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When an Avalanche Hits the Wall: Experiments and Analysis

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The flow state in the rapid flow regime of the avalanche is reasonably approximated by a depth integrated dynamical model. An adequate treatment of the deposition regime and the regions in the vicinity of an obstacle requires better resolution without the reduction of the dimension. A first step towards modelling such complicated three-dimensional flows is to reduce it to two dimensions by first studying the chute flow variant, and then to obtain detailed experimental information on velocities and the geometries of the deposition build up. Particle Image Velocimetry (PIV) experiments were conducted by recording the moving material from the side of a rectangular channel with CCD cameras. Velocities were deduced by using the PIV technique. Various kinematic quantities were determined. Analysis of the shock front formation and propagation upslope, evolution of the height of the supercritical flow, maximum and impact velocity at the transition point from the supercritical to the subcritical flow, flow height and momentum flux are presented and discussed in detail. A single mass balance relation at the shock discontinuity corroborated the correlation existing between the shock front heights and shock speeds in good agreement with the experiments. The analysis carried out in this paper clearly demonstrates that, in a transition region, there is considerable momentum transfer and velocity shearing in the direction perpendicular to the sliding surface. Therefore, a fully three-dimensional model is urgently needed in order to describe the complete three-dimensional intrinsic behaviour of such flows. The outcome of this study forms a basis for numerical simulation and calibration of the theoretical models of avalanches and debris flows. In this scenario, we will also discuss a frame-work for a suitable theoretical model.

Reference: Shiva P. Pudasaini and Kolumban Hutter: *Avalanche Dynamics: Dynamics of Rapid Flows of Dense Granular Avalanches.* Publisher: Springer-Verlag, 2006.