The main purpose of hydraulic-fill dam construction in the Soviet Union is to build coreless dams or dams with thin cores consisting of sand and gravel soils [1].

The first hydraulic-fill dam — the Ivankovo dam on the Volga — was built up from alluvial sand and did not have a core zone; its body was practically homogeneous, since the pit soils contained only negligible amounts of silt and clay fractions. The hydraulic-fill soil of this dam was characterized by a permeability coefficient of 1-10 m/day. To reduce the seepage, along the dam axis a metal diaphragm was built which cut through sand of varying coarseness in the foundation down to moraine loam. Homogeneous hydraulic-fill sand dams with diaphragms in the central portion were constructed at the Uglich and Rybinsk hydroelectric plants.

The construction of hydroelectric plants on wide plains rivers has called for development of new types of dams built up from sand soils and new solutions for the underground outline of such dams. Although formerly for joining the dam body to the native rock in the foundation, use was made of a cutoff wall, a diaphragm, or a grout curtain, with thick layers of pervious sand or gravel–pebble soils, such measures were extremely costly and in many cases technically impracticable.

In 1939 at the site of the Rybinsk hydroelectric plant hydraulic-fill construction work, using fine sand, was started for the 33-m-high Sheksna dam on pervious soils of varying coarseness in a stratum up to 40 m thick at some depressions. The project design did not include any antiseepage components in the body and foundation of this practically homogeneous dam. The upstream slope of the Sheksna dam was 1:7 on the average, and the downstream slope 1:5. Hydraulic-fill construction of this dam was completed in 1941.

Based on experience with operation of the Sheksna dam, a new type of hydraulic-fill homogeneous sand dam was developed.

A large number of homogeneous dams have been built and are now under construction on the Volga, Kama, Dnepr, Ob, and other plains rivers. In the bodies of these dams and in their foundations there are no antiseepage components, although the thickness of the pervious alluvial deposits (which include lenses and seams of gravel soils) in the foundation reaches 20–30 m.

Of particular interest is the 30-m-high homogeneous sand dam of the Kakhovka hydroelectric plant, built on weak marine estuary silts characterized by an angle of internal friction of 8° (under a load of 0.25 MPa). This dam has a spread cross section.

In the design of dams on pervious foundations, two aspects are primarily considered: ensuring of seepage resistance of the foundation soils under the design gradients taking into account the geologic characteristics of deposition of these soils (chiefly in the zone of exit of the seepage losses at the downstream side); the seepage losses from the reservoir and the magnitude of these losses with respect to the river flow having the specified frequency at the given site. For instance, at the Kiev plant, where the length of the hydraulic-fill dams was about 50 km, the total seepage losses from the reservoir amounted to 1% of the low-water discharge of the Dnepr. In the foundations of the dams of the Kiev plant, there are fine and medium sands lying in 10–30-m-thick layers.

In 1939 in the Soviet Union for hydraulic-fill dams use was made of the so-called "artificial lapping" shape, in which the slope copies the outline of the natural beaches formed in sand shores of lakes and seas. This "artificial lapping" was used for the first time in

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dike No. 46 of the Rybinsk plant on the Sheksna River. Subsequently, hydraulic-fill lapping was applied in the floodplain dam of the Gorkov plant, in the Orel' dike of the Dneprodzerzhinsk plant, and in many other dams. Thus, a new type of homogeneous hydraulic-fill dam of spread section was developed, which was applied for dams less than 10-15 m high. In a number of cases the upstream slope of such dams may withstand wave action without special revetments.

Along with construction of homogeneous sand dams, in the Soviet Union a small number of heterogeneous gravel-sand dams are being built with a central zone of fine sand or with a sandy loam-clay core zone on rock and confining beds. Hydraulic-fill construction of such dams is carried out in regions where the corresponding pit soils exist and special limitations are placed on the reservoir water losses.

For construction of heterogeneous gravel-sand dams, in certain cases use is made of a combined work execution scheme. For instance, the upstream, lateral, and central zones are built by the hydromechanization method, and at the same time coarse gravel-pebble material is placed by trucks in the downstream zone (dam of the Plyavinyas hydroelectric plant on the Daugava River). This combined work execution method significantly speeds up the construction of earth structures.

In seismic regions, hydraulic-fill dams are strengthened by large up- and downstream embankments built up from rock or gravel-pebble material. The hydraulic-fill body proper lies between the above-mentioned embankments, and the up- and downstream slopes are usually surcharged with a rock or gravel-pebble fill. For hydraulic-fill construction of such dams, fine sands, sandy loams, and loess soils are used.

The experience with construction of hydraulic-fill dams in the Soviet Union has demonstrated the feasibility of using, for the hydraulic fills, pit soils in the wide range from silty loam (loess soil) to gravel-pebble soil with a maximum particle size of 100-150 mm.

Based on the particle-size distribution of different pit soils in hydraulic-fill dams, taking into account the recommendations of a normative document [2], Fig. 1 shows limit curves of five soil zones which serve for approximate evaluation of the particle-size distribution of the pit soil for construction of any type of hydraulic-fill dam.

Thus, depending on the zone within whose limits the particle-size distribution curve of the selected pit soil is located, the following types of hydraulic-fill dams may be built: zone 1—homogeneous sand dam; zone 2—heterogeneous gravel-sand or loess dam; zone 3—homogeneous sandy loam or loess dam. The pit soils of zone 4 can be used, after the corresponding substantiation, for separate hydraulic-fill placement of the dam core zone, and the soil of zone 5 can be used for separate hydraulic-fill placement of the lateral zone of the dam. Moreover, if the clay soil of zone 4 is in a solid state and yields a lumpy material when excavated by suction dredges, then it can be used for hydraulic-fill construction of a homogeneous clay dam.

A characteristic of Soviet hydraulic-fill dams is their comparatively spread section. Based on experience with construction of these dams, Table 1 shows the dam slope values which are recommended for use during the preliminary design stage. The basis of the adopted dam