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Study on Overtopping Failure of Concrete DAM: A Review

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ABSTRACT:

The dam structure are made popular day by day. There are many forms of dam are used, Now a days the concern about dam failure is becoming very highlighted point in present scenario. There are many causes of dam failure like Hydraulic Failures, Overtopping failure, Seepage Failures, Structural Failure and Combined Failures etc. The major failure issue of dam is overtopping failure. In this review many researches based on failure of dam problems and analysis are studied and conclude.

Key points: Dam failure and overtopping

I. INTRODUCTION

Modern society is becoming more and more concerned with the safety of dams and dikes. The new laws require a higher standard of safety. In order to increase the safety of both new and current dams while using the limited resources at their disposal, the technical community that deals with dams is working to understand the failure mechanisms that endanger dam safety, priorities measures using informed criteria, and develop more efficient solutions. The safety of dams and dikes involves multiple issues such as the understanding of the behavior, even in extreme conditions near failure; proper design, construction, and exploitation; and also logical and efficient management and assignment of available economical and personal resources.

II. OVERTOPPING

The overtopping of embankment dams has been the main cause of dam failure in the last decades. Consequently, the main challenge related to dam safety is to find efficient solutions to quantify risk and avoid the failure of new and existing dams due to overtopping. Hydrological safety is one of the most active areas in dam engineering research, involving a considerable technical community all over the world. These failures occur as a result of poor spillway design, leading to a reservoir filling too high with water, especially in times of heavy rainfall. Other causes of this type of failure include settling of the crest of the dam or spillway blockage.

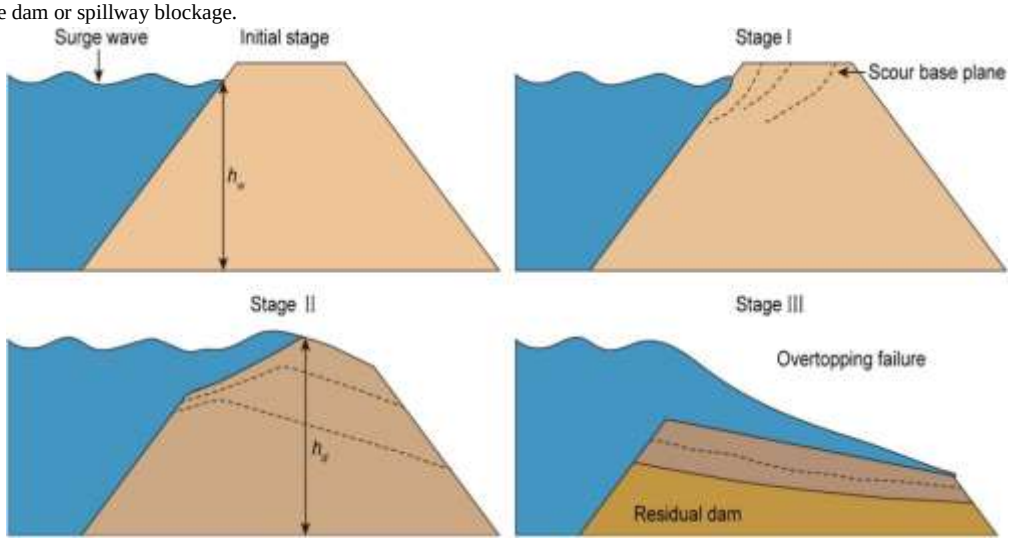

Figure 1 Overtopping failure of dam

III. LITERATURE REVIEW

Many works are given on the Failure of dam. which are as follows-

Myoung-Soo Won (2008) According to journal, Concrete face rockfill dams (CFRDs) are often regarded as being a low-cost alternative and being fundamentally safe, particularly against leaking. Instead of theory, their design is built on real experiences. Using 27 CFRD case studies, the current research covers post-construction deformation and leakage. Analysis demonstrates that deformation When the dam height surpasses 100 m, it is usual for the face slab to be greater than the post-construction crest settlement, and when the dam height exceeds 125 m, the long-term leakage rate increases quickly.

C. Deangeli (2009) This thesis explains the various dam typologies made of various materials (earthfill, rockfill, and concrete) as well as the types of failure that are related to the material properties, foundations (soil and rock), and loading conditions throughout the various stages of the dam life (from the construction to operation phases).

Zhixian Cao (2011) In order to supplement this experimental investigation described in the companion work, a coupled 2D mathematical modelling study of landslip dam failure and flood is presented. The shallow water hydrodynamic equations serve as the foundation for the model. With the use of the HLLC (Harten, Lax and van Leer with Contact wave restored) approximate Riemann solver and the total-variation-diminishing variant of the second-order weighted-average-flux approach, the governing equations are numerically solved. Using the measured stage hydrographs from two runs of the flume experiments, two parameters relating to bed-load sediment transport and critical slope stability are calibrated. The calibrated model is then used to simulate additional independent runs of the tests with various beginning breach dimensions, dam composition, geometry, and inflow discharges.

Ehsan Goodarzi (2013) The Meijaran Dam in northern Iran is the subject of this study's application of risk and uncertainty analysis to dam overtopping caused by varying inflows and wind speeds. The process incorporates reservoir routing, integration of wind set-up and run-up, and univariate flood and wind speed frequency analysis to determine the reservoir water elevation. The likelihood of overtopping was then calculated using two uncertainty analysis techniques (Monte Carlo simulation and Latin hypercube sampling), while taking into account the spillway discharge coefficient, initial reservoir water depth, and quantile of flood peak discharge as uncertain variables. The results revealed that rising water level in the reservoir is the most important factor in overtopping risk analysis and that wind speed also has a considerable impact on reservoirs that are placed in windy areas.

David F. Imbrogno (2014) The purpose of this project is to offer a user-friendly dam safety evaluation tool, raise situational awareness among dam owners and regulators, and enhance overall dam safety across the country. Three steps are used in the strategies to reach these objectives: Review and prepare pertinent background data on dam safety, including information on the many types of dams, their designs, common reasons of failure, and appropriate inspection methods; examine current incident and dam failure data from the Significant Incident Reporting (SIR) database and make suggestions for future event reporting; To assess the general level of safety of a certain existing dam, develop a Knowledge Based Expert System (KBES) computer programmed.

Lisa Broberg (2015) This report's goal was to determine whether current concrete dam design criteria are enough to represent actual failure mechanisms. The other goal was to determine whether Eurocode and RIDAS are equal in terms of dam design. Analytical calculations for various types of concrete gravity dams with diverse geometry and loading circumstances were performed in order to address the mentioned problems. In order to further examine whether failure occurred as anticipated, the programmes CADAM and BRIGADE were also employed as calculating tools. The findings of the analytical calculations and the FE study show that limit turning does happen and frequently produces lower safety factors than overturning. Although it takes into account material failure in the rock, limit turning is comparable to overturning failure. As a result, this design criterion is very dependent on the condition of the rock and necessitates foundational research to provide an accurate prediction of the actual behavior of the dam body.

Jinsheng Jia (2016) The cemented material dam (CMD) idea was initially put forth by the first author in 2009. With this idea, a safer, more cost-effective dam might be built, benefiting both the area downstream and the environment. The concept includes the rockfill concrete (RFC) dam, also known as the cemented rockfill dam (CRD), the cemented sand, gravel, and rock dam (CSGRD), and the cemented soil dam (CSD). Based on studies and actual practises in projects all around the world, this article provides an overview of the CMD's idea and guiding principles. Additionally, it describes recent advancements in the CSGRD, CRD, and CSD.

Ana Margarida Bento (2017) The velocity normal to a breach cross section and the anticipated area of that cross section are combined in this study to create the breach hydrograph. This direct technique, albeit theoretically straightforward because it is based on the fundamental notion of discharge, is a complete first in studies of dam breaches. A laboratory model of an earth dam made of cohesive sediments was carefully monitored to show how the technology might be used. Surface velocity maps obtained using large-scale particle image velocimetry (LSPIV) were used to estimate competent velocities. By examining photographs of the laser sheet's imprints on the free surface and the breach bottom, the breach area was calculated.

Qi-ming Zhong (2018) To mimic the breaching of the Gouhou concrete-faced rockfill dam (CFRD), the only high CFRD breach example in the world, a simplified physically-based model was created. In order to replicate the initial scour position on the downstream slope while taking into consideration the dam height and the steepening of the downstream slope, a hydraulic approach and a headcut erosion formula were both used. The ultimate length of a concrete slab under its self-weight and water loads was calculated using the moment equilibrium method. The computed outcomes of the Gouhou CFRD breach scenario demonstrate that, with relative errors smaller than 15% when compared to the measured data, the suggested model offers reasonable peak breach flow, final breach breadth, and failure time. The outputs of the proposed model are more or less sensitive to certain inputs, according to sensitivity studies.

Zhongzhi Fu (2019) A simplified numerical model for CFSGD breach was created based on field studies and model tests on the Gouhou concrete-face sand-gravel dam (CFSGD) breach case. The model adopts the total-load no equilibrium transport equation to simulate the erosion of sand gravels with a wide range of gradation, and it establishes an analogy to simulate the failure of each concrete-face slab under various loads during the dam breaching process. These two features are its two main selling points. The proposed model was validated using the analysis of the case study of the Gouhou dam breaching, and the findings demonstrated relative errors of less than 15% for the output of breach parameters. The sensitivity analysis indicated that the soil erodibility and grain-size distribution significantly affect the prediction of breach flow of the dam.

Kai Dong (2021) In this work, An actual engineering project is applied to the suggested models. The findings demonstrate that slope instability risk is greatly influenced by the geographical variability of material properties, without which the hazards of slope instability and dam overtopping may be overstated. This study provides a more accurate and realistic risk assessment of dam overtopping failures, which can offer technical support for the assessment of reservoir dam safety and risk management.

Yanlong Li (2021) This study addressed the impact of the vertical joint water barrier failure while examining the physical process of a CFSGD overtopping breach. The face slab that complied with the model test's requirements was produced using the similarity criterion of the model test as a guide. The process of an overtopping dam breach was split into four stages through flume model tests: Stage I, seepage erosion; Stage II, slow erosion; Stage III, dramatic dam breach; and Stage IV, gradual stabilization. The findings demonstrated that the initial breach of the dam under the effect of seepage erosion took place near the upper margin of the seepage surface of the downstream slope. The breach's flow process line was of the "lean and high" variety, and there was a noticeable rise in the breach's average rate of undercutting and horizontal expansion, underscoring the significant impact of the early seepage erosion stage on the subsequent dam breach process.

Wen Qiu (2021) In this task A numerical modelling approach of concrete faced sand-gravel dam overtopping break is developed based on the field study of dam break incidents. The three components of the approach are as follows: (3) Based on the moment balance method, the failure process of the concrete face slab under dead weight and water load is identified. (1) Aiming at the erosion and scour of vortex flow on dam body, an appropriate model is used to simulate the flow movement. (2) The interaction between water flow and sand particles in dam break process is accurately simulated.

IV. CONCLUSION

After read all the above researches, we conclude that the failure of dam is one of the major issue in our structural life. and we should aware about this, and take reliable solutions for failure of dam. overtopping failure is very concerning part of dam structure.

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