

Procedure for Monitoring the Process of Behavior of Thermal Cracking in Concrete Gravity Dams: A Case Study

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Abstract : Several dams in the world have already collapsed, causing environmental, social and economic damage. The concern to avoid future disasters has stimulated the creation of a great number of laws and rules in many countries. In Brazil, Law 12.334/2010 was created, which establishes the National Policy on Dam Safety. Overall, this policy requires the dam owners to invest in the maintenance of their structures and to improve its monitoring systems in order to provide faster and straightforward responses in the case of an increase of risks. As monitoring tools, visual inspections has provides comprehensive assessment of the structures performance, while auscultation's instrumentation has added specific information on operational or behavioral changes, providing an alarm when a performance indicator exceeds the acceptable limits. These limits can be set using statistical methods based on the relationship between instruments measures and other variables, such as reservoir level, time of the year or others instruments measuring. Besides the design parameters (uplift of the foundation, displacements, etc.) the dam instrumentation can also be used to monitor the behavior of defects and damage manifestations. Specifically in concrete gravity dams, one of the main causes for the appearance of cracks, are the concrete volumetric changes generated by the thermal origin phenomena, which are associated with the construction process of these structures. Based on this, the goal of this research is to propose a monitoring process of the thermal cracking behavior in concrete gravity dams, through the instrumentation data analysis and the establishment of control values. Therefore, as a case study was selected the Block B-11 of José Richa Governor Dam Power Plant, that presents a cracking process, which was identified even before filling the reservoir in August' 1998, and where crack meters and surface thermometers were installed for its monitoring. Although these instruments were installed in May 2004, the research was restricted to study the last 4.5 years (June 2010 to November 2014), when all the instruments were calibrated and producing reliable data. The adopted method is based on simple linear correlations procedures to understand the interactions among the instruments time series, verifying the response times between them. The scatter plots were drafted from the best correlations, which supported the definition of the limit control values. Among the conclusions, it is shown that there is a strong or very strong correlation between ambient temperature and the crack meters and flowmeters measurements. Based on the results of the statistical analysis, it was possible to develop a tool for monitoring the behavior of the case study cracks. Thus it was fulfilled the goal of the research to develop a proposal for a monitoring process of the behavior of thermal cracking in concrete gravity dams.

Keywords : concrete gravity dam, dams safety, instrumentation, simple linear correlation

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