



**BUILT  
FOR THE FUTURE**

**PRESTRESSED CONCRETE TANKS**



# **DURABILITY FOR GENERATIONS TO COME**

Effectively managing water and other vital liquid resources is a priority for communities and companies everywhere. And safe storage is a core component of any effective solution. That's why DN is more than a designer and builder of liquid storage tanks: We're a partner in keeping the world's most precious resource safe.

The promise of our AWWA D110 Type I Prestressed Concrete Tanks is their ability to stand the test of time. They require little to no maintenance over decades, delivering the best long-term value possible. And behind each of these tanks is the power of our people. We draw on decades of proven expertise to deliver productive relationships that are as enduring as our tanks themselves.



## KEY ATTRIBUTES OF A DN AWWA D110 TYPE I PRESTRESSED CONCRETE TANK

- **Tank Capacities** — from 40,000 gallons to 50 million gallons (MG) and more.
- **Custom Dimensions** — liquid heights from 8' to over 100' and diameters from 25' to over 500'.
- **Siting Options** — at grade, partially buried, differentially back-filled and fully buried (with multi-use capabilities).
- **Seismic Resilience** — designed with an anchored flexible base for enhanced ductility and seismic performance.
- **Durability** — proven reliability through weather extremes, including fire and freeze thaw events, tornadoes and hurricanes.
- **Bi-axial Wall Compression** — provides longevity, durability and liquid tightness.
- **Reinvesting in the Local Economy** — use of materials, labor and equipment from within the community.
- **Enhanced Water Quality** — concrete inherently insulates, keeping liquids at a more consistent temperature.
- **Best Long-term Value** — our tanks speak for themselves. No coatings required, which eliminates routine maintenance costs and downtime. Request a lifecycle cost analysis today.



# SITE PREPARATION

A properly prepared subgrade is essential to tank construction. Before the structural tank design begins, a licensed geotechnical engineer prepares a site-specific geotechnical report. The report provides design parameters that include bearing capacity, anticipated settlements, seismic criteria, and recommended subgrade and foundation preparation.

- Subgrade preparation for each tank is completed in accordance with the civil site plans and the site-specific geotechnical report.
- Piping connections that penetrate through the floor (e.g., inlet, outlet, overflow, etc.) are encased in underslab concrete pipe blocks.
- A waterstop is incorporated between the floor and pipe block to ensure a liquid-tight connection.
- Wall and roof pipe penetrations can be easily incorporated.





# FLOOR & FOOTINGS

A typical prestressed concrete tank floor consists of the following features:

- A cast-in-place, highly reinforced, concrete floor with a slight upward slope to the center allows for drainage.
- Monolithic or large section pours limit joints to improve tank performance and achieve construction efficiency.
- A thickened perimeter wall footing transmits the concentrated wall loads to the subgrade beneath.
- A permanent PVC waterstop at all joints for water tightness.
- Seismic base restraint cables are developed into the perimeter footing to account for site-specific seismic loading.
- Experienced field crews place the concrete and ensure it is vibrated, screeded and finished to meet the project specifications.





# CAST-IN-PLACE WALL CONSTRUCTION

Prestressed concrete places steel in tension and concrete in compression, allowing for both materials to resist forces in their ideal states. The corewall is designed to account for project-specific parameters and loadings. A typical tank corewall consists of a 10" minimum uniform thickness. For larger capacity tanks, walls may be thicker and tapered on the inside face to accommodate increased loads.







## FEATURES OF AN AWWA D110 TYPE I WALL

### Enhanced Operational and Seismic Performance

- Anchored flexible base connection between the floor and wall enhances ductility and reduces bending moments from hydrostatic, thermal and seismic forces, allowing these structural elements to act independently.
- Seismic base restraint cables anchored into the footing extend into the corewall, providing load transfer during a seismic event.

### Quality Control

- Circumferential wall forms curved to the specific tank radius are equipped with equally spaced pour windows to enhance quality control, reduce overall drop height, and allow ease of access for concrete placement and vibration.
- 50' wide circumferential sections are poured at full height.
- Rebar congestion is significantly reduced, promoting more efficient inspection and concrete placement.

### Liquid Tightness and Durability

- Vertical prestressing threadbars cast in the wall provide vertical compression and minimize vertical bending moments caused by differential temperature and extreme weather conditions.
- Horizontal joints are eliminated and vertical joints are minimized to provide superior water tightness.
- All construction joints incorporate permanent PVC waterstops.



# ROOF OPTIONS

Prestressed concrete tanks can be designed with a variety of roof options.







## Flat Roof Features

- Low-profile, cast-in-place, two-way flat slab roof minimizes visibility.
- Option to bury or accommodate multi-use structures such as parks, recreation facilities, pump stations, etc. on the tank roof.
- An anchored flexible wall/roof connection allows for thermal expansion of the roof slab while also providing seismic restraint.
- Evenly spaced concrete columns, designed with drop panels and footings, support the roof and transfer the corresponding loads.
- A slight upward slope to the center, matching the floor, provides drainage.



## Dome Roof Features

- A clear-spanning concrete dome with no interior supports or obstructions can easily accommodate various equipment needs.
- Continuous reinforcement is incorporated in both radial and circumferential directions.
- Circumferential prestressing applied at the dome ring places the dome in permanent compression.



## Open Top Features

- Allows for stairway and catwalk systems and launders
- Automated or manual tank cleaning systems
- Used in various wastewater systems as a clarifier, EQ, aerator, or digest storage tank.





# VERTICAL PRESTRESSING

AWWA D110 Type I tanks incorporate vertical prestressing threadbars within the wall to provide vertical compression and counteract bending.

## Features include:

- High-strength steel threadbars are either 1¼" or 1¾" diameter, depending on corewall thickness.
- Threadbars are equipped with a screwed-on nut anchor at the top and bottom to eliminate stress concentrations.
- Each threadbar is housed inside of a rigid PVC pipe to allow for proper installation.
- A hydraulic ram is used to tension the threadbars after the concrete walls are poured.
- Threadbars are tensioned to 137 or 173 kips for the respective diameter, with a tight force tolerance of 1.5%.
- Force and elongation recordings are electronically and instantaneously produced for each vertical threadbar, documenting the applied stress.
- After tensioning, threadbars are pressure-grouted from the bottom up with a two-part epoxy to achieve a fully bonded system and corrosion protection.





## ABRASIVE BLASTING

Prior to starting circumferential prestressing and shotcrete operations, DN uses an advanced abrasive blasting system to roughen the exterior corewall surface.

### System features include:

- Automated hydroblasting applies water at a high pressure of up to 40,000 psi to etch the wall to a precise roughened finish, providing a superior bonding surface.
- An automated system reduces jobsite hazards, optimizes construction schedule and provides a consistent finish.
- Hydroblasting is environmentally friendly, as it requires very low water usage and eliminates dust.



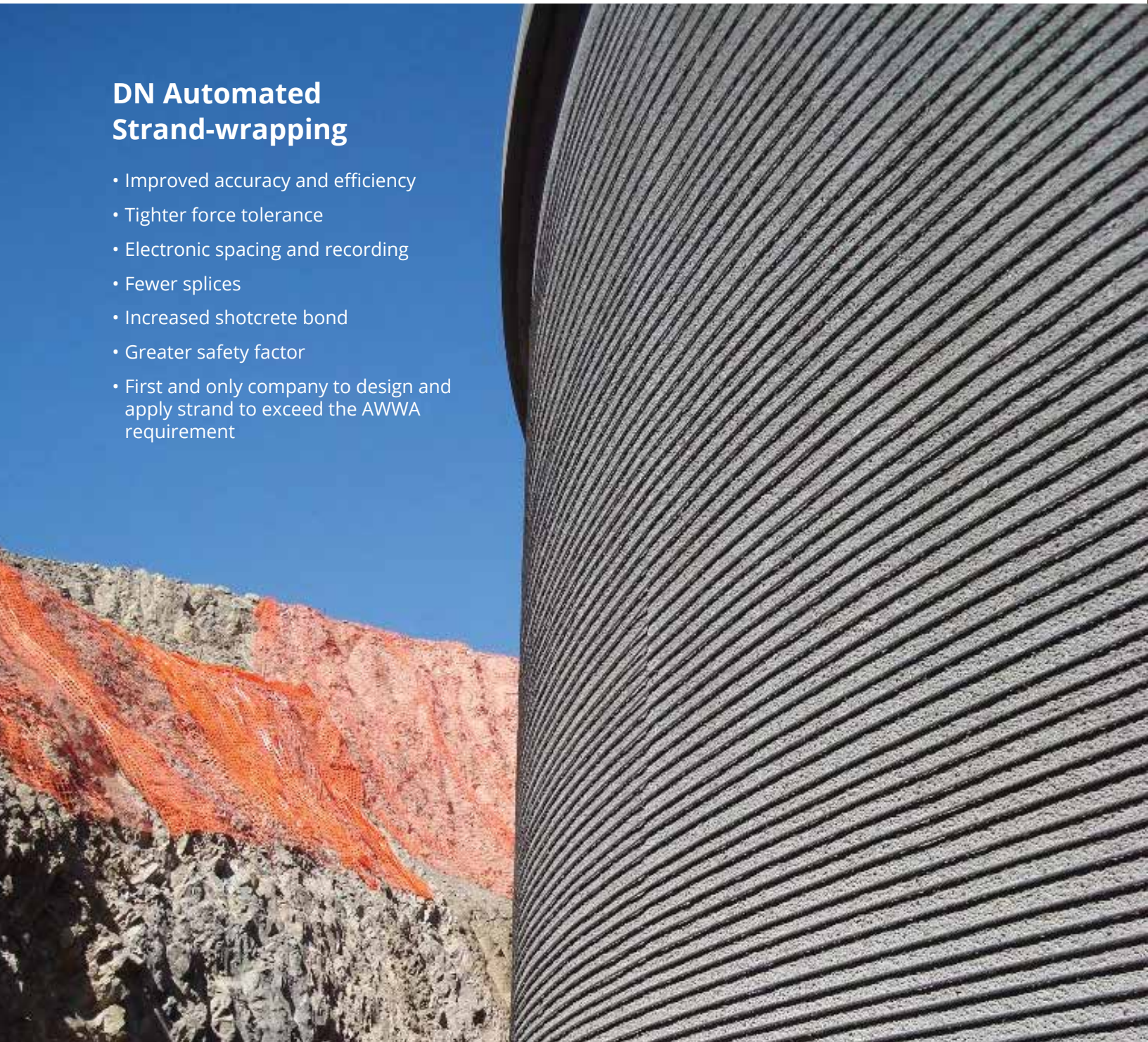
# CIRCUMFERENTIAL PRESTRESSING

Circumferential prestressing is the heart of the tank structure, counteracting the liquid load and placing the tank wall in 200 psi residual compression. DN provides significant industry advancements, including the automated machine application of tensioned, hot-dip galvanized,  $\frac{3}{8}$ " diameter 7-wire strand.

By placing the strand in tension, and thereby the concrete wall in compression, the prestressed concrete tank incorporates both materials in their ideal states.

## DN Automated Strand-wrapping

- Improved accuracy and efficiency
- Tighter force tolerance
- Electronic spacing and recording
- Fewer splices
- Increased shotcrete bond
- Greater safety factor
- First and only company to design and apply strand to exceed the AWWA requirement







# ADVANCED TECHNOLOGY

Our state-of-the-art circumferential prestressing equipment is able to perform multiple sophisticated tasks with one simple, automated, quality-controlled unit.

## ELECTRONIC MONITORING & CONTINUOUS RECORDING

Continuous electronic recording and instantaneous self-correcting force application are essential to ensure the proper stress is applied to the prestressed steel. The prestressed steel places the concrete into permanent compression and resists all hydrostatic loads. It is imperative that the stress is applied accurately. The automated system offers:

- Computerized, continuous electronic force readings for the highest quality control.
- In-line calibration, allowing for instantaneous control of the force applied.
- A record of the force readings submitted to the owner, providing confidence that the most critical part of the hydrostatic resistance has correctly been applied.







# AUTOMATED SHOTCRETE

The advanced technology of the automated shotcrete process is proven to preserve the integrity of a DN structure by providing corrosion protection and a permanent bond.

## Features of Automated Shotcrete

- Control of numerous variables such as uniform distance, angle, and applied thickness on large surface areas ensures complete encapsulation of the prestressing strand as well as a proper bond to the corewall.
- Wet-mix shotcrete applied from a nozzle mounted on a mechanized tower travels at a controlled uniform speed and path.
- A minimum final shotcrete cover of 1.5 inches is applied and built up in multiple layers.



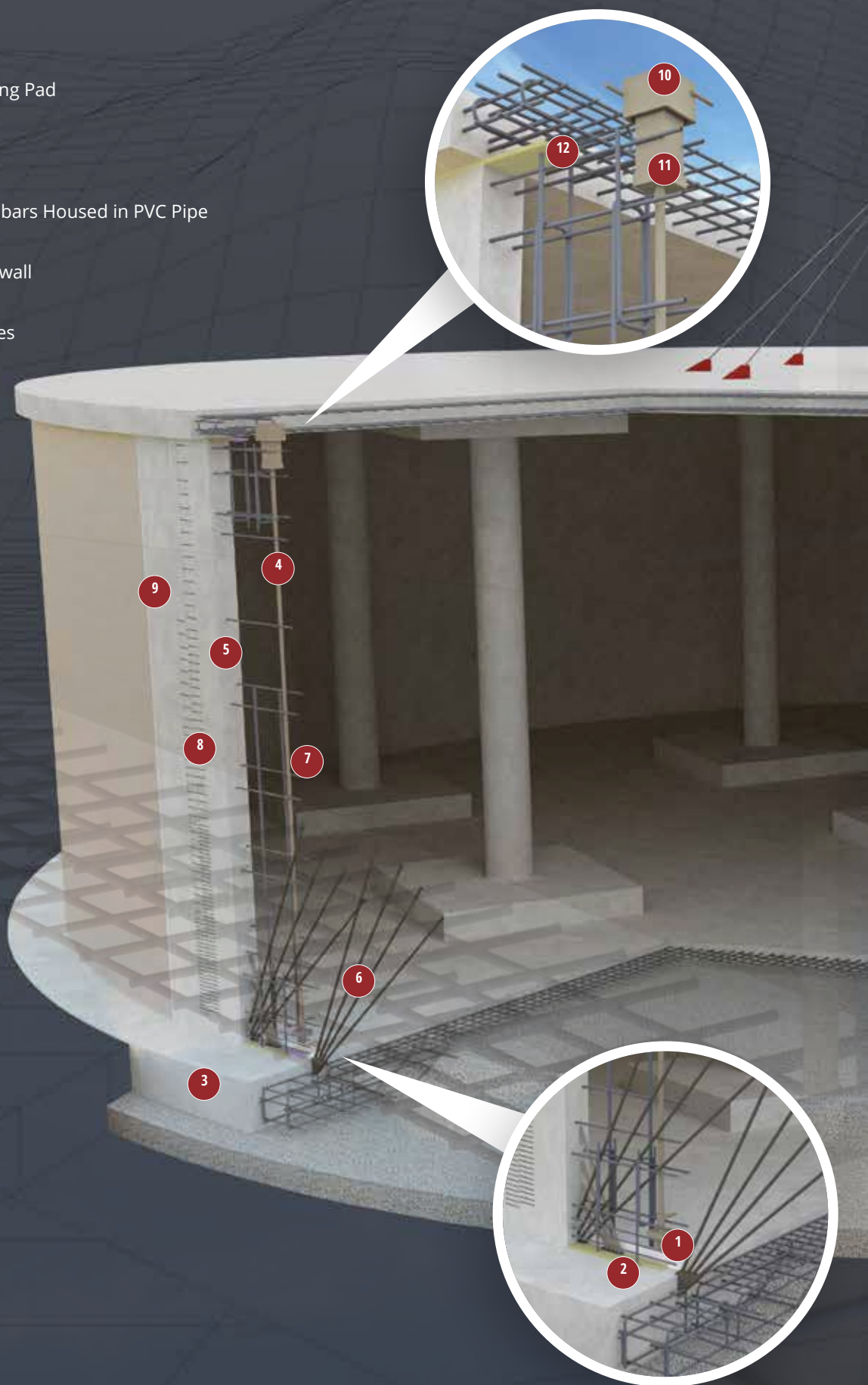


## APPURTENANCES

Prestressed concrete tanks can accommodate a variety of accessories, such as roof and wall access hatches, interior and exterior ladders, vents, safety railings, level-sensing equipment, or specialized security hardware. Additional wastewater accessories can be included with your design needs. Our experienced team can help recommend and install appurtenances to meet specific project requirements.



- 1 PVC Waterstop
- 2 Elastomeric Wall-base Bearing Pad
- 3 Tank Foundation
- 4 Vertical Prestressing Threadbars Housed in PVC Pipe
- 5 Cast-in-Place Concrete Corewall
- 6 Seismic Base Restraint Cables
- 7 Continuous Circumferential Reinforcing
- 8  $\frac{3}{8}$ "  $\varnothing$  7-Wire Galvanized Circumferential Prestressing Strand
- 9 Shotcrete Encasement
- 10 Roof Shear Can
- 11 Wall Shear Can
- 12 Elastomeric Wall-top Bearing Pad







- Center Pin 13
- Base Unit and Engine 14
- 7-Wire Galvanized Strand Reel 15
- Automated Shotcrete Arm and Nozzle 16
- Adjustable Tower 17
- Stressing Head 18
- Operations Cabin 19



# DN SHOWCASE









WE KEEP  
THE WORLD'S  
MOST PRECIOUS  
RESOURCE SAFE.

PRESTRESSED CONCRETE TANKS  
AWWA D110 Type 1



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