IN THE SOVIET NATIONAL COMMITTEE ON LARGE DAMS

THE MEDEO MUDFLOW-PROTECTION DAM


OPERATING FEATURES

The Medeo dam on the Malaya Almaatinka River is the most complex and essential structure in the mudflow-protection system of the city of Alma-Ata. The dam is located at an elevation of about 1750 m. The construction region is located in a seismic zone having a scale rating of 10. The Malaya Almaatinka River is quite active, mudflows have occurred on it repeatedly. In 1921 a mudflow destroyed a considerable part of the city. Construction of the dam made it possible to reduce markedly the mudflow threat to the city and created conditions for systematic implementation of a complex of mudflow-protection measures.

The main part of the mudflow-protection dam was created in 1966-1967 at Medeo by means of massive explosions [1, 2]. In subsequent years fill was added to the dam and in 1972 it acquired the design profile. Also constructed were a tunnel, temporary channel intake through which the river was discharged during construction, and a right-bank intake for withdrawing water and the liquid component of the mudflow at lower levels of the mud reservoir. However, the main left-bank multilevel intake, which was to discharge water and the liquid component of mudflows at any level of filling the mud reservoir, including at the highest level, was not constructed. Nor was the open mud escape stipulated by the construction project.

The catastrophic mudflow on July 15, 1973, which formed as a result of the bursting of morainal lakes in the upper reaches of the Almaatinka River, was retained by the Medeo dam, the mud reservoir of which was filled with mud to an elevation of 1835.0 m (volume of deposits 3.8 million m³) [3]. In connection with clogging of the draining structures by the mud mass, water began to accumulate in the mud reservoir and threatened to overflow the dam. The rockfill dam withstood the dynamic and static load of the mudflow without deformations of the crest and slopes, though the maximum discharge of the mudflow reached 10,000 m³/sec at a speed of 10-12 m/sec.

The effect of the mudflow on the temporary channel intake and right-bank intake was manifested only in clogging of the racks of these intakes with mud without any destruction. The racks performed their task and did not allow the mud to penetrate into the tunnel spillway, which, therefore, was not damaged (excluding blocking up with mud of the diversion from the main tunnel to the left-bank intake that had been open at the time of the mudflow).

The maximum volume of water accumulated on top of the mud deposits was more than 1 million m³ and the total volume of filling of the mud reservoir reached 5.0 million m³ (its total capacity is 6.5 million m³). Pumps and three lines of 1.4-m-diameter steel conduits were installed to pump out the water. Later the natural stream flow was released by gravity flow through a constructed "Caucasian" intake [a submerged intake in the form of a gallery arranged across the river and covered at top by a rack] and 1300-m-long steel pipeline.

The accumulation of water in the mud reservoir and the yield of the water component of the mudflow caused saturation of the dam and the occurrence of numerous centers of seepage on its downstream slope; the total seepage discharge was about 4.5 m³/sec. The flows of water eroded the upper layer of the downstream slope as much as 1.0 m, in connection with which it was necessary to divert the seepage water in order to prevent erosion of the only operating road on the dam crest. It is necessary to point out that removal of earth from the dam body was not observed and the results of calculations of the piping stability of the soils of the dam were completely confirmed [4].

Thus, the dam of the I phase, having held back the catastrophic mudflow, completely lived up to its purpose and protected the city from grave consequences. In connection with...
depletion of the mud-retaining capacity of the dam of the I phase, the need to build it up arose. In determining the parameters of the dam and mud reservoir the experience of retaining the mudflow was taken into account and in conformity with the method of the Kazakh Hydro-meteorological Research Institute the capacity of the mud reservoir was determined to be 12.6 million m$^3$, which corresponds to an elevation of 1900 m.

In addition to the increased capacity, the following requirements where imposed on the structures of the II phase of the Medeo dam in connection with the elimination of the mud escape: doubling of the intake and discharge structures to ensure their reliability and to provide for their inspection and repair during operation; elimination of the possibility of overfilling the mud reservoir and overflowing the dam crest; retention of the river sediments in the mud reservoir under natural conditions. The structures of the II phase of the mudflow-protecting dam include an earth dam, permanent service spillway, and an emergency-repair spillway.

**EARTH DAM**

In choosing the design for building up the dam (Figs. 1 and 2) different variants of placing fill on the upstream slope of the existing dam and on the mud deposits and the downstream slope with buildup of the crest were examined. The variant of filling the downstream slope meeting the reliability requirements called for greater volumes of fill, complicated the construction conditions, and involved the relocation of certain municipal waterworks structures and the Medeo sports complex. The variant of placing fill on the mud deposits required about half the volume of fill and was accordingly cheaper. However, in this case the problem of the reliability of a foundation composed of unstabilized mud arose.

The mud material that filled the reservoir, having good textural indices (dry bulk density 2.2-2.4 tons/m$^3$; average values of the granulometric composition: boulders larger than