DYK Inc., El Cajon, CA, a leader in the design and construction of prestressed concrete water storage tanks, is reaching the final phases of construction on the 35,000,000-gal. capacity Earl Thomas Reservoir at the Alvarado Water Treatment Plant in San Diego, CA. Working under general contractor C.E. Wylie Construction Co., San Diego, CA, DYK called on operators and concrete pumps from Conco Pumping & Belting, Fontana, CA, to install 20,000 yd$^3$ of structural concrete into the tank. To complete vertical prestressing and the exterior finish of the 35,000,000-gal. structure, DYK utilized one of their five WP 1000 XP trailer-mounted concrete pumps in an automated wet-mix shotcrete process.

The upgrade and expansion project is part of the City Water Department’s Capital Improvements Program to ensure San Diego area water will meet all current and future drinking water standards, and provide maximum protection of public health. Measuring 1289 ft (393 m) in circumference with a 406-ft (124 m) interior diameter, the $27 million reservoir will be the world’s largest circular prestressed concrete tank of its kind. The addition will increase the storage capacity of the plant to a total of 77,000,000 gal. (291,000,000 L) of drinking water, servicing 500,000 citizens. DYK’s construction, prestressing, and shotcrete divisions and pumping contractor Conco began work on the reservoir on August 21, 2003.

Over their 40-year history, DYK is responsible for engineering, constructing, or building more than 2.5 billion gal. (9.5 billion L) of low maintenance prestressed concrete tanks. The company is known for embracing technological advancements to improve the construction of these tanks for water

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treatment, distribution, storage, and the retention of storm water runoff from industrial sites. Each phase of the Earl Thomas Reservoir tank construction reflects DYK’s dedication to building strong, attractive tanks with greater seismic reliability, less leakage, low maintenance, and longer life spans for municipal, industrial, and commercial users.

In the early months of construction, DYK maximized production by simultaneously pouring the foundation, floor, and walls on one section of the Earl Thomas Reservoir while grading was being completed on an adjacent section. Engineering and design plans by Malcom Pirnie/Richard Brady & Assoc., San Diego, CA called for a highly-reinforced membrane concrete floor with a slight upward slope to the center of the tank. This conical-hopper bottom design facilitates collection and removal of sediment at the perimeter. Conco’s KVM 52 and KVM 45 concrete boom pumps completed 12 separate floor pours, pumping between 400 and 500 yd³ (306 and 382 m³) at a time. Southern California Sales Manager Louis Arcia said that with over 170 ft (52 m) of vertical reach, the contractor’s 170 ft (52 m) pump was able to complete 10 of the 12 total pours alone.

Curved steel wall forms were then erected along the outer circumference of the tank. The core wall was cast continuously to the full height and in equal sections. Vertical prestressing tendons cast inside the walls provide compression and minimize cracking and deterioration. Conco completed the tank’s 27 wall sections using their 75 ft (23 m) boom pump manufactured by Schwing America. Equipped with an 87 ft (26.5 m), three-section boom, the concrete pump easily completed the 39 ft, 3 in. (12 m) tall core wall sections. To reduce bending caused by hydrostatic, thermal, backfill, and seismic forces on the tank wall, the top and bottom of the core wall was separated from the roof and floor by neoprene bearing pads to provide an unrestrained connection. A continuous PVC bulb waterstop at each wall-roof and wall-floor connection prevents leakage.

Columns on the Earl Thomas Reservoir were completed concurrent to wall construction. To support the tank’s 18 in. (457 mm) thick, two-way flat slab concrete roof crews completed 227 round columns measuring 30 in. (762 mm) in diameter.

The next phase of the tank’s construction involved 12 separate roof pours, each pour requiring an estimated 700 to 800 yd³ (536 to 612 m³) of concrete. Conco utilized their KVM 52 and S 58 SX boom pumps to place concrete into the tanks “cap.” Forms created the desired slight upward slope to the roof’s center.

Once the roof was completed, DYK utilized their state-of-the-art circumferential prestressing equipment in a three-phase process to produce a durable, crack-free, leak-free storage structure.

To create an ideal bonding surface on the core wall for the initial layer of shotcrete, DYK utilized their newly developed, automated, hydroblasting process to clean and etch the tank wall instead of conventional abrasives like sand. DYK’s hydroblaster is carried, powered, and controlled by a mechanized tower that travels around the circular wall at a controlled speed. The machine recycles the water used by the operation.

Next, wet-mix shotcrete was applied on top of the blasted core wall from a nozzle mounted on a mechanized tower. DYK’s WP 1000 XP remained stationary while 500 ft (153 m) of line measuring 2-1/2 in. (63.5 mm) in diameter fed the end nozzle mounted on a mechanized tower.
The third step of DYK’s state-of-the-art prestressing technique, external circumferential strand wrapping, supplies the core wall compression. The galvanized 3/8 in. (10 mm) diameter, seven-wire strand was applied to the wall with the same mechanized tower, this time equipped to provide stringent stress-tolerances and electronic winch controls to assure accurate strand spacing. DYK utilized 58 reels of strand, measuring 242 miles (390 km) long. If placed end to end, the strand measures approximately the distance from San Diego to Santa Barbara, CA. The strands withstand 14,950 lbs of force (66.5 kN) with a ±1.5% differential.

Utilizing the same system as the initial grout application, crews then apply several protective layers of the same shotcrete mix, with the addition of polypropylene fibers (in conjunction with curing) for shrinkage crack control, over the prestressing strand. The full cover of the exterior is built up in numerous thin layers. Shortly after the final shotcrete layer is applied and soaked with water, plastic sheeting is lapped and sealed as necessary to retain moisture and properly cure the shotcrete. Upon completion, the exterior wall of the Earl Thomas Reservoir tapers from 38 in. (965 mm) thick at the base to 12 in. (305 mm) at the top. A total 750 yd³ (574 m³) of shotcrete mixture was applied during the prestressing and exterior construction phases.

Smith commented on the World Pump’s twin circuit hydraulic system: “On most pumps, there are short periods of time when the supply hesitates while the valve switches cylinders. That sacrifices quality and affects productivity. We’ve tried equipment from just about every manufacturer, and the Schwing 1000 trailer pumps have the performance we’re looking for. Our pumps are equipped with rock valves, and I’m convinced they perform the quickest, most aggressive cylinder switch in the industry.”

Beginning in October 2004, general contractor C.E. Wylie commenced on the installation of piping and pumping components. The Earl Thomas Reservoir is scheduled for completion in summer 2005.

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