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Testing for Seismic Stability using High Power Explosions

Essais de la résistance antisismique au moyen d'une explosion de grande puissance

Erdbebensicherheitsprüfung mittels einer Explosion grosser Leistung

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Tests for seismic stability of a full-scale model of the bridge section consisting of the frame- and massive-type piers mounting a 16 m long span structure (see Fig.1) have been carried out. The frame-type pier of 17 m elevation above the foundation edge is a three-dimensional structure consisting of four reinforced concrete posts joined at the top by a cast-in-place packing, and at the bottom with a foundation on the natural semi-rock base. The massive-type pier is of a traditional construction consisting of two rectangular-section reinforced concrete blocks. A metal packet loaded with concrete blocks is used as the span structure. The span structure has the total weight of 215 t.



Fig.1. General view of the railway bridge section model

The main purpose of tests was to check actual seismic stability of the frame-type railway bridge pier.

The seismic loads were simulated by explosion effects. Three explosion fields located on one side of the bridge section model and representing the totality of the well rows, were prepared. The number of wells amounted to 99 pieces. Well depth - 20 meters. From 300 to 637 kg of explosives were placed in each well of the explosion fields. The total weight of explosives used in the tests made 46.7t. The explosions were started from Fig.1. General view of the rows most remote from piers (see Fig.2). Duration of the explosion effect is 1.6 s.



Fig.2. Explosion effect

Oscillations of the bridge section and adjoining ground sections were registered by the standard engineering-seismomentering equipment with galvanometric recording. Data on displacement, speed and acceleration of the pier foundations, posts and packings of the frame pier, lower and upper blocks of the massive pier and span structure were fixed. Evaluation of the ground oscillation intensity proved it to be close 9 numbers of the MSK scale (ground accelerations reached 0.4 g). As a result of tests, a large amount of full-scale data was obtained making it possible to assess the errors of the employed methods of pier calculations receive information on the actual seismic stability of the structures under tests. The test results have proved the possibility of simulating the seismic effects of 9 numbers in force by a high power explosion. Analysis of the instrumental data obtained made it possible to make a conclusion of a high seismic stability of the frame-type pier.