Interpreting Snow Profiles

Why

Snow profiles are carried out in order to formally record the snowpack structure and other factors which help identify weaknesses and processes. The findings help us to determine the evolution of the snowpack and it's state of change in terms of how stable or unstable it may be or may become.

Limitations

- The snow profile is only one of the many observations that are carried out daily by SAIS forecasters in the field, they are used as part of the process of determining the observed avalanche hazard.
- Information gained solely from a snow profile is insufficient in enabling someone to determine the avalanche hazard for an area, typically the snow profile will provide us with 15-20% of our daily information.
- Snow profile information must be related to other observations and findings when traveling through the observed and travelled landscape in order to get a complete understanding of the hazard situation.
- It is not necessary to carry out a snow profile in order to evaluate the avalanche hazard, as a compilation of straightforward field observations will also provide sufficient information to enable this.

Choosing the snow profile location

The snow-profile is carried out in a location that represents what is considered the most unstable snowpack area aspect and altitude. The location is determined by considering the latest (overnight) weather factors and /or monitoring a known snowpack weakness.

The Snow Profile layout comprises 3 main sections:

Data fields

Grain type symbols, comments and key temp gradient and hardness info.

Temperature and hardness profile relative to depth of snowpack

Data Fields

This information in the data fields of the SAIS Snow Profile record are fairly self explanatory . The main factors to note though are the **wind speed**, **direction** and **temperatures** from the summit station data as this helps with hazard evaluation and can be related to the mountain area. For example **windslab can build from winds of 10-15 mph**. **Foot penetration** is another useful factor to note, in this case 30cm, this is how far your boot sinks into the snow in a normal weighted step. This is useful information to note on a day to day basis. If the foot penetration stays at 30 cm for many days the snowpack is not settling, is not getting stronger and one can assume that weaknesses may remain present. If on the other hand foot penetration gets progressively less, then it is an indicator that the snowpack is settling and potentially stabilising.

SAIS - Snow Profile - Location Details

Date:	24/02/2010	**Time:**	13:10	**Area:**	Northern Cairngorms	**Obs:**	N/A
Grid:	1041	**Alt:**	1070m	**Aspect:**	315°	**Incline:**	30°
Location:	Cairngorm NW						

SAIS - Snow Profile Data

Air Temp:	-5.0°	**Wind Dir:**	135°	**Wind Speed:**	15mph	**Cloud**	100%
Precip Code:	8	**Drift(Y/N):**	Y	**Total Snow Depth:**	500cm		
Foot Pen:	30cm	**Ski Pen:**	N/A	**Rain at 900(Y/N):**	N		

Summit Station Data

Summit Air Temp:	-7.4°	**Summit Wind Dir:**	134°	**Summit Wind Speed:**	25mph

Avalanche Data

Observed aval. hazard:	High	**Forecast aval. hazard:**	High	**Avalanche Code:**	9900
Comments:	not to ground				

Any single observations though cannot be taken in isolation and must be related to the many other factors and observations in order to make a proper avalanche hazard assessment.

Grain type symbols, comments and key temp gradient and hardness info

The comments fields contain the information of any failures between layers, if they have occurred. The type of test used eg SS: shovel shear, TT: tap test. (The 'tests' carried out are used to explore the presence of weaknesses and are **not directly used to determine wether a slope will avalanche or not**.) the depth from the surface and the grain type found on a shear plane are also noted.
F is form or shape
E is size in mm
R is hardness on a 1-5 scale, this duplicated and best seen in the temperature and hardness box.
e is the wetness
The max temp gradient in centigrade over 10 centimetres throughout the snowpack depth is noted here

Max temp gradient: 1.0 °C/10cm
Max hardness diff. of adjacent layers: 3

Depth	Comments	F	F2	E	R	e
10	TTfail@10onV	⟋	N/A	1	✕	|
30	TT@30onfacets	□	N/A	2	⟋	
60		•	N/A	1	✳	
68	"x2TT@68facets	⍋	N/A	4	✕	
90		○	N/A	2	✳	

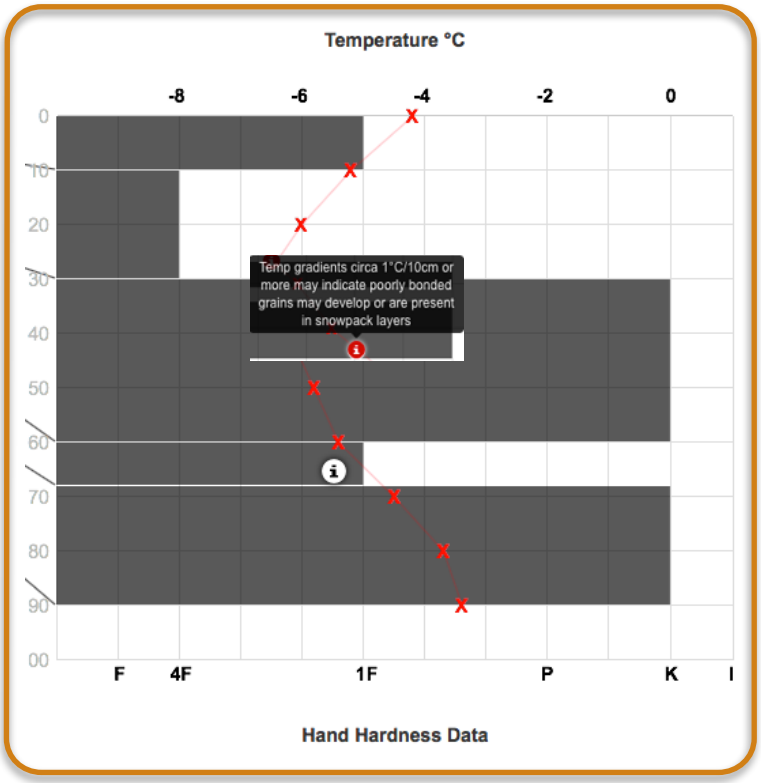
The most common symbols used by the SAIS forecasters are in the adjacent box. The main grains to note are the following if buried;
new snow, graupel, partly decomposed, facets, depth hoar and surface hoar. If failures occur one or more of these grains tend be found on the sliding surface.
For a detailed list of Snow forms go here: International Classification for seasonal Snow on the Ground

Crystal/Grain Shape (F)

Main Symbol	sub symbol	Description	Main Symbol	sub symbol	Description
+		New snow	⟋		Partly decomposed
	⍋	Graupel	•		Rounded Grains
	↔	Needles		·	Small rounds
	▭	columns	□		Faceted grains
	⊙	Plates		⍚	Rounding facets
○		Melt Freeze/ wet	∧		Depth Hoar
	⍜	Clustered grains	∨		Surface Hoar
	⍢	polycrystals	▬		Ice Layer
	⍤	Slush		▭	Basal ice layer
	⍝	Melt Freeze crust			

Temperature and Hardness Profile.

The temperatures obtained in the snowpack with measurements taken at 10 cm intervals provide valuable information in respect of determining the regime of stability at the snow profile location. The temperature gradient can be seen clearly in red. Generally if the **temperature gradient is around 1°C/10 cms or <u>more</u>** (colder nearer the surface) **this may indicate weakness may develop or are present in the snowpack** , associated grains will persist (dendrites,needles, graupel surface hoar etc) and/or other non bonding grains will develop (facets etc). If a temperature gradient is present an info icon will be present on the online profile.



If the **temperature gradient is <u>less</u> than 1°C/10 cms** this will indicate that grains may be bonding and 'rounding', which is **a stabilising process**.

The temperature gradient is one of the few observations that may be related to a wide area, as opposed to the snow structure in the snow profile which may only represent that small sample area. This is because of the great spatial variation of snow structure that is common in the Scottish snowpack.

The hardness is indicated by the dark grey bars, soft layers (1Finger to Fist hardness may indicate areas where weaknesses are potentially present. If a hard layer overlies a soft layer by more than two levels of hardness this may indicate a potentially weak snowpack. In this case and info icon will appear on the online profile.

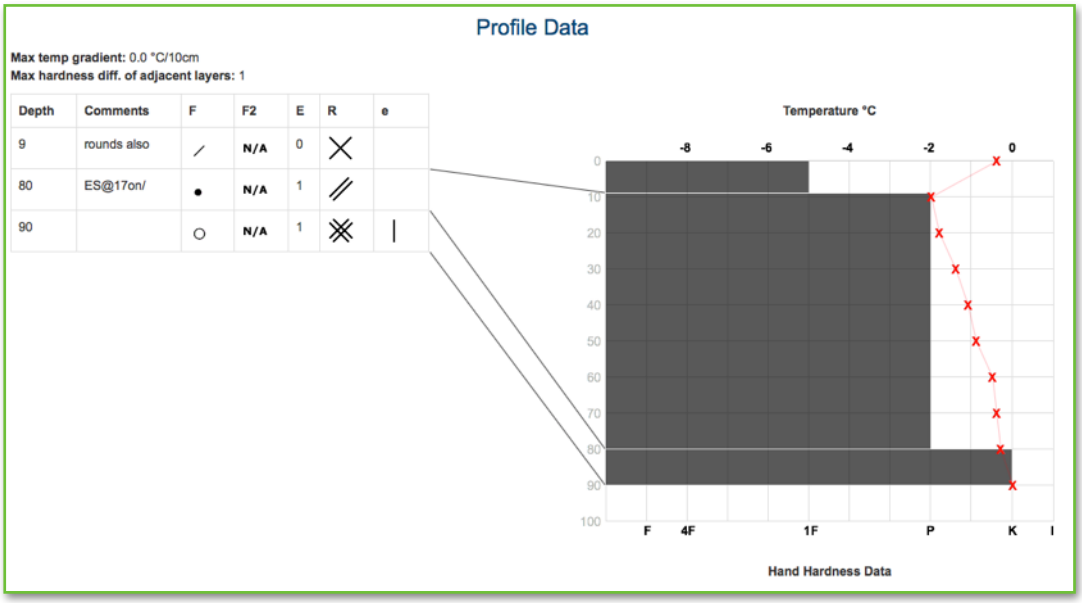
Sometimes though, soft layers can be overlain by a very hard layer (snow ice or hard windslab) which can act as a bridge and protect the layer below and present a stable impression for the traveller,

In this example field tests produced failures at 10, 30 and 68 cms below the surface with poorly bonded grains which may have been preserved or developed by the temperature gradient and which are present in the soft snow layers of four finger(4F) and one finger (1F) hardness.

Snow profile examples

1. A profile showing good stability

- Temperature gradient is generally less than 1°C/10 cms.
- Hardness of layers is stepped toward being firmer toward the ground
- Grains are generally small in size.



2. **A profile showing poor stability**

- Temperature gradient is greater than 1°C/10 cms in places. (note info icon)
- Hardness of layers shows hard overlying very soft (note info icon)
- Poorly bonded grains are present (buried surface hoar, facets, partially decomposed)
- Field observation noted failure between layers.