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Microstructure and micromechanical elastic properties of weak layers

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Weak layers are the mechanically most important stratigraphic layer for avalanches. Yet, there is little known about their exact geometry and their micromechanical properties. To distinguish weak layers or interfaces is essential to assess stability. However, except by destructive mechanical tests, they cannot be easily identified and characterized in the field. We casted natural weak layers and their adjacent layers in the field during two winter seasons and scanned them non-destructively with X-ray computer tomography with a resolution between 10 - 20 μm. Reconstructed three-dimensional models of centimeter-sized layered samples allow for calculating the change of structural properties. We found that structural transitions cannot always by expressed by geometry like density or grain size. In addition, we calculated the Young's modulus and Poisson's ratio of the individual layers with voxel-based finite element simulations. As any material has its characteristic elastic parameters, they may potentially differentiate individual layers, and therefore different microstructures. Our results show that Young's modulus correlates well with density but do not indicate snow's microstructure, in contrast to Poisson's ratio which tends to be lower for strongly anisotropic forms like cup crystals and facets.