

EXPERIMENTAL AND ANALYTICAL DETERMINATION OF THE STRESSES IN BUTTRESS DAMS

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Abstract

The dissertation is concerned with experimental and analytical investigations of the stress distributions in a buttress dam of web constant thickness, resting on an elastic foundation. The general case is considered where the elastic properties of the foundations differ from those of the material of the dam.

The experimental investigations were made by “frozen-stress” photo-elastic methods in which the composite model of the dam and foundations, together with its impounded liquid, was subjected to a centrifugal acceleration which amplified the body forces and liquid pressures about 28 times.

The model was analysed in a polariscope to obtain the difference of the principal stresses and their directions, while the sum of the principal stresses was found from measurements of lateral extension of the model. For the latter purpose a new accurate technique was developed.

The theoretical investigations aimed at producing a method of analysing a buttress of triangular profile with the aid of an electronic computer. The approach selected was to modify the stress distribution resulting from the “classical” trapesoidal rule of means of correcting Airy stress function formed so as not to affect the applied loads. This condition produced the correcting function as an infinite series, each term of which satisfied the equations of elasticity and yielded a self-equilibrating system of stresses.

The stresses obtained from taking the “classical” solution with a finite number of terms of the correcting function were applied to the surface of the semi-infinite plane of the foundations at the given number of points at which, subsequently, the relative displacements between the dam and the foundations were minimised. In the latter operation mathematical difficulties were encountered with the minimisation process in which excessively large residuals occurred.

The current method of designing buttresses of constant thickness is presented and suggestions are made on the possibility of introducing in it stress analysis on accordance with the theory of elasticity.

A review of pas experimental and theoretical work in the field is presented, accompanied by a bibliography.