leading to sealing and strengthening of the concrete.

Not dwelling on a detailed examination of this last type of corrosion, we can note that all examined cases of corrosion fit in the given scheme.

We will now examine, also briefly, certain basic problems of protecting concrete, first, cement. Of course, sulfate-resisting cements and barium-containing Portland cements have a high resistance in sulfate media. However, under conditions of type II corrosion this problem is not indisputable. Actually, cements have a high resistance, but mainly under those conditions when the concrete will be under water. If the concrete is located above water or in the zone of the variable water level, then this advantage is not the sole means providing resistance - other measures are necessary. Waterproofing of concrete is this measure, which produces an effect due to a change in the character of wetting of the walls and eliminates capillary migration of water. This indirectly affects also an increase of concrete resistance. Waterproofing produces a positive effect in the presence of only three phases (solid-water-air), otherwise its positive effect is absent. But the use of a more resistant binder and density of concrete is also here a necessary means of increasing the corrosion resistance.

COMBINED LAYOUTS OF CONCRETE STRUCTURES OF MULTIPURPOSE HYDRO DEVELOPMENTS

B. P. Petukhov and N. A. Sonichev

Combined designs of concrete structures, making it possible to solve multipurpose problems, are widely used when designing and constructing multipurpose hydro developments.

A classical example of such combination is the concrete structures of Pavlovka hydro development on the Ufa River (Fig. 1), where the powerhouse of the hydroelectric station is combined with the spillway and the navigation lock performs a function of an outlet and abutment connecting the powerhouse of the spillway hydrostation with the earth dam. The structural and functional combination of concrete structures made it possible to substantially reduce the consumption of materials and construction time of the Pavlovka hydro development.

In 1982-1983, the All-Union Planning, Surveying, and Scientific-Research Institute (Gidroproekt) performed research and development works in which the layout of the lock and units of the hydrostation combined in one block was proposed and developed.

Two variants of a combined layout of the lock and hydrostation units in one block were examined: with the units located in a niche of the upper lock head sill (Fig. 2); with the units in the shaft of the abutments of the upper lock head (Fig. 3).

According to the first variant, two turbines each with a capacity of 21,800 kW with headrace and tailrace channels-conduits located in the head floor are placed in a niche of the sill of the drop wall of the upper lock head. Beyond the limits of the upper lock head the water is discharged from the hydrostation units into the lower pool through conduits located in the abutment to the rear faces of the chamber and to the abutments of the lower lock head, forming with them a unified structure.

The culverts of the lock filling and discharge system are arranged in the floor of the abutments of the heads. The culverts of the abutments of the heads and chamber floor are linked within nonstandard sections of the chamber adjacent to the heads. The machine hall of the powerhouse, assembly area, and bridge cane intended for assembly and repair of the units are located in a niche of the sill of the drop wall of the upper lock head. In the abutments of the head are located a freight shaft for delivering equipment to the assembly area of the hydrostation, which is accomplished by an outside bridge crane, service and other auxiliary rooms, and also elevators and stairways for communication with the machine hall of the hydrostation and production-service rooms.

The headraces and tailraces of the units are equipped with gates, trash racks, and mechanisms for operating the latter, which provides stable operation, preventive maintenance,
Fig. 1. Combined layout of lock-outlet with the powerhouse of the spillway hydrostation: 1) Spillway hydrostation; 2) right-bank earth dam; 3) left-bank earth dam; 4) combined lock-outlet; 5) upstream approach to lock; 6) mooring-guard walls; 7) downstream approach to lock.

and repair of the units.

According to the second variant (Fig. 3), one unit with a capacity of 21,800 kW is located in the shaft of each abutment of the upper lock head. The headraces of the units are located in the drop wall of the sill and partially in the abutments, and the tailraces are completely in the abutments of the upper head. The culverts of the lock filling system are located in the floor of the upper head and the discharge culverts in the abutments of the lower head.

The headraces and tailraces of the units and also the lock culvert system are equipped with gates and trash racks, and also with mechanisms for operating the gates and racks.

The machine hall of the hydrostation with the assembly area and other rooms needed for operating the units are located in niches of the abutments of the upper head.

The machine halls of the units are equipped with bridge cranes for assembly and repair of the units. Delivery of the elements of the unit to the assembly area of the machine hall of the hydrostation is accompanied by an outside bridge crane.

The variants of locating the units in the drop wall of the sill and abutments of the upper lock head with respect to capital investments and adjusted costs were approximately equal. With respect to operating conditions the first variant deserves preference, since it makes it possible:

To provide the general machine hall of the powerhouse with one assembly area and a single bridge crane;

To locate the mechanisms of the main gates of the culverts at unflooded elevations;

In the second variant an absolutely reliable sealing of the rooms where the drives of the main gates are located should be provided;

To maximally use the area of the machine hall of the hydrostation during repair and operation of the units.

With consideration of these factors, the arrangement of the units in the niches of the sill of the upper lock head is recommended as the main variant. The design layout [1] for combining a lock and hydrostation units on one block was developed.

A new effective design layout was proposed and developed for introduction at one of the planned hydro developments, the technical and economic substantiation of the construction of