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Testing a Rockfall Simulation Program in an Alpine Valley in Slovenia: the Osojnik and Berebica Rockfalls in the Trenta Valley, NW Slovenia

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Two rockfalls in the Trenta valley in NW Slovenia (Upper Soča River) were analysed using a commercially available computer program for rock fall simulation (Rockfall version 6.1, forest module RockTree). The Osojnik rockfall happened more than a century ago and became active again on June 28, 1989. An estimated volume of 300,000 to 400,000 m^3debris was released, and some blocks were larger than 10 m^3. The Berebica rockfall, just on the opposite side of the Trenta valley, was activated on December 19, 1993. An estimated volume of 7,500 m^3 debris was released and single blocks between 0.5 m^3 and 100 m^3 damaged 150 m of the regional road. In 1998, two large blocks were released from the rock face and as a consequence an alarm system was set up as a temporary measure. In May 2001, more than 400 m long reinforced concrete gallery was built as the final measure.

The computer program was calibrated in the Osojnik rockfall in two longitudinal profiles. The starting values of relevant model parameters were taken from the literature and different combinations were tried out. The computer runs were performed using different number of blocks of sizes between 0.2 m and 6.0 m. The model was successfully calibrated using silent witnesses (more than 20 rockfall blocks with volumes between 1 m^3 and 340 m^3, having shadow angles between 28º and 32º). The optimised values were R_g = 33˚ for the dynamic friction angle, R_h = 40˚ for the static friction angle, and R_w = 0.3 for the rolling resistance. The slope surface properties were chosen in the following intervals: D_n = 0.25–0.45 for the normal damping, D_t = 0.4–0.9

for the tangential damping, O_a = 0.3–1.0 m for the amplitude of surface roughness, and O_f = 1–8 m for the frequency of surface roughness. Rockfall runout was to a large extent determined by terrain configuration (roughness) and vegetation (surface) properties. Large blocks had high total kinetic energy and large bounce height but not larger runout than small blocks. The forest could effectively stop blocks smaller than 0.2 m, and had no effect on 6 m blocks.

The calibrated model was applied on the Berebica rockfall in two longitudinal profiles: with and without the gallery. The program performance was tested using silent witnesses (over 10 rockfall blocks with volumes between 1 m^3 and 220 m^3, having shadow angles between 28º and 30.5º). The simulation results (total kinetic energy, bounce height) have shown that the decision to build a gallery was right. The study confirmed the simulation program to be a useful engineering tool. We also gained insight into realistic values of relevant model parameters that may be applied to similar conditions elsewhere in the Slovenian Alps.