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Experimental study of the wedging – ratcheting mechanism in rock slopes using a large physical model in thermally controlled room

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A thermally-induced wedging ratcheting mechanism has been recently suggested to explain rock slope instability in fractured rock masses. In this study the proposed mechanism is validated by means of a large-scale physical model in a thermally controlled environment. A concrete block assembly representing the rock mass is placed in a specially designed climate controlled room. Displacement transducers and a visual range camera monitor the time dependent evolution of block displacements and a series of thermocouples track the block temperature evolution over time. Two setup configurations are tested: with and without a wedge block in the “tension crack”. It is shown that the wedging ratcheting mechanism accelerates the creep-like response of the blocky structure. An existing analytical solution is calibrated using the experiment results with all necessary mechanical properties determined in lab. It is shown that the analytical solution is sensitive to the linear thermal expansion coefficient, and that the displacement rate obtained from the analytical solution is four times faster than the measured displacement rare. The reason for this discrepancy apparently lies in the fact that the analytic model is one-dimensional whereas the physical problem is of a volumetric nature. Nevertheless, this study confirms the possibility for this new failure mechanism to develop in jointed rock slopes.
The results obtained from this experimental study are utilized for the calibrating 3DEC (3D version of the Universal Distinct Element Code) model. The calibration process and the numerical investigation of this mechanism are detailed separately in another abstract entitled: "Numerical simulation of the thermally-induced wedging ratcheting mechanism is rock slopes", and is submitted as a Poster to the current EGU meeting.