DAM MIKLIM (HALHAL SMALL SCALE EARTH DAM CONSTRUCTION)

Construction and Hydrological Study of Halhal Earth Dam

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Ministry of Agriculture (MOA), Asmara, Eritrea

Location: Halhal Village, Anseba Region, Eritrea

Date: February 1997 - June 1997

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ABSTRACT

The Halhal Small Scale Earth Dam Construction project, located in Halhal village, Anseba region of Eritrea, was initiated by the Ministry of Agriculture (MOA) to address the growing need for water conservation and efficient irrigation. The primary goal of the project was to provide a sustainable water source for local agricultural activities, improving crop production and supporting the surrounding community.

The project, spanning from February to June 1997, involved the design and construction of an earth dam, along with various associated infrastructures, such as a spillway, outlet structure, and a gravel and sand filter system. The dam was constructed using heavy machinery, including rollers, dozers, and excavators, with significant efforts directed toward ensuring the stability and functionality of the structure.

Hydrological studies played a vital role in the design process, with empirical methods used to estimate runoff and gauge the dam's capacity for water storage. A comprehensive hydrological analysis, including runoff calculations and flood risk assessment, was undertaken to ensure the dam's efficiency and sustainability.

This report provides a detailed overview of the construction phases, hydrological studies, and associated infrastructure work. It also includes an evaluation of the project's cost, outlining both the machinery and manpower employed. The role of site engineers and construction supervisors is emphasized, showcasing their contributions to the successful completion of the project. Ultimately, the Halhal dam project stands as a key initiative for sustainable water management in the region, with ongoing impacts on local agriculture and water availability.

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1. HALHAL SMALL SCALE EARTH DAM CONSTRUCTION (DAM MIKILIM)

In 1997, the Ministry of Agriculture (MOA) initiated the construction of a dam at Halhal village, aimed at conserving water for irrigation purposes. The primary objective was to provide water for the village farm, allowing it to directly benefit from the reservoir or the replenished groundwater system.

Construction Period: February 1997 – June 1997 (Approximately 4 months of intensive work)

Location: Halhal Village, Anseba Region, Eritrea. Figure 1 provides a birds-eye view of the reservoir.

Figure 1 Halhal small-scale earth dam, Mikilim Dam (google image).

Enterprise: The Ministry of Agriculture (MOA), Asmara, Eritrea, a governmental organization with six regional offices and numerous sub-regional offices. The main office was based in Asmara, the capital city of Eritrea.

Method of Construction: The project utilized a range of heavy equipment including rollers, loaders, dozers, graders, and loading trucks for transportation.

The responsibility of the team was not only to construct the dam but also to monitor and manage various smaller diversion structures in surrounding regions, such as the Asmat area, where a small weir was built to divert floodwater into a basin irrigation system. Figure 2 illustrates the Asmat irrigation project survey.

Figure 2 Photo taken at Asmat irrigation project, 1997.

1.1 Gravel and Sand Filter

The downstream toe of the dam was equipped with a sand and gravel filtration system to safely discharge water from the phreatic line. Figures 3 and 4 depict the typical earth dam profile and the gravel filter laying process at Halhal dam.

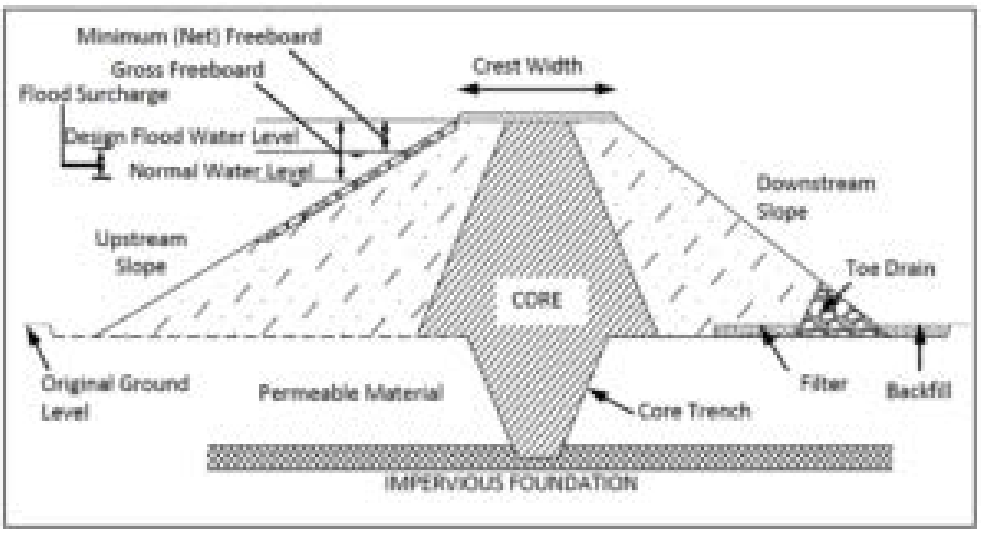

Figure 3 Typical example of earth dam profile.

Figure 4 Gravel filter lying, Halhal.

1.2 Spillway

The spillway was a simple dugout with dimensions of approximately 10 meters in width and 1.5 meters in depth. It extended to the downstream side of the existing river course, as shown in Figure 1. The freeboard level of the dam was set at 15.5 meters from the bottom, equating to a maximum water depth of 15.5 meters. The reservoir's fetch length extended over 120 meters towards the upstream boundary.

1.3 Outlet Structure

The outlet was constructed using a standard concrete pipe, protected by a reinforced concrete cover. Around 11 collars (spaced 7 meters apart) were placed along the pipe to prevent water creeping.

Figure 5 demonstrates the type of collars used at Halhal dam (image sourced from the internet for illustrative purposes).

Figure 5 Seepage protection collar.

The outlet structure at Halhal shown in Figures 6 and 7

Figure 6 Halhal outlet structure (photo taken after the construction ended).

The external end of the outlet structure, constructed with a metal pipe that connects the valve to the concrete pipe, is shown in Figure 7.

Figure 7 Valve and concrete pipe connector used at Halhal dam.

1.4 Foundation

The foundation at the central axis of the dam was excavated and filled with clay soil up to the freeboard level. Figure 8 shows the construction process of the dam at Halhal.

Figure 8 Construction of Halhal earth dam (Dam Mikilim).

1.5 Compaction

Compaction was achieved using two rollers, with the method involving rolling four times over a 0.3-meter-thick layer of dirt, while water was applied to assist in compaction. A dozer was used to spread the dirt evenly, and the rollers compacted the material. Figure 9 shows the compaction process during the construction of Halhal dam.


Figure 9 compaction process during the construction of Halhal dam.

1.6 Hydrological Studies

The hydrological study for the dam was carried out using empirical formulas. 10% of the annual rainfall was considered runoff, and the volume was calculated by multiplying the runoff depth by the area of the catchment (watershed).

1.7 Project Cost

As this was a government project, detailed cost information was available through the government bureau. However, an estimate can be made based on the machinery used and the personnel involved during the construction.

Machinery: The machinery worked 8 hours per day, 5 days a week, and included compactors, loaders, excavators, dozers, graders, water tank trucks, pickup cars, and loading trucks.

Personnel: A trained engineer, a foreman, two machinery foremen, operators for each machine, and approximately twenty laborers and craftsmen participated in the project.

The construction cost, excluding material costs such as cement, sand, reinforcement bars, concrete pipes, and vehicle repairs, is estimated to be over 1 million Nakfa (~$71,428.57).

1.8 The Role of Site Engineers

The site engineer was responsible for regulating the concrete mix and soil types, assisting the foremen with interpreting drawings, controlling compaction, organizing machinery and materials, managing the reinforcement bar schedule, overseeing excavation, and supervising the overall construction in alignment with the plan.

The team consisted of both skilled and unskilled personnel, including one trained engineer, carpenters, masons, laborers, and numerous machinery operators and foremen.

1.9 Points to Highlight

Location: Halhal, Anseba region, Eritrea

Type: Earth dam
Height: ~17m
Crest Width: ~5m
Crest Length: ~65m
Spillway (Earth) Width: 10m
Dam Profile Slope: U/S 1:3, D/S 1:2

Link to the current status of the dam: link