WET SNOW

Isothermal = One temperature (0° C)

Wet Snow Avalanches vs Dry Snow Avalanches – snowpack loses strength vs stress on a snowpack overcomes strength of a snowpack

Questions to Ask About Wet Snow:

- Did it freeze overnight?
  - Air temp? Cloud Cover?
- How thick did it freeze?
  - In camp or at the trailhead? Up high?
- How is new snow affecting the old snow?
  - Insulating a crust or glop?
  - Poor bond between new and old snow or good bond?
- How wet is the snowpack?
  - Does the water have anywhere to go? Are there percolation columns?
- How far and how fast are wet slides moving?
- Where can I go to stay on the "best" snow for as long as possible?

Wet Snow Red Flags

- Natural avalanche activity
  - Aspect/Type/Time/Runout Angle
- Heavy sustained rain
- Rain on dry snow
- Non-freezing nights
- New snowfall – First heat up
- Overnight clouds
- Deep boot penetrations
- Glide cracks
- Cornice failure

Heat Sources to Add Liquid Water to the Snowpack

Solar Radiation
Long Wave Radiation
Turbulent Exchange
Rain

Water moving through the snowpack

Percolation columns and rain runnels = established routes for water percolation. This is the drainage system for the snowpack.
Once these runnels are established, the snowpack can absorb significant amounts of rainfall.

- Percolation columns form downslope as saturated layers become thicker
- Existing ice layer can trap draining water
- Spatial variability of snow layers can enhance snow stability in a wet snowpack as it allows water to exit the snowpack

Stratigraphy: uniform snowpack vs layered snowpack?

Wet loose avalanches = may indicate a more uniform snowpack. These can also precede wet slab avalanche activity.

Wet slab avalanches = may be more likely in a layered snowpack

This often occurs with fine grained snow about coarse grained snow.

Sample wet slab stratigraphy:

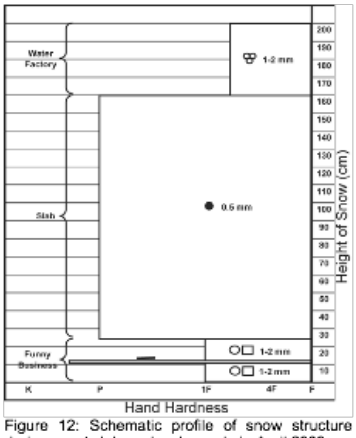


Figure 12: Schematic profile of snow structure during a wet slab avalanche cycle in April 2003.

Wet Avalanche Types

Glide Avalanches – the snowpack moves as a unit, gliding on the ground or some other bed surface.

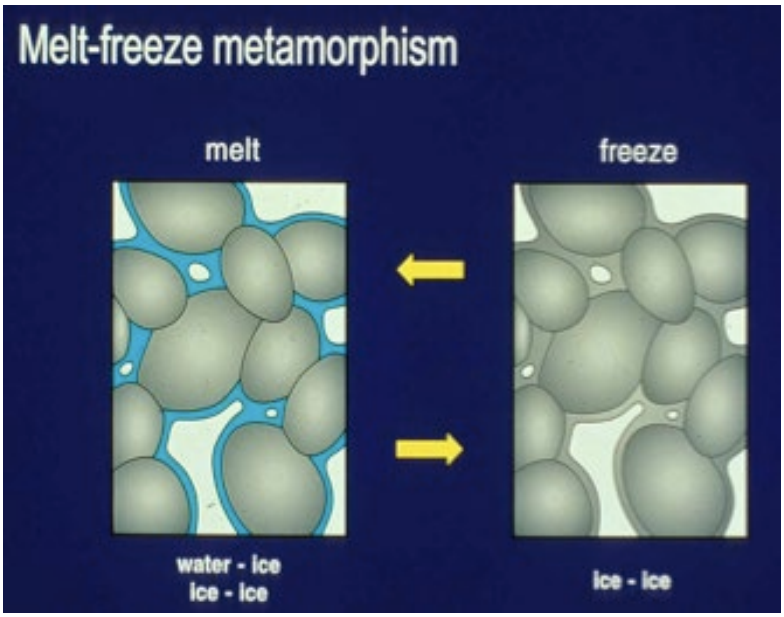
Wet Loose Avalanches – can see mid-winter with rapid warming

Sun/roller balls are indicators of loss of strength in the snow surface

May form runnels as the snow surface weakens

Wet Slab Avalanches – often fail on persistent grain types

- Snowpack typically weakens from the top down
- Avalanches typically initiate because the slab loses strength, not because of added stress



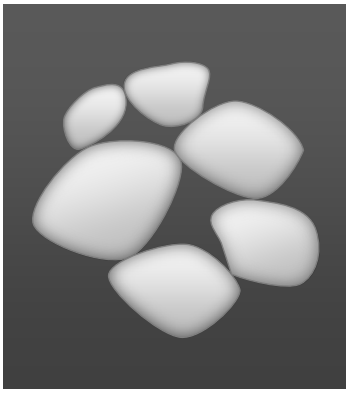
Melt phase = liquid water present. The more liquid water, the weaker the bonds between grains. Rapidly loses strength in this phase. Freeze phase = ice to ice bonds between grains. In this phase, the snow is strong.

Early in the melt-freeze cycle, the grains are small. Rounds connect and the bond size increases.

Later in the melt-freeze cycle, the grain size increases. Small grains melt and are consumed by the larger grains. There are fewer, larger grains in this phase. This is often referred to as “corn snow.”

EVOLUTION OF AN ISOTHERMAL SNOWPACK

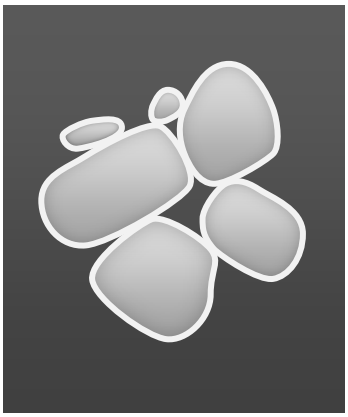
Dry Snow



No liquid water present – snow grains may be transitioning between original crystal types to advanced rounds. Clustering of grains may have started to develop between adjacent crystals. But all connections are **ice to ice bonds**.

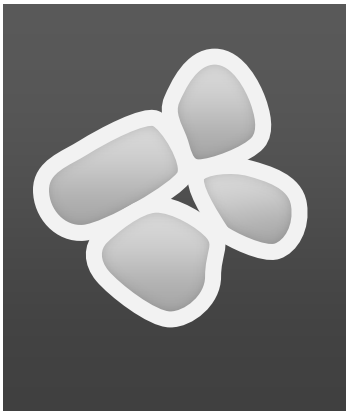
Dry snow makes lousy snowballs. It takes a lot of pressure, or work hardening, to form enough bonds to make a throwable snowball.

Moist snow



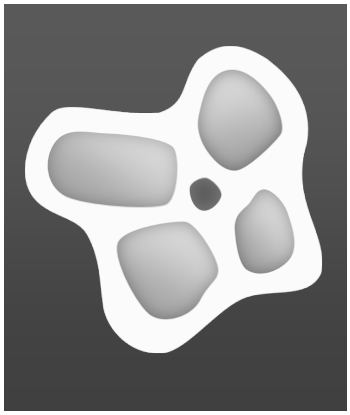
Liquid water content increases from 0% to 3% as heat is added to a snowpack that is already at 0°C. A meniscus, or coating of liquid water, develops around the grains, and smaller grains start to melt away. The ice-to-ice bonds between grains start to melt, but **snow strength remains strong as the thin film of water between the grains holds them together with capillary forces** (e.g. a beer glass that sticks to a coaster). This snow is great for scoop and throw snowballs.

Wet Snow



Liquid Water Content between 3% and 8%. As heat continues to be added to the snowpack the layer of water between the ice grains becomes thicker and the distance between the adjacent grains increases. As that distances increase, the capillary forces between grains decrease and the snow strength **slowly** decreases. This type of snow forms the “school yard bully” snowball when compressed.

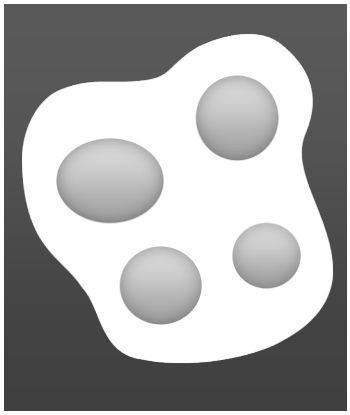
Very Wet Snow



Liquid Water Content is between 8% and 15% - increasing as more heat is added to the snowpack; or as liquid water percolates through the snowpack to impound at a specific layer. The pore spaces between the grains start to fill with water and the distance between adjacent grains is far enough that **strength dramatically decreases**. This type of snow makes a sopping wet snowball that will soak your gloves instantly and will drip water when you squeeze it.

Snow vocabulary: When wet snow dramatically loses strength, it crosses from the Pendular Regime (swinging between strong and weak snow) into the Funicular Regime (where there is so much water that it wants to 'funnel' out of the snowpack).

Slush



>15% water – pore spaces are fully flooded – grains have no cohesion to one another at all. If the snow is on any incline >30° it will already have slid off before it gets this wet. Snow that is this wet will not make a snowball (picture making a snowball out of a Slurpee) and under the right circumstances it will 'slide', or flow on ridiculously low slope angles. Slush flows are generally found in extremely faceted snowpacks that warm up rapidly – typically north of the Arctic Circle.

NOTE:
The liquid water percentages for each wet snow type apply to a snowpack that is changing between a winter/multi-layered snowpack into a spring/homogenous isothermal snowpack. As the melt-freeze process continues and "firnification" occurs the snowpack becomes more adept at draining the water and snow strength persists even with higher percentages of liquid water. We see this in the summer, when the snowpack receives frequent rain, seldom fully freezes, yet wet loose slides and wet slab avalanches become much less frequent.

Reference: *Of Wet Snow, Slush, and Snowballs,* Sam Colbeck, The Avalanche Review, VOL. 13, NO. 5, MARCH 1995