DEM ROCK-SLIDE MODELLING AS BASIS FOR THE DESIGN OF A ROCKFALL EMBANKMENT

Alexander Preh[1,2], Mariella Illeditsch[1], Michael Mölk[3]

[1] pi geotechnik, Vienna, Austria
[2] TU Wien, Institute of Geotechnics Vienna, Austria
[3] Austrian Torrent and Avalanche Control, Geological Service, Austria

OBJECTIVES

After massive rockfalls at two different locations, which required the evacuation of houses and threatened further rockfalls, the construction of rockfall protection dams was considered the only suitable measure to protect the affected settlement area. To ensure sufficiently reliable protective measures, particular emphasis was given to the determination of the forces acting on the planned dam. This could not be achieved with standard rockfall simulation programs, as these can only determine the trajectories, velocities, probable impact locations etc. of individual blocks. The effects caused by a fragmented rock mass impacting the dam must be determined otherwise. Therefore, the entire process was modelled using the distinct element modeling (DEM) framework PFC3D. To accurately assess the effects on a dam using the DEM, it was necessary not only to simulate the runout and interaction of the rock mass with the dam, but also to realistically model the detachment. For this purpose, the unstable volume determined based on field mapping was discretized using a Discrete Fracture Network (DFN) to be able to represent both the initial failure mechanism and the most accurate block shapes and sizes possible. The DFN was obtained using manual measurements and photogrammetry. The detachment of the rock mass was initiated using the strength reduction method. The stiffness and damping parameters were calibrated for the interaction of the rock mass with the ground and with the embankment. In the interaction of a block with the embankment, the momentum transfer determines the magnitude of the maximum occurring force peaks. The stiffness and damping parameters decisive for modelling the semi-plastic impacts were estimated based on penetration depths determined from experiments [1]. The force-time curves derived from the DEM calculations were used to design the embankments fulfilling the ultimate limit state (ULS).

MATERIALS AND METHODS

- Discretization of unstable rock mass using a Discrete Fracture Network (DFN)
- Modelling of runout and interaction of the rock mass with the retaining structure using DEM
- Calibration of contact stiffness and damping parameters based on the penetration depth of the blocks.

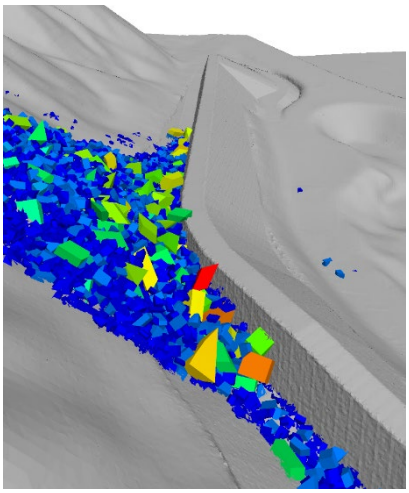

Figure: The modelled deposits in front of the retaining structure

MAIN RESULTS AND CONCLUSIONS

- The force-time curves show that the forces generated by the 11.200 simulated blocks can be absorbed by the dam.
- The fragmented rock volume of around 3.600 m³ can be effectively contained by the modelled dam.
- Localized overloading is possible and must be accepted.

REFERENCES

[1] Pichler B., Hellmich C., Mang H. A.: Impact of rocks onto gravel Design and evaluation of experiments. In: International Journal of Impact Engineering, 31, 2005, S. 559–578.