EXPERIMENTAL STUDIES AND CALCULATIONS OF EARTH DAM SEISMIC STABILITY

by

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To substantiate the design of a 40 m high sandy dam with an inclined core and a fore apron of sandy loam, erected in a zone with seismicity IX by a modified Mercally scale and resting on a 15 m thick layer of medium grained sands underlain by base rock, experiments and calculations were carried out with the following purpose:

- the definition of the elastic and dissipative properties of sandy soils sample free vibration, ultrasonic and seismic survey methods;
- soil structural stability and deformability studies by testing soil samples in uniaxial compression and simple shear dynamic devices;
- calculations of natural vibration modes and frequencies of a dam together with a layered sandy foundation as well as seismic inertial loads acting upon them. The evaluations are based on applying the results of a one-dimensional approach as well as the results of a plain strain problem of the dynamic elasticity theory with the use of the finite element technique;
- structural slope stability tests by circular slip surfaces taking into account the inertial loads defined by the above two approaches (in the latter case higher values of the safety factor were obtained);
- the finite element method evaluations of the stress state of the dam together with a layered sandy foundation under the influence of static and inertial seismic loads with consideration of the first ten natural vibration modes.

A condition $B = \omega k_p (ng)^{-1} \ll 1$ (where ω is the highest seismic vibration frequency out of the range taken into account, n and k_p - soil porosity and permeability coefficient, g - gravity acceleration) is obtained, allowing to perform the evaluation of the seismic stress state of the dam and its foundation from saturated soils using the quasi-homogeneous model with the appropriate characteristics (a case of the joint motion of the solid and liquid components). If the above condition is not observed, similar calculations should be performed using a model of saturated soil presented as a multicomponent system of mutually penetrating media with a deformable skeleton, that is with consideration of the relative motion of the components.

The dynamic stability of a dam of saturated sandy soil was assessed by comparing the design static and seismic effective stresses in different points of the dam and foundation with the critical values obtained by the corresponding tests.

The investigations revealed that the dam design meets the requirements for seismic stability.

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