4. Sliding or sticking?

As described in my 2[d] note, the weak layer (WL) may collapse, for instance due to a skier's impulse, into an unstable material prone to glide. The size of this initial collapse is usually larger than the critical instability size defined in my 1[st] note, which is of a few tens of cm. Thus, the "basal crack" is expected to extend rapidly, leading to avalanche triggering. Yet, one may wonder why lots of collapses only result in simple "whumpfs", without any release!

The explanation is as follows. In my 2[d] note, I mentioned surface hoar, that provides incomparable glide feelings. On the opposite, it is well known that stopping for a few seconds in some "warm" snows results in snow sticking on ski soles, impeding further glide.

We showed during field experiments that a similar phenomenon may occur shortly after WL collapse. The slab is cut vertically in order to bring to light the WL, whose material is then retrieved with a shovel. In doing so, the delicate bonds between crystals are broken, and the collected snow can flow like dry rice grains. But after a few seconds, it "clots" in the shovel, and cannot flow any more (video). Such a behavior can be easily explained and generalized to collapsed WLs using a theoretical model [1], whose conclusions are twofold:

i) snow grains of the collapsed WL go on flowing as long as the contact time with each other is long enough to prevent them from welding together, i.e. as long as their flowing velocity is large enough.

ii) if the flowing velocity becomes less than a "welding" threshold (that depends on temperature), the grains weld together after a few seconds, resulting in WL clotting and failure of the triggering process.

The main parameters controlling the slab velocity, and therefore the flowing vs clotting choice, are the slope angle and the slab weight. But peripheral slab anchorings as stauchwalls would also have to be considered.

Taking a very large slab, peripheral anchorings would have a small influence, and the WL collapse would extend keeping its fluid character to a considerable slab area, favoring crown crack opening as detailed in my 5[th] note. In the paper quoted in reference [1], I took the example of a typical WL, with a resistance to collapse of 480 MPa (determined from PST tests), a slab density of 300 kg/m^3, and a slab thickness of 40 cm. In this case, the collapsed zone becomes unstable for slope angles larger than 28°. Other usual values can be ascribed to these parameters, giving critical slopes ranging roughly between 20° and 45°, in agreement with the ackowledged value of 30° above which avalanches are observed to be triggered.

If the slab is smaller and (or) hold by anchoring points, the conditions given above would not allow avalanche release. The skiers responsible for the collapse would only notice an audible "whumpf" and possibly feel some slab subsidence, but nothing else would happen.

The different triggering steps will be detailed in my 5[th] note, from basal crack initiation to crown crack opening, with a particular attention to how each step would either fail, or proceed up to the final triggering.

[1] - "*Modeling a fluid to solid phase transition in snow weak-layers. Application to slab avalanche release*". François Louchet, april 2015: http://arxiv.org/abs/1504.01530