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Assessment of the Significance of Flood Flows Affecting the Technical Condition of Earth Dams

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ABSTRACT: This article considers the safety assessment of earth dams and other hydraulic structures related to the quality of design and construction work, natural and man-made impacts during operation, operation, technical condition and other factors. Measures are presented to eliminate the problems that arise during the operation of earth dams and other hydraulic structures.

I. RELATED WORK

Numerous scientific studies have been conducted on the design and construction of earth dams, ensuring their reliability and safety during operation, improving existing calculation methods, developing new technological methods and software, and other measures reflected in regulatory documents.

D.V.Stefanishin, V.B.Stilman, D.V.Kuznetsov, V.Ya.Zharnitsky, E.V.Andreev, A.B.Veksler, Yu.M.Kosichenko, M.R.Bakiyev, A.A.Yangiyev, D.T.Paluanov conducted research on the development and implementation into practice of negative consequences arising as a result of water overflow through earth dams, emergency situations, calculation methods, technologies for eliminating problems and other similar measures.

Despite this, in the context of climate change, comprehensive scientific research has not been conducted on the overflow of water through earth dams as a result of increased flooding and its impact on the technical condition of the structure, which determines the relevance and necessity of conducting research in this direction.

II. INTRODUCTION

Earth dams are the most common type of water-retaining structures, which are part of most hydraulic structures of various purposes and are widely used in hydromelioration construction. In the history of hydraulic engineering construction on earth dams, many emergency situations have been observed. Some of them have led to numerous disasters, serious economic, environmental, and social losses and damage.

According to the International Commission on Large Dams, more than 45 thousand large dams have been built worldwide to date, of which more than 60% are earth dams. Earth dams, as a rule, are designed so that the body of the structure is waterproof, and overflow of water through its crest is not allowed (only in rare cases is the passage of flood waters through the crest of small dams of special design provided). In this regard, the construction of earth dams necessitates the installation of special water-discharge and drainage structures.

The reliability of earth dams is three times lower than that of concrete dams, and in most cases, accidents occur due to overflow of water through the dam's crest and filtration of water through its body and base. According to the Japan Water

Agency, about 33% of accidents on embankment earth dams occurred due to filtration, and 18.7% due to overflow of water through their ridge [1].

III. METHODS

According to the Ministry of Water Resources, 58 reservoirs are currently operating in the republic. The dams of all reservoirs, except the Andijan reservoir, are built from earthen materials. The age of these earth dams is 50-60 years and more, their technical condition decreases due to prolonged use, insufficient volume and quality of repair work, which leads to a decrease in their technical capabilities and reliability. In addition, the lack of attention to environmental factors during operation leads to a decrease in the level of reliability in the operation of structures [2].

It is required to carefully study changes in the safety of earth dams and other hydraulic structures, to constantly monitor them, to promptly process data directly obtained from control and measuring instruments installed in reservoirs and other structures, to analyze the implementation of instructions in diagnostic work and their impact on the strength of structures, as well as the experience of foreign countries in this area, and to assess the safety of operating hydraulic structures using new innovative methods based on acquired skills [3].

Natural emergencies in the territory of the republic in recent decades have a tendency to increase. Floods, mudflows, and other dangerous natural phenomena are becoming commonplace. The results of this study show that with the increase in the consequences of global climate change, the frequency of natural hazards is increasing. The number of floods in the region has been rapidly increasing since 2015. Such short-term flows, calculated for tens of minutes or several hours, destroy the hydraulic structures of reservoirs, bridges, roads, flood canals, fields, and other agricultural lands. At the same time, mudflows threaten settlements located in the mountains and foothills of the republic [4,5].

For information, this year alone, devastating mudflows were observed in several regions of the republic. As a result of the floods, hydraulic structures of reservoirs, residential buildings, social facilities, and communication networks were damaged. In March-May, due to heavy rainfall, about 15 major mudflows and landslides occurred in the Bukhara, Jizzakh, Namangan, Samarkand, Surkhandarya, Syrdarya, and Tashkent regions. Mudflows and floods mainly occurred as a result of heavy rains (i.e., torrential rains) in high-altitude areas. In high-altitude areas, as a result of rainfall flowing along one riverbed and the merging of several river waters in populated areas, mudflows and floods occurred.

IV. RESULTS

As a result of the conducted research, for example, in the Kashkadarya region (the large centers of mudflows are the Kashkadarya, Guzar-Darya, Tankhizdarya, Yakkabagdarya basins, as well as the mountainous regions of the region), the number of mudflows during the year was 1 in 2015, 2 in 2016, 3 in 2017, 3 in 2018, 3 in 2019, and 6 in 2015. It is noted that in recent years, fluctuations in this change have been increasing, and mudflows are intensifying during periods of high river flow. This, in turn, has a great impact on the safety of reservoir hydraulic structures and their adjacent territories (Figure 1).





Fig 1 Damage to reservoir spillway structure caused by mudflows

Based on research conducted by leading scientists and specialists, it was noted that water overflow over the ridge of earth dams often occurs as a result of excessive mudflows or catastrophic events at hydraulic structures located above. In this case, if the water discharges (water discharge structures) do not withstand the flow passage, then the level of the upper reach rises above the mark of the earth dam ridge, and the flood passes through it [6-10].

Therefore, the safety assessment of earth dams is determined based on a number of reasons, the quality of design and construction work, natural and anthropogenic impacts during operation, operation, technical condition, and other factors. That is, it is necessary to pay special attention to the reliability of earth dams, their normal settlement and movement, the prevention of malfunctions in water discharge structures and the constant normal capacity, the prevention of malfunctions in the mechanical equipment of the reservoir (accumulation of traffic jams in the gateways, immobility, failure of mechanisms, drives or their elements), and other similar factors.

Analysis of research results shows that assessing the safety of earth dams and other hydraulic structures requires strict adherence to reliability criteria, which depend on the quality of design and construction work, natural and anthropogenic impacts during operation, operating period, technical condition, and other factors. Addressing problems arising during the operation of earth dams requires the use of innovative methods used in global practice.

V. CONCLUSION

In general, assessing the safety of earth dams and other hydraulic structures depends on the quality of design and construction work, natural and anthropogenic impacts during operation, operation, technical condition, and other factors. Preventing mudflows that occur during the operation of earth dams and other hydraulic structures, their negative consequences, is an integral part of ensuring safety.

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