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Wham, Bam, Plug that Dam (What the engineer said when piping began)

A rapidly developing piping problem on a high hazard dam in Virginia required a quick, decisive, and proactive response by the Owner and Consultant to prevent failure of the structure.

On a sunny day following a period of relatively calm weather in December of 2008, cloudy seepage was observed exiting from the downstream right side of an out-of-service, stone masonry spillway structure at Lee Hall Dam, located in the City of Newport News, Virginia.

Emergency actions were immediately initiated which included lowering of the reservoir pool, installation of a sand, geotextile, and gravel filter blanket over the seepage area; geotechnical borings with installation of piezometers; and a monitoring program. Permanent repair alternatives were being evaluated when piping initiated a second time, at a higher elevation than previously observed and immediately above the first temporary repair area. Emergency actions were again initiated, which included further lowering of the reservoir pool, installation of a much larger sand and gravel blanket over the problem area; followed immediately by emergency design, bidding, and construction of sheet pile cofferdam to isolate the problem spillway.

The sheet pile cofferdam design utilized force balancing for stability; water forces on the upstream side counteracted soil lateral pressures within the cofferdam on the downstream side. The sheet pile cutoff wall effectively isolated the old spillway from the reservoir, dropping the phreatic surface in the piping area until seepage stopped completely.

Lessons learned from the project included:

- Lowering of the reservoir pool proved the most effective means of slowing the seepage rate
- C33 sand used in the first filter blanket stopped piping, but was not permeable enough to prevent the rise in phreatic levels upstream of the repair that led to the second piping event
- Because the seepage path was found to be along the existing masonry spillway structure, a seepage cutoff was the most effective approach for this project
- A force-balanced sheet pile cofferdam can be successfully constructed provided adequate monitoring and proper sequence are utilized during installation