EXCAVATION OF CORE CUT FOR THE NUREK HYDROELECTRIC PLANT DAM


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The 300-m-high embankment dam, with a central loam core, for the Nurek hydroelectric plant is being constructed in a narrow canyon on the Vakhsh River. For the contact of the loam core with the foundation and the canyon sides, a cut is being made, whose width, within the limits of the third-stage excavation, varies from 120 m at the lower elevations to 20 m in the upper part. The rock mass, consisting of sandstones and aleurolites, is to be removed by blasting. The rock lies in monoclinal layers without substantial dislocations or disturbances. Tectonic joints in the rock are relatively sparse (the mean distance between them is 1.0 m) and are filled with calcite. Only now and then are open passages of measurable width observed in the joints. The weak tectonic disturbance of the mass and its consolidation by secondary calcite make it possible to consider this rock as close to a homogeneous medium and to classify it under Group VIII according to the SNiP norms. The strata dip 30-35° toward the upstream. The depth of the cut varies from 1.0 to 15 m, the height of the mass to be removed is 145-150 m, and the relief is complex: the side steepness varies from 30 to 90°. The surface is lightly sodded and there are separate portions with alluvial rock up to 5 m thick. Taking into account the complex relief, difficult construction of access facilities to the excavation levels, and the state of the work (within the limits of the cut, the loam core was already being placed), a scheme for simultaneous shattering of the entire mass from tunnels was adopted. For this purpose, the mass was divided into three drilling levels (at elevations 20, 77, and 85 m, Fig. 1). At two levels (elevations 20 and 85 m), horizontal adits were driven on the slope along the trench perimeter. At the third level (elevation 77 m), an open drilling shelf was constructed because of the small thickness of the mass to be excavated there.

The upper adit was driven from two faces by the drilling-blasting method. A long portion from the upstream side was excavated with the aid of a scraper winch. From the adit mouth, the rock was pushed down the slope by a DT-54 bulldozer into previously installed cable-net traps. The driving equipment—the drills, scraper winch, and DT-54 bulldozer—were conveyed to the working level by a cable hoist. A 57-m-long portion, from the downstream side, was driven with the aid of a PML-5 mucking machine. The equipment and materials were conveyed to the face by a winch, using an inclined railway track constructed on the slope. The adopted 14-m² adit section conformed to the driving equipment.

At the working level at elevation 20 m, the 109-m-long adit was driven from a single face, from the upstream side, with the aid of an SBU-2 drill carriage and a PNB-3k mucking machine. The blasted rock was transported in railway cars to the dump. The materials and equipment were conveyed over a specially built trestle from the upstream side. The rock dump was located on a cable-net trap installed on the slope.

The drilling shelf at elevation 77 m was constructed by drilling and blasting. The rock was loosened by the small-hole method. The blasted rock was transported to the dump by the scraper winch. The required equipment and materials were conveyed to the working level by an 11-TTs cable hoist from a transfer yard at the mouth of the grouting gallery. Later, this hoist was used to transport materials and explosives to the adit at elevation 85 m and to the drilling shelf at elevation 77 m. After completing construction of the drilling shelf and the adits, drilling of the rock mass was started.

Along the perimeter of the cut—bottom and slopes—line holes were drilled, and in the mass to be loosened fans of break-down holes were made (Fig. 2). The spacing between the line holes was in the range 0.5-1.0 m, and the hole diameter was 105 mm.

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The weight of the break-down charges in the fans was calculated from the equation

$$Q = KSb,$$

in which $Q$ is the total charge weight, kg; $K$ is the design weight consumption of explosives, kg/m$^2$; $S$ is the area covered by the given fan of holes, m$^2$; and $b = 3$ m is the distance between the fan planes.

The total length of the charged portion of the holes in the fans was determined from the equation $L = Q/P$, in which $P$ is the capacity of 1.0 m of hole. For the blasting operations use was made of the following values, $K = 0.45$ kg/m$^2$, $b = 3$ m, and $P = 9$ kg/m. The stemming length was 5 m for the preline holes and 3 m for the rest of the fan holes. The holes were drilled by NKR-100m drills, which were suspended from guide tubes welded at 4-5-m spacings to vertical posts made from pipes. The posts were anchored in the roof and floor of the adit. Altogether, 1544 holes with a total length of 41,680 m, which include 732 break-down holes and 812 line holes, were drilled.