MONITORING THE GURA APELOR DAM BEHAVIOUR IN TIME

Cuzic OvidiuŞtefan* , Man Teodor Eugen **

*University Politehnica, Faculty of Civil EngineeringDepartment of Hydrotechnical Engineering, George Enescu 1/ATimişoara 300022 România e-mail: cuzic_ovidiu@yahoo.com
**Polytechnica University of Timisoara, Faculty of Civil EngineeringDepartment of Hydrotechnical Engineering, George Enescu 1/ATimişoara 300022 România e-mai : eugen.man@upt.ro

Abstract

The paper presents an analysis of the response of buildings and adjacent areas to stress during the analysed period and the identification of causes of potential risk situations for the statics, establishment and functioning of the works in the future. Impact issues of the buildings and accumulations on the environment (erosions, sediments, land glides, water level increases in the adjacent areas, damping, marching, springing, etc.) that could result from the current monitoring of the constructions being operated. The correct assessment of the impact of these aspects on the environment is the result of special measurements conducted on a constant basis on the dam.

Keywords: rock dam, filtration, exfiltration, clay core, Gura Apelor

INTRODUCTION

The goal of the paper was to analyse the behaviour of the Gura Apelor Dam of the AHE Râul Mare Retezat.The dam on the upper basin of the Râul Mare is located in the Godeanu Massif, south-west Retezat Massif and southeast Ţarcu-Petreanu Mountains, crossing the "Parcul Naţional Retezat" Scientific Reserve; it is the largest rock dam and clay core in Europe. The founding rock is made up of a complex of crystal share and granite gneiss. This dam is the basis of a strictly energetic operation. The Râul Mare hydro-power plant in the Retezat Mountain uses the dam to produce electric power based on the water flows from a hydro graphic basin of about 383 km^2.

TECHNICAL DATA

The dam holds back about 210,000,000 m^3 of water in a reservoir of about 4.7 km along the Lăpuşnicu Mare River, 3.9 km along the Lăpuşnicu Mic River and 5.4 km along the Şes River, with a NNR of 1,072.50 mdM. The building of the dam was prepared starting with early 1976 and the final height (1,078.50 mdM) of the fillings was reached in 1998. The founding rock is made up of a complex of crystal share and granite gneiss. The right slope, the river bed and the left slope below about 1,030 mdM consist in gray quartz shale with greenish chlorine-sericitous bands. The left slope below about 1,030 mdM and down to about 950 mdM is made up of tectonised, breciphied graph shale. The rock in the dam is, in general, waterproof, water circulation in the rock taking place through the clefts. Water permeability trials under stress in the geological research drills pointed out important absorption on the left slope, particularly in the tectonised area between the granite and the shale. The large absorption area covers important depths down to 70-90 m along almost the entire slope. The granulometry of the clay in the core of the dam at the contact line with the founding rock is in the 0-5 mm range and that of the core is in the 0-150 mm range. The content of fine fractions (Ø < 0.005 mm) was 35-56% in contact clay and 12-39% in current clay. Permeability coefficient was below 5 x 10^{-8} cm/s. Optimum compaction moisture established based on the Standard Proctor Curve (L = 60 kgfm/dm^3) evolved within the 15-20% range. Plasticity features was within the project range (low limit Wp and high limit Wl), i.e. 15-35% in contact clay and 12-30% in current clay. Based on the mean values of WI, Wp and of plasticity indices Ip from trial processing we can see that contact clay is, according to Cassagrade classification, within the good plasticity category and current clay is within the less plastic category.

In the profiles monitored through AMC, water infiltration pressure in the rock clefts corresponds to the water column height at the upstream end of the core. Representations of the equal value curves of the filtering pressures in the rock discontinuities measured in the interstitial pressure cells in the drills show that the most important hydraulic loss takes place up to the tightening volume; the subterranean hydraulic loss of the lake water level during the analysed period can be about 4...10 m^3 in central profiles, i.e. practically the same as the one pointed out upon completion of fillings and charging with the highest hydrostatic pressure of partial operation. On the right slope, where depth tightening is done with injections from vertical drills between galleries and drilling rosettes towards the founding rock of the core, filtering pressures are practically reduced completely up to the wall from the slope galleries located about the axis of the construction; this supposes a more effective injection of the rock on the right slope (quartz bands) related to that on the left slope, particularly at levels above about 950 mdM.

On both the left and right slopes, filtering pressures reduce completely towards the downstream core end in the cells located in this area the pressures ranging within 0.2...0.6 daN/cm^2.

For the levels of the lake water reduced nowadays down to 995 mdM, subterranean filtering in the core monitored through AMC corresponds largely to the theoretical model known in literature. During the period analysed, there were no significant changes of the filtering compared to the previous years, as shown by the shape of the equal pressure curves in chronological order from the completion of the fillings (1998) to the current analysis period. The complexity of the subterranean flow under the core excludes the analysis of the flows drained by each drain or source of the dam galleries; it suffices to analyse the total flows in each gallery, i.e. the sum of the flows measured volumetrically in each drainage or source.

To avoid clogging of the infiltration and filtering ways in time, we modelled the series of total exfiltering flows measured in the galleries and of those measured in the discharges between 2003 and 2004...2009 depending on the lake levels; processed results point out the following important aspects:

There was clogging of infiltration and filtering ways of the lake water in the founding rock of the core because mainly of the fine sediments on the bottom of the lake upstream the core, along the clefts of the rock under the core and probably of the drainage drills identified by the decrease in time of the exfiltered flows; As is found in the use of the veil running stage, under the approximatlez share. 995mdM could not be executed in the period under the review of major work to seal in the rock. In the previous periods analysed, it is known that Lake levels rise above this quota, producing a significant increase in debt drained from the collection and drainage of the left wall, as a result of injection should be discontinued under this quota. It said that during the next level restrictions or other periods of clear lake in connection with continued use of the veil at low rates do not form the subject of this documentation; UCCH laboratory will study the documents or specialized projects that will develop in future in connection with the possible continuation of the use of the veil under 990mdM and himself share the provisions relating to operating levels of the Lake. In this documentation, you resorted to just analizările during the 2004 ...2009.

Though there was clogging of the infiltration ways, it was of little significance; according to the data between 2004...2008, there was an exaggerated trend of the flow increase of the lake levels above the 990...1,000 mdM, which asked for a restriction of the operation level of the lake in 2009 to NM = 1,000 mdM and a continuation of injections.

CONCLUSION

The analysis of exfiltrations shows that, though there occurred during the 15 years of dam operation clogging of the infiltration ways it was relatively low and seemed to maintain the risk of increasing infiltrations at levels above about 990-995 mdM, which motivates the restrictions of lake operation below levels of 995...1,000 mdM and the continuation of injections on the left slope below these levels, up to 1,005...1,010 mdM, which could confirm or not the hypothesis above and motivate the measures to be taken later on.

The analysis in 2006 of the sediments in the discharge basins Dv1 and Dv4 through specific laboratory methods pointed out that they did not contain clay from the dam core. From laboratory analysis of sediment deposited in the basin outflow DV1 (the gallery collection, dimensions about. 1000Mdm) and DV4 (based on slope, collection gallery, share approx. 914 mdM), conducted in 2006 and whose data results study found that sediment samples showed traces of clay minerals (illite and montmorillonite), most likely derived from material deposited on the slope of the rock cracks. During the period under review, there were no studies analyzing taught mineralogical deposits of river weirs.

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