

Prestressed Concrete Tanks— Mundane? Or Architectural Gems?

By Charles S. Hanskat

Circular wrapped prestressed concrete tanks (WPCTs) have been built for over seven decades in the U.S. They range in capacity from 50,000 gal. (189,270.60 L) to over 30,000,000 gal. (113,562,360 L). These tanks use shotcrete (either dry- or wet-mix) for the construction of all or a portion of the walls that serve as the primary liquid containment.

The final exterior structural layer of all WPCTs is shotcrete. The cement-rich shotcrete provides an ideal environment to protect the highly stressed prestressing steel from corrosion and mechanical damage. Also, the versatility inherent in shotcrete allows tank builders to provide a final shotcrete finish that can range from a natural gun finish (rough and lumpy) to a screeded and floated surface with sharp lines and a smooth finish.

Although the plain shotcrete wall surface may be fine in a wastewater treatment or industrial plant, it may not, however, be attractive to the neighbors that live outside the water plant in residential areas where water tanks supply the water distribution system. Although most residents want to be able to turn on the tap and get clean, potable water at any time, they often react very negatively to having a water storage tank in their backyard or neighborhood. WPCTs can be over a football field in diameter and nearly 100 ft (30.48 m) high; thus, it is often impossible to hide a tank using plants, trees, and shrubbery.

The “not in my backyard” (NIMBY) attitude can be a real challenge to siting and building a new WPCT. One option is to completely bury the

tank and thus hide it from view. This results in a much greater cost for excavation and backfill, however, as well as the extra cost to add structural capacity to carry the backfill loads. Another option used by all the WPCT builders in the U.S. is to add architectural treatments to their tanks to make the tanks much more acceptable to the neighbors. In fact, creative architectural treatment often creates visually attractive structures that become landmarks in the community.

Architectural treatments on WPCTs range from simply providing an additional shotcrete thickness in the exterior shotcrete layer to create pilasters and arches to add-on exterior insulation finishing systems (EIFSs) and even brick and rock facings.

Figure 1 shows a 750,000 gal. (2,839,059 L) water storage tank built by The Crom Corporation for the Department of Veterans Affairs at the VA Hospital in Gainesville, FL. The architect wanted an architectural treatment that would complement the hospital building and provide the durability of shotcrete. The architectural treatment used both welded wire reinforcement and polypropylene fibers with a grout mixture to create an additional 1.5 in. (38 mm) thick shotcrete thickness. The surface preparation of the normal shotcrete cover coat preceding the placement of the architectural treatment included stiff brooming to provide a profile for the subsequent application of shotcrete to ensure proper bond.

Figures 2 through 4 show the sequence of construction of a shotcrete/EIFS architectural system with brick pilasters for a 1,000,000 gal. (3,785,412 L) water storage tank for East Hazel Crest, IL, built by Preload Inc., based in Hauppauge, NY.

In Fig. 2, the shotcrete cover coat is nearly complete. An oval temporary manhole is still open. The permanent manhole—about one-third the height of the wall above grade—is open. Shotcrete corbels are reinforced using T-shaped bolts to tie back to the tank core wall. These corbels will act as a shelf to support the brick pilasters. Vertical strips of dovetail anchors are shotcreted in a 1 in. (25.4 mm) pad (beyond the 1 in. [25.4 mm] of shotcrete covering the prestressing wires). The brick ties back to the dovetails, leaving an air gap between the shotcrete and brick. The brick contains weep holes at the first course above grade, and the sides between the brick and the shotcrete are caulked with a backer rod.



Fig. 1: 750,000 gal. (2,839,059 L) tank, Gainesville, FL
Courtesy The Crom Corporation, Gainesville, FL



Fig. 2: Shotcrete corbel and pilaster on a 1,000,000 gal. (3,785,412 L) tank, East Hazel Crest, IL
 Courtesy Preload Inc., Hauppauge, NY

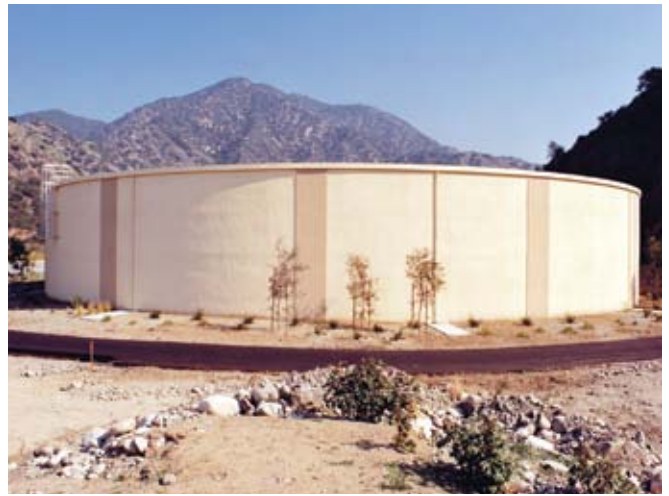


Fig. 5: 4,000,000 gal. (15,141,648 L) tank, Azusa, CA
 Courtesy DYK Inc., El Cajon, CA (a division of DN Tanks)



Fig. 3: EIFS arches being placed, East Hazel Crest, IL
 Courtesy Preload Inc., Hauppauge, NY



Fig. 6: 1,000,000 gal. (3,785,412 L) tank, Tuscaloosa, AL
 Courtesy The Crom Corporation, Gainesville, FL



Fig. 4: Finished tank, East Hazel Crest, IL
 Courtesy Preload Inc., Hauppauge, NY

In Fig. 3, the final shotcrete flash coat is complete. The brick pilasters have been placed and masked for construction of the EIFS arches. Polystyrene is glued to the tank wall with a permanent adhesive and then coated with a mesh reinforced latex-modified acrylic mortar.

In Fig. 4, the architectural treatment is complete with a stepped relief pattern on the arches and two-tone acrylic paint.

Figure 5 shows a straightforward shotcrete pilaster architectural treatment on a 4,000,000 gal. (15,141,648 L) tank built by DYK Inc. of El Cajon, CA, for Azusa Light and Power in Azusa, CA. The pilaster and two-tone paint visually breaks up the large expanse of wall and makes the tank seem less industrial.

Figure 6 shows a 1,000,000 gal. (3,785,412 L) water storage tank built by The Crom Corporation for the city of Tuscaloosa, AL, in 2007. The owner wanted architectural treatment on the tank with the color permanence of EIFS. The Crom Corporation recommended a system using both EIFS and shotcrete so that the lower portions of the tank would be resistant to grounds maintenance equipment. The treatment was built using welded wire reinforcement and a grout mixture for shotcrete work, which included polypropylene fibers. The bottom 10 ft (3 m) of the pilasters is a 2.25 in. (57 mm) thick shotcrete



Fig. 7: Tank in Sheboygan, WI
 Courtesy Preload Inc., Hauppauge, NY



Fig. 8: Aerial view of tank in Altoona, PA
 Courtesy Natgun Corporation, Wakefield, MA (a division of DN Tanks)

construction, whereas the upper portions use an EIFS system.

Figure 7 shows a WPCT built by Preload Inc. for Sheboygan, WI. This tank has vertical precast concrete pilasters on shotcrete corbels and a horizontal circumferential precast concrete pilaster supported by stainless steel shelf angles bolted to the wall. It also features a large steel-reinforced thickened shotcrete pad as a base for the stainless steel block letters.

Figures 8 and 9 show another WPCT—built by the Natgun Corporation from Wakefield, MA—for the city of Altoona, PA. The aerial shot shows how NIMBY could have been a big



Fig. 9: Close-up view of tank in Altoona, PA
 Courtesy Natgun Corporation, Wakefield, MA (a division of DN Tanks)

problem at this location. The owner, however, added the recreational pool facility alongside the tank and Natgun added an architectural treatment that made the tank look more like a building than a tank. The close-up shot in Fig. 9 shows how the brick veneer was added to give the appearance of a railroad tunnel entrance, with the locomotive painted on the tank's shotcrete surface.

In the foreground of Fig. 10 is a Preload tank using a brick and stone veneer with false windows



Fig. 10: Stone-brick veneer tank with barn pumphouse

Courtesy Preload Inc., Hauppauge, NY

to give the appearance that the tank is just a circular building. The barn in the background is not a barn—it’s the pump house for pressurizing water from the tank into the water distribution system.

Figure 11 shows another Natgun tank in Vestal, NY, that uses brick pilasters with shotcrete (or perhaps EIFS) arches. Once again, the pilasters/arches and paint scheme help to visually break up the large cylindrical surface of the tank.

If you’re lost at sea in Laconia, NH, and see the light from the lighthouse in Fig. 12, you’ll probably be thankful for the guiding light but never know it is a water storage tank built by the Natgun Corporation.

In summary, WPCTs are extremely durable structures built with concrete and shotcrete to last up to 100 years. Unfortunately, many people see normal cylindrical concrete tanks as unattractive, utilitarian structures. As can be seen in the photos, however, with the creative use of paint, shotcrete, EIFS, brick, and stone veneers, today’s tank builders are able to create visually attractive tanks that can be proud landmarks for the municipalities they serve. Now the neighbors can say, “Sure, I’ll have THAT in my backyard!” Of course, they will also appreciate the improved water pressure.



Fig. 11: Night view of tank in Vestal, NY

Courtesy Natgun Corporation, Wakefield, MA (a division of DN Tanks)



Fig. 12: Lighthouse tank in Laconia, NH

Courtesy Natgun Corporation, Wakefield, MA (a division of DN Tanks)



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