FROM THE EXPERIENCE OF CONSTRUCTION ORGANIZATIONS

LOWER THE WATER TABLE WITH RADIAL DRAINS

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Recently, a rise in water table has frequently been observed at construction sites. This is explained by a number of reasons: a disturbance in the equilibrium between atmospheric precipitation and its evaporation after paving the site and building various structures; leakage from water-carrying utilities, water towers, sprinklers, and artificial reservoirs; insufficient capacity of existing storm inlets and storm-runoff collectors; a rise in the water level in rivers as a result of the construction of hydrotechnical facilities; the filling of ravines and the construction of their slopes without providing for sufficient drainage facilities; and so forth. The variety of causes for a rise in water table complicates its control. Until recently, it was done by installing various components of vertical and horizontal, as well as curtain drains. Their use at construction sites in the presence of a large number of underground utilities is, however, difficult. Radial drains have therefore come into recent use for this purpose. This method consists in the fact that vertical shafts of the necessary depth are installed in the area being drained, and horizontal holes—laterals in which underdrains, which convert the laterals into drains located at the required depth, are drilled from the shafts.

The basic value of the method consists in the fact that the lateral drains can be installed at the construction site under existing buildings and structures without disturbing basement rooms and utilities. Since the length of the laterals may reach 100 m, the water-entrapping capacity of the radial horizontal holes is very high. All of this opens broad perspectives for use of radial drainage to protect industrial and urban areas from underground water.

A major research study on the implementation of radial drainage to dewater quarries and mine deposits and on the development of a method for its design and installation technology was performed by the Belgorod Institute BIOGEM [1-5].

In using radial drainage to lower the water table at a construction site, the technology previously mastered for its installation had to be altered, and a method of computation and a computer program developed for the new conditions. The fact is that a relatively ordered computational scheme exists for the case of the symmetric positioning of lateral holes in a group [4], which can be accomplished only in dewatering open deposits [3]. The problem, by nature, has no solution for an arbitrary arrangement of lateral holes in a group. Moreover, the positioning of holes in a group may be extremely arbitrary in lowering the water table under buildings and structures at construction sites using radial drains; as a rule, the length of the holes well also vary. To evaluate the effectiveness of radial drains, it is necessary to have a computational method that makes it possible, so to speak, to determine roughly the extent to which the water table will drop within the limits of the section being protected. As approximate computational procedure based on successive use of available equations for the discharge of a group with symmetric holes and an equation for lowering of the water table with separation by hole in a constant-flow regime under conditions of constant-intensity infiltration is therefore used [4, 5]. This computation is performed on a computer via a program introduced by the Ukrainian Design Institute for Special Construction as applied to the described conditions according to which the computation is carried out in the following sequence: the discharge from a single lateral is determined first, and then the overall discharge of each shaft, i.e., the group of lateral holes arranged in it (Fig. 1), and subsequently, the entire system of interacting drains. The discharge of each shaft is determined with consideration of their interaction; the delivery for each drain as introduced per 1 m of lateral drain. The drop in the water table at arbitrary points of the seam is subsequently computed for the operation of a certain number of radial drains.


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The computations are performed by the method of successive approximations for several controls at the most critical points in the area being dewatered. The required drainage effect is attained by increasing the number of radial drains; the calculations are completed when the required drop in water level is attained at given points of the area.

As an example, let us examine the dewatering using a lateral drain built according to drawings developed by the Ukrainian Design Institute for Special Construction in cooperation with the Dnepropetrovsk Civil Engineering Institute at the Dnepropetrovsk Tire Plant.

Beginning in 1970, wide cracks with an opening ranging from 50 to 200 mm began to appear in the walls of the buildings at this plant. As observations and analysis of local conditions indicated, fundation settlements, which had reached 40-100 mm, were caused by the wetting of loess soils prone to slump-type settlement in which the industrial buildings of the plant were constructed.

During the survey period for the plant's construction (1956), no ground water was observed to a depth of 30-35 m. In 1978, the water table was located at a depth of 5-7 m, i.e., the groundwater had risen by 25-30 m during the plant's occupancy, and this ascent was continuing at a steady rate. On wetting the soils composing the compressible stratum, foundation deformations could have increased significantly; it was therefore required to take urgent measures to lower the water table, and, primarily, to prevent its further ascent.

Use of vertical and latent drainage under these conditions of active shops was found impossible due to the high building density, equipment saturation, and the development of a dense network of underground utilities. It was therefore decided to lower the water table under the plant's buildings using radial drains.

A unique dewatering system was developed for each building. Radial drainage, which includes eight reinforced-concrete shafts with lateral radial drains 40-90 m long was designed for the administration building (designed to cover the entire area under the building). The 14-m-deep shafts were positioned on the outside along the perimeter of the building; 4-5 laterals were opened from each shift. Dewatering beneath the plant's small structures was accomplished by a system of laterals from a single shaft. This scheme was adopted, for example, for dewatering beneath a tank storing fuel oil for a central boiler (Fig. 2). The lateral drains in this system were opened beneath the embedded tank compartments to lower the water table below the foundations and to dewater the basements (Fig. 3).

With the lateral drainage in service, the groundwater that enters the radial drains discharges into the collecting receivers of the shaft, from where they are periodically pumped into the storm sewer.