Beneficial Use Case Study

Saluda Dam

Coal Combustion Product Type
Fly Ash

Project Location
Columbia, South Carolina

Project Participants
South Carolina Electric & Gas, Paul C. Rizzo Associates, Barnard Construction Company, Griffin Dewatering Southeast, Kleinfelder, H.B. Mellott Estate, Hayward-Baker/Nicholson (joint venture)

Project Completion Date
2005

Project Summary
At the time of its construction in 1930, Saluda Dam was the world's largest earthen dam, creating the then-largest man-made reservoir in the world, Lake Murray, 10 miles upstream from Columbia, South Carolina. With improved understanding of the area's susceptibility to earthquakes—and the potential for a catastrophic flood in the case of a major seismic event—dam owner South Carolina Electric & Gas (SCE&G) developed a remediation plan to mitigate against that worst-case scenario. The design challenges were many: as a functioning hydroelectric dam, source of drinking water and cooling water for SCE&G's McMeekin Steam Electric plant, and region-wide recreational resource, the reservoir's water levels needed to be roughly maintained. Moreover, any excavation work required to build a supporting structure near the dam could risk breaching it.

Project Description
To bring the dam up to compliance with federal regulations, engineers considered a range of alternatives, eventually focusing on two potential solutions: a rockfill berm on the downstream slope of the existing dam and a new roller compacted concrete (RCC) gravity dam downstream of the dam. They eventually settled on a hybrid of the two, constructing an RCC dam around the existing powerhouse flanked on each side by zoned earth/rockfill embankments. The structure would serve as a backup dam in the event that the original dam were to fail.

While it incorporates the same materials as conventional concrete, RCC is a drier mix that has almost no slump. The concrete is delivered by conveyor or truck and placed in a fashion similar to paving, with the material spread by bulldozers or modified asphalt pavers and then compacted by rollers. Compaction gives the concrete its strength, density, and smoothness. The surface of RCC can be walked or even driven upon immediately after compaction—allowing concrete layers to be placed in quick succession.

Fly ash is essential to RCC mixes, as it improves the workability of the lower-moisture concrete and helps control the heat of hydration. Due to the particularity of RCC mixes, as well as the proposed use of reclaimed fly ash from on-site ponds, design engineer and construction manager Rizzo Associates undertook a rigorous testing and analysis of potential RCC mixes over a two-year period prior to the start of construction. Testing involved the production of lab trial mixes and an eventual 4,500-cubic-yard field test placement to ensure optimal performance characteristics had been achieved. Ultimately, engineers settled on a 50/50 fly ash-to-cement mix that incorporated 150 lbs. of fly ash per cubic yard. Physical and chemical analyses were performed on the ash reclaimed from SCE&G's McMeekin ponds—which were required to be excavated and moved prior to the start of construction, as they were situated in the design footprint of the planned remediation dam—to ensure it would meet ASTM standards and dam design criteria.

At the time of its construction, the Saluda remediation dam was the third-largest RCC dam in the U.S., incorporating 1.3 million cubic yards of concrete and 97,500 tons of recovered fly ash. The project also set a North American record for placing 18,590 cubic yards of RCC in a single day. Despite the efficiency with which the work was carried out, construction of the remediation dam nonetheless required great care to ensure that the required excavation work would not disturb the existing berm nearby. To that end, hundreds of wells—shallow, deep, and eductor—were dug to dewater and improve the stability of the excavation slope. For the benefit of close-by residents, crews installed a sprinkler system to lessen the dust generated by the batching plants.

The innovative methods used to complete the dam earned it several awards, including the Outstanding Civil Engineering Achievement from the American Society of Civil Engineers. Moreover, it helped prove the ability to use ponded ash as a major component in RCC to build strong, durable critical-infrastructure projects.