

Seismic analysis of an asphalt facing rock-fill dam for assessing its structural integrity and the repairing method of its cracks caused by 2011 Tohoku earthquake

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Abstract

2011 Tohoku earthquake caused cracks in the asphalt face of Yashio-dam located Tochigi-ken, Japan. Yashio-dam was damaged even though the ground acceleration recorded during the earthquake was below the critical value, which is obtained by the safety assessment based on two-dimensional seismic analysis. This fact motivated the investigation on the mechanism of damage initiation.

In order to take into account the site effect of dam-site, which was not considered in the two-dimensional seismic analysis, the surrounding mountains and Yashio-dam including the asphalt face were modeled in the finite element model. Ground motions recorded during the earthquake were used as input to dynamic analysis.

It is demonstrated that the three-dimensional site effect of mountains surrounding Yashio-dam can have significant influence on the earthquake-induced strains in the asphalt face. The locations of maxima of the dam axial strains agreed with the cracked location on the asphalt face.

It is suggested by the analysis that it is important to include an appropriate area of mountains in order to capture the site effect for the seismic safety of the asphalt facing dam especially for long-period earthquake ground motion.

Keywords: Large scale finite element analysis, asphalt impervious face, dam, seismic analysis, three-dimensional dynamic analysis