

Investigation on Deformation Field Progression in High Arch Dam Under Overloading Test Via DFOSs and DIC Techniques

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Abstract

The progression of deformation filed including strain and displacement of scaled high arch dam model under overloading test enable reflect the static failure mechanism, and provide an important reference for structural performance analysis of high arch dam. Therefore, a novel, reliable and sensitive deformation filed monitoring system composed of distributed fiber optic strain sensors (DFOSs) and digital image correlation (DIC) is proposed and applied on scaled high arch dam model under overloading test to precisely and sensitively monitor the deformation field progression. The test results indicated that the failure mode of high arch dam is mainly categorized into elastic, plastic and damage process according to load-displacement results, which is also coincided with crack progression. The upstream failure is governed by the crack at arch dam heel and abutments while the downstream failure by the crack at crown-cantilever of arch dam. The DFOSs and DIC construct a full-range monitoring network and correct for each other in deformation filed characterization. The distribution range and regulation of deformation filed monitored by DFOSs and DIC are well coincided with the crack progression and failure mode. The values of deformation filed captured by DFOSs and DIC are continuous and similar as those of the spots monitored by the conventional strain gauges and deflection device. Meanwhile, the capturing efficiency of DFOSs and DIC is much higher and sensitive than the conventional reference techniques. Finally, it could be concluded that the synergistic work of DFOSs and DIC enable high-efficiently, precisely and quantitatively manifest the progression of deformation filed including crack.

Keywords

High Arch Dam, Overloading Test, Deformation Field Progression, Distributed Fiber Optic Strain Sensor (DFOSs), Digital Image Correlation (DIC)