



# URS Corporation

Civil Engineering

U.S.A.

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ANSYS® DesignXplorer VT™

## Overview

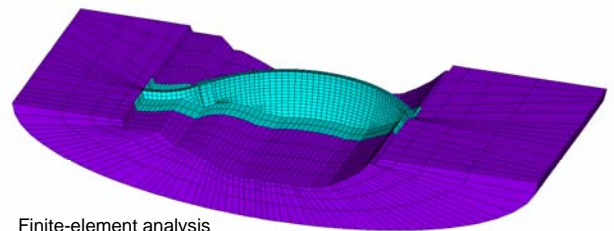
McKelvey Lake Dam in Mahoning County, Ohio, is a 77-ft.-high concrete arch structure with a crest length of approximately 350 ft. The structure forms a water reservoir with a maximum storage capacity of 4,345 acre-ft. To ensure that repeated freeze-thaw cycles had not compromised the integrity of the dam for increased flood loads, URS Corporation was retained to perform a comprehensive structural stability evaluation.

URS has conducted business for nearly 100 years and is one of the premiere full-service engineering, planning, design and construction companies in the world. With a staff of more than 26,000 in 300 offices and 20 countries, URS is considered a leader in dam engineering, design analysis and safety. The firm frequently performs safety inspections for municipalities, utility companies and government agencies such as the U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation and U.S. Army Corp of Engineers.

## Testimonial

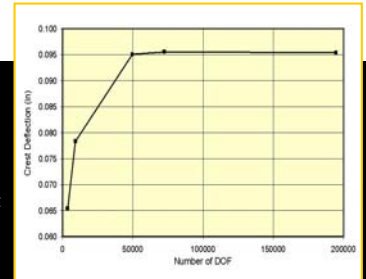
"Sensitivity studies with ANSYS DesignXplorer VT enable us to quickly pinpoint key variables that have the greatest influence on dam behavior and safety. Response surfaces and other plots are particularly beneficial in showing the sensitivity of structural behavior to multiple parameters. This helps guide evaluations and refine the scope of investigations so that only required field information needs to be gathered. As a result, the cost of field investigation programs can be reduced and, sometimes, eliminated. Moreover, we have a deeper understanding of the behavior of the dam and more confidence in the analysis. Regulators also have greater confidence in our evaluation when they can see results displayed clearly for a range of scenarios. In this way, ANSYS DesignXplorer VT allows us to better leverage our decades of field experience in designing and studying dams and other structures worldwide."

**Guy Lund**  
Senior Project Engineer  
URS Corporation

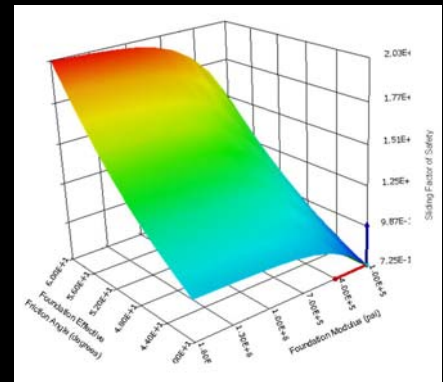


Finite-element analysis simulated the behavior of the dam for maximum flood-loading conditions.

ANSYS mesh sensitivity study indicates that the FEA model is sufficiently refined to assure the results are not dependent on the size of the finite element mesh.



Response surface generated by ANSYS DesignXplorer VT showed that the behavior of the dam is influenced by foundation modulus more than any other parameter.



## Challenge

Historically, the initial phases of a structural analysis of such a dam would include extensive field investigations to collect concrete and foundation rock samples for laboratory testing. However, because engineers are unaware at the start of the project which structural parameters are most important, a large number of physical samples must be collected and tested: a time-consuming and costly process, especially for dams located in remote areas. Exhaustive work also is needed in creating numerous computer models and running a wide range of individual simulations to thoroughly analyze all interrelated variables. As a result, performing an accurate evaluation that includes information often requested by state and federal regulators is a time consuming and costly process.

## Solution

In evaluating the dam, URS engineers performed sensitivity and parametric studies using ANSYS DesignXplorer VT to assess the influence of a range of variables on structural strength, including concrete wall and foundation rock material properties as well as maximum load assumptions. The software uses a variational technology (VT) approach to determine the impact of multiple parameters on overall structural performance using a single finite-element solution. Results are provided in various formats, including response surface plots that provide insight into design behavior that would otherwise be difficult to generate using individual single analysis runs. The studies quickly verified that the dam has adequate capability of redistributing loads for a large range of assumed foundation and material properties.

## Benefits

Results from the sensitivity studies using ANSYS DesignXplorer VT quickly showed that the behavior of the dam was influenced by foundation strength assumptions more than any other parameter. Seeing the effect of a wide range of foundation variables in this manner allowed engineers to narrow the scope of field investigations, thus saving considerable time and cost on the project. Running a series of studies for a variety of parameter assumptions also enabled engineers to generate results showing the impact of a range of "what-if" questions typically asked by regulators. Providing this level of supporting detail in a graphical format gave regulators greater confidence in a study's conclusions and thus avoided unnecessary delays in the approval process.