THE APPROXIMATE APPROACH TO EVALUATING SEISMIC LOADS ON STRUCTURES INTERACTING WITH WATER

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The definition of seismic loads acting upon hydraulic structure necessitates the inclusion of hydrodynamic pressure in addition to the inertial forces induced by the structural mass. The exacting formulation requires the solution of a hydroelasticity problem, which is possible by numerical methods alone.

Within the bounds of the evaluations by spectral curves it becomes possible to formulate approximate expressions, identical by their structure to the well known expressions derived with no consideration of the influence of water.

Based on the assumption of the identity of natural vibration modes of a coupled structure-fluid system and a separated structure, these expressions give results which involve errors acceptable for practical cases.

Seismic load for each natural vibration mode of a distributed parameter system may be defined by the following expression:

$$S_i^* = K_c g m \beta(T_i^*) \eta_i^*$$

where

$$\eta_i^* = \frac{X_i \int_{(v)} (m+\mu_0) X_i \, dV}{\int_{(v)} m X_i^2 \, dV}; \quad T_i^* = T_i \left(1 + \frac{\mu_i}{m}\right)^{-1/2}$$

X_i - natural vibration mode of a structure in vacuum; μ_0 - added mass of water when the structure moves as a solid body; μ_i - added mass of water for the X_i th mode of structural vibration, distributed in a way similar to the structural mass m and equivalent by its inertial effect to a real distribution of the added masses; β - dynamic coefficient.

Expressions for systems with discrete parameters have an identical form.

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