths on a trans-mountain highway. But a look at any existing mountain highway demonstrates that some of the hazard could have been avoided by design. I look for the day when avalanche defense will be just as much a part of mountain highway engineering as drainage, guard rails or embankment stabilization.

I want in my remaining time to describe to you an extreme example of highway avalanche protection. I don't say it's the worst problem in the world but it will do until a worse candidate appears. That anyone would seriously undertake this project is a gesture of confidence in modern techniques of avalanche control.

On the screen you are looking at one billion dollars worth of copper. This is quite a tidy fortune to be lying around in the open; it's untouched because the only way to get at it is through a thirteen mile gantlet of avalanches, the canyon of the Rio Blanco. Now an American company is engaged in a bold and calculated attempt to break through the avalanches and take the treasure. The company expects to spend two hundred million dollars of its own money before it ever markets a pound of copper. Every problem of a large-scale enterprise is present: power, transportation, fuel, supply, housing, labor, politics; exaggerated by the sheer physical dimensions of the locale, the second highest mountain range in the world. All can be solved by conventional procedures--except the avalanches.

I became involved with the Rio Blanco project in 1959 at a rather crucial moment. My predecessor as snow problems consultant had just resigned and the company had just had its first avalanche fatality. The first time I saw the canyon it was from the backs of a pair of skis and I sat out a two-day blizzard in a goat-shed. When I got back from my survey trip I was bluntly asked by the company: "Can we operate a highway in this canyon?"

The answer was: "Yes, if you can afford to pay the price."

That goat-shed stood on the only naturally avalanche-proof site in the whole canyon. The spot is now occupied by a camp capable of supporting a 200-man work force with everything from a complete machine shop to hot showers. It is joined to the outside world by

a modern two-lane highway, serviced by the newest and best in snow removal and avalanche control equipment.

Let us consider the elements of an avalanche control plan as applied to the Rio Blanco, starting with item number six: pre-planning. We have studied the location of the highway almost inch by inch. The canyon is twenty-six miles long in which distance it climbs from palm trees to eternal ice and snow. The first eight miles coming up from the lowlands are only occasionally plagued by avalanches. The last five miles we'll do in a tunnel since this fits in with the plan of mining the orebody from underneath. That leaves thirteen miles of battlefield.

Identification: A snow-weather-avalanche observation station has been operated since 1958 and has provided us with indispensable data on the location, frequency and severity of the hazard. Snowfall is about the same as in the Sierras: 400 inches per year. Storm characteristics, wind, temperature, quality of snow--the combinations add up to extreme hazard during and immediately after storms, rapid stabilization thereafter. Depth hoar, the bane of colder climates such as Colorado's, is a rarity.

Observations: The snow-weather-avalanche observation station and the observers are now capable of making accurate hazard forecasts. This function is particularly important on a highway where anticipation of danger several hours before the fact is required in order to get traffic under control.

Structures: After several years observation of avalanche occurrence patterns, we have begun installing defense structures in carefully chosen locations. A few will be sheds, but for the most part they are mounds, diversion walls and terraces which are cheap to build and highly effective where the terrain suits. Stabilization barriers are out of the question in the Rio Blanco.

Explosives: The company owns two 75 mm recoilless rifles, those violent and superbly accurate little weapons so cherished by every avalanche buster. With them on our side, no Rio Blanco avalanche is beyond our reach.

Traffic Control: In the management of this highway we have an important advantage. There is no unscheduled or casual traffic on it. Exploiting this advantage has been a difficult task. The company clung to the belief that somehow we were going to overpower nature and keep that highway open at will. In the winter of 1961 we were ready for our first serious attempt to operate the highway. A three-day blizzard, not unique in any way by Andean or Sierra standards, dumped over a hundred inches of snow on the Rio lanco. When it was over, our highway wasn't just buried, it was inundated. Eighty per cent of it was under from twelve to thirty feet of avalanche snow. It took us two weeks to dig out, an achievement in itself. This was a test operation only with less than half the snow removal equipment and manpower we'll have eventually. The virtue of maneuver over brute strength was apparent to all.

When the mine goes into production several years hence our plan of operation will be anchored upon a series of self-sufficient bases. When Nature throws a real tantrum we will simply withdraw from the most exposed portions of the highway. Within our fortified bases, business will go on as usual. However, on certain key sections of the highway, where the battlefield is isolated and of our choosing, we intend to shoot it out, no quarter asked or given.

Can the company afford the price? In a modern low grade copper ore operation the costs of production are figured in fractions of a cent. Following the 1961 blizzard came the moment of truth. The president of the company asked me to lay out for him the requirements of getting the most possible use of the highway. Somewhat dubiously I did it: so many rotary snowplows at fifty thousand dollars per copy, so many bulldozers, push plows, service vehicles, Sno-Cats, maintenance facilities, ammunition, manpower---the long, costly list.

When I was finished the president gave me the biggest lift I've had since the first day I saw the Rio Blanco and was stunned by its awesome dimensions. He said, "Well, it appears that the cost of fighting snow will be a lot less than the cost of fighting desert."