SOME RESULTS OF THE 40-YEAR OPERATION OF THE ACADEMICIAN
G. O. GRAF'TIO LOWER SVIR HYDROELECTRIC STATION

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The Lower Svir hydroelectric station was constructed 40 years ago in accordance with Lenin's plan for the electrification of Russia. The first generating unit was put into operation on December 13, 1933, and the last (fourth) on September 30, 1935. During the Second World War the station was damaged extensively and reconstructed in 1944-1948. The presence of Lake Onega at the source of the Svir River, with a surface area of 9700 km² and useful storage of about 17 km³, favorably affects the runoff regime. The total length of the Svir from the source to its discharge into Lake Ladoga is 225 km; the drop of the river between the lakes is 27.5 m, including 26.5 m over rapids (to the site of the Lower Svir station).

Two hydroelectric stations have been constructed on the Svir - Upper Svir and Lower Svir. A number of problems of shipping were solved by the construction of the sequence of hydroelectric stations on the Svir, which is a part of the most important transport lines of the Volga-Baltic and White Sea-Baltic waterways.

The exceptionally complex and unfavorable geologic and hydrogeologic conditions were a special feature of the construction site of the Lower-Svir station.* The foundation bedrocks consisted of a variegated stratum of Devonian clays with thin (from 1.5 mm to 1.5-2 m) interlayers of sands and very soft clays overlain by saturated moraine deposits, enclosing quicksand here and there. Artesian waters entering from deep water-bearing horizons are present ubiquitously in the Devonian deposits. The elevation of the free surface of these waters is 20-25 m higher than the elevation of the water level in the river. The Devonian clays and sand beds are extremely nonuniform in their density.

The construction of a large hydroelectric station with massive concrete structures under severe soil conditions was successfully accomplished for the first time in world hydraulic engineering practice, which was a major achievement of Soviet science and Soviet hydropower construction. The hydraulic structures of the Lower Svir hydro development include a 220-m-long spillway (the spillway front is 153 m), powerhouse channel earth dam, and abutting left- and right-bank embankments.

The dam (Fig. 1) is a structure with a flattened profile to which adjoin an upstream anchored apron and a downstream spillway apron. To avoid damage from differential settlement, the apron at the juncture with the dam has an asphalt-concrete section, which was developed for the first time here at the construction of the Lower Svir hydro development.

The foundation slab of the dam, resting on an elastic base, is continuous and nonsectional. The contraction joints of the dam end above the slab. In the base of the dam and upstream and downstream aprons is a 0.65-m-thick drainage layer in the form of a graded filter for collecting the water that percolated under the base. To lessen the effect of deep artesian waters a deep drain was made in the form of cylindrical wells filled with a filter.

The construction of deep and surface drains under the dam, along with the flattened profile, a continuous large massive foundation slab, and anchored-upstream apron also number among the accomplishments used for the first time in hydraulic engineering practice on the Lower Svir hydroelectric station.

The station powerhouse (about 128 m long with base width of 56 m) does not have contraction joints in the underwater part, which provided the necessary rigidity of the structure and eliminated differential settlement of individual parts caused by local nonuniformity of the soil. To increase the shear resistance, a thin reinforced-concrete

*The article of N. N. Maslov, which is supposed to be published in a future issue of the journal, gives more details on these conditions and on overcoming the difficulties - Editor.
Fig. 1. Sections through the dam. a) Sector gate; b) deep gates; c) high crest gates; d) earth dam.
1) Devonian; 2) horizontal drain; 3) asphalt-concrete; 4) anchored apron with waterproofing; 5) loam;
6) tamped concrete; 7) sand; 8) reinforced-concrete slabs; 9) deep drain; 10) sheet piling; 11) sand
placed without compaction; 12) the same with compaction; 13) supporting concrete slabs.

apron was constructed, just as on the dam, at the level of the powerhouse foundation, 20 m toward the upstream side,
and a massive concrete support was laid on the downstream side. The roof framing, support columns of the power-
house, part of the walls of the generator room, and roof, for the first time in the practice of Soviet hydraulic con-
struction, were made of precise reinforced concrete.

The channel part of the earth dam for a length of 70 m has a watertight skin of loam over its entire height
adjacent to the steel piling, which was driven along the axis of the dam.

To prevent the entry of ice and floating objects into the turbines, the powerhouse is guarded by an ice protect-
ing wall forming a forebay in front of the station.

A new lock chamber was developed and implemented for the first time in hydraulic engineering practice. The
walls of the single-lift, single-lane lock were constructed on solid foundations, and the foundation slab was cut by a
longitudinal through-joint along its axis.

Considering the complexity of the hydrogeologic conditions and the crucial nature of the structures, a check
of their condition acquired special importance. To check the deformations of the structures, 205 bench marks were
installed. The seepage flow is observed by means of piezometer tubes installed at 159 points in the foundation of
the structures at various depths. Working as individual monoliths, the blocks of the dam and powerhouse experienced