Integrated natural hazards protection concept Vitznau LU - case study Altdorfbach

Timo Heinisch, PhD[1]; Roland Hollenstein, PhD[1]

INTRODUCTION

The disaster risk map of the municipality of Vitznau (canton of Lucerne) shows high risk areas (red zones) in a residential area. Therefore, the Canton of Lucerne required that an integral protection concept be prepared for all eight torrents of the municipality of Vitznau. Highest risks come from the torrents Altdorfbach, Kalibach, Widibach and Plattenbach. Protection measures for each torrent were evaluated and the best practical concept for each torrent was defined. For the torrents Kalibach, Widibach, Altdorfbach and Plattenbach, the Canton of Lucerne now has procured conceptual preliminary designs of the identified priority measures. The present report covers the preliminary design for torrent Altdorfbach. For this torrent, the mudflow process is the highest risk. In case of a dangerous occurence, the potential debris flow volume (G300 = 80.000 m^3) would lead to enormous property damages in the municipality of Vitznau. The damage potential is estimated to about 870‘000 CHF/a.

A variation study was elaborated based on the alternatives defined in the integral protection concept. All conceivable options were analysed and pros and cons identified in due consideration of all the different ecological or cultural inventories and boundary conditions.

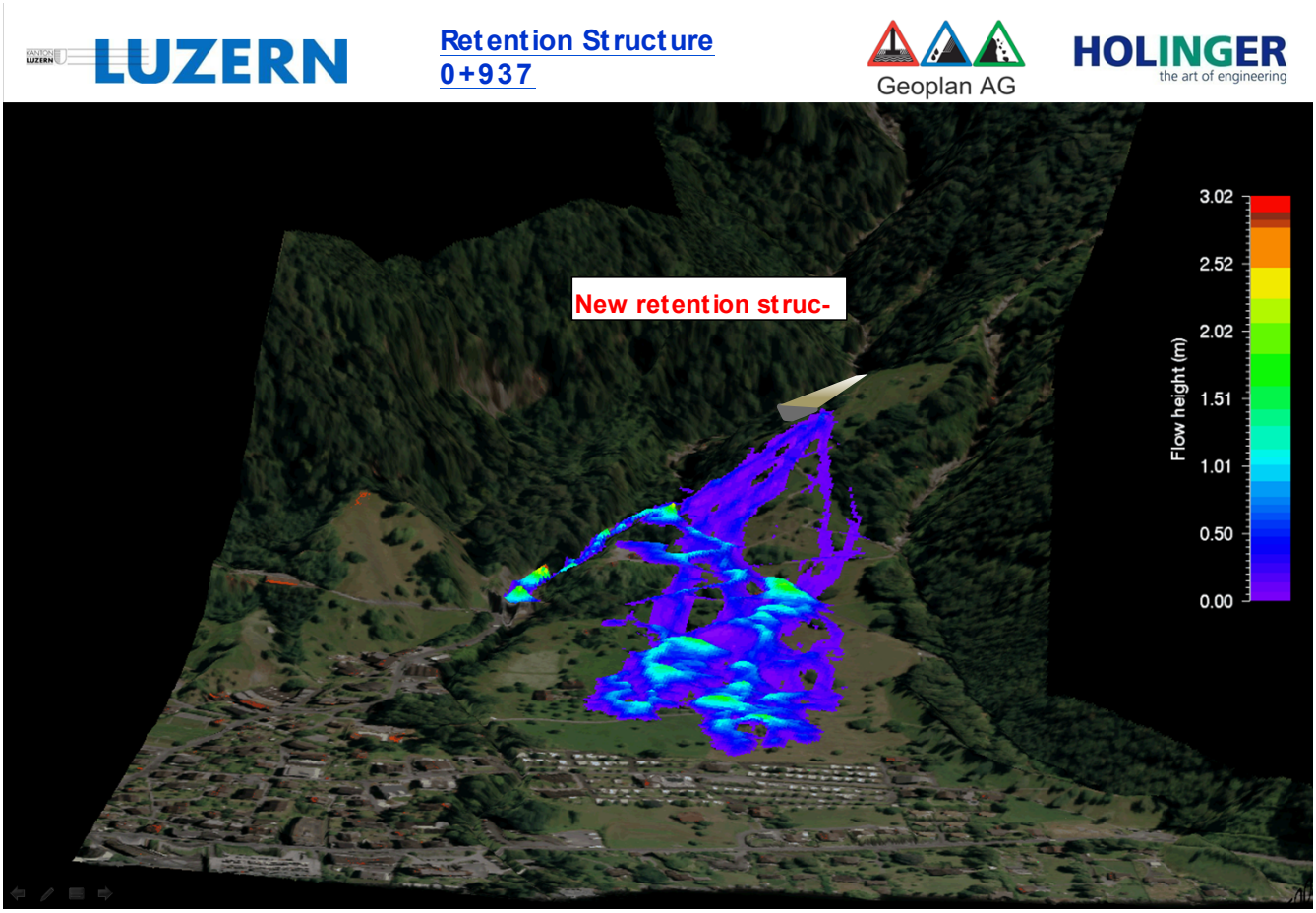

Figure 1. Numeric simulation of an overload. Pictured for overload of G300 plus 20.000 m3

METHODS AND MEASURES

For the civil engineering measures, the concepts of conveying, bypassing and retaining as well as flood-proofing (of buildings) were evaluated. The only feasible solution was proved to be the retention option. For the retention option, measures were evaluated in the catchment area, in the transit area and in the residential area. As a result neither in the catchment area nor in the residential area effective and strong measures proved to be feasible. The following criteria were evaluated: degree of protection, robustness, overload Situation, inventories and landscape, existing building structures and benefit/cost-ratio. Hence, the best practical solution turned out to be the construction of a new, massive retention structure in the transit zone.
The structure was dimensioned for a G300 design event with a total sediment volume of 80.000 m^3. The structural solution proposed was a reinforced-concrete wall slab barrage with a ground culvert and vertical discharge slot. The new retention structure, featuring a horizontal overflow edge, was specifically positioned for the case of overload when the major part of the spill-over is no longer lead into the torrent Altdorfbach, but discharges over the left slope into a less built-up area. In order to confirm this solution, complex numeric simulations were undertaken with the programme RAMMS (Figure 1).

RESULTS

After completion of this project, the municipality of Vitznau will be completely protected against a 300-year debris flow event and in the case of an overload (>G300) the damage po-tential would be significantly reduced. For the simple flooding process (HQ100 = 57.0 m3/s) only smaller, locally restricted modulations of the landscape are necessary. For ecological improvement, the nowadays artificially straightened and canalised river mouth at the lake shore is going to be widened up, the river bed to be adapted, and the water course to be restored to a more natural condition. In this way, the connection of the torrent Altdorfbach to the lake Lucerne is safeguarded in the future. Upstream of the lake shore road, a new refugium and spawning ground for fishes will be created. With the new low water channel it will remain even in low flow conditions functional. The cross-linking of lake and stream for small and micro-organisms will be improved, too. In addition, a new cultivation with indigenous plants will upgrade the ecological and recreational value of the area.

COSTS

The estimated costs for implementation of the best practical option (exclusive land acquisi-tion) amount to 24 m CHF with an accuracy of +/- 20%. The cost benefit ratio is 1.5 and therefore the project can be classified as economical.
The preliminary design was submitted to the canton for approval in March 2015.

REFERENCES:

- HOLINGER AG (2015). Integrales Schutzkonzept Altdorfbach Vitznau, Vorprojekt vom 30.09.2015
- WSL (2013). RAMMS, rapid mass movements Simulation, User Manual v1.5, Debris Flow

KEYWORDS

integrated hazard management; protection concept; debris flow; protection measures; RAMMS

1 HOLINGER AG, Winterthur, SWITZERLAND, timo.heinisch@holinger.com