Prediction and measurement of pore pressure

Prévision et mesure de la pression interstitielle

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SYNOPSIS A comparison is made between the predicted and values measured in situ of pore pressure in the clay of core of the Yovkovtsy Earth Dam. For this purpose already at the time of construction check-rate instruments were installed in two cross sections to follow the stress-strain state, pore pressure and seepage both at the time of building and of operation. A long period of time analysis of the records of the observations and comparison of the values of the forecasted pore pressure is made on the basis of laboratory analysis and theoretical calculations.

INTRODUCTION

Yovkovtsy Dam was built in 1972-1978 ans is part of the hydroelectric complex designed mainly for drinking and industrial water supply; It is a rockfill dam (Fig. 1) with a vertical clay core A1. Three filter layers are built at both sides of the watertight element, B1 (0,01-10 mm) with a thickness of 2 m, B2 (0,05-100 mm) with a thickness of 3 m, and a transitional zone - filter B3 (0-300 mm).

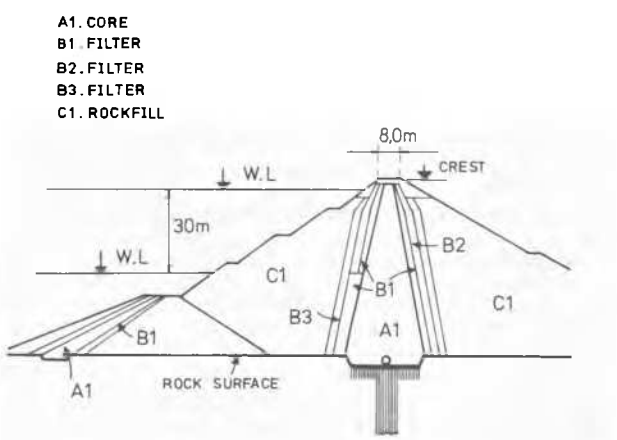


Fig. 1

The core is laid on a concrete slab of a thickness of about one meter, lying directly on the bed rock. Under the clay core a grouting and an area cementation of a depth of about 3,5 m are made. The main upstream and downstream shells C1 with slopes 1:1,4 and 1:1,7 are rock embankments. The tight element of the cofferdam, included in the embankment of the main dam is made of the same material as the clay core.

Clay core

Disposed in the central part of the dam, the clay core is made of a material with the following properties.

optimal water content	19 - 20	%
maximum dry density	17.0-17.3	kN/m^3
liquid limit	36,5	%
plasticity index	18	
200 - 2 mm	-	
2 - 0,1 mm	12 - 18	%
0,1-0,005 mm	51 - 58	%
< 0,005 mm	30 - 31	%
permeability	10^{-10}	m/s

The compaction of the material in the core is made in layers under conditions of optimum water content and maximum dry density after Proctor. Out of a total of 2240 days 816 days were necessary for the continuous filling and 1423 days - for stoppage because of climatic circumstances.

Laboratory analyses and theoretical calculations

On the basis of numerous laboratory investigations made under triaxial stressed conditions, samples of the material of the clay core were examined up to 1500 kPa confined pressure in a triaxial cell to determine the coefficient of pore pressure $\bar{B}$ according to the Skempton-Bishop method. The laboratory results and the adopted theoretical model of calculation, based on the VODEGO-method for determining the two-dimensional problem, when the three-phase soil system begins to deform under its own load and the deviation of the limit value of the pressure function as well as under certain preconditions were presented to the 8th ICSMFE by Dingosov, G., Markov, G., Alexieva, L. Alexiev, A. (1973).

Check-measurement instruments

Check-measurement instruments for observations of the behavior of the stress-strain state, pore pressure and seepage were installed at the

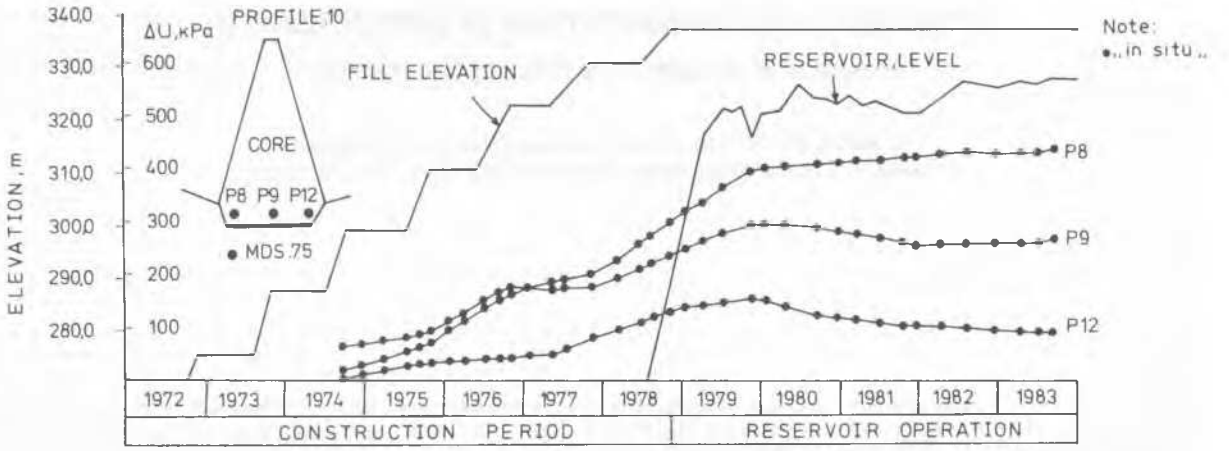
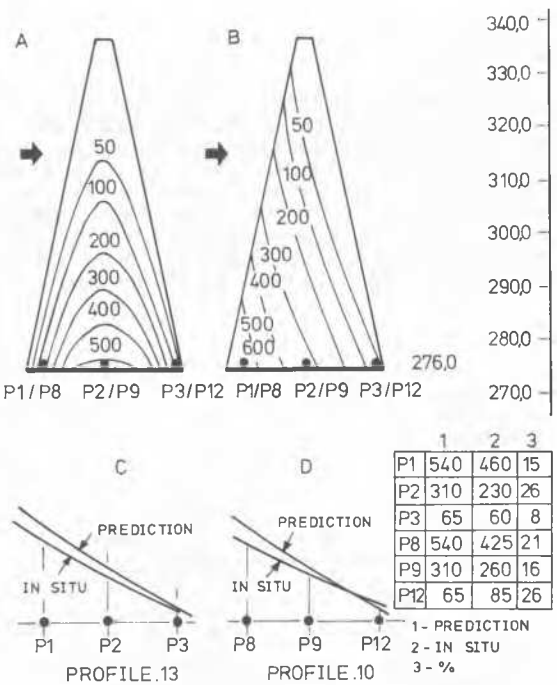


Fig. 2

time of clay core construction and in the period of operation. 14 and 9 instruments type Maihak, MDS-75 for measurung the pore pressure are installed in two cross sections "10" and "13", disposed approximately 17 m on both sides of the central section in three levels: 276.00, 296.00 and 320.00, respectivelly. 23 instruments are installed in the clay core. The measurements in the embankments began in 1973. Since then regular measurements are conducted.

Analysis of the observations and data comparison

The analysis of the results of the observatious for a comparatively long period of time (1973-1983) given in Fig. 2 allows to comparison of the predicted values of the pore pressure with the actually measured in-situ, as this was done at Kamchia Dam (Dingosov, G., Markov, G., 1977). It was found that optimum comparison between in-situ measured values of the pore pressure and those predicted for the development of the consolidation processes in the core should be done at the time corresponding to the embankment compaction at optimum water content and maximum density. A computer programme, which allows the determination of the consolidation process in the core has been set up. During the 4-years period after the construction of the dam a perfect correspondance between the values for level 276.00 from section "10" measured in-situ by means of the instruments P8, P9 and P12 (Fig. 2) and the predicted values has been established. In the table at the right down corner of Fig. 3 are given the values of the pore pressure (predicted-measured in-situ) and the procentage deflection. As it is seen the deflection ranges from 8% to 26%.



	1	2	3
P1	540	460	15
P2	310	230	26
P3	65	60	8
P8	540	425	21
P9	310	260	16
P12	65	85	26

Fig. 3

CONCLUSION

Bearing all this in mind we have to design in the future such grounds engineering structures and use the already adopted laboratory methods as well as the theoretical solutions applied for determining the type and distribution of the isochrones of the pore pressure in the process of consolidation in the clay cores of embankment dams.

REFERENCES

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Dingosov, G., Markov, G. (1977). Pore pressure distribution in a rock-fill dam. 9th ICSMFE (2/24), Tokyo.