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SOLVING THE PROBLEMS OF PROTECTING THE AREAS FROM WATERLOGGING AND FLOODING THROUGH EQUIPPING DAMS WITH DRAINING ELEMENT

In recent years, Ukraine has encountered an acute problem of protection against the harmful effects of water (especially flooding and waterlogging) on settlements, economic facilities and agricultural lands.

At present, a number of state targeted programmes are being implemented in Ukraine, in particular, a comprehensive program of flood protection in western Ukraine, in the basins of the Tysa, the Dniester, the Prut and the Siret rivers. In the center of Ukraine the reconstruction of hydrotechnical structures of defensive arrays of the Dnieper reservoirs is being conducted. Most dams of the Dnieper cascade reservoirs that were built to protect 197 ths. ha and the population of 600 thousand residents have been utilized for about 50 years that corresponds to their maximum period of exploitation [1]. World Bank experts claimed the investment project "Reconstruction of hydrotechnical structures of defensive arrays of the Dnieper reservoirs" to be the best for national investments in 2016 [2]. All these activities are carried out to implement the State Environmental Policy of Ukraine [3] and the Water Strategy of Ukraine. As a result of implementation of these programs in western Ukraine there has been created a set of protective flood control structures, which include 3.5 ths. km of dams, 1.2 ths. km of shore facilities, 600 pumping and compressor stations to pump excess water. But complex protective structures on rivers and reservoirs are inadequate and require significant reconstruction of existing and construction of new ones [4, 5]. Moreover, according to the national experience, to defend against the harmful effects of water with the use of engineering measures only is impossible, although they are crucial in the fight against floods. Changes in people's attitudes to the surrounding environment are necessary.

The implementation of engineering measures to protect against flooding, depending on local conditions, the nature of the river (the regime of water level, flow velocity, etc.), landscaping can be done in the following areas:

1. diking of the area by building dams;
2. regulating of the river stream to increase its capacity and lower the water level within the populated area;
3. regulating of the river flow by building flood control reservoirs and dry containers;
4. artificial increasing of the areas relief to uncovered marks.

These are the main trends of state targeted programmes in Ukraine are aimed at solving the problem of protection from the harmful effects of water [4]. However, they are associated with the implementation of substantial quantities of earthworks,

construction of special protective structures on the designated lands, and therefore call for comprehensive analysis and feasibility studies, selection of the most appropriate and affordable options of protection.

In case of broad flooding area, the protective dikes are constructed. They can be uncovered and flooded. The crest level of the uncovered dam should be higher than the maximum level of flood water of estimated frequency. The width of the dam crest is taken 4.5 meters, providing the passage of operational transport. Flooded dams are arranged for temporary protection of agricultural lands only during the spring floods. During the period of growing crops and summer-autumn floods, the overflowing of water through the dam crest is not allowed.

Dams, depending on application area and floodplain topography, can protect one or two banks. Protective dams on both banks of the river are arranged under the conditions when the river flows through a settlement, and the banks are low. Such bilateral dams are built on the rivers Tysa and Siret.

The experience in the construction of protective flood control structures shows that the most economical are soil and stone-cast dams, built from local materials, which significantly reduce construction costs [5].

However, the soil dams during their prolonged moistening from the part where there is water, are subjected to washing out of the soil smallest particles that leads to natural aging of dams and reducing its reliability. In the course of their operation the soil dams can be subjected to deformation and destruction. The biggest risk here is filtering and wave forwarding, causing breakouts, landslides and other damages. A large number of bulk dams in Ukraine were built over 20 years ago and need restoration of the project profile and repair of varying difficulty [6]. About 40% of soil dams are in poor condition, about 30% are dangerous. The main reasons for this situation are:

1. sinking of dams body and foundations, large deformation, destruction of the coast;
2. thinning, erosion and (or) the destruction of slopes;
3. occurrence of cracks that appeared as a result of uneven subsidence of dams body, poor laying of soil, using soils with different properties, freezing of upper facilities, the impact of earthmoving animals;
4. mechanical, chemical and colloidal suffusion and bulging of soil, deterioration of the properties of the material and structures in the course of time;
5. destruction of slopes consolidation structures;
6. filtering through the base and body of the structures;
7. violation of normal functioning of the structures because of the delay of water passes through the conduit elements and their consequent destruction under the water overflow through the comb structures (incl. large floods);
8. deformation and destruction under the influence of anthropogenic factors.

The world and domestic practice has a series of engineering measures that can be used in the reconstruction of soil dams to protect surrounding areas from waterlogging and flooding.

In particular, to reduce the filtration when protecting the areas by means of diking, you can use a dam equipped with drainage-screen module (DSM). The special design used for the reconstruction of dikes (DSM) is placed from the side of the bottom slope of a dam, module drain is placed from the side of the slope and the screen is located behind the drain and reaches the soil surface), surface and filtration water flows are trapped and, consequently, the filtration resistance of the structure that prevents suffusion processes from the tailrace of the dam is increased [7].

The scientists of the National University of Water and Environmental Engineering suggested another engineering solution to protect the areas from waterlogging and flooding that are aimed at improving the stability of filtration facilities and avoiding the suffusion processes of the tailrace. By equipping the dikes with a drain element, the filtration water flows are captured both in the body of the dam and under it. The drain element is placed from the side of the slope bottom of the dikes. As an element of draining, geotextiles with different surface density can be used, in which the filtration rate is much higher than that of the soil in the dam body. In addition, the filter element is hydraulically linked to the drain dug in the ground from the side of the tailrace drains [8].

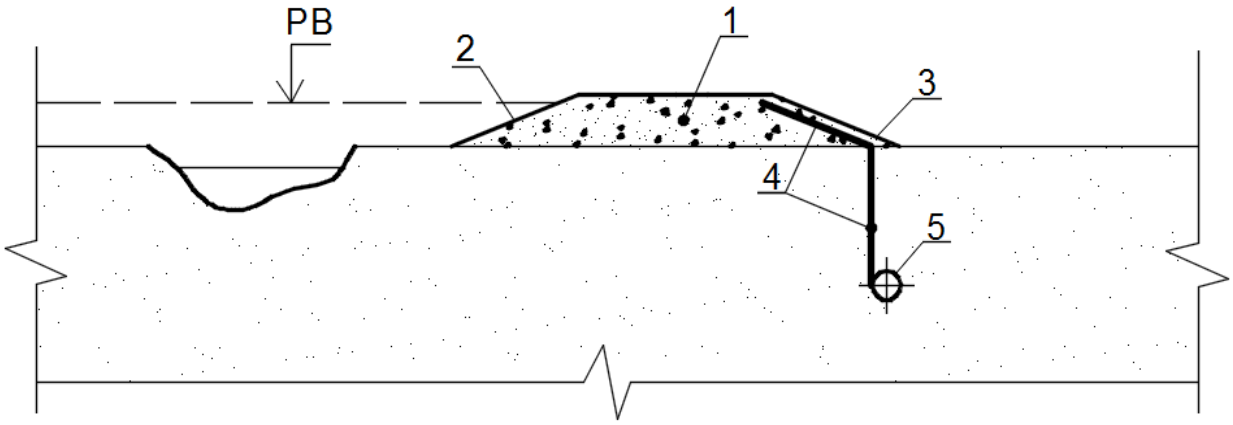

Fig.2. The dike equipped with a drain element:
1 – dike, 2, 3 – upper and bottom slopes;
4 – drain element; 5 – drain

The draining element being placed from the side of the bottom dam slope, ground water flows in the body of the dam and under it are captured by the drain, and due to the fact that its filtration rate is greater than the rate of filtration of soil of the dam body, the ground water that got into draining element is directed to the drain and, as a result of hydraulic connections, gets into it. This allows you to fully intercept the seepage that did not come out to the surface through the lower slope and the surrounding area, making suffusion processes impossible.

The suggested dike with a drain element, in most cases, provides better protection of the surrounding areas from waterlogging and flooding than conventional dam construction.

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