

SEISMIC ANALYSIS OF DAM-RESERVOIR-FOUNDATION SYSTEMS

by

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SYNOPSIS

The dynamic response of the coupled system of dam, reservoir, and foundation is analysed taking into account the flexibility of the dam and the foundation. The foundation may be taken as a half-space or an elastic layer and the reservoir is taken infinitely long.

FORMULATION

The formulation consists of five stages: i) a closed form solution for the pressures in the reservoir is obtained for general displacements of the dam-reservoir interface, ii) the equations of motion of the dam represented by a system of finite elements are formulated taking into account the general hydrodynamic nodal forces in (i), iii) using the equations of motion, general expressions are derived for the base shear and overturning moment of the dam in terms of displacement amplitude functions, iv) alternative expressions are derived for the base shear and overturning moment considering the motion of the foundation, and v) the displacement amplitude functions may be obtained by solving the simultaneous equations from (iii) and (iv). The complete response is determined once the amplitude functions are known. The deformation of the contact plane between dam and foundation is approximated by a rotation and translation.

Earthquakes generate both vertical and horizontal accelerations and a full analysis of the problem should take both into account. The equations governing the coupled system are linear and superposition of the solutions for vertical and horizontal accelerations are possible. The general procedure developed applies to either acceleration provided appropriate changes in boundary conditions are made.

The dynamic responses are evaluated for horizontal input motions with complex frequency. The response to arbitrary input motions can be readily found by superposition in the frequency domain using frequency response curves obtained in the analysis.

RESULTS

The response of a concrete dam-reservoir system on an elastic half-space and elastic layer is evaluated. Analyses were performed for two different types of soils. The results show clearly the influence of the dynamic characteristics of the foundation and the reservoir on the natural frequencies of the dam. The radiation damping effect of the infinite reservoir and the foundation on the response of the coupled system can be clearly recognized.

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