The propagation saw test

The propagation saw test (PST) is a recently developed snowpack test that enables assessment of the fracture propagation propensity of selected persistent week-layer and slab combinations, which are known to release dry-slab avalanches. In this paper, we assess the slopescale accuracy of the standard PST method at validated sites of observed weak-layer fracture initiation, with or without propagation. We also report on experiments with alternative test methods and varying saw thicknesses. Results show the standard PST method is comparably accurate to other common snowpack tests in predictive skill when predicting propagation propensity on the slope scale. Although a slight but significant dependence on saw thickness was found, it did not affect the interpretation in our validation study. Alternative methods such as scaling the test column length with weak-layer depth or leaving the upslope end of the column attached to the surrounding snowpack did not improve slopescale accuracy and these tests were often more difficult to interpret.

1. INTRODUCTION

Dry slab avalanche release involves the consecutive processes of fracture initiation and fracture propagation within a weak layer or interface buried beneath a snow slab. Although fracture initiation is required prior to fracture propagation, the propensity for self-sustained propagation is thought to be independent of the ease of initiation.
For this reason, alternative snowpack test methods have been sought that test the fracture propagation potential of slab and weak-layer combinations independently of, or in addition to, the ease with which fractures can be initiated. Such efforts include the recently developed extended column test and recording the observed 'release type' or 'fracture character' in the rutschblock test and compression test.
In most common snowpack tests, including those just mentioned, weak-layer fractures are initiated via dynamic surface loading, and the ease with which and way in which fractures initiate are interpreted as an indication of overall slope stability. These test methods may miss favorable propagation propensity in deeply buried weak layers where initiation is difficult, or conversely may indicate instabilities in numerous near-surface weak layers that do not possess the characteristics required for extensive propagation and avalanche release. In light of these limitations, the propagation saw test (PST) was recently developed to specifically test the propagation propensity of weak layers buried within the snowpack.

2. STANDARD PST PROCEDURE AND RECORDING CONVENTION

The standard PST (Fig. 1) involves a column 30cm cross slope by >100cm upslope isolated to below the weak layer of interest on two sides by shovel and, typically, on the other two sides by cutting with a cord. The upslope length is the greater of 100cm or equivalent to the vertical depth of the weak layer being tested .
Fracture initiation is simulated by steadily drawing the blunt edge of a snow saw, approx. 2mm thick, upslope within the weak layer until the onset of propagation, or until the entire column has been cut.
Three different results can be observed in the PST:

- The fracture propagates suddenly from the end of the saw-cut to the end of the column (denoted end)
- The fracture propagates but stops within the column either at a slope normal fracture through the overlying slab (denoted sf)
- At a point of self-arrest along the layer (denoted arr). To interpret the PST results, propagation within the weak layer is considered likely on adjacent slopes (assumed to have similar snowpack conditions) only when fracture propagation initiates with a saw cut of <50% of the column length and continues uninterrupted to the end.

When performing multiple PSTs in the same pit, sufficient snow (15cm minimum) must be cut away laterally between each test column to ensure an undisturbed and intact slab and weak layer for the subsequent test. If multiple weak layers exist in a single test column they can be tested successively starting with the lowest and working up, ensuring that the overlying weak layers and associated slabs are not disturbed by the deeper tests.
PST results are recorded as: x/y (arr/sf/end) down z on yymmdd (or alternative layer ID) on a slope angle, where x is the cut length, y is the column length, (arr/sf/end) indicates noting one of the three observable results, z is the weak layer depth (measured vertically) in the snowpack, yymmdd refers to the date of burial (weak-layer ID) for the weak layer being tested.

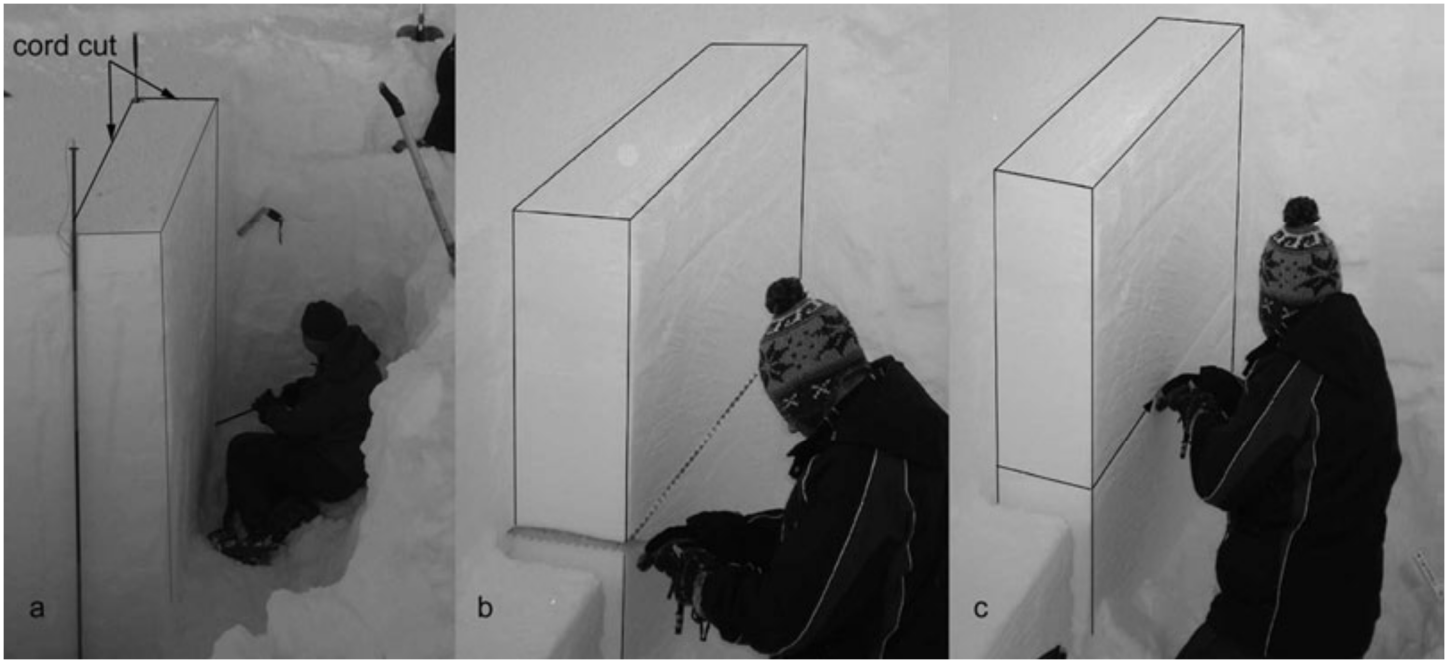

Fig. 1. PST in process. (a) The upslope and left side of the column has been cut from the snowpack by a cord or saw. (b) The operator begins drawing the blunt edge of a snow saw upwards through the weak layer, (c) stopping and marking the spot where the fracture propagates suddenly forward from the leading edge of the saw.