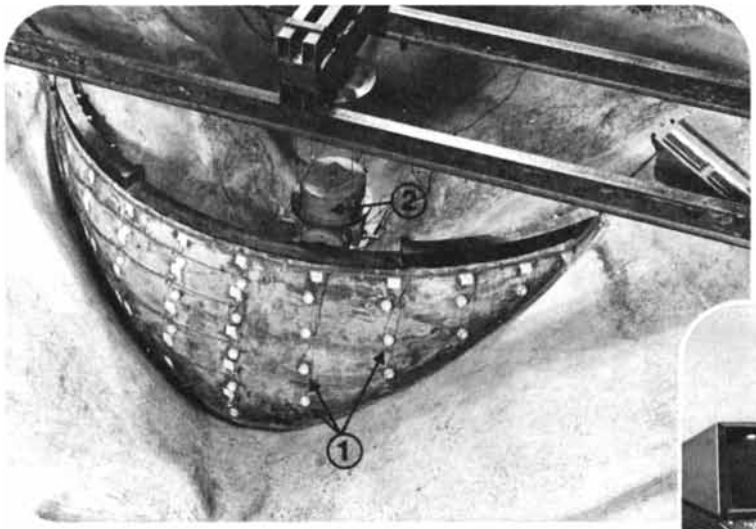


Dam model at left is .775 meters (30.5 inches) high. Accelerometers **(1)** placed at points along the structure's surface monitor its response to earthquake-simulating vibrations produced by an electrodynamic exciter **(2)**. Modal information thus generated is analyzed by the HP 5451B (below), which displays the animated mode shapes on a CRT screen and/or records the shape on a plotter for future reference.

Modal analysis of scale models accurately predicts structural response to earthquakes.

Investigators at ISMES rely heavily on Hewlett-Packard's computerized modal analysis system to study the response of geomechanical scale models to simulated earthquakes. The results of these tests help them to predict the safety of the full-scale structure more accurately than by conventional means.

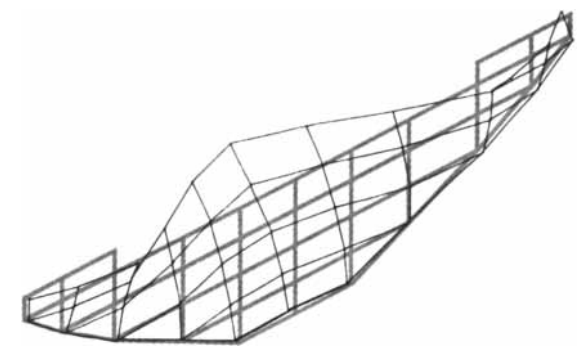
Because large architectural or engineering structures are likely to be complex, dynamic tests on simulation scale models are often essential to verify their behavior under dynamic loads. To which end, the Hewlett-Packard 5451B Fourier Analyzer with modal analysis package is being used extensively at ISMES (Istituto Sperimentale Modelli e Strutture—or Experimental Institute for Models and Structures), in Bergamo, Italy, for performing dynamic tests both on scale models and full-scale structures.

Modal analysis, briefly, is a technique for identifying modes of vibration in a structure when subjected to dynamic loads. One characteristic of each mode of vibration is called a mode shape—a spatial description of the relative motion of each point on the structure. The mode shape reveals important information about behavior at each resonant frequency, helping the designer locate weak points in a design that could result in structural failure.

One important test area is the interaction of dam foundations and dam reservoirs under varying reservoir conditions, in terms of their response to seismic and hydrodynamic loads. Of critical interest are vibration modes in the frequency range of 0-15 Hz, which represent the structure's response to earthquake. In one dam design test typical of the method, the HP modal analysis system measured transfer functions between the input point, where a broadband excitation force is applied, and numerous response accelerometers mounted at points of interest on a 1:100 scale test model. These transfer functions contain all structural modes within the excitation bandwidth and can be used to define the response at each measurement point.

With this HP 5451-produced information, ISMES investigators can accurately visualize the dynamic behavior of the model, identify its weak points, and thus suggest to the designer where the full-scale structure should be strengthened.

The 5451B Fourier Analyzer, with modal analysis package, has a basic cost of $81,440* with a complete operating system including all necessary hardware, software, and peripherals.



Mode shape of the undeformed dam (gray) is compared with a typical mode shape (black) showing deformation at one mode of vibration.

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*Domestic U.S. prices only.

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