NOVATEUR PUBLICATIONS
INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY
[IJIERT] ISSN: 2394-3696 Website: ijiert.org
VOLUME 10, ISSUE 3, Mar. -2023

CALCULATIONS OF REGULATION OF THE DRAIN FRONT OF THE REZAKSAY RESERVOIR

Khaydarov Sherzod Ergashalievich,
Senior Lecturer, Namangan Engineering - Construction Institute
E-mail: inventor_uz@mail.ru,

Khudaikulov Savet Ishonkulovich
D. T.S. Professor, Tashkent Institute of Chemical Technology
E-mail: S.Xudaykulov@mail.ru

Abstract:

The article considers the numerical solution of the problem of finding the relative velocity within the apron using an electronic computer.

It is shown that a greater increase in specific flow rates within the apron than in the case of alternating partially and fully open doors, and during the operation of structures, the entire opening of the dam should be partially opened at the beginning.

Keywords: Rezaksay reservoir, modeling, regulation, spillway front, flow expansion, flow rate, hole opening, Froude number.

Аннотация:

В статье рассмотрена численное решение задачи нахождения относительной скорости в пределах рисбермы с использованием ЭВМ.

Показано, большее увеличение удельных расходов в пределах рисбермы, чем в случае чередования частично и полностью открытых дверей, а при эксплуатации сооружений следует в начале открывать все отверстие плотины частично.

Ключевые слова: Резаксайская водохранилища, моделирование, регулирование, водосливной фронт, расширение потока, расход, открытия отверстие, число Фруда.

Introduction

Modeling the regulation of the spillway front of the Rezaksai reservoir was carried out according to the following data, where the width of the core of constant velocities b_* was determined from experimental data depending on the degree of expansion of the flow β. Correction of the momentum α_{0B} at $\beta_i < 2$, $\beta < 4$ is found from expression (13) using the known value b_*.

Problem Solving

The numerical solution of the problem of finding the relative velocity within the apron was carried out on a computer.

The following parameters were considered given in the task: $\beta_i = 2 \Leftrightarrow 6$; $Fr_1 = 10 \Leftrightarrow 100$, their corresponding conjugate depths $\frac{h_1}{h_2}$; α_{0B} .

The calculations were carried out for the spillway, the Rezaksai reservoir, which has 24, 12 and 6 spans. The final results of the calculation are presented in the form of a series of curves of the dependence of the relative velocity $\frac{u_m}{u_1}$ on the Froude number Fr_1 and the degree of expansion of the flow β (Fig. 2, a at $\alpha_{0B} = 7$, Fig. 1.b. at $\alpha_{0B} < 7$).

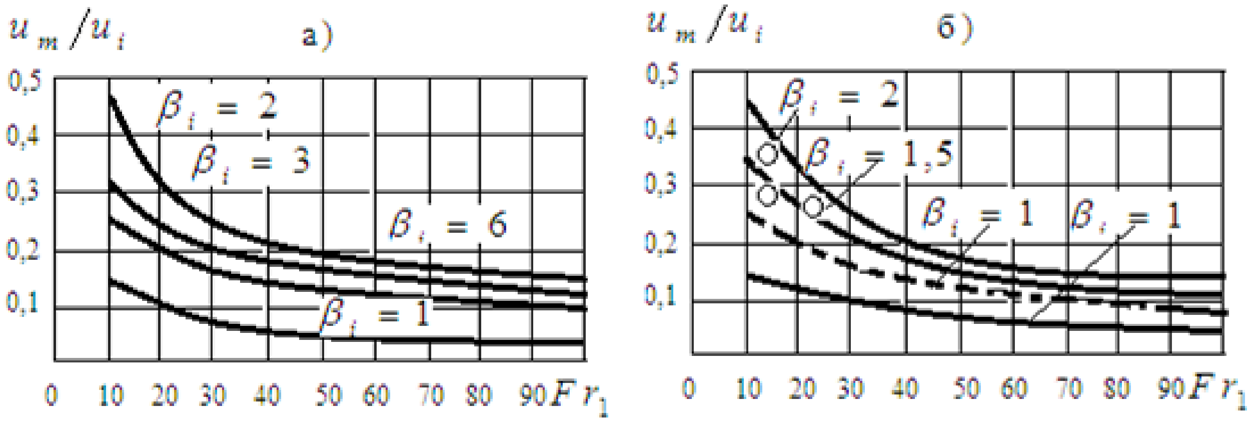

Fig. 1. Graphs $\frac{u_m}{u_1} = f(Fr_1, \beta)$ a) at $\beta_i > 2$ b) at $\beta_i < 2$

The maximum flow velocities occur in the downstream under the condition that half of the spillway front is partially open, and in the second half, partially and completely open holes alternate through one. This position is consistent with the experimental data given below.

At $\beta_i = 1$ half of the spillway front openings will be fully open, and half - partially (hence, $\beta = 2$, $\beta_i = \frac{\beta}{2} = 1$, in the downstream - flat conditions, and within the dam - an uneven distribution of flows along the front, since each partially open hole alternates with a fully open one).

An analysis of the graphs shows that at $\beta_i > 2$ (Fig. 1, a) for a constant Froude number, with a decrease in the degree of expansion, the relative velocities increase, and at $\beta_i < 2$ (Fig. 1, b) they decrease, approaching the values of the relative velocity in flat conditions ($\beta_i = 1, \beta = 2$); for a constant degree of expansion, as the number Fr_1 increases, the relative velocities decrease.

The given results are valid if the Froude number in the compressed section of the flow is $Fr_1 > 10$. At $Fr_1 < 10$ the conjugation of the pools will be carried out according to a type close to a jump-wave, for which the given dependences in some cases do not give a solution.

An estimate of the degree of increase in the specific flow rate within the apron will be obtained by comparing the specific flow rate q_{np} in the spatial flow with the specific flow rate q_1 in the section I-I behind the dam with the full opening of all holes ($\beta = 1$):

$$\frac{q_{\text{пр}}}{q_1} = \frac{u_m h_B}{u_1 h_1 n_3} = \left(\frac{u_m}{u_1}\right)_{\text{пр}} \left(\frac{u_1}{u_2}\right)_{\text{пл}} / \frac{1}{n_3}$$

where $n_3 = \frac{h_2}{h_B}$ - relative velocities in the downstream in flat (with full opening of all holes, Fig.2, b, curve at $\beta = 1$) and spatial (Fig.2, a, b, $\beta_i > 1$, $\beta > 2$) conditions; are determined from the formulas:

$$\left(\frac{u_2}{u_1}\right)_{\text{пр}} = \frac{h_1}{h_2}\left(\frac{u_1}{u_2}\right)_{\text{пр}}$$

Dependence graph $\frac{q_{\text{пр}}}{q_1}$ (Fig. 3, curve 2) shows that at $\beta = 4$ the specific flow rate within the apron with alternating partially and fully open holes is 1,7 times higher than the specific flow rate in the I-I section behind the dam with full opening of all holes.

When the entire weir front is operated according to the alternating scheme, openings are partially and completely opened in the downstream, the lowest specific flow rate is set to $\frac{q_1 + 0{,}2q_1}{2} = 0{,}6q_1$. With an increase in the degree of expansion of the flow in the downstream β_i from 2 to 6, the ratio $\frac{q_{\text{пр}}}{q_1}$ tends to unity, and when β_i decreases from 2 to 1, $\frac{q_{\text{пр}}}{q_1}$ tends to 0.6. The Froude number has little effect on the change in relative unit costs.

For comparison, in Fig. Figure 3 shows curve 1, which characterizes the change in the relative specific flow rates in the case of one-sided opening of spans completely, provided that the remaining spans are already open at $\frac{1}{5}$ full head on the spillway crest [8,12].

Conclusion. With this scheme, a greater increase in specific flow rates within the apron is obtained than in the case of alternating partially and fully open holes.

Thus, during the operation of structures, the weight of the opening of the dam should first be partially opened. After all the shutters are partially open, it is recommended to raise the shutters completely through one, starting from the second. Then all holes are allowed to open completely in a row. [8,10,11]

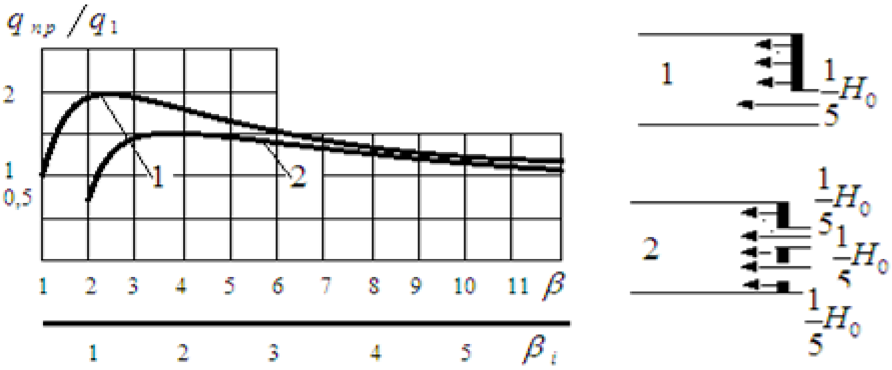

Fig. 2. Graphs of changes in relative specific costs 1 with sequential one-sided full opening $\frac{q_{пр}}{q_1} = f(Fr_1, \beta)$

2 - with alternating partially and fully open shutters $\frac{q_{пр}}{q_1} = f(Fr_1, \beta_i)$

Experimental studies: In order to study the qualitative side of the process and verify the calculated dependencies obtained theoretically, experimental studies were carried out in the laboratory “Reservoir and their safety” Research Institute of Irrigation and Water Problems.

Experiments according to the scheme shown in Fig. 1 were carried out on a model of a six-span dam with a smooth reservoir installed in a rectangular horizontal flume 2.4 m wide, the working part 7 m long. The clear span width was taken to be 34 cm, and the thickness of the steers 6 cm.

The profile of the spillway dam with a height of 28.5 cm was outlined according to the coordinates of Krieger - Ofitserov and smoothly mated with the bottom of the dam. The limited number of spans (maximum $\beta = 6$) and the height of the dam made it possible to carry out only three experiments.

Depending on the flow rate Q through the fully open holes (the rest of the holes are still closed) and. of the corresponding head H_0 on the crest of the weir, the second conjugate depth of the h_2 - bottom hydraulic jump was calculated under the conditions of a two-dimensional problem. Depth h_2 was set at the end of the tray and kept constant. Then the remaining holes were opened by 1/5 H_0 and the flow rate was increased until the depth in the upper pool was set at the same level. [8,9,12].

At the same time, in the tailpipe, the jets flowing from completely open holes merged into one outside the jump, forming a jet stream so that the entire water flow was concentrated at one side of the flume, which is explained by the ejecting property of the jet. A whirlpool with a vertical axis of rotation formed at the other side. The transverse slope of the free surface outside the jump was equal to zero, no flow separation from the side wall was observed.

The measurement of velocities in the transit flow was carried out using a three-point method using a Pitot tube. The piezo metric head was measured with a static hole of this tube in five sections located in the tray every 0.5 m, starting from the compressed section. Experiments have established that the collection of the flow with a given scheme of operation of the structure is expressed only in an increase in specific costs.

The values of the maximum speed within the apron for various flow rates at $\beta_i = 1{,}5$ were plotted on the corresponding curve (Fig. 2.6). The experimental values of $\frac{u_m}{u_1}$ and $\frac{q_{np}}{q_1}$ are in good agreement with the calculated curves. The table illustrates the significance of the hydraulic parameters in the experiments.

Table

Experience number	Q, lit/sec	$\beta_i = N/n_i$	$H, см.$	$h_k, см.$	$h_1, см.$	$h_2, см.$	Fr_1	u_m/u_1	q_{np}/q_1
1	80	1,5	19,6	14,65	5,3	22,4	10,9	0,934	1,28
2	65	1,5	13,9	13,3	3,96	20,3	16	0,248	1,21
3	13	1,5	5,2	7,8	2,79	15,3	17,6	0,229	1,22

The results obtained from the experiments confirm the correctness of the chosen mathematical method.

References:

1. Абрамович Г. Н. Теория турбулентных струй. Физматгиз, 1960.-.
2. Леви И. И. Движение речных потоков в нижних бьефах гидротехнических сооружений. Госэнергоиздат, 1955.
3. Михалев М. А. К теории гидравлического прыжка. Изноетня, ВНИИГ, т. 78, «Энергия», 1965.
4. Михалев М. А. Расчет второй сопряженной глубины в пространственных условиях сопряжения бьефов. Гидротехническое строительство, 1965, № 8.
5. Чугаев Р. Р. Водосливные бетонные плотины. Ч. I, ЛПИ., 1958.
6. Рахманов А. Н. Очертание поверхностного водоворота транзитного» потока и некоторые характеристики донного гидравлического прыжка. Известия ВНИИГ, т. 59. «Энергия», 1958.
7. Гунько Ф. Г. Методика гидравлических расчетов нижних бьефов. многопролетных плотин на равнинных реках при маневрировании затворами. Госэнергоиздат, 1957.
8. Якушкина О. И. Исследование сбойного течения в нижнем бьефе за многопролетной плотиной в случае одностороннего планового расширения потока. Труды ЛПИ, № 312, 1971.
9. У.И. Бегимов,Н.А. Усмонова, Х.М. Якубова, С.И. Худайкулов «Моделирование ударного импульса в водовыпускном трубопроводе»каркидонского водохранилища. Журнал «Проблемы механики». – Ташкент, 2020. - №4. – С.45-48.
10. Begimov U. I., Khudaykulov S.I., Narmanov O. A. «Formations of Ventilated Caves and Their Influence on the Safety of Engineering Structures» International Journal of Academic Information Systems Research (IJAISR) ISSN: 2643-9026 Vol. 5 Issue 1, January - 2021, Pages: 105-109. 1,05.Impact Factor.
11. N.A. Usmonova, Prof. S.I. Khudaykulov. Spatial caverns in flows with their perturbations impact on the safety of the karkidon reservoir. 3rd Global Congress on Contemporary Science and Advancements Hosted From New York USA www.econferenceglobe.com. TECHMIND-2021, 126-130.
12. Худайкулов С.И., Жовлиев Ў.Т., Усмонова Н.А.Схемы кавитационных течений многофазной жидкости. Ўзбекистон республикаси олий ва ўрта махсус таълим вазирлиги Фарғона политехника институти «Замонавий бино – иншоотларни ва уларнингконструкциялари ни лойиҳалаш, барпо этиш, реконструкция ва модернизация қилишнинг долзарб муаммолари» Республика онлайн илмий – амалий конференция материалларитўплами. 21 – 22 апрель. Фарғона 2021.С: 277-280