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Avalanche Awareness

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Snow avalanches are a common feature of the Utah mountain landscape. The combination of heavy annual snowfall, wind, and steep slopes result in potential instabilities in the layered mountain snowpack.

The Utah mountains receive 22-25 inches of precipitation annually, most falling in the winter as snow. This amounts to 200-600 inches of annual snow at elevations above 7000 feet. It is not unusual to receive one to four feet of snow in a single storm cycle.

The most significant weather factor contributing to avalanche formation and release is wind. Wind speed and direction varies with elevation, latitude and topography. Average wind speeds at 8000 feet are 15-20 miles per hour with speeds increasing at higher elevations. In general, winds greater than 15 miles per hour transport snow from windward aspects and deposit it as wind slabs on lee slopes.

Of the elements contributing to avalanche potential, terrain is the most constant. Most slab avalanches occur on slopes with steepness between 30 and 45 degrees. Aspect, or the direction a slope faces, affects wind loading and exposure to sun.

Mid winter avalanches are most common on north, northeast and east facing slopes. Colder temperatures cause the development of weaker snow. Slopes with these aspects are most often loaded by prevailing winds. Other terrain features that influence avalanche occurrence are elevation, slope configuration (e.g. convex vs. concave), and the presence of gullies, cirques and vegetation.

This large hard slab avalanche ran on a buried rain crust

There are several types of avalanches including loose snow, cornice falls, ice and slab avalanches. The most dangerous of these are slab avalanches.

The mountain snow pack is ever changing, subject to additional snow fall and erosion by wind and sun. These changes result in a characteristic layered pattern. Slab avalanches are possible when a cohesive layer (the slab) is separated by a weak layer from a bed surface below.

Note the fine textured debris in this soft slab avalanche

The crown and flanks are clearly visible in this avalanche

When the stress on a slab exceeds the strength that holds it in place, the potential for a slab avalanche exists. The slab is identified by the crown at the top, the flanks along the sides, and the stauchwall at the bottom. In order to have a slab avalanche, failure must occur at all of these surfaces. Slabs can be very large with crown lines hundreds of feet long. Most avalanches triggered by humans, however, are quite small.

The large majority of slabs are between 10 and 40 per cent in density, although considerable variability exists. Slab avalanches are often distinguished based on the hardness of the slab itself. The most common are soft slabs, and as the term implies are often soft enough to be penetrated a person's finger. Hard slabs are more dense and can sometimes barely be etched by a ski edge. Upon releasing, soft slabs break into small chunks and create finely textured debris.

Hard slabs break into large, angular pieces which can be as large as a car, and may survive as refrigerator-sized chunks in the debris. Hard slabs are notoriously unpredictable and may remain sensitive for long periods following snow or wind events.

Hard slabs are often involved in incidents involving snow machines since the slab is hard enough to support the machine's weight, and may fracture and release far beyond the area where the machine is traveling. Wet slabs can also occur during periods of rain or warm temperatures and in Maritime climates. Most natural slab avalanches occur during or shortly after significant loading by additional new snow or wind redeposited snow or rain. If natural avalanches do not occur within this period the snow pack will adjust to the new load.Most human triggered avalanches occur before the snow pack has had sufficient time to stabilize.

Encounters between humans and avalanches have increased in recent years in Utah and North America in general. One obvious reason for this is the increase in the numbers of people engaged in back country winter use. Another is that technological advances in skis, snow boards, snow shoes and snow machines enable users to more easily access dangerous avalanche terrain. Most avalanche accidents occur when the victim or a member of the victim's party triggers a slab avalanche.

Avalanche awareness, route selection, stability evaluation, and hazard assessment are essential in preventing backcountry avalanche incidents. The most obvious sign of instability is recent avalanch activity. Other clues to instability include collapsing or hollow sounds, shooting cracks, and evidence of recent wind loading. A variety of snow pack stability tests can be conducted to look for slabs, weak layers, and bed surfaces (see back page).

General knowledge of current avalanche danger should be obtained prior to backcountry tours by contacting the local avalanche forecast center. In Utah forecast center numbers are as follows:

This soft slab avalanche was triggered with explosives during avalanche control at Snowbasin.

Provo area (801) 378-4333
Salt Lake City area (801) 364-1581
Alta (801) 742-0830
Park City (435) 658-5512
Ogden (801) 626-8700
Logan (435) 797-4146
Moab (435) 259-7669
Snowmobile Hotline (800) 648-7433
Or visit www.avalanche.org

Surviving an Avalanche

By definition, backcountry avalanche accidents occur far from organized avalanche rescue resources. While avalanche prevention through safe travel protocol is the ultimate goal, avalanche accidents will always occur. The chances of survival decrease very rapidly with time, reaching about 50 percent chance of survival after 30 minutes. If an avalanche victim is to survive, he or she will likely be rescued by members of their own party. There is simply not enough time to obtain outside help. Organized rescue parties from mountain resorts or county sheriff search and rescue groups will only be of use in victim recovery. It is therefore obvious that having the necessary equipment and possessing the ability to execute an avalanche rescue is essential for all winter recreationists traveling in avalanche terrain. Equipment includes an avalanche transceiver worn at all times, a shovel and probe. If caught in an avalanche try to stay near the surface using swimming motions. As you begin to feel the snow slow, try to create an air space around your face, and thrust you hand toward the surface. Remain calm and trust that your travel partners will rescue you.

If your partner has been caught, identify the point last seen. Buried victims are often located at the toe of the avalanche debris below the point last seen.

After assessing further danger, look for visible signs of the victim on the surface of the debris. Equipment and articles of clothing can also provide clues to the victim's location. Try to use the point last seen and any clues found to reduce the search area size. Use your beacon and probe to locate the victim. Once the victim is located with the probe, leave the probe in place and dig down to the victim. All things considered only one in three totally buried victims will survive. Practice in the use of rescue equipment is very important and should be done regularly.

Avalanche education is important to gain the knowledge necessary for safe travel, and rescue in avalanche terrain. Numerous sources of avalanche information are available from avalanche information centers, ski patrols, universities and other organizations.

Large slabs in the deposition indicate a hard slab avalanche

Snow Stability Evaluation

Stability evaluation is an attempt to determine the likelihood that an avalanche will occur within a given time period. The process involves integrating elements of weather with the mountain snowpack for decision making in avalanche terrain. Stability evaluation is easiest when the avalanche danger is very high as during or immediately after significant snowfall and/or wind. The most obvious sign of instability is recent avalanch activity.

If recent avalanches are observed, terrain of similar characteristics should be approached with caution. Often when the avalanche danger is high other signs of instability are observed. These include collapsing sounds or shooting cracks, suggesting that sensitive slabs are resting on weak layers below. Stability evaluation is also straight forward when the danger is low as in extended snow free periods often associated with common mid winter high pressure systems. It is in the range of conditions between the extremes that stability evaluation is most challenging and when most avalanche incidents occur.

A variety of snow stability tests exist to help determine if sensitive slabs are overlying weak layers and the amount of force required to produce slab failure during the period in question. Stability tests can be very subjective, difficult to quantify and require a great deal of practice and experience to judge properly. There is also considerable variability from one place to another, even on the same slope. The goal is to look for a pattern of instability and to base travel decisions on real observations. It is always best to err on the side of safety.

Snow stability tests are of two general types, active and passive. Active test are done on the move, and can be conducted many times during the course of a tour. The most well known active test is a slope cut in which the traveler exerts force onto a short and safe slope similar to slopes traveled during the tour. The objective is to observe how the snow behaves under the force of the traveler, and to observe if small avalanches can be triggered or weak layers identified. Other common backcountry active tests include hand shears, ski pole tests, and cornice drops. Passive tests are done in snow pits. The location of a snow pit must be similar to the slopes in question, but always in a safe location. Dig a pit with a vertical uphill wall to the ground or to a maximum of six feet. Look for strong layers, weak layers, and isolate columns and subject them to various stresses. Each experienced observer will develop his or her own favorite tests. Tests should be repeatable and quantifiable so information can be exchanged between observers. It is best to learn the specific techniques from experienced winter travelers or by taking an avalanche class.

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