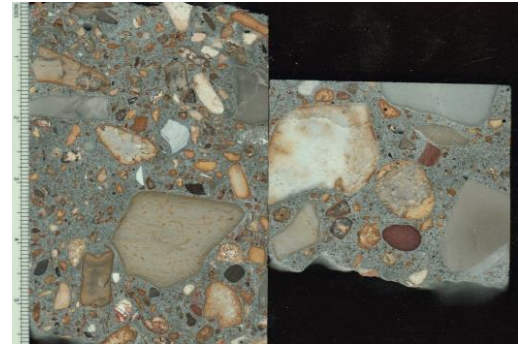
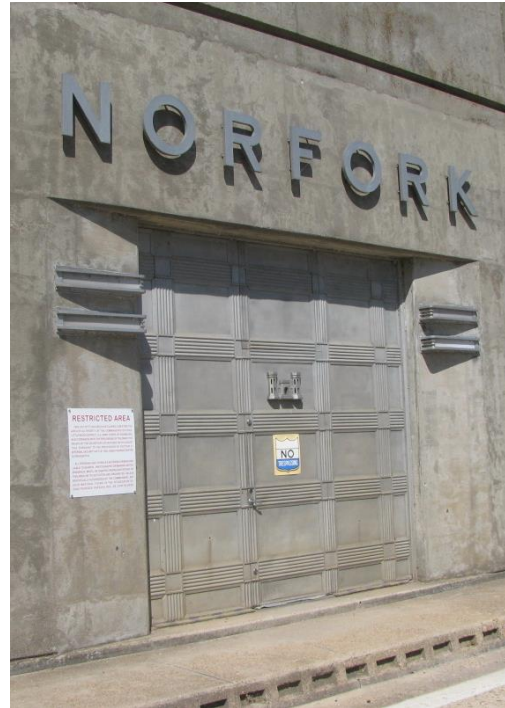




PROJECT PROFILE

Norfolk Dam

Bulkhead Support Analysis | Baxter County, AR



CLIENT

Garver LLC and
Mobley Contractors, Inc.

BACKGROUND

The construction of the Norfolk Dam on the North Fork River in the 1940s created Norfolk Lake in northern Arkansas. The dam, which is operated by the U.S. Army Corps of Engineers, utilizes twelve spillways to control the flow of water into the North Fork. In 2009, a large steel bulkhead, which controls water flow through the spillway during periods of maintenance, was designed. The 140,000-pound moveable bulkhead was designed to be mounted to existing pier caps in the spillways utilizing high-capacity, deep-embedment post-installed concrete anchors.

During construction of the bulkhead, cracking, delamination, and other concrete distress were observed beneath bolted connection brackets supporting the bulkhead. Additionally, new, post-installed concrete anchors that fastened the connection brackets to existing dam pier caps were installed closer to the edge of the pier cap than specified by the engineer of record. Rather than implementing extensive repairs and modifications, the clients enlisted the services of WJE to perform a peer review of the structural design and an evaluation of the as-built strength.



SOLUTION

WJE engineers researched technical literature, manufacturer's test results, and applicable codes to evaluate research and design procedures related to high-capacity post-installed anchors. WJE's experience with testing post-installed concrete anchors for various manufacturers and industry groups allowed the design team to gain a better understanding of the behavior of the high capacity anchors despite the limited availability of published test data.

WJE supplemented compressive strength testing of the original 1940s-era concrete with petrographic analysis by WJE materials scientists. WJE discovered unique characteristics of the concrete composition that allowed for a more accurate interpretation of the compressive strength results. A field investigation by WJE engineers, including a detailed survey of reported distress, confirmed that the distress was isolated, shallow, and not indicative of a structural deficiency.

WJE's extensive experience with testing of post-installed concrete anchors allowed for a more realistic prediction of the bulkhead connection strength. By doing so, WJE conveyed to the clients and the U.S. Army Corps of Engineers that repairs or strengthening of the connections would not be required.