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Urgent grout repair was required prior to commissioning the new auxiliary spillway control structure at Folsom Dam in Folsom, California. Deficient placement coupled with constraining geometries resulted in cracking and debonding of grout surrounding embedded steel plates within the spillway conduits, within and above the water surface profile during releases. With high flow velocities being conveyed across grout surfaces during releases, the primary concern was potential for “pop-out” of the grout, launching debris downstream, and impacting gate operation; an additional concern was personnel safety during maintenance. Extensive evaluations using sounding techniques and focused destructive tests indicated near-zero bond of the grout with the underlying (parent) concrete surface. Repair attempts by the contractor were insufficient, and a tailored engineered solution was necessary to achieve adequate bond between the grout and parent concrete.

The design team developed a “hybrid” approach that limited grout removal and replacement. Given the importance of the precision-installed embedded seal and bumper steel plates for proper functionality of the six submerged Tainter gates, the design objective was to salvage and protect the embedded steel in the repair areas. High-pressure epoxy injections were utilized at identified cracks in the remaining original placements. Surface conditioning of the parent concrete was achieved using water-jetted techniques per ICRI guidelines prior to new grout placement. Epoxy-coated rebar (L-bar anchors and straight bars) and epoxy anchors were installed to ensure strength and stability.

A commercial self-consolidating grout was chosen by the contractor for new placements. However, initial placements showed excessive density of “bugholes,” driven by the constraining geometries (angles, depths) of placements, material properties of the grout, and placement technique. Following a regimen of different methodologies performed on test sections, including varying water-cement ratios and consolidation techniques (hammering, etc.), a methodology was selected, and grout sections were placed with improved performance and acceptable results. Pull-out testing was performed to evaluate successful bond with parent concrete, indicating bond strengths achieved were greater than required.

The paper will describe the initial failed grout placement, failed efforts to repair, design considerations for the new “hybrid” repair, challenges encountered during construction, testing results, and lessons learned.