Interpretating Rutschblocks in Avalanche Start Zones

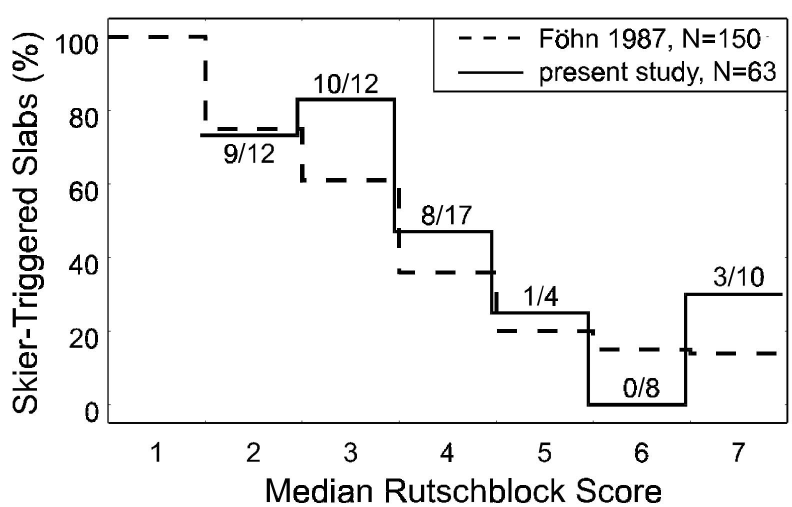
Bruce Jamieson and Colin Johnston
Dept. of Civil Engineering, University of Calgary
Calgary, Alberta, T2N 1N4

Rutschblock tests in avalanche start zones should be better indicators of slab stability than tests on nearby slopes. But how just effective are rutschblocks in start zones? Let's start with the usual interpretation: rutschblock scores of 1, 2 or 3 (blocks that slide before the first jump) indicate that the slope can probably be skier triggered; rutschblock scores of 6 or 7 (blocks that did not slide on the first or second jump) indicate that the chance of skier triggering has dropped to about 15% (Föhn 1987).

The fact that 15% of the slopes with rutschblock scores of 6 or 7 slide is important. The first and most obvious message is that we should not bet our life on the results of one or two rutschblocks–other factors must also be considered before we commit ourselves to a slope. The second and more subtle message is that picking a *representative* site for a rutschblock requires experience. Föhn attributes the fact that slides occur on slopes with rutschblock scores of 6 and 7 to difficulty selecting sites that are safe yet representative.

Rutschblock Scores on Skier-Tested Avalanche Slopes

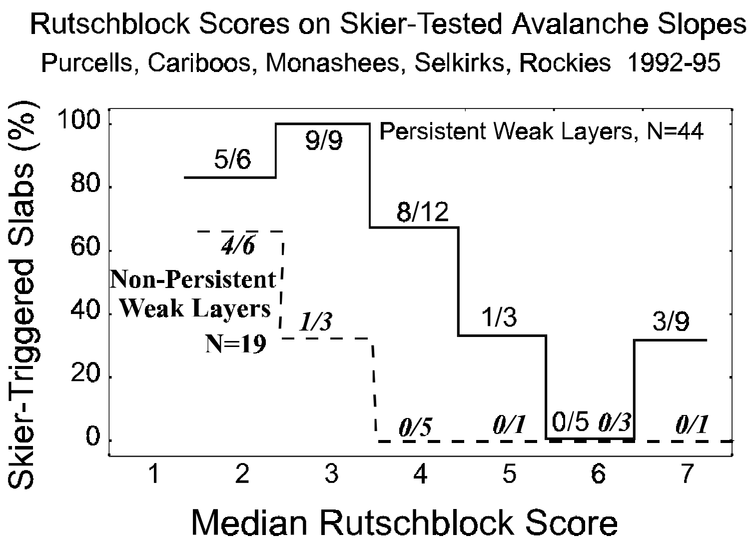
Cariboos, Purcells, Monashees, Selkirks, Rockies 1992-95



As a small part of a larger project (Jamieson and Johnston 1995), we did a field study in the Columbia and Rocky Mountains of western Canada that was similar to Föhn's study in Switzerland. The good news is that our study showed a similar decrease in skier-triggered[1] slabs as rutschblock scores increase from 2 to 6. The bad news is that skiers did trigger 3 of the 10 slopes with rutschblock scores of 7! Two factors contribute to such *false stable* results. First, our field

[1]We use *skier-triggered* to refer to avalanches intentionally or accidentally initiated by a skier.

staff seek out unusual and unexpected avalanches for study and any unusual rutschblock results are included in the graphs. Second, for this study our field staff did the rutschblock tests where slab conditions appeared *typical of the start zone*. Unfortunately, not all slab avalanches are triggered where slab conditions are typical. On the ten start zones with rutschblock scores of 7, skiers triggered two of them where the slab was much thinner than average, and the other was likely triggered from a small weak area near rocks. We will get back to two of these as case studies.

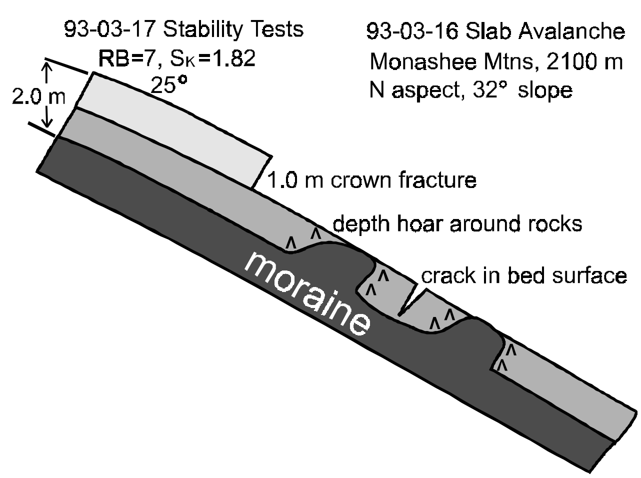


But first, let's look at the most interesting outcome from this Canadian study. We separated these 64 results into rutschblocks that slid on *persistent* weak layers such as surface hoar and facets, and those that slid on *non-persistent* layers such as low-density layers of decomposing stellars. While there were only 19 results for non-persistent layers, the frequency of skier-triggering is clearly less than for persistent layers. Note the fit that occurs if the dashed line for non-persistent layers is shifted 2 steps to the right. For persistent layers with rutschblock scores of 4, the frequency of skier-triggering is the same as for scores of 2 on non-persistent layers. And the frequency of skier triggering for rutschblock scores of 5 and 6 is the same as for scores of 3 and 4 respectively on non-persistent layers. So, the next time someone tells you they got a "rutschblock 4", ask them what the rutschblock slid on! Knowing the grain type of the failure plane can make a big difference to the interpretation of the result. Of course, the depth of the failure plane, as well as terrain characteristics such as slope angle, aspect, elevation and terrain feature should also be noted (CAA 1995).

A word of caution: although skiers did not trigger any of the 10 non-persistent slabs with rutschblock scores of 4 to 7 in our study, this does not mean it cannot happen. A larger study might show some skier-triggered slabs for such rutschblock scores.

Case Study 1

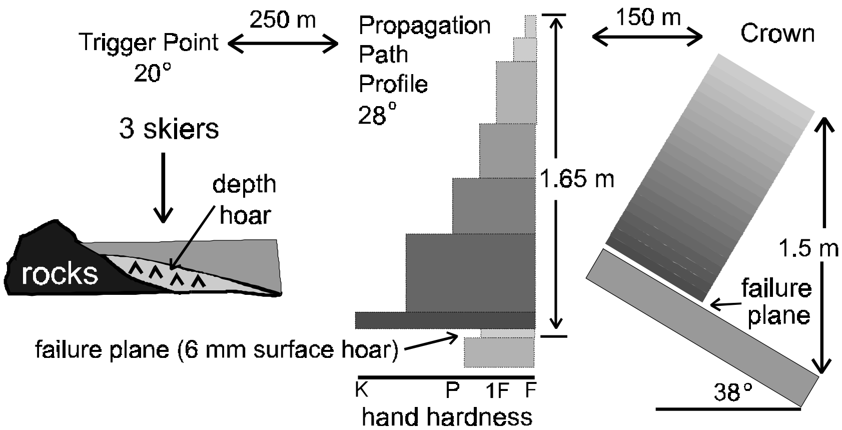
On 16 March 1993, a 1 m thick slab was triggered by a skier on a 32° moraine slope in the Monashees. When we reached the site the next day, the most representative undisturbed site was on the 25° slope above the crown fracture. At this site, both the shear frame stability index (Jamieson and Johnston 1995) and the rutschblock (*RB*=7) indicated stability. At 5-6 places, rocks and humps in the moraine were exposed in the bed surface. At these places where the snowpack was only 1 m thick prior to the avalanches, depth hoar surrounded the rocks and humps. Although the exact trigger point is not known, the slab was likely triggered at one of the shallow places with depth hoar. Hence, a stability test several metres away from a localized weak spot



can be misleading. Features of the terrain and ground cover that may be hidden under the snowpack sometimes play an important role in the stability of avalanche slopes.

Case Study 2

The slab avalanche on Silvretta Glacier in the Purcells on 24 February 1994 illustrates remote triggering. Three of us skied down gentle terrain stopped near rocky outcrops on the east edge of the glacier. We felt the shallow snowpack collapse under our skis and heard a “whumpf”. Moments later we received a radio call saying that a large avalanche was running down the west-facing slope approximately 400 m to the west.



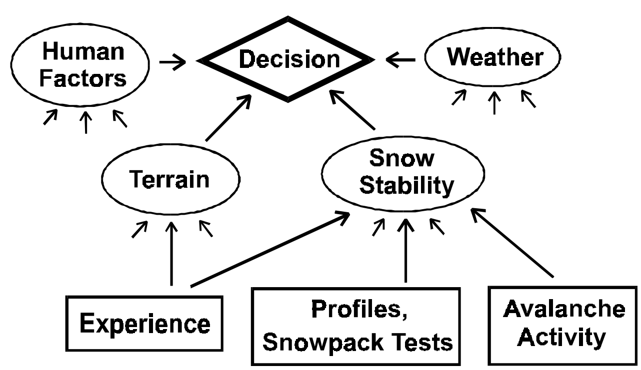
We could not get safely to the crown, so we observed a profile approximately 150 m east of the crown. The thickness of the slab at the profile site was approximately the same as the average thickness of the crown. The bottom 0.7 m of the 1.65 m slab consisted of *pencil* to *knife* hard layers. (Extensive fracture propagations are commonly associated with thick slabs containing such hard and stiff layers.) The rutschblock did not fail (*RB*=7), even when all three of us jumped without skis on the rutschblock at the same time.

We believe that the fracture started in thin weak snow near rocks, spread through a snowpack that could not be triggered by skiers and released a large slab avalanche when it reached a slope steep enough to slide. As with the first case study, the fracture probably started in weak snow where the snowpack was particularly shallow and associated with a terrain feature less than a few metres long.

Logan (1993) gives similar examples of triggering from local depth hoar weaknesses in the Colorado Rockies.

Local snowpack fractures occur whenever skiers break into weak snow over rocks, bushes and near ridges. However, although a weak layer and a stiff slab are required for propagation, there is presently no practical snowpack test that indicates whether these local fractures will propagate over tens or hundreds of metres or not at all. The more extensive the propagation, the more likely the fracture will encounter a slope steep enough to slide.

The rutschblock is a practical stability test, especially when done in avalanche start zones or where conditions are similar to avalanche start zones. However, as the case studies illustrate, the rutschblock tests cannot, by themselves, indicate stability consistently. For making decisions about access to avalanche terrain, such tests can complement but do not replace experience, knowledge of terrain, other snowpack observations and weather observations.



Summary

For slabs of less than 90 cm in thickness, rutschblock tests in avalanche start zones are useful but not definitive indicators of slab stability for skiers.

For a given rutschblock score, slabs overlying persistent weak layers are more likely to be skier triggered than slabs overlying non-persistent weak layers.

Fractures started by skiers at localized weaknesses in the snowpack sometimes spread through areas where stability tests indicate that skiers could not start fractures. If these propagating fractures encounter slopes steep enough to slide, slab avalanches can result.

There is a need for a snowpack tests that indicates whether local fractures that start near rocks, bushes and ridges will propagate over distances large enough to release slab avalanches.

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