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Extraction of Mohr-Coulomb failure properties of snow weak layers using FEM

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Snowpack weak layers may fail due to excess stresses of various natures, leading to snow avalanches. This research presents a model describing the behavior of 'sandwich' snow samples subjected to shaking. The Finite Element model treats weak layers as interfaces with variable constitutive behavior parameters. This approach is validated by reproducing cyclic loading snow fracture experiments of Podolskiy et al. [2010]. The model revealed that the Mohr-Coulomb failure criterion, governed by cohesion and friction angle, was sufficient to describe the experiments. The "best fit" cohesion and friction angle were $\sim$1.6 kPa and 22.5$-$60°, indicating that the cohesion determines the outcome of tests. Next, the model showed the complexity of non-homogeneous stress evolution within snow samples, and especially the significance of tension for fracture initiation at the edges of the weak layer. Accordingly, the analytical solution, described by Newton's second law, underestimates tangential stresses along the failure plane by up to about 20% and together with non-constant normal stress may incorrectly estimate the shear strength of weak layers.