RATIONALIZATION AND EXCHANGE OF EXPERIENCE

USE OF STRING CELLS FOR INVESTIGATION OF SEISMIC EFFECTS ON HYDRAULIC STRUCTURES

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The increasing volume of hydraulic construction carried out in recent years, in particular in the highly seismic regions of Central Asia, has enhanced the role of the investigation of the dynamic processes occurring in hydraulic structures as a result of seismic action. However, the high metrological advantages of string cells, which have been widely used in the investigation and control of deformations in hydraulic structures,* are fully realized only for study of static phenomena. In this connection, the writer proposed new methods and devices,† which permit widening significantly the frequency range of the investigated phenomena, including those caused by impact loads. These methods are characterized by simultaneous polarization of the string element by a magnetic as well as an electric field. The first type is used for the transverse force action, and the second type is used as carrier of information about the operating regimen. This ensures high sensitivity and interference-killing features of the method, which permit widening significantly its frequency range.

The analytical expression for determination of the instantaneous values of the string deformation was obtained by solving the wave equation

$$\frac{\partial^2 h}{\partial t^2} = \frac{\sigma \partial^2 h}{\rho \partial l^2} + \frac{F}{\rho},$$

in which $h = f(l, t)$ is the deflection of the axial points of the string from the equilibrium position with time; σ is the tensile stress in the string; ρ is the linear density of the string; and F is the shear force.

For the following initial conditions

$$\frac{\partial h(l, t_0)}{\partial l} = 0 \text{ and } h(l, t_0) = H \sin \frac{\pi}{L} l$$

we obtain for the instantaneous value of the longitudinal deformation the equation

$$\Delta = \frac{L^3 \rho}{\pi^2 E (H^2 - h^2)} \left(\frac{\partial h_{L/2}}{\partial t} \right)^2,$$

in which L is the string length; H is the amplitude value of the deflections of the middle of the string from the equilibrium position; h is the instantaneous value of this deflection; $\partial h_{L/2}/\partial t$ is the deflection rate; and E is the modulus of elasticity of the string material.

With this method of evaluating the results of the measurements, the frequency range of the phenomena which can be studied with the help of the strip cells is expanded by several orders, that is, the frequency limitations are practically eliminated.

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*A. A. Uginchus and V. P. Bombchinskii, Control-Measuring Instrumentation for Hydraulic Structures [in Russian], GISL, Moscow (1954).

†Yu. M. Romanenko, "Method for measuring deformations of vibrating elements," Author's Certificate No. 351100 (USSR). Published in Otkrytiya, Izobreteniya, Promyshlennye Obraztsy, Tovarnye Znaki, No. 27 (1972).

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