



## First tests with a new Snow-Penetrometer

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The forecast capability of the instability of the snowpack is still quite low. While it can be assumed that the causes that generate the snowpack instability are adequately understood, their prediction in a particular avalanche site is rather difficult.

Currently many nivo-meteorological parameters are measured at stations, distributed in a systematic way over the Alpine regions, located in easily accessible areas.

The measurements are often related to avalanche events that occur at sites characterized by different exposures, different elevations, different microclimatic properties.

The forecast difficulties based on the measurements carried out at the nivo-meteorological stations depend, on the one hand, on the poor relation between the values of the parameters measured at the stations and the values at the avalanche sites and, on the other hand, on the difficulty of giving a useful meaning to the performed measurements. It is thus fundamental the experience of the observer applied to the individual avalanche sites.

The description of the snowpack is done through the stratigraphic analysis and the penetrometric profile. Both are long procedures that furnish a detailed representation of some properties of the snowpack. The second is carried out, generally, with the ram penetrometer with the aim to evaluate the hardness of the different layers inside the snowpack.

The adopted procedure and the used equipment do not allow the identification of thin and fragile layers (depth hoar) within the snowpack that are often the origin of the formation of slab avalanches. For this reason the instrument, although easily transportable, loses much of its attractiveness.

With the aim of obtaining a better description of the resistance characteristics of the snow cover, was designed and, after the use, improved a prototype of a "constant penetration velocity penetrometer", applying techniques similar to the ones used for the investigation of soils.

The instrument is constituted by a base on which the mechanical part for the support and movement of a guide rod is mounted. The guide rod contains another rod that connects the tip with a load cell located at the other end of the rod guide, outside the snowpack.

The vertical displacement of the rod guide is controlled manually by a system of gears. A springs system is used to reduce to zero the weight of the force transmission rod and of the tip.

The values of resistance to penetration and the location inside the snowpack are recorded simultaneously and stored by means of a data logger.

The instrument has been tested in the laboratory and in the field, carrying out various tests in parallel with measurements made with the ram penetrometer by the operators of the Autonomous Province of Trento (Italy).

The tests were run at different velocity of penetration into the snowpack and using tips of different diameter and shape.

The analysis of the collected data has shown a vertical resolution and a sensitivity to thin layers much greater compared to the traditional instrument. Tests have shown remarkable repeatability and execution time significantly reduced.