HIGH-SPEED PHOTOGRAPHY OF FRACTURES IN WEAK SNOW-PACK LAYERS

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During the winter of 2002-2003, fractures in weak snow-pack layers were observed using a portable digital high-speed camera in the Columbia Mountains of British Columbia, Canada. Fractures were photographed at an interval of 4 ms in 21 compression tests, 2 rutschblock tests, 2 cantilever beam tests as well as on 5 skier-tested slopes.

Slab avalanches are generally thought to be released by rapid propagation of brittle shear fractures in weak snow-pack layers. Analysis of the high-speed videos has shown that fracturing of weak snow-pack layers is associated with slope parallel and slope normal displacement of the overlying slab. However, displacement measurements of markers in the snow above weak layers indicate that the slope normal displacement is directly caused by the fracture.

Displacement measurements from a row of markers in the snow above weak layers resulted in fracture speed measurements ranging from 18 to 30 m/s. These values are in good agreement with the only other published fracture speed measurement known to the authors: 20 m/s. This is in contrast to theoretical models that assume the propagation speed to be on the order of the shear wave velocity, an order of magnitude higher than the measured values. Moreover, despite limited data, there is a significant trend for the fracture speed to increase with increasing slope normal displacement at the time of fracture. A recently proposed theory for fracture propagation on low angle terrain is based on compressive fracture of the weak layer resulting in a bending wave in the overlying slab. The present results suggest that a similar theory could be applicable to slab avalanche initiation on a slope.