



Subsurface instrumentation for evaluating water-pressure changes and deformation at the Åknes rockslide, western Norway

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The Åknes rock slope, located in the county of Møre and Romsdal in western part of Norway, is known as one of the most hazardous rock slope in Norway and may cause a tsunami with potential run-up heights of up to 70-85 m in nearby villages. As part of a new investigation project in order to evaluate if the rockslope can be stabilized by drainage of groundwater, several new deep boreholes have been drilled and two of them instrumented.

New borehole instrumentation has been designed and implemented in order to fulfil the need for a robust system measuring displacements, multilevel water pressure and temperature. The instrumentation is a DMS[®] system made by CSGsrl in Italy, and has been done specifically for installation in uncased borehole with a diameter of 98mm. This means that there are no casing, and simplifies the installation since there is no need for specialized barriers and permeable material between casing and borehole walls. The system is made of multi-parametric monitoring column with total lengths of 105 and 130 m, and is made of stainless steel modules linked together by special joints having traction 50kN. The columns has been suspended on top and the expansion of the packers positioned at defined depths (after detailed investigation and geophysical boreholes logs) allow to separate the different pore pressure zones for a detailed hydrogeologic monitoring in combination with 3D displacement and vibration analysis in the entire rockslide body. The system includes accelerometer, inclinometer, extensometer, piezometer and temperature sensors.

The DMS[®] systems are fully enclosed inside a maritime type container, specifically built for the storage of all equipment and facilities necessary to transport, operation and maintenance. Additional equipment with accessories and spare parts are also available inside each container system in a way to be always ready in case of potential maintenance, also in periods of the year with harsh conditions.

The first data evidenced specific deformations in different sliding zones shortly after the installations (days). The cumulative displacement in the uppermost borehole at Åknes show a cumulative displacement at the top of more than 13 mm, with the largest displacements at two distinct sliding planes at 30-34 and 65-70 m depth. The water table levels, monitored by 10 piezometers, shows clearly different behaviours at different depth. The isolated water pressure data demonstrates that the hydrological conditions in the rock slope are much more complicated than earlier suggested, including isolated water levels on higher levels. This new insight into the hydrological conditions will be important for the evaluation of the possibility for drainage to stabilize the slope.