Verification of the performance of reinforced concrete profiles of alpine infrastructure systems assisted by innovative monitoring

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The verification of the structural behaviour of existing structures and its materials characteristics requires the application of tests and monitoring to gather information about the actual response. The comparison of the actual performance and the designed performance enables the verification of the design assumptions in terms of implied loads and materials resistance. In case of non-compliance of the designed with the current performance, the design assumptions need to be updated. The objective of this contribution is to provide a guidance for the verification of the performance of reinforced concrete profiles of alpine infrastructure systems like tunnels assisted by monitoring, testing and material testing.

The application of defined loads to a structure to verify its load carrying capacity is a powerful tool for evaluating existing structures. In particular, in this research different types of load tests are employed depending on the limit state which is being investigated on tunnel profiles, on the other hand, the system responses to validate the structural performance are recorded with monitoring systems innovative in tunnel systems, such as accelerometer arrays, fibre optic sensors, laser distance sensors and digital image correlation system, see also the related paper by Neuner et. al. In these studies we also pay special attention to the capabilities of Digital Image Correlation and Nonlinear Finite Element Analysis. Digital Image Correlation (often referred to as "DIC") is an easy-to-use optical method for measuring deformations on the surface of an object. The method tracks changes in the grayscale pattern in small areas called subsets) during deformation.

Finally, we will present the process for the implementation and validation of proof loading concepts based on the mentioned monitoring information in order to derive the existing safety level by using advanced digital twin models.