A STRATEGY FOR LANDSLIDE RISK MITIGATION

THE LANDSLIDE OF SIBRATSGFÄLL/AUSTRIA

Wolfgang Jaritz[1], Robert Supper[2], Margarete Wöhrer-Alge[3]

Already in the past the municipal area of Sibratsgfäll in Vorarlberg (Austria) has been the scene of landslides of disastrous dimensions. The last catastrophic event that happened was a large landslide at the Rindberg in 1999, where an area of 1.4 km² was involved. 19 buildings and the complete infrastructure were either damaged or destroyed, 0.5 km² of forests and 0.7 km² of meadows and mountain pastures were devastated.

OBJECTIVES

In the main settlement area of Sibratsgfäll damages caused by movements have been observed for a long time. In contrast to the landslide at the Rindberg, where only a thinly populated part of the municipal area was affected, the impact of the slope failures in Sibratsgfäll concentrates on a permanent residential area with about 300 inhabitants and approximately 110 residential and farm buildings. These circumstances caused the Forest Technical Service for Torrent and Avalanche Control of Vorarlberg to commission an interdisciplinary research in order to answer the following questions:

- What are the factors for the mass movements in the main settlement area of Sibratsgfäll?
- What are the dimensions of those mass movements and how deep do the gliding surfaces reach into the subsoil?
- What kind of hazard potential emanates from the movements and can the future development be predicted?
- Is there a hazard potential for the main residential area of Sibratsgfäll comparable to that at the Rindberg?

On the basis of the research results an assessment of technical measures which can improve the actual state and/or prevent the acceleration or the progression of this hazardous situation should be done. Major parts of the study area have already been identified as susceptible to landslides in the existing Hazard Zone Map of Sibratsgfäll. The findings of the given investigations required a revision and modification of the Hazard Zone Map.

[1] ZT-Büro Moser/Jaritz, Sagschneiderweg 5, 5760 Saalfelden, (Tel.: +43-6582 74 494; email: w.jaritz@moser-jaritz.at)
[2] Geological Survey of Austria, Neulinggasse 38, 1030 Vienna, Austria (Tel.: +43-1 7125674 380; email: Robert.supper@geologie.ac.at)
[3] Forsttechnischer Dienst für Wildbach- und Lawinenverbauung, Sektion Vorarlberg, Rheinstraße 32/5, 6900 Bregenz, Austria (Tel.: +43-5574 74995 416; Fax: +43-5574 74995 6; email: margarete.woehrer@die-wildbach.at

With an improved map showing the torrential and geogenic risk potentials in the research area an instrument should be given to the municipality and the land use authority to enhance the land dedication and the future development of this village.

RESEARCH PROGRAM

To investigate the causes for the slope movements there were used not only conventional geological surveying and mapping methods as well as exploratory work like prospect wells, drilling holes and probes were used but geophysical methods as well. The applied aero-geophysical, borehole-geophysical and terrestrial geoelectrical surveys gave information about the spread and the thickness of the involved bedrock in the research area. The technical properties of the affected soils were determined by soil-physical laboratory methods. The differentiation of the affected areas (1,8 km² in the main residential area of Sibratsgfäll) took place on basis of the morphological inventory as well as on the created geological scheme. The results were verified through inclinometric measurements and through the area-wide installed geodetic observation net.

RESULTS

Using the obtained data it was possible to show that the area affected by the mass movements is built up by thick, complexly composed granular sediments that have been accumulated in the course of the siltation of a vast glacial lake in the basin of Sibratsgfäll. The movement takes place within the fine-sediment-dominated sequence of the granular sediment layers along a few, partly low-lying sliding horizons.

Having the synopsis of all the measurement and survey results, the chronological process of the basin siltation at the end of the last ice age and the composition as well as the internal structure of the geological bodies of the basin siltation could be reconstructed. Thus crucial information about the cause of the slope movements, the sequence of the movements, the dimension of the affected area and the depth of the movements could be gained. Furthermore a scheme for the future progression could be developed by fragmenting the single subsystems. As the predominant part of the main settlement area is located on sediments at the ice-margin deposits, which are involved in the mass movements, an evaluation key should be compiled that allows a selection of areas ranging from "*qualified for construction work* " to "*suitable for construction work only with special requirements*". For this purpose enquiries concerning structural damages on existing buildings and the cause of the damages (anthropogenic or geogenic) were carried out. In addition an attempt was made to quantify terrain changes of anthropogenic as well as geogenic origin. For this purpose photogrammetric techniques were applied to compare the first aerial photographs made in 1950 with the recent aerial survey results. Using all the obtained data hazardous areas were identified and plotted on a map in the scale of 1:2000.

On the basis of the constructed geological scheme, measures to prevent an infiltration of arising surface waters and shallow slop drainage into the water-sensitive subsoil were proposed.

Keywords: Landslides, hazard mapping, mitigation strategy, geophysics, monitoring