RCC Dam Saves City's Sole Source of Water Supply

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Franklin Dam is located in a rural area along the West Fork Drakes Creek in Franklin, Kentucky. The dam impounds water from a watershed encompassing approximately 108 square miles (280 km^2). Its primary purpose is to serve as the City's sole municipal water supply.

The 20-foot (6.1-m) high dam was built in 1975 to impound the immediate creek area. In 1987 the dam was raised 6 feet (1.8 m) to increase storage capacity. The dam consists of an 80-foot (24.4-m) long concrete gravity spillway section adjacent to the left abutment and a 500-foot (152.4-m) long embankment extending from the spillway to the right abutment. The embankment consists of a tiered gabion wall along the downstream portion and dredged material placed on a 3H:1V slope on the upstream section. A filter fabric separates the fill from the gabion wall. A membrane on the upstream slope serves as a seepage barrier. The top portion of the upstream slope, the dam crest, and the area within about 18 feet (5.5 m) from of the downstream toe of the dam are protected against normal overtopping by a 9-inch (230-mm) thick gabion mat with a thin concrete overlay. Even with the raising of the dam, it still overtopped several times a year.

In 1996, a large flood event overtopped the dam and caused severe damage and voids in the dam. The dam was repaired by installing sand bags within the embankment portion.

RCC conveying system

Aerial view of old dam prior to construction

Extensive seepage took place through and beneath the dam. However, in spite of the repairs sinkholes developed at several locations and required additional repairs.

Replacement Dam

Due to the progressive deterioration of the dam, the City engaged the team of CDM of Louisville, Kentucky, and Raleigh, North Carolina, and Barge Waggoner Sumner and Cannon (BWSC) of Nashville, Tennessee, to evaluate the feasibility of either repairing the existing dam or replacing it with a new dam. Rehabilitation of the existing dam was ruled out because of its poor condition. Based on the results of the feasibility study, it was decided to replace the existing dam with a new dam immediately downstream.

The design team conducted a geotechnical investigation to evaluate the subsurface conditions at potential locations for a new dam. Based on the results of the investigation, they concluded that the new dam should be located about 100 feet (30.5 m) downstream of the existing dam, and that the normal pool should be kept at the same elevation. By keeping the normal pool at the same elevation as the existing dam, any concerns regarding the upstream environmental impacts would be mini-

Spreading mortar to control seepage and bond RCC lifts downstream from facing concrete

Completed dam

mal. It would also reduce the need for any land acquisitions and make permitting efforts less cumbersome. In addition, it would avoid karst features located further downstream of the dam.

The team evaluated a range of alternatives—conventional concrete dam, embankment dam with overtopping protection, and roller compacted concrete (RCC) dam. Based on the results of the geotechnical investigation and hydrologic/hydraulic analyses, an RCC dam with a conventional concrete spillway was selected as the preferred alternative.

The RCC dam was designed to withstand overtopping flows during the Probable Maximum Flood, with flood depths up to 8 feet (2.4 m) above the top of the dam. The new dam is 450-feet (137.2-m) long and has a maximum height of 20 feet (6.1 m). It has a vertical upstream face. The upper portion of the downstream face is sloped at 0.8H:1V. Below the sloped portion, the dam is shaped to form a basin sloped from the right abutment to the spillway. See photo of completed dam. This basin routes water during overtopping events toward the spillway and the creek main channel.

The design included conventional concrete facing on the upstream and downstream faces. A reinforced-concrete armor cap along the crest of the dam and on the downstream portion was also included to reduce the potential for damage from large trees and other debris during overtopping events. The dam is founded on bedrock about 10 to 12 feet (3.0 to 3.7 m) below existing ground surface. An RCC apron and 6-foot (1.8-m) deep cutoff wall are located immediately downstream of the dam to reduce the potential for erosion during overtopping events. Seepage control was provided by the use of the conventional concrete facing systems, control joints with water stops spaced at approximately 15 feet (4.5 m) on center, and bedding mortar between RCC lifts for an approximate width of 10 feet (3.0 m) immediately behind the concrete facing.

The spillway is an 80-foot (24.4-m) long ogee spillway constructed with conventional concrete. It is keyed 5 feet (1.5 m) into bedrock to provide for stability and seepage cutoff. The spillway has a 40-foot (12.2-m) long stilling basin.

ASI-RCC, Inc. of Buena Vista, Colorado, was the low bidder for the project. Construction started in late January 2005 and was completed in February 2006. The project required approximately 8,160 yd^3 (6,240 m^3) of RCC and 5,560 yd^3 (4,250 m^3) of conventional concrete. The in-place cost of RCC (including cost of aggregate, cement, fly ash, mixing, transporting, placing, and curing) was \$135/yd^3 (\$176.56/m^3). The total construction cost was about \$4,776,000, approximately \$200,000 below the total bid amount.

RCC Mix Design

Type II portland cement	205 lb/yd^3 (122 kg/m^3)
Class F fly ash	105 lb/yd^3 (62 kg/m^3)
Aggregate (1-1/2 in. (37.5 mm) MSA)	3,628 lb/yd^3 (2,152 kg/m^3)
Water	202 lb/yd^3 (120 kg/m^3)
Specified 28-day compressive strength	3,000 psi (20.7 MPa)

Credits

Owner: City of Franklin, KY

Designer: CDM and Barge Waggoner Sumner and Cannon

RCC Mix Design and QA Testing: CDM

Contractor: ASI-RCC, Inc.

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