PRECAST CONCRETE
ON-SITE
WASTEWATER TANKS
OUTLINE

• Purpose
• Precast Advantage
• Design Goals
• Applicable Standards
• Structural Design
• Materials
• Production
• Watertightness
• Installation
• NPCA Plant Certification
• On-site Wastewater Accreditation Program
PURPOSE

Provide current and accurate technical information as it relates to the design, production and installation of precast concrete on-site wastewater tanks.
PRECAST ADVANTAGE

- Available nationwide
- Environmentally friendly
- Watertight
- Long life span and durability
- Delivered and set by manufacturer
- Strength
- Buoyancy
- Competitively priced
- Produced in a controlled environment
DESIGN GOALS

Structurally Sound
Able to withstand a variety of loading conditions

Watertight
Eliminate infiltration and exfiltration

Durable
Proper materials and production practices
APPLICABLE STANDARDS

ASTM C 890
- Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures

ASTM C 1227
- Standard Specification for Precast Concrete Septic Tanks

IAPMO PS-1
- Prefabricated Septic Tanks

CSA B 66
- Design, material and manufacturing requirements for prefabricated septic tanks and sewage holding tanks
REFERENCES

NPCA Best Practices Manual
REFERENCES

NPCA Quality Control Manual for Precast Plants

Local Codes and Regulations
REFERENCES

Precasters Notebook
STRUCTURAL DESIGN

Loading Conditions

• Surface surcharge
• Concentrated wheel loads
• Lateral loads
• Presumptive soil bearing capacity
• Buoyant forces
• Connections and penetrations
• Point loads

Tanks shall be designed with rational mathematical calculations performed by a qualified professional engineer or by proof of performance.
Optional Loading Where Appropriate

Manufacturer to specify maximum depth of cover
Structural design by performance requires the manufacturer to demonstrate that tank failure will not occur by physically applying loads to the product. The load applied will be 1.5 times the actual anticipated loads.

- Loading may be accomplished by physical application or by vacuum (negative pressure).
STRUCTURAL DESIGN

Vacuum Test
• This test for structural integrity is performed by application of a vacuum (negative pressure) to the tank equivalent to 1.5 times the anticipated design loading.

• A water test cannot be used for structural proof of design regardless of material.
STRUCTURAL DESIGN

ASTM C1227

Proof of Design Test
**STRUCTURAL DESIGN**

Proof of Design Test Load (psf) = \(14.7 \frac{lb}{in^2} \times 144 \frac{in^2}{ft^2} \times \frac{\text{Partial Vacuum (inches Hg)}}{29.7 \text{ inches Hg}}\)

<table>
<thead>
<tr>
<th>Partial Vacuum (inches Hg)</th>
<th>Load on Wall (psf)</th>
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<tr>
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Partial Vacuum (inches Hg)

Load on Wall (psf)
**Warning**: Testing with negative pressure involves potentially hazardous conditions. Take precautions to minimize potential risks by incorporating safety devices that will prevent excessive vacuum levels (safety release valves, redundant gauging, etc.).
STRUCTURAL DESIGN

Concrete Thickness
• Sufficient to meet minimum reinforcement cover and withstand design loading conditions

Concrete Mix Design
• Concrete Compressive Strength – Minimum 4,000 PSI strength at 28 days
• w/c < .45 (water/cementitious ratio)
• Quality materials, using well-graded aggregates
• Air entrained in accordance with ACI 318

Reinforcement
• Reinforcement design by structural calculations as required by code or as proven by testing
Standard concrete septic tanks are not designed to be installed under traffic loads. Tanks designed for traffic loading or special situations are available.

Design loads and test verification for precast concrete structures are based upon AASHTO Standards and ASTM Standards.
Cement

The majority of cement used in the manufactured concrete products industry is governed by ASTM C 150, “Standard Specification for Portland Cement.”
MATERIALS

Aggregates
MATERIALS

Water

Admixtures & Supplementary Cementitious Materials (SCMs)

Admixtures and SCMs allow the manufacturer to fine-tune and enhance the properties of the concrete mix.

- Air entraining admixtures per ASTM C 260 improve freeze-thaw properties while SCMs per ASTM C595 and C618 have impacts upon the water content and can lead to significant improvements in permeability of the concrete.

Today, precast concrete is the high-tech material of choice.
MATERIALS

Reinforcement

- Reinforcement of concrete is required and must be provided and designed to meet structural loading and handling conditions.
MATERIALS

Reinforcement

- Reinforcement types can vary from WWR to conventional rebar to fibers – all reinforcement must comply with applicable standards.
Pre-pour Inspection
• Trained and qualified plant personnel perform inspection before each pour to verify form cleanliness, proper amount of release agent, and reinforcing steel placement and configuration.

Post-pour Inspection
• As an essential part of the production process, the post-pour inspection verifies product conformance to project specifications.
Final Inspection

- Validation of Quality
WATERTIGHTNESS

Pipe to Tank Connections
Basic Function – Prevent Infiltration and Exfiltration

- Provide a permanent flexible connection between pipe and tank.
- Provide for angular deflection of pipe.
- Provide for shear deflection of pipe.
- Provide sure, simple connection for installer.
WATERTIGHTNESS

Pipe to Tank Connections
Extended Functions
• Positively locate inlet tee and outlet tee or filter.
• Prevent rotation of pipe.
• Prevent axial displacement of pipe.
WATERTIGHTNESS

Testing
Testing for watertightness can be achieved by vacuum testing or water-pressure testing and take place at the plant and/or at the job site.

• Vacuum testing – The recommended procedure is to introduce a vacuum (negative pressure) per ASTM C1227, Section 9.2.1.
WATERTIGHTNESS

Vacuum Testing Demonstration
INSTALLATION

Responsibilities for installing a watertight wastewater system include:

- Inspection of inlet, outlet and baffle pipes
- Proper connection of all watertight fittings and joints
- Proper connection of tank to sewer line from residence
- Planning for site conditions
- Excavation and bedding
INSTALLATION

- Tank Placement
- Proper Sealing Methods
- Installation of Access Risers and Pipe
- Penetrations
- Backfilling Procedures
- Testing
QUALITY

The On-site Tank Manufacturer Assuring Quality

• Quality Control (raw materials, mix design, reinforcement, concrete placement, production process, etc.).

• Conformance to specification or regulations, as applicable.

• Testing as required by specification or regulations.

• Supply appropriate lifting apparatus for tank.

• Transport tank to job site undamaged.
The Installer / Plumber Assuring Quality

Responsibilities for installing a watertight septic system include:

- Inspect inlet, outlet and baffle pipes
- Properly connect all watertight fittings and joints
- Properly connect tank to sewer line from residence
QUALITY

The General Contractor Assuring Quality

Responsibilities for ensuring a watertight wastewater system include:

- Receipt, inspection and unloading of tank from manufacturer
- Excavation
- Preparation of bedding
- Placement of tank
- Backfill
- Installation of leachline
- System test
NPCA Plant Certification

Quality Control Manual for Precast Concrete Plants describes the production processes required for quality precast products.

Plant Inspections conducted by third-party consultants.
On-site Wastewater Accreditation Program (OWAP) has same standards as plant certification, only specific to on-site products.

OWAP ensures end-user that on-site products will be watertight, structurally sound and long-lasting.
Regulators and Specifiers can consistently obtain precast concrete on-site wastewater products when designers, producers and inspectors consistently stress compliance to standards and specifications.

- High Quality
- Watertight
- Structurally Sound