Numerical gravel transport investigations in alpine torrent-catchment-areas

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Within the description of the danger potential of torrents, the analysis of the "effective gravel flow" was hardly possible until now. But for the conceptual and detail design of retaining measures, the event related total gravel flow has to be determined.

The recent methods were basicly estimations of the mobilizable gravel potential along the overall torrent, in order to obtain an impression of the torrents activity. Thus the investigations were based mainly on experience and intuition, what can differ strongly between the individual experts.

In the last years several experimental and semi-empiric based developments were made in order to set up algorithms which describe the mobilization- and transport-capacity of torrents (Smart und Jäggi 1994; Rickenmann 1990, 2005).

With these algorithms we are now able to calculate a gravel flow under consideration of an idealized torrent bed or torrent section and under consideration of a discrete runoff and a constant morphological situation.

By implementing the different formulas to a software tool (GRA-trans), complete torrents, build of a number of internal homogeneous sections, can be numerically investigated to obtain gravel transport rates and gravel transport sums, related to characteristic flood events. The output of the tool, which is demonstrated within this paper, is a gravel transport section, containing detailed information obtained within extensive field investigations such as gravel potential, mobilizeability of gravel as well as the calculated water run-off, the gravel transport rate and the total gravel flow over the time.

Beside extensive general field investigations in the catchment area and in the torrent in detail, geometrical basis data have to be measured. An other obligatory data set for

the transport calculation, which has to be delivered, is the gravel-size-distribution for each homogeneous section of the torrent. Due to the logistic problems which occur if gravel-samples have to be taken, this very sensitive data was estimated until now.

We could develop an optical/digital method for the calculation of the gravel-size-distribution in-situ, which provides us with detailed information for each gravel-deposition (GRA-frac).

The last step of the evaluation process, presented within the current paper, is still the check of the calculated data within a final walk to the catchment area as well as a critical discussion of the processes occurring in the torrent at a flood-event.