EXPERIMENTAL INVESTIGATION INTO THE ONE-DIMENSIONAL CALCULATED MODEL OF WAVE PROPAGATION IN BLOCK MEDIUM

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The strain wave propagation in the one-dimensional block medium is experimentally studied. The experimental and calculated data are compared. It is shown that the proposed model provides satisfactory description of low-frequency pendulum wave propagation at the proper selection of the model parameters.

Block medium, interlayers, viscoelastic deformation, impact, low-frequency pendulum strain waves

The rock mass at different scale levels consists of separate blocks, fairly homogenous in their physical properties bound with relatively weak joints [1]. The joints influence on wave propagation in such a medium [2]. Besides longitudinal and transverse waves, slow pendulum wave propagation is also induced [3–5]. To study pendulum waves in a block medium experimentally, a physical model constructed of lime-and-sand bricks was used [4]. Here, the relationship between the acceleration and spectral distribution of oscillations during wave propagation in physical model is studied. In [6,7] the problem of strain wave propagation in a chain of masses connected by elastoplastic elements is theoretically examined, and the calculated scheme is developed and compared with the experimental data obtained in impact loading of the strain wave in a chain of steel bars separated by rubber interlayers.

In the present paper a model of block media made of bricks was used. The researches aim at obtaining data on the velocity of pendulum wave, attenuation of its magnitude with distance depending on the presence of rubber interlayers, and comparing with the data of theoretical calculations [7].

The scheme of the physical models is shown in Fig. 1. We used 8 bricks with the size of 250×120×85 mm and weight of 5.2 g at a density of 2040 kg/m³ and a longitudinal wave velocity of 3100 m/s. To record the process of the wave propagation in this model, accelerometers GT-200 were attached to the lower edge of the bricks by a plasticine layer 1 mm in thickness. To arrange free areas for mounting sensors, six upper bricks were advanced for 25 mm out of the system, each to its own side in turn (Fig. 1). The model was mounted on a laboratory bench. The lowest natural frequency of the system amounted to 90 Hz.

As a wave exciter, a hammer was used with its impacting part in the form of a steel cylinder 13.8 mm in diameter and 43 mm in length, with accelerometer 9803 (“Brüel&Kjær”) to measure force and duration of an impact. In Fig. 2 the specific oscillograms of separate blocks are shown. They demonstrate peculiarities of a signal induced by the impact action of the hammer on the upper brick, that propagates along the system of 6 bricks with the damping interlayers.

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Curve 1 shows the impact force, whereas curves 2–7 are the accelerograms of the blocks (Fig. 2). The numbers to the right of the plot correspond to the sensor numbers (Fig. 1). The numbers to the left are the signal magnitudes.

Fig. 1. Arrangement of bricks and accelerometers in physical model (▱—accelerometers)

Fig. 2. The wave propagation in bricks separated by rubber interlayers 1 mm thick; low-frequency wave velocity is 164 m/s; impact duration is 0.21 ms