OPTIMISATION OF A BEDLOAD RETENTION AREA AT THE VORDERBERGERBACH, AUSTRIA, BY PHYSICAL SCALE MODEL STUDY

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INTRODUCTION

During the heavy rainstorm on August 29, 2003, the village of Vorderberg/St. Stefan, Austria, was hit by a severe flood event. The peak discharge of around 120 m³/s has been estimated to correspond to the peak discharge from a rainfall event of a 105-year return period. In the course of the event some 250 000 m³ of sediment were delivered to the fan and were partially deposited outside of the channel due to blocking of the channel with sediment and woody debris at critical cross sections. Around 60 % of the buildings were affected by the water and sediment masses.

The torrent 'Vorderbergerbach' is the right tributary to the Gail River in the Carnian Alps which represent the border to Italy in the Southern part of Carinthia, Austria. The Vorderbergerbach drains an area of 26.1 km², the highest point in the catchment is at 2052 m a.s.l. and the mouth is at 558 m a.s.l. Lithologically, the basin consists mainly of limestone of local type (Eder chalk) and Ordovician shale. The upper parts of the catchment are characterised by glacial deposits like ground moraines, whereas the lower areas are stamped by quaternary deposition of unconsolidated sediment (Hübl et al., 2004).

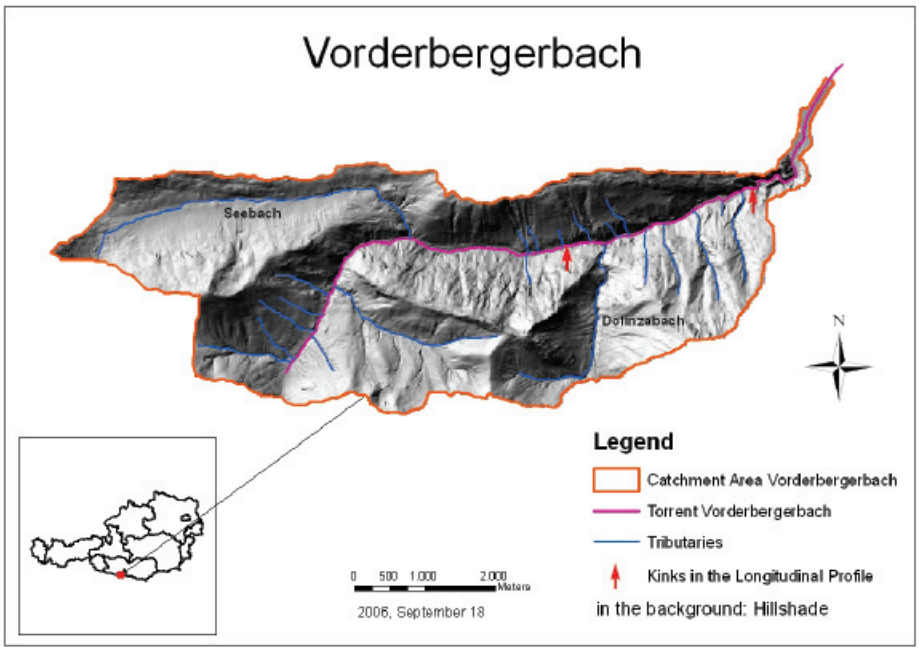

Fig. 1: Vorderbergerbach catchment area

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EXPERIMENTS

In order to protect the village from future inundation with water and sediment, a retention area on the alluvial fan upstream of the village is planned. The objective of this study is to optimise the sedimentation capacity and the bedload deposition process of the retention area by means of scale model investigation.
At the Institute of Mountain Risk Engineering of the University of Natural Resources and Applied Life Sciences (BOKU), a physical scale model of the retention area has been developed. Three different types of structures installed into the retention area to improve the deposition process have been evaluated on the basis of a 150-year flood event ('design discharge') and the event from August 2003. The hydrograph of the 150-years event has been generated from rainfall – runoff analysis using the 'time-lag' model ZEMOKOST. Since no continuous discharge measurements were carried out during the flood event 2003, the hydrograph was also derived from a rainfall – runoff simulation using the precipitation data of rain gauges, located close to the watershed.
A model scale of 1:30 has been chosen. Using the Froude similarity criterion (Fr in nature = Fr in the model) the model roughness has been successfully calibrated with numerical simulations of the clear water flow pattern by different discharges.
During the tests, the following parameters have been continuously measured:

- Water discharge
- Bedload input
- Water level in the cross-section above the basin and within the basin
- Bedload output

The elevation of the deposited bedload in the retention basin has been measured by a 2-D laser scan after each test. The results of the tests with several variants of retention area geometries and input hydrographs have been analyzed.

Fig. 2: Scale model

REFERENCES

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