Wet Slab Avalanches

Introduction

Wet slab avalanches are caused by a thick cohesive slab of snow losing its bond to an underlying thin weaker layer or interface after becoming damp, moist, or saturated with water. The slab that initially fails can be very firm or even hard but once moving, the debris generally becomes a dense mushy mass, often composed of large rounded lumps and there is no powder cloud. Wet slab avalanches are generally slower moving that dryer slab types, tend to flow in channels, and are easily deflected by irregularities in the terrain. The deposited debris commonly has channels and ridges on the surface. Wet slabs are often highly destructive due to great mass created by the high water content of the snow.

Development

Wet slab avalanches form when a slab or the underlying weak layer are affected by liquid water which decreases cohesion but before a total loss of cohesion (and a loose wet avalanche) develops. Over time, wet slab problems can evolve into loose wet avalanches if there is enough lubrication throughout a layer to saturate the snow essentially.

Time of the Season:

In most climates, wet slab avalanches are typically a late spring phenomenon. This is when temperatures are warm enough, solar radiation is strong enough, and/or rainfall amounts are great enough to produce the thick wet layers required to produce this type of avalanche. The exception may be low elevation areas, especially in maritime climates where extended warm spells and significant rainfall can occur at almost any time of year.

The development of the weak layers on which a wet slab might fail may be related to the wet conditions that form the wet slab but they can also be any number of other weak layers that have formed at any point in the season.

Weather Patterns:

Extended periods of temperatures above the freezing point (especially if there is no diurnal re-freeze), strong solar radiation, and rainfall are the weather events associated with wet slab formation. More than one of these in conjunction or subsequent to each other have a greater effect than any one factor in isolation.

Snow Climates:

Wet slabs are most common in warm climates, especially those with maritime influences. By late spring, however, wet slabs can be expected in practically any climate. Wet slabs often occur first in shallow snowpack areas where heat from the earth, numerous exposed rocks acting as heat conductors, and warm spring conditions combine to produce wet slabs that fail at or near the ground, especially where facets or depth hoar form the basal layers.

Avalanche Activity Patterns

Seasonal Timing and Persistence:
Avalanche activity closely mirrors the development cycle. That is, for the most part, wet slabs are more common in late spring with the exceptions noted above.

In the early stages of wet slab activity, the problem is often cyclical and persists only for hours as the wet surface layers freeze overnight and thaw the next day. During periods where no overnight re-freezing occurs, however, it is possible for wet slab activity to persist for days before the snowpack loses all cohesion and activity evolves into loose wet avalanches.

Size and Propagation:
Size and propagation potential is linked to the nature of the failure layer and the slab development mechanism. In a situation where widely distributed failure layers deep in the snowpack combine with warm temperatures and rainfall over a large area can produce wet slab avalanches that rival any other type in terms of size and propagation. Under these conditions it is possible for wet slabs to span multiple start zones, run to valley bottom, and extend historical path boundaries.

At the other end of the scale, a wet slab problem related to an isolated weak layer and solar warming may produce avalanches that are much smaller.

Spatial Distribution and Variability:
Wet slabs can be widely distributed or very isolated. Again, this depends on the nature of the failure layer involved and the development mechanism. In the case of a widespread weak layer, warm temperatures, and rainfall avalanches can be expected on all aspects, elevations, and terrain features. At the other extreme, when solar radiation is the primary development factor and no widespread weak layer exists, activity will be more localized or perhaps even isolated.

When avalanche activity does start, however, variability is often low: that is, once the condition has developed and activity has begun many or most slopes within the given locations are suspect.

Triggering:
Sensitivity to triggering is closely related to the location and nature of the weak layer and the stage of development. When weak layers are closer to the surface and more lubricated by liquid water and in the latter stages of development when the slab is wetter, triggering by lighter loads (snowmobiles or skiers, for example) is a concern. However, by this stage of development, travel conditions are usually poor and people are seldom attracted to slopes where they might trigger such an avalanche.

In the earlier stages of development or with dryer weak layers that lie deeper in the snowpack, triggering generally requires larger loads. Cornice fall and smaller avalanches on a slope or from above that step down are common triggers.

Certain weather conditions increase sensitivity to triggering:

- Loading by rain or perhaps wet, dense snow (especially rapid loading of >3mm/hour water equivalent).
- Extended periods of rain, which saturate the snowpack and percolate into deeper layers.
- Solar radiation warming the snow to the point where it is no longer dry or frozen snow on the surface.
- Above freezing temperatures that melt the snow at or near the surface.
- Overnight temperatures that stay above 0oCand do not allow the upper layers of the snowpack to freeze.

Recognition and Assessment in the Field

Avalanche Activity:
Snowballing, pinwheeling, and small wet slab or loose wet avalanches are often precursors of wet slab activity. Recent wet slab activity is a reliable indicator of the terrain on which another cycle will occur if the conditions that triggered the previous cycle reoccur. Current wet slab activity is generally a very good indicator for similar terrain.

Snowpack Layering, Tests, and Observations:
A wide variety of layering can produce wet slab avalanches including any number of weak layers such as those discussed in other avalanche character types. In the late stages of development when the upper snowpack is very wet and water has percolated deep into the snowpack, a weak layer can form due to pooling and/or lubrication even where bonds were good when the snowpack was dry and cold.

Instability often builds slowly, peaks quickly, and lasts for short periods. Tests and observations made before the instability window opens are often inconclusive. Some professionals believe that temperature provides a means of assessing the onset of a wet slab avalanche cycle. These practitioners feel that a slab temperature of -0.5oC with wet snow above and a weak layer (either dry or wet) below is when light triggers may be enough to start avalanches and is a sign that critical instability and natural avalanches are imminent.

Surface Conditions:
Wet slabs are generally associated with wet, very wet, or slushy surface conditions; however in some cases these may be hidden beneath a layer of new snow or a thin, soft, or breakable crust. Generally speaking a strong melt-freeze surface crust that is
15cm or thicker and supports a person on foot will not allow wet slabs to release, although in extreme cases people have been known to trigger large wet slab avalanches even when travelling on a fully frozen and supportable surface crust. It is worth noting that even a thick, supportive crust can break down very quickly if the underlying snowpack is warm and wet and when warm temperatures, strong solar radiation, or rain affect the surface.

Risk Management Strategies

Timing:
Timing is the key to managing wet slab avalanche hazards. The conditions that promote instability and avalanche activity can progress rapidly but are generally quite predictable.

Solar radiation affects upper elevations earlier in the morning and lower elevations later in the day. Radiation is strongest on southeast aspects early in the day then progresses through the southerly quadrant ending on southwest (and in late season west aspects) at the end of the day. In all cases on sunward aspects, steep slopes warm faster than less steep ones. Air temperatures generally peak in the early afternoon. The onset of rain is a good time to start looking for safe terrain options.

Human Factors:
In many cases, conditions are poor (wet, slushy, too warm, rainy) when wet slab instability becomes a significant problem, and most people generally leave the mountains or find places where travel conditions are better, leading them to slopes where the wet slab problem does not exist.

The human factors that affect risk are generally related to underestimating how quickly the conditions can change, especially on a warm, clear, sunny day with cool valley bottom temperatures in the morning. People tend to underestimate conditions at higher elevations early in the day which lead to rapid deterioration of the snowpack and significant overhead hazard. This can lead to being caught by surprise later in the day when the period of critical instability arrives.

It is not uncommon for danger to rise from Low to High in 30 minutes or less as early as 10:00 a.m. even on a day with little sign that an instability is lurking. In addition, it’s easy to forget that even early in the morning when the snowpack is relatively stable, a large trigger such as a cornice fall, ice fall, or smaller avalanche from above can trigger a wet slab on impact with a slope below.

Terrain:
Terrain choices revolve around the likely trigger mechanism and weather factors. If cornice fall, ice fall, or avalanches from above are potential triggers then avoiding or minimizing exposure to avalanche terrain below these features is advisable. If solar radiation is the most likely trigger, then careful choice of aspect is an effective terrain choice. If warm air temperatures or rainfall are the problem then elevation may be something to consider. If there’s been no solid overnight freeze or after the first or second night of freezing temperatures following a period of above freezing nights, then all avalanche terrain may out for the day.

Perhaps even more so than with other avalanche types, careful assessment of and minimizing or eliminating exposure to terrain traps is advisable. The high density, significant water content, and low volume of air in wet debris tends to shorten survival times so small avalanches, shallow burials, and short burial times may be less survivable in wet avalanche debris than in dry.

USE AT YOUR OWN RISK

Mountain travel is dangerous and can involve exposure to avalanches and other hazards. The advice and decision guidelines provided in this field book cannot eliminate these hazards, but they can help you understand and manage them. This field book is no substitute for training, experience, and choosing skilled and responsible travel partners.

To find an avalanche training course near you, visit www.avalanche.ca.

CITATION

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