

VERLETZLICHKEIT VON GEBÄUDEN UND WIRKSAMKEIT VON OBJEKTSCHUTZMASSNAHMEN

BUILDING VULNERABILITY AND THE EFFECTIVENESS OF PROPERTY PROTECTION MEASURES

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The investigation is based on the high number of buildings affected by the 2005 flooding and will aim to use these concrete examples to make a deeper analysis and reappraisal of the largely theoretical core principles concerning building vulnerability and the effectiveness of property protection measures.

BUILDING VULNERABILITY

Building vulnerability in relation to the intensity of the hazard processes recorded will be examined. The effective intensity will be compared to the damage inflicted on the load-bearing structures of the building. The evaluation will consider the debris flow process based on various different case studies – for the purposes of this particular evaluation, Schüpfheim will be used as the case study.

Schüpfheim – a case study

This residential building was hit by a powerful debris flow resulting in significant damage to the simple timber-framework load-bearing structure (Figure 1). The building was inhabited at the time of the event.



Figure 1: House in Schüpfheim completely destroyed (photo: Egli Engineering).

The pressure values recorded for the debris flow and the structural analysis display a large degree of variation: according to the structural reverse calculation, structural failure would occur at less than 20 kN/m². The debris flow pressure values are calculated using the mud splashes on the impact surface and yield a value 8 times higher.

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PROPERTY PROTECTION MEASURES

Examples of successful and unsuccessful provisions provide the perfect means of illustrating property protection for buildings and for defining the key factors for efficient protection. The following factors will be explored (this evaluation will only use the Dallenwil case study):

Hazard scenario: Does the scenario seen during the 2005 flooding correspond to the anticipated hazard scenario?

Reliability: Reliability can be established using evaluations of structural safety, fitness for purpose and durability as defined in SIA standards 260 and 261. Reliability is graded as high, restricted or low.

Cost effectiveness: Property protection measures are considered to be cost effective if the cost-benefit ratio is equal to or lower than 1. This means that the usefulness of the protection measures is equal to or exceeds the costs involved.

Dallenwil - case study

The Dallenwil electricity power station was flooded by the Engelberger Aa river. The temporary protection measures comprise sealing off the doors and entrances with concrete shields (Figure 2).



Figure 2: Property protection measures used at the Dallenwil hydro power station (photo: Nidwaldner Sachversicherung)

The hazard scenario was correctly assessed and the reliability of the protection measures is correspondingly high. The cost-benefit ratio of 0.02 shows that the protection measures are particularly economically worthwhile.

CONCLUSION

The case studies we have used to assess the vulnerability of buildings to debris flows have shown just how difficult it is to evaluate the impact of the hazard processes. The simple models used were not able to deliver satisfactory results. The pressure values resulting from the reverse calculations and the structural calculations exhibit a correspondingly high degree of variation.

Case studies involving the successful use of property protection all feature an accurate appraisal of the scenario and highly reliable protection measures as seen at Dallenwil. Any measures derived from an incorrect assessment of the hazard scenario will, themselves, be flawed. Structural safety plays a super-ordinated role in the classification of reliability: where protection measures are under-dimensioned, they can be expected to fail when used in a real event. Reliability also depends upon fitness for purpose (is the installation temporary or permanent, is there any advance warning?) as well as its durability (how can the protection measures be expected to perform long-term, has someone been assigned to maintain the protection measures and install them when they are needed?).

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