



The Rihand Dam

Sonebhadra, Uttar Pradesh, India



Completion Date
JULY 2019

Contractor
APAAR INFRATECH PVT. LTD.

Engineers
UP IRRIGATION DEPARTMENT

Owner
UP JAL VIDYUT NIGAM LTD.

Products Used
**CONCENTRATE,
PATCH'N PLUG, MEGAMIX II,
ADMIX C-2000**

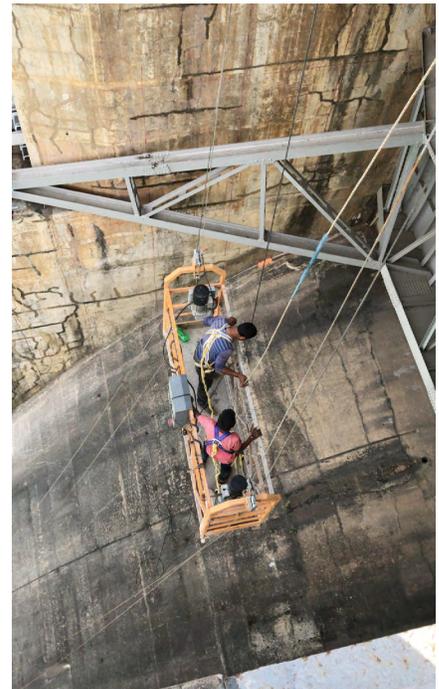
Project Type
DAMS

Rihand Dam is located in the state of Uttar Pradesh in India and is the largest dam in Asia by reservoir volume. Construction began in 1954 and was completed in 1962 with a reservoir holding capacity of 10.6 billion cubic meters. The length of the dam is 934.45 meters with a height of 91.46 meters, consisting of 61 independent blocks. The powerhouse is located at the toe of the dam and has a generation capacity of 300 MW.

Rihand Dam provides critical hydro-electricity to a vast region including the aluminum industry in Renukoot and the nearby industrial belt. Being one of the oldest dams in India, the concrete of the dam body has experienced deterioration due to ageing and AAR (Alkali Aggregate Reaction) resulting in cracking and surface loss. The dam has undergone various maintenance and repair work over its life.

In-depth Studies

In 2014, on the recommendations of the Rihand Dam Structural Behaviour and Monitoring Committee, the engineers of Uttar Pradesh Irrigation department prepared a proposal for the extensive rehabilitation of the Rihand Dam. The findings of the 12 months research conducted by Central Soil and Material Research Station (CSMRS), a Government of India laboratory under Central Water Commission (CWC), examining the efficacy of **Xypex Crystalline Technology** to mitigate the effects of ASR/AAR was one of the prime considerations in selecting the suitable product and technology for the rehabilitation of Rihand Dam. Xypex's unique crystalline technology was chosen as the preferred repair solution due to its cementitious nature and compatibility with concrete along with other technical reasons. Due to the critical importance of the project, the scrutiny and review process by various technical teams took almost 3 years.



The spillways suffered deterioration of the concrete surface, structural cracking as well as spalling at the crest.



Significant Spalling



Alligator cracking in the piers indicated the occurrence of AAR.

Three Critical Structures

The three critical areas of the dam's structure were identified as the Spillway, Piers and Dam Top.

The problem areas identified included deteriorated concrete surfaces, loose construction joints, structural cracks, alligator cracking due to AAR, corrosion of embedded reinforcement, spalling, voids in concrete elements, and deteriorated brittle epoxy repairs of cracks in the piers from earlier maintenance. The evaluation report established specific criteria for the repair solution, namely, it should be integral and become a permanent part of the concrete matrix, provide protection of embedded reinforcement steel, resist chemical attack, suppress AAR and ASR, self-heal existing cracks and provide long term waterproofing and protection to the structure.

The Repair Solution

Xypex's unique crystalline technology was chosen as the preferred repair solution. Xypex's proprietary chemicals react with the natural by-products of cement hydration in both new and existing concrete, forming a non-soluble crystalline structure within the inter-connected cracks, capillaries, pores and voids in the



The top of the dam showed severe deterioration.

concrete. In this way, the crystalline formation becomes a permanent, integral part of the concrete matrix itself, preventing the ingress of water and other liquids even under hydrostatic pressure and protecting the concrete in harsh, aggressive conditions. The four major products used in this rehabilitation project were all based on **Xypex Crystalline Technology**:

In the spillway, cracks and construction joints were chipped out as per the specification to repair it with a first layer of Xypex **Patch'n Plug** followed by a second layer of Xypex **Megamix II**. Nozzles were also fixed along the cracks, construction joints and honeycombed concrete which were grouted with a specified mix of Xypex **Admix C-2000 NF**, cement and fine silica.

Xypex Megamix II was then applied to the entire surface of the spillway and a two coat application of Xypex Concentrate was applied to the mortar repaired surface to provide extra protection.

The same technique was used in both the piers and the top of the dam. A total of 57,000 kg of Xypex Patch'n Plug were used to repair cracks and joints. Xypex Megamix II was applied at a thickness of 12.5 mm to resurface 14,000 m² of deteriorated concrete surface. Xypex Concentrate was applied to an area of over 21,000 m² to provide final protection to the concrete.

Each phase of the repairs of the Spillway, Dam Top and Piers was constantly monitored and guided by the engineers of the UP Irrigation Department (UPID) and UP Jal Vidyut Nigam Ltd. (UPJVN). Various senior officials from Government of Uttar Pradesh, the Indian Institute of Technology (Kanpur) and the CSMRS (New Delhi) also inspected the ongoing works. As a result of the collective efforts, the rehabilitation works of Rihand Dam, by Xypex Crystalline Technology resulted in the strengthening and durability enhancement of Rihand Dam requiring no further major rehabilitation in the long term.



Pier before repair



Pier after repair