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## HYDROGEOLOGICAL MODEL OF THE TERRITORY OF KOWSAR HYDRAULIC PROJECT

Mathematical hydrogeology model of the territory of Kowsar Project was created with account for the results of the engineering surveys and hydro geological monitoring, which was conducted in the process of Kowsar Project construction. In order to create the model in the present work a universal computer system Ansys was used, which implements the finite element method and solid modeling technology, allowing to solve the filtration problem with the use of thermal analogy.

The three-dimensional geometric model was built with use of the principle “hard body” modeling, which displays the main line of the territory relief, including the created water reservoir, geological structure (anticline Duk) and the main lithological complexes developed within the territory.

In the limestone mass As here is a zone characterized by water permeability on territory of Kowsar Project, and a layer characterized by seepage feeding, which occurs outside the considered territory. The water reservoir is a source of the change of hydro geological situation. The results of field observations witness, that the levels of underground waters within the area of the main structures reacts almost instantly on the water level change in the water reservoir; the delay period of levels change is not more than 1,5…2,0 weeks at maximum distance from the water reservoir. These particularities of the hydro geological regime allow using the steady-state scheme of the decision of forecast problems.

The mass of limestone As, containing the structures of the Kowsar Project, is not homogeneous and anisotropy in its seepage characteristics. The heterogeneity is conditioned by exogenous influence on the mass up to the depth of 100…150 m. The seepage anisotropy of the mass is expressed by the difference of water permeability of the mass along and across the layers for almost one order.

The structures of Kowsar Project is presented by a dam, grouting curtain on axis of the dam and consolidation curtain in its both banks, drainage structures.

Underground waters of the territory are formed by infiltration. They unload in river Heirabad.

In accordance with this circumstance, the northwest (the right bank) and the south-east (the left bank) hydro geological borders of the model are the borders with constant discharge seepage, entering from the area of the feeding in the area of unloading. The borders are distanced from the river on 2,5 km. In accordance with the regional direction of the flow of underground waters, the model is limited along the lines of the current (the impervious borders) at northeast (upwards on river) and southwest (down on river). Those borders are distanced from river on 2,2…2,3 km. As a result, the area of model is 28 km$^2$. A roofing of almost watertight marls of the retinue Pb is the bottom border of the model. The internal borders are presented by the river Heirabad, the water reservoir and the drainage structures.

The calibration of the model was conducted at the reservoir water mark of 580 m and 606…610 m. The correctness criterion of the decision had shown the convergence of the obtained values of discharge level of underground waters with the data of natural observations. In the process of calibration the revision of the input data was carried out — a seepage characteristic of thick limestone mass As and discharge, entering from the right and left bank borders of the model.

The forecast calculation was performed for water reservoir level of 620 m.

The creation of water reservoir has influenced the seepage regime of the territory by the area of more than 25 km$^2$. As a result of the buttress of the natural inflow there occurred the redistribution of the natural inflow and change of the direction of the natural inflow that has caused the appearance of springs in downstream of dam near the contact of the series As-Gs.

The design inflow of underground waters in the river Heirabad on the area from dam up to the contact of the suites As and Gs in downstream is 2,4…2,6 m$^3$/s including springs. The share of the direct seepage from water reservoir forms ~40 % of this values, the rest 60 % correspond to the unload natural inflow redistributed as a result of buttress.

It is possible to define the level and discharges of underground waters on the territory of hydro unit under any elevation of water reservoir with the help of the created geo seepage model. The model can be used for effectiveness evaluation of the grouting curtain in the operation period.

Key words: hydrogeological model, underground water, water permeability, water reservoir, grouting curtain, drainage structures, seepage anisotropy, calibration, Kowsar, Iran.

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