As a result the mass of the structure is markedly reduced by simplifying the structure with elimination of dozens of electric pumps with valves and cavities for accommodating them, which makes it possible to increase the height of raising the gate above the sill by 4 m compared with the design and an additional effect is achieved by this due to a reduction of specific expenditures, as well as due to a reduction of the bending loads in the load-bearing frames. The hoisting mechanisms and the elements connecting them to the gate are arranged so as not to obscure the navigation opening and so that these mechanisms do not produce a force in the horizontal plane — in the direction of action of the mechanisms drawing the gates into the side niches 13.

To compensate the change in the mass of the metal structural elements upon submergence into the water or extraction from the water, there are float tanks 14 with regulators of the hydraulic surcharge 15 and 16, which make it possible to a still greater degree to reduce the pulling forces in the hoisting mechanisms. The reliability of the modernized radial gate markedly increases, the mass of the metal structural elements will be reduced by about 1000 tons, and the cost will be reduced by more than 5 million rubles.

LITERATURE CITED

HYDRAULIC TESTS OF THE SPILLWAY OF THE ZEYA HYDROELECTRIC STATION

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The 113-m-high buttress dam of the Zeya hydroelectric station consists of 41 sections, of which 12 are spillway sections. The spillway has eight 12-m-wide bays separated by 3-m-thick walls. The maximum head on the crest is 13.1 m. The capacity of the spillway is up 9500 m³/sec during passage of a flood of 0.01% probability. The scheme of operation of the hydro development calls for the spillway to be put into operation at a head on the crest of 8.5 m, in which case its capacity is 4800 m³/sec.

The outline of the head of the spillway (Fig. 1) is made in the form of a Creager–Ofitsersov curve, below the head the spillway face is straight and its slope is 1:0.8. The ski jumps of the spillway are located at two levels at different elevation and have different angles of descent. The ski jumps of different height alternate along the front of the spillway. In the six central bays the separating walls of the ski jumps narrow in plan from 3 to 1 m over a length of 5 m. This promotes the distribution of the flow being ejected by the ski jumps over the area of the river bottom. To divert the water arriving on the ski jumps from leaks through the gate seals, there are drain pipes on the side surface of the separating walls of the lowest part of the ski jump. The water is drained from the high to the low ski jumps, and from them into the cavity between the buttresses of the dam. The heads of the drain pipes are made in the form of an indent of a special shape (see Fig. 1).

The spillway face was concreted in the warm season of the year, but concreting of the separating walls was allowed also in the winter. When performing the concreting works, to impart a high cavitation resistance to the spillway special attention was devoted to the quality of its surface. The formwork was made with an absorbing layer of two layers of burlap and two layers of coarse calico. Prestressed OVG-50 formwork was used for the straight part of the spillway [1]. Heated formwork was used in the cold season when concreting the separating walls. The ski jumps were to be made in two variants: in the traditional in situ and with the use of precast reinforced-concrete elements. The in situ concrete ski jump was made

in one bay with the use of a rack vibrator for smoothing. Concreting of the in situ ski jump was distinguished by great labor intensity, and the technology used did not guarantee a high quality of its surface. Therefore, for the other seven bays it was decided to use precast reinforced-concrete beams. These beams, having a length of 12.6 m, width of 1.5 m, and height of 0.5 m with a mass of 20 tons, were placed across the flow at a distance of 0.33 m from one another and were aligned by special devices. The spaces between the beams were covered with formwork with an absorbing layer. This formwork was removed 4-6 h after concreting and the concrete surface of the so-called closing joint was smoothed flush with the beam.

The following grades of concrete were used over the length of the spillway in accordance with the conditions of cavitation resistance and frost resistance (Mrz) [2]: on the head and parts of the separating walls adjacent to it — 300, Mrz400, cement content 360 kg/m³; on the straight part of the spillway, ski jump, and parts of the separating walls adjacent to them — 400, Mrz400, 380 kg/m³.

A distinctive feature of the spillway of the Zeya dam is that gravel was used for preparing the frost-resistant and cavitation-resistant concrete. This was due to the absence in the construction region of rock suitable for preparing rubble. The largest size of the gravel aggregate of the concrete did not exceed 40 mm. The content of plasticizing additive GKZh-94 was 0.1% of the mass of cement.

With consideration of the high contents of cement, measures to control the temperature regime of hardening of the concrete were used in the concrete of the spillway to eliminate thermal cracking of its blocks [3]: pipe cooling, which began before the start of placing the concrete, in which case the water was fed from the top down, and its temperature in the summer did not exceed 15°C and in the fall 10°; the formwork was removed 12-18 h after the end of concreting and the concrete surface was sheltered by a canopy of burlap and canvas; the burlap was kept wet for at least 6 days; the canopy was removed not earlier than 10 days after striking the formwork of the blocks, when the temperature difference between the core and face of the blocks did not exceed 30°; the intervals in placing the blocks with respect to height were 5-6 days.

The fulfillment of these measures substantially limited cracking of the spillway elements. The beams of the precast ski jumps were made of concrete of grade 400 Mrz400. It is not simple to obtain precast reinforced concrete of such a grade, the more so as the requirements imposed on the quality of the surface exposed to the flow complicated the engineering problem. After a number of experiment at the casting yard of the housing-construction plant.

Fig. 1. General views of the spillway bay (a); view A (b); scheme of indent at the inlet to the drain pipe (c).