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# RUN-UP OF LANDSLIDE RUNOUTS AGAINST PROTECTIVE BARRIERS – A COMPARISON OF THE PARTICLE FLOW CODE (PFC) AND DAN

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Extremely rapid, flow-like landslides, such as debris avalanches, debris flows, flow slides, and rock avalanches, are the most important landslide hazards, threatening human lives and infrastructure (e.g., Hungr et al. 2001). Risk reduction can be achieved, for example, by means of designed protective structures. A common type of active protective structure is a "terminal barrier," a dyke or wall placed perpendicular to the expected motion of the landslide and designed to absorb the landslide impact and force the motion of the avalanche to stop before reaching the protected area. Several important quantitative parameters are required for the design of terminal barriers: (i) run-up of a potential landslide against the face of the structure to ensure that the dyke crest is sufficiently high to avoid overtopping; (ii) manner and geometry of deposition of slide material arriving into the space upstream of the structure ("storage basin"); and (iii) static and dynamic forces exerted by the moving debris on the face of the structure. Numerical modelling of landslide motion provides the means of obtaining all of this design information, provided that models exist that are correctly verified and calibrated. Mancarella and Hungr (2010) carried out a series of granular avalanche experiments involving rapid flow of dry sand in a flume, arrested by a steep adverse slope. The barrier slope was varied and included a wall perpendicular to the flume. These laboratory experiments have been back calculated by means of the Particle Flow Code (Itasca Consulting Group) and the DAN Code. The purpose of the study was to verify if the codes used are capable of simulating the behaviour of granular avalanches run-up against protective barriers. In order to achieve appropriate results some modifications of the codes have been necessary. The original version of the numerical Lagrangian shallow flow dynamic analysis (DAN) had to be improved by an original velocity-smoothing algorithm to prevent numerical instability. In the case of PFC, the implementation of a rotational particle-particle damping has been necessary to get results coinciding with the laboratory experiments.