

Appendix IV



Figure 1 The material used in different proportions in the granular avalanches. These are four different granular sizes composed of subrounded gravels and subangular corundum sand.

Table 1 Properties of the material used in the granular avalanche experiments.

	<u>GRAVEL</u> <u>9.5-16mm</u>	<u>GRAVEL</u> <u>16-22.4mm</u>	<u>SAND</u> <u>0.355-0.50mm</u>	<u>SAND</u> <u>0.5-1mm</u>
<b>Basal friction angle</b>	25.2°	22.3°	30.3°	29.8°
<b>Critical angle of repose</b>	32.2°	29.1°	27.4°	29.3°

Basal friction angles were measured by tilting plane tests (Jiang and Towhata, 2013; Mancarella and Hungr, 2010; Pudasaini and Hutter, 2007). This involves placing a sample of the material on the variable inclination plane and steadily increasing the inclination until motion is initiated. The inclination angle was then measured. The critical angle of repose was measured by gently releasing a pile of the material from a 5L bucket onto a horizontal surface into a conical pile and measuring the steepest slope angle in a digital elevation model from a photogrammetric rendering of the pile. In all experiments, the angle of the inclined plane was greater than the basal and internal angle of the material.

### **References:**

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- Pudasaini, S.P., Hutter, K., 2007. *Avalanche dynamics: dynamics of rapid flows of dense granular avalanches*. Springer Science & Business Media.