Education reduces the risks : avalanche research

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Education reduces the risks

Avalanche research

For several years, NRC's Division of Building Research has been studying the characteristics of snow avalanches, a dangerous phenomenon responsible for extensive loss of life and property damage in western Canada. Through education, the toll from avalanches can be reduced.

Mount Temple, Lake Louise, Alberta, 11 July, 1955: seven mountain climbers killed, two injured;

Marmot Basin, Jasper, Alberta, 11 March, 1956: one skier killed;

Grand Duc Mine, Steward, B.C., 18 February, 1965: 26 workmen killed, 20 injured;

Rogers Pass, B.C., 8 January 1966: two members of a road crew killed;

Terrace, B.C., 22 January 1974: seven occupants of a building killed and the building destroyed;

Cap-Santé, Québec, 14 January 1976: one tobogganer killed.

(From a Division of Building Research technical report by Peter A. Schaerer and Chris Stethem.)

Between 1970 and 1979, snow avalanches in Canada resulted in an annual toll of seven deaths (on average) and about $400,000 damage to buildings, power lines, bridges and vehicles. The winter of 1978-1979 witnessed unusually destructive avalanches, causing 14 deaths and estimated property damage of about $1.8 million dollars.

Until the 1960's, victims of avalanches in Canada were normally found in buildings, travelling on roads or working in the mining, construction and logging industries. Today, however, skiers and mountain-climbers form the majority of avalanche victims; in fact, all fourteen deaths in 1978-1979 were in this category. The shift has been partly caused by an increase in skiing and mountain-climbing, and partly due to better protection on highways and in industry, where accidents and property loss have been reduced by building roads, power lines and settlements in safer areas and restricting traffic during hazardous times.

This reduction is no surprise to NRC avalanche specialist Peter A. Schaerer working out of the Division of Building Research's Regional Station in Vancouver, British Columbia. Schaerer and his colleagues from the Division's Geotechnical Section have played a major role in the development of avalanche safety on roads and in industry by providing the technical information necessary for recognizing avalanche hazards; they also participate in instructional courses for engineers, planners and other personnel involved with living and working in avalanche-prone areas. Having investigated the characteristics of avalanches and avalanche defence methods for more than two decades, the NRC research team is well suited to these tasks.

"Our work", says Mr. Schaerer, "has two main facets: we study the dynamics of snow avalanches to obtain the information needed when engineering works like roads, buildings and structures are planned in

For several years, DBR specialists have recorded data on avalanches at a test site in Rogers Pass, where some 20 to 30 avalanches are experienced each year; these observations allow scientists to test theories on avalanches.

All photos: Division of Building Research

Depuis plusieurs années, des chercheurs de la DRB accumulent des observations sur les avalanches affectant un site expérimental du col Rogers. Il s'y produit de 20 à 30 avalanches par année, ce qui permet aux scientifiques de la DRB d'obtenir de nombreuses données techniques sur le phénomène et de vérifier les théories actuelles.

Photographies: Division des recherches en bâtiment

A DBR specialist estimates the size and mass of an avalanche as part of an observational program.

Un chercheur de la DRB évalue la taille et la masse d'une avalanche, dans le cadre d'un programme d'observation.

avalanche-prone areas. Secondly, we are heavily engaged in educating people on avalanche safety, and for this purpose, we collect and publish case histories of avalanche accidents."

For the western mountains of Canada, the peak of the avalanche season is January, the month of heaviest snowfalls. This is the period when the greatest material damage is experienced. Avalanche accidents involving skiers generally occur in February and March, one reason being that January is generally too cold for much skiing. On the other hand, mountain climbers reaching higher altitudes can encounter avalanches at any time of the year, whenever the conditions are right. These usually involve a snowfall with wind speeds of 30 km/h or more, or a snowfall followed by warm weather.

"The most common avalanches," says Mr. Schaerer, "are caused by the weight of new snow sliding on top of old snow. When snow is unstable, any small perturbation, such as the passage of a skier, vibration due to traffic or an explosion can trigger an avalanche. First, the snow slab that breaks away slides as a rigid body, but after a short time it disintegrates into small fragments. While the motion of avalanches is very complicated and has not yet been described satisfactorily in mathematical terms, the NRC observations suggest that typical dry snow avalanches consist of a core of dense snow flowing along the snow surface, accompanied by a cloud of powder snow. The powder cloud is well developed in avalanches of dry snow and has very little density; it is less pronounced in moist snow and absent altogether in wet snow avalanches."

Although the powder part is spectacular, Schaerer explains, the destructive power of the avalanche is contained in the flowing snow which has most of the mass and momentum.

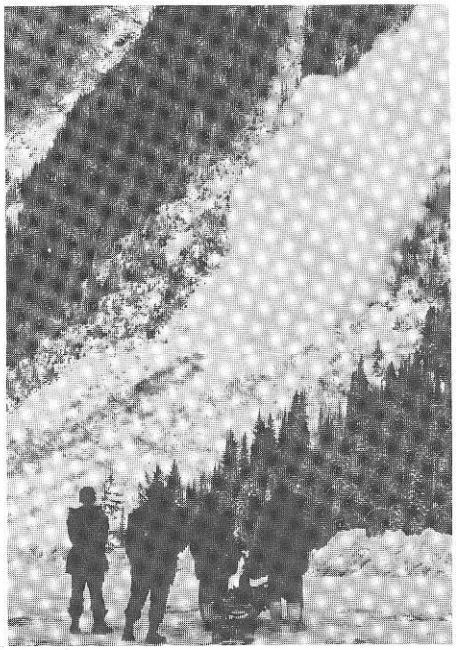
To get observational data on their behavior, the Division of Building Research started to monitor avalanches in 1971 at a test site in the Rogers Pass area of the Trans-Canada Highway, in eastern British Columbia. The site, Tupper No. 1, is ideal for avalanche studies: it is readily accessible from a highway and experiences 20 to 30 avalanches every year, making frequent observations possible. Using buried seismic geophones and a battery of pressure sensors in the path of avalanches, the NRC scientists have recorded data on the speed, distribution of mass, and evolution of these dangerous phenomena, thereby permitting them to test theories that seek to explain avalanches and their destructive forces.

One of the aims of the DBR work is to come up with methods of predicting the maximum size of avalanches that can be expected during a 30-year or greater period at a given site, in order to estimate the protective measures needed. For this purpose, the field staff of NRC measures the mass of snow brought down and the distance reached by medium and large size avalanches at selected sites. One method of protection is to initiate avalanches with artillery or a dynamite explosion when it is recognized that conditions are right. When the snow cover is stabilized in this manner, there will be no further risk of avalanches in the area until the next snowfall.

Structures are also a means of

A common protective technique against avalanches involves triggering them with artillery when snow conditions indicate an avalanche is likely. Once the snow cover is stabilized in this manner, further avalanches will not occur until the next snowfall.

On se prémunit souvent contre les avalanches en les déclenchant au moyen d'un tir de mortier quand l'état de la neige donne à penser qu'il y a danger imminent. Cette manoeuvre permet de stabiliser la neige jusqu'à la prochaine chute.



protection. Snowsheds, over which an avalanche can slide, protect troublesome sections of the Trans-Canada Highway in the Rogers Pass area. Because of the substantial cost, however (some $10,000 a metre), their use is limited and road builders accept that there will be instances when a showshed is blocked off at the ends by a particularly large avalanche. After such an event the snow is simply cleared away with heavy equipment.

"As engineers," continues Mr. Schaerer, "we are concerned with technical and scientific considerations, with measuring the speed and impact pressure of avalanches and designing better protective structures and deflecting dams; but we have had to come to grips with the fact that in recent years, the biggest problem with avalanches has been their danger to skiers and outdoorsmen. These people often venture into dangerous zones and mistakenly trigger avalanches."

To promote avalanche safety, the Division of Building Research cooperates with the British Columbia Institute of Technology (BCIT) in organizing annual courses covering many facets of avalanche safety and how to recognize avalanche hazards. These courses, which combine theoretical instruction and field trips, have been offered since 1972, with ski patrollers, road maintenance workers and other interested people attending them every year. BCIT organizes and administers the courses, and DBR provides the course content. In the winter of 1978-1979, a total of 180 students attended eight avalanche courses held at Rogers Pass, Banff, Whistler and Rossland.

Mr. Schaerer and other avalanche specialists in western Canada cooperate extensively and exchange information on avalanche conditions through annual meetings and the publication of a newsletter. As in weather forecasting, understanding avalanches and predicting their occurence depends on the pooling of information.

Schaerer points out, however, that avalanches are a very local phenomenon, and that while conditions might be very safe near Vancouver, for instance, a local combination of weather and other factors might make crosscountry skiing very dangerous near Banff. The best protection, then, is to be able to recognize avalanche-prone areas and to avoid them. With the growing number of ski guides and other people trained to recognize avalanche danger signs and to take action in case of an accident, there is every hope that casualty figures will decline in the coming years.□

Michel Brochu