The dynamics of collapsing granular columns and its implications in earthquake mechanics

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Utilizing a high-speed digital video camera system, we perform a series of laboratory experiments related to the collapse of granular columns, which may be observed in nature in the failure of slopes and cliffs (due to earthquakes, rock avalanches, debris flows, landslides etc.). We photographically record -at an interval of some microseconds- the dynamic transient granular mass flow initiated by abrupt release of a pile that consists of dry granular material. The pile, or an acrylic tube partially filled with glass beads, has a cross-section of either fully- or semi-cylindrical shape, and upon the sudden removal of the tube, the granular solid may disintegrate under the action of its own weight and the particles spread on a horizontal plane. This study is essentially the extension of the previous study by Lajeunesse, Mangeney-Castelnau and Vilotte (Phys. Fluids, 2004), and the newly-introduced striped layers of particles with a semi-cylindrical cross-section enables us to monitor, for the first time, the precise particle movement inside the granular pile: The development of slip lines inside the pile and the movement of particles against each other can be clearly identified. We mainly investigate the controlling parameters of the spreading dynamics, the fraction of granular mass mobilized by the flow, and the final shape of the deposit. The major parameters considered here are the initial aspect ratio of the granular (semi-)cylindrical pile, the frictional properties of the horizontal plane (substrate) and the size of beads. The influence of each parameter on the average flow velocity and final radius and height of the deposit is shown. This simple yet fully-controlled series of experiments might assist in understanding the role of granular flows in mechanics of earthquake faulting and largely deformable media.