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Water Resources Engineering Department MONTHLY NEWSLETTER

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College of Engineering Salahaddin University

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Cut-off Wall of Bastora Dam

A cut-off wall, commonly used across various projects, has long been employed to prevent groundwater infiltration at excavation sites, negating the need for costly dewatering procedures. Its effectiveness was demonstrated at the Bastora dam, northeast of Erbil, successfully preventing seepage in the presence of an alluvial layer over clay stone or clay, along with conglomerate layers. This choice of a cut-off wall was deemed preferable over injection or piling due to the dam's specific geological composition. The cut-off wall was created by filling pre-drilled holes, reaching a depth of 18 meters, with plastic concrete.

Fig. Plastic concrete placing.

The concrete mix included Portland cement and bentonite. To create each cubic meter, a mix of 800 kg gravel, 750 kg sand, and 50-60 kg bentonite was combined with 300 litres of water, achieving compressive strength values of 1 to 5 MPa. The built cut-off wall achieved a low seepage rate (10^{-8} to 10^{-10} m/s), meeting acceptable limits.

Dr. Abdulla Botany

Assistant Professor

Compaction Test

During the construction of an earth dam, it is typically essential to perform compaction tests for each layer of soil or fill material being placed. Compaction tests are conducted to ensure that the soil or fill material is compacted to the desired density and moisture content, which are crucial for the stability and performance of the dam.

The compaction tests are usually performed using standard procedures such as the Proctor compaction test or Modified Proctor compaction test. These tests involve compacting a representative sample of the soil or fill material in the laboratory to determine its maximum dry density and optimum moisture content. These values serve as a basis for quality control during construction. During construction, the following steps are typically taken: **1. Sampling:** Representative samples of the soil or fill material are collected from each layer to be compacted. **2. Laboratory Testing:** The samples are taken to a laboratory where compaction tests are performed to determine the **maximum dry density** and optimum moisture content. **3. Field Compaction:** In the field, the construction equipment (such as rollers or compactors) is used to place and compact the soil or fill material in thin layers or lifts. The compaction process is monitored to achieve the specified density and moisture content. **4. In-situ Testing:** In-situ tests, such as the **sand cone test** or **nuclear density gauge**, may also be performed in the field to verify the achieved compaction. **5. Quality Control** If the field test results do not meet the specified criteria, **adjustments are made** in terms of moisture content or compaction effort to ensure that the desired compaction is achieved. By conducting compaction tests for each layer, the construction team can ensure that the dam is constructed to the required specifications, which is crucial for its stability and long-term performance in terms of resisting seepage and potential failure. Proper compaction helps in **reducing settlement** and **increasing the overall strength** of the dam.

Bruska Mamand

Assistant Lecturer

Isotope Technique for Flood Mitigation and Management

The modern engineering hydrology, known as **isotope hydrology**, addresses hydrological challenges by utilizing innovative techniques. In flood mitigation management, stable isotopes like oxygen-16, oxygen-18, nitrogen-14, and nitrogen-15, as well as radioactive isotopes like phosphorus-32, serve as tracers.

Isotopes provide quantitative data on soil transport and the size of carbon, nutrient, and water pools in the soil-water-plant system. Identify factors influencing ecosystem resilience to flooding impacts, as well as the origins of soil erosion, and enhance soil and water management strategies. Utilizing a variety of isotopes, such as Fallout Radionuclides (FRNs), isotope discrimination techniques, and compound-specific stable isotopes, along with mapping approaches, potentially degraded terrain susceptible to erosion and sediment flow can be mapped to provide crucial information for risk management and flood mitigation.

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Lecturer

Labyrinth Weir Spillway

A labyrinth weir is a linear weir that is folded in a plan-view to increase the crest length for a given channel or spillway width (Fig. 1). There are an infinite number of possible labyrinth weir configurations and design variations; however, labyrinth cycles are typically placed in a linear fashion. A labyrinth weir can handle large discharges at relatively low heads compared to traditional linear weir structures of equal width. Beside trapezoidal labyrinth weir there is a semi-circular Labyrinth weir that exhibits higher efficiency (Fig. 2). The Discharge coefficient of Tangential component is approaches 0.2, which is the lowest discharge coefficient.

This type of spillway is installed in narrow gorges where space is limited or in cases of high flood discharge with limited freeboard. Labyrinth weirs are well-suited for spillway rehabilitation, where aging infrastructure, dam safety concerns, and larger probable maximum flows have necessitated increased spillway capacity.

Fig. 1

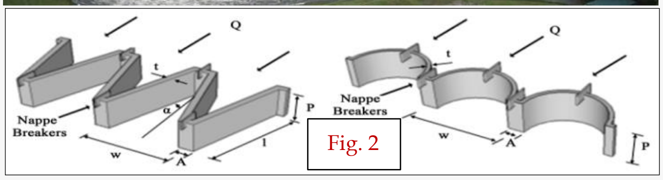


Fig. 2

Sarkawt H. Muhammad

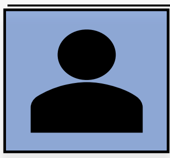
Assistant Lecturer

Fish Ladder, design criteria and its consideration

Obstacles like dams and weirs significantly impact the character and quality of river ecosystems. They transform large portions of rivers into reservoirs for water storage, erasing their natural features. Furthermore, these structures disrupt the continuous flow of the river, hindering the unobstructed movement of aquatic organisms. Various criteria influence fish ladder design, including fish species' size and swimming abilities in the river, flow velocity and water depth tailored for comfortable swimming in both directions, and the design of baffle, entrance, and exit pools to create resting areas and decrease water velocity.

Strategic baffle placement enhances fish navigation in the ladder, and the ladder structure should utilize materials mimicking natural river conditions. In fish ladder design, considerations include the topography surrounding the main structure, hydraulic conditions like sediment transport and flow turbulence, monitoring environmental impact on species, and compliance with local and national regulations for fish passage and habitat protection.

Fig. Fish ladder system.



Saman Hasan, Heleen Hasan, Lewzha Salam, Yar Kareem, Rawa Shwan, Mhammad Sherzad

4th Stage Students- Water Resources Department

Retaining Wall Re-analysis: 150 Road in Erbil as a Case Study

As fourth-year undergraduate students, our primary objective in conducting this re-analysis was to apply the principles learned in the course "**Earth Retaining Structures**" Our assignment involved analyzing a constructed retaining wall with a height of 8.8 meters situated along the 150m road from **Erbil-Bahrka to Erbil-Duhok Highway Sector**. The re-analysis adhered to established code of practices, employing common analysis methods such as Rankine and Coulomb. Also, the wall was subjected to various earthquake scenarios to assess its overall stability against sliding and overturning. The re-evaluations revealed marginal differences compared to the original design performed by the Hemn Group.

Fig. Image of the re-analyzed wall.

Acknowledgment: gratitude to Hemn Group for providing the essential data needed for this analysis.