

Project work: Geophysical investigations of an experimental dam

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Points: 30 or 45

Summary

Knowledge of dam integrity is vital for safe operation of hydropower installations. Geophysical methods provide the means for non-invasive and non-destructive investigations of dam sites and detection of anomalous conditions. Various geophysical methods have been used to investigate the internal structure of a dam for issues such as leakage, internal erosion and sinkholes (e.G. Karastathis et al., 2002; Miller et al., 2003; Kim et al, 2006; Hunter and Powers, 2008; Loperte et al., 2016). In this project we will apply a series of geophysical methods on a specially constructed dam with known flaws when constructed or with flaws introduced during the project. This will allow testing of the geophysical methods and an evaluation of their suitability to be applied real dam situations.

Background

Minor flaws in dams may lead to comprising dam integrity and potential serious disasters. Therefore, it is vital to detect these flaws at an early stage. Geophysical investigations provide a potential methodology for detecting these flaws. In particular, time lapse geophysics can be highly useful since measurements are repeated and differences in the response of the dam are monitored. If geophysical methods are to be employed it is important to know which have the greatest potential for detecting flaws and monitoring dam integrity. The opportunity to test geophysical methods on an experimental dam with known flaws is an unusual opportunity.

Work plan

Together with the advisers, the masters student will perform a literature study on what geophysical methods have been applied in the past for investigating dam integrity. Particular focus will be on the methods proposed for the Vattenfall dam. In parallel, modeling of the acquisition geometries for the various methods will be performed to determine the optimum field procedures. Once determined, data acquisition at the dam will follow the identified procedures. Four geophysical methods will be tested: seismic, gravity, magnetics and DC electrics. Data processing will focus on detecting flaws in the dam. If the modeling indicates that one of the methods is not suitable it will not be tested in the field. Based on the data processing and knowledge of the dam an evaluation of the methods will be made in the form of a report. Upon completion, a research paper to an international may be submitted.

Time schedule (can be modified)

A masters student will be identified by mid- March. The student will then be involved in the literature study and modeling until May. Data acquisition will be in the time window May-June. Data processing and interpretation will follow up until November. Reporting and presentation of results will be in November and December.

References

- [1] L. E. Hunter, M. H. Powers, 2008. Geophysical Investigations Of Earthen Dams: An Overview, 21st EEGS Symposium on the Application of Geophysics to Engineering and Environmental Problems.
- [2] V. K. Karastathis, P.N. Karmis, G. Drakatos, G. Stavrakakis, 2002. Geophysical methods contributing to the testing of concrete dams. Application at the Marathon Dam. *Journal of Applied Geophysics* 50, 247–260.
- [3] H. -S. Kim, KG. Park, Y.S. Yoo, J.-Y. Kim, Y.S. Kim, 2006. Successive seismic reflection methods aided to find the change of structure and material properties in center core type earth-fill dam. *Dams and Reservoirs, Societies and Environment in the 21st Century – Berga et al. (eds). Taylor & Francis Group, London, ISBN 0 415 40423 1*
- [4] A. Loperte, F. Soldovieri, A. Palombo, F. Santini, V. Lapenna, 2016. An integrated geophysical approach for water infiltration detection and characterization at Monte Cotugno rock-fill dam (southern Italy), *Engineering Geology*, Vol. 211, 162-170.
- [5] R. D. Miller, J. Ivanov, D. R. Laflen, and J. M. Anderson, 2003. Seismic investigation of a sinkhole on Clearwater Dam, Preliminary Report, Kansas Geological Survey, KS.