Underwater Work at Lake Chabot, Castro Valley, CA
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Constructed in 1874-75, San Leandro Lake was renamed Lake Chabot after Anthony Chabot, the water visionary who led construction of the dam that created the lake, which is situated within Castro Valley. When it was built, the lake was the primary source of water for San Francisco East Bay. Currently this 315-acre reservoir is a controlled recreational area and serves as a standby emergency water supply.

In 1924 the outlet structure was upgraded (Figure 1) and in 2016 DMZ Builders was awarded a contract by East Bay Municipal Utility District (EBMUD) to complete a seismic retrofit, which included a major upgrade to the stone and brick masonry outlet structure and its appurtenances. Outlet retrofit work shown in Figure 2 included excavation, demolition, shaft retrofit, concrete placement, and pipe installation, along with underwater work using divers.

To avoid a large and expensive earth cofferdam around the outlet structure, EBMUD specified that a reinforced concrete tremie beam (wall) be installed underwater to seal the base of the outlet structure and provide lateral support for the structure to resist water pressure during dewatering. To complete the seal, EBMUD specified that a contractor-designed steel bulkhead be placed underwater atop the tremie beam.

DMZ retained Brierley Associates to perform the contractor’s design work on the project. Elements of our work, led by David Berti in our Moraga, CA office included design of the steel bulkhead with seals, and the temporary support system that was used to keep the masonry structure from collapsing during dewatering.

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Placement of the tremie beam to support the steel bulkhead wall was accomplished with a landside concrete pump truck and crane along with a barge crew utilizing a mobile personnel lift and divers. See Figure 3. This was followed by lowering the steel bulkhead into place to block the 8-ft wide opening of the outlet works. Our steel bulkhead design, shown in Figure 4 was configured to allow dewatering of the outlet works structure to elevation 197. Also, the design took into account high lake level condition of elevation 232, which is five feet above the dam spillway. In March 2017, during dewatering, the lake level reached elevation 228.5 without affecting the bulkhead wall performance.

The rough surficial condition of the 140-year old outlet structure challenged Brierley’s design team to create a relatively water tight bulkhead seal. The successful solution was to use continuous rubber “J” or “P” seals on the flat face of the steel bulkhead in a U-shape, in concert with soft neoprene pads as shown on Figure 5. The estimated leakage into the outlet structure, upon dewatering, was about 30 gpm (0.07 cfs) from all sources, including the masonry structure, existing tunnel, and the 53 linear feet of wetted seals. Minor leaks also came through the bulkhead (bolted) joints that provided added flexibility to obtain a better seal.

For the bracing, Brierley Associates specified a system consisting of individual Ellis jacks with a safe working capacity of 30 kips each. Stiff neoprene pads were placed under the modified end plates and the jacks were hand tightened for preload and then locked in place. Most jacks were installed in the dry, but some had to be placed by divers. This efficient system shown in Figure 6, did not require the installation of walers, thereby reducing project schedule and cost.

Although the 140-year old outlet structure had been constructed by manual labor without benefit of today’s mechanized equipment, the stone masonry was hard and broke out like monolithic, unreinforced concrete. The brick masonry that was used for facing in areas was not as hard, but also broke in a monolithic fashion. In contrast, concrete that had been placed in limited locations was of generally poor quality. In Fall 2017, the project work was successfully completed to protect this historic and important water infrastructure asset.