Industrial Potable Water Infrastructure Project

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Abstract *— This project is for the design of an industrial-grade potable water infrastructure system capable of supporting all required manufacturing activities with approximately 100 employees, for three days after the occurrence of an external city water disruption event. The scope will be designed following all safety, environmental, and government requirements, providing operational flexibility. The design will be performed according to the user's requirements and specifications, which is the key to fulfilling the client's needs and robust infrastructure design. The scope will include mechanical distribution, storage capacity, structural and seismic design, external servicing capability, with automation operational control equipment.*

Key Terms*: Industrial Water, Manufacturing Support, Structural Design, Tank Selection.*

INTRODUCTION

Water plays a vital role in manufacturing operations, from cooling equipment to creating manufacturing products and people's use. Manufacturing plants, such as factories, food and beverage industries, depend greatly on reliable water use and storage options to ensure smooth functioning and compliance with regulations.

The significance of water use in an industrial manufacturing complex is driven by the use of:

- Heating and Ventilating Air Conditioning Systems (HVAC) – Manufacturing operations often produce heat that needs to be managed by cooling machinery and components with water.
- Production Requirements – Formulations in sectors such as food and beverages often require water as a component.
- Equipment Cleaning – Maintaining cleanliness is essential to upholding quality standards in equipment and production areas.
- Fire Safety – Facilities are required to have water reserves in place to meet fire safety regulations.
- Environmental Control – Manufacturing operations, dust control, or humidifies the air.

When the water supply chain is disrupted, manufacturing operations result in downtime. Furthermore, water scarcity may cause product contamination, safety breaches, and decreased operational effectiveness. The avoidance of these adverse scenarios can be diminished with the use of potable water storage tanks. A complete industrial potable water infrastructure project will include:

- Potable water demands calculation.
- Potable water storage capacity calculation and fabrication material selection.
- Piping distribution and flow design to meet the required potable water demand.
- Structural design following engineering codes, considering hazard exposure.

Water Storage Used in Manufacturing

When deciding on a water storage option for your manufacturing facility's needs, the choice of a water reservoir tank plays an important role in managing your water resources. Steel bolted water storage tanks are commonly used in industries for their flexibility in size options, from small (1,000 Gallons) to large-scale (6 million Gallons) capacities. They also offer the added benefit of customization with coatings or linings for protection against corrosion and impurities. Why Choose Steel Core Tanks?

- Durability – Steel-Core tanks are designed and manufactured for longevity and are equipped with the latest upgrades that guard against the effects of challenging weather or industrial settings.

- Customization – Steel-Core offers a wide range of tank sizes and designs so that you can select the solution that best suits your facility's requirements.
- Compliance – All Steel-Core tanks are crafted with adherence to regulations as a priority to guarantee that your facility aligns with national standards.
- Quality Installation – Installing Steel Core tanks is a breeze. They are crafted for efficient setup, minimizing any downtime.
- Great value – Steel Core offers cost solutions by providing high-quality products with highly durable tanks requiring little maintenance.

Potable Water Defining

Potable water infrastructure must comply with the following considerations:

- Meet the Safe Drinking Water Act (SDWA) enforced by the U.S. Environmental Protection Agency (EPA).
- Adherence to Puerto Rico Department of Health (PRDOH) regulations for potable water quality.
- Compliance with NSF/ANSI 61 standards for water treatment components.
- Must follow World Health Organization (WHO) guidelines for drinking water quality.
- Microbiological, zero count of E. coli in the Total Coliforms test per 100mL sample.
- Chemical, pH: (6.5–8.5).
- Chlorine Residual, (0.2 – 4.0 mg/L).
- Heavy Metals: - Below EPA's Maximum Contaminant Levels (MCLs).

Potable Water Demand Parameters

The potable water infrastructure will be designed to supply 100% of the required potable water demand based on the following criteria:

- Daily Per-Capita Demand.
  - Light manufacturing Industry **40–60** gallons per day (GPD) per employee.
  - Heavy manufacturing Industry 80–150 GPD per employee.
  - Food & beverage industry 300+ GPD per employee.
- Storage Requirements
  - On-site storage capacity for at least **48–72 hours** of supply.
  - Minimum water distribution pressure of **45–80 psi** for process stability.
- Distribution Requirements
  - Pipe Materials:
    - Ductile Iron (DI) or High-Density Polyethylene (HDPE) for main supply lines.
    - Copper type L piping for internal potable water lines.
  - Minimum Velocity: 2 ft/s to prevent stagnation.
  - Maximum Velocity: 8 ft/s to prevent piping erosion.
- Pumping & Pressure Management
  - Variable Frequency Drives (VFDs) on pumps for pressure control and energy use efficiency (DOE, 2021).
  - Backflow prevention devices to protect against cross-contamination.
  - Inlet water pressure regulation for overpressure control while supplying water from external sources.

City Water Source Requirements

To be sourced by the city's potable water infrastructure, it must be required to meet the following considerations:

- A formal potable city water metering service from Puerto Rico Aqueducts and Sewer Authority (PRASA).
- A backflow preventive device connected to the main potable water inlet source to avoid backflow contamination.
- The installation of a water pressure regulator to maintain the required water pressure throughout the facility.

- The potable water distribution piping must comply with PRASA and Building Codes requirements.

Manufacturing Site's Potable Water Requirements

Below are the specific industrial client considerations for the potable water demand analysis:

- The manufacturing building operates with **100** light industrial employees.
- Manufacturing process water consumption of **5** gallons of potable water per minute (GPM) per shift, 2 shifts per day.
- Manufacturing cleaning process water uses **1000** gallons of potable water per week.
- Buildings and grounds maintenance uses **500** gallons of potable water per day.
- Cafeteria uses **500** gallons of water per day.

Potable Water Tank Installation Requirements

Potable water tank installation will be performed, considering it is exposed to weather and seismic events in the selected geographic location. Below are the requirements for the design:

- The selection of a steel-core potable water tank.
- The construction of a concrete footing base designed for the potable water tank, piping, and electrical potable water pumps skid.
- Installation of an external hose port with an electrical pump to fill up the potable water tank by external truck suppliers due to extended city water disruption events.
- Concrete base and tank exposure must comply with the current ACI-318 code, International Building Code, and ASCE 7 requirements.
- The electrical pump skid:
    - Have a flow capacity of **40**gpm at **80**psi, **NEMA 3R**, with a Programmable Logic Controller (**PLC**) and variable frequency drive (**VFD**) operation.
    - Electrical requirements for the pumping skid are **480V, 3PH**.
    - Design must comply with the current National Electric Code (NEC) requirements.
- Equipment and installation design:
    - Must be aligned with Puerto Rico industrial manufacturing standards, Good Manufacturing Practices (GMP).
- Potable water distribution piping design:
    - Copper water piping for potable water compliance with a distribution design velocity of **3.0ft/sec**.
    - Must comply with the current PRASA and International Building Code requirements.

Location Hazard Report by the American Society of Civil Engineers (ASCE)

Infrastructure design is evaluated following the American Society of Civil Engineers' (ASCE) hazard considerations web-based site [1]. This report brings the hazard consideration for a safer construction based on soil characteristics, wind exposure, and historical seismic events. Figure 1 shows the project location hazard report using the ASCE webpage tool.

Figure 2 shows the wind exposure results based on the probability recurrence in years of the infrastructure location area. Wind Exposure: Use **174mph** wind exposure design.

Figure 3 shows the seismic exposure based on the project infrastructure location.

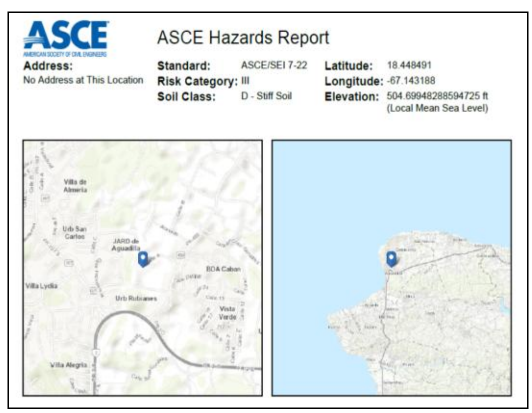


Figure 1
ASCE Location Hazard Report Map, Aguadilla, Puerto Rico

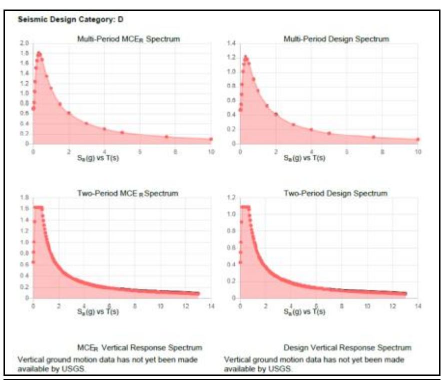
Wind	
Results:	
Wind Speed	174 Vmph
10-year MRI	74 Vmph
25-year MRI	103 Vmph
50-year MRI	120 Vmph
100-year MRI	134 Vmph
300-year MRI	150 Vmph
700-year MRI	162 Vmph
1,700-year MRI	174 Vmph
3,000-year MRI	181 Vmph
10,000-year MRI	196 Vmph
Data Source:	ASCE/SEI 7-22, Fig. 26.5-1C and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed:	Tue Jan 07 2025

Figure 2
Wind Exposure Results

Seismic			
Site Soil Class:	D - Stiff Soil		
Results:			
PGA_M :	0.6	T_L :	12
S_{MS} :	1.63	S_S :	1.33
S_{M1} :	1.11	S_1 :	0.44
S_{DS} :	1.09	V_{S30} :	260
S_{D1} :	0.74		

1) Soil Class: D-Stiff Soil; 2) SDS= 1.09

Figure 3
Seismic Exposure



1) Seismic design Category: **D**

Figure 4
Seismic Design Category

Potable Water Tank Capacity Calculation

The capacity of the potable water tank will cover the amount of water for three consecutive days:

1) Industrial building with **100** light industrial employees = 100 x 60 = **600gpd**.
2) Manufacturing process water consumption is **5 gallons per minute** (GPM) = 5gpm x 60min x 16hrs = **4,800gpd**.
3) Manufacturing equipment cleaning water use is 1000 gallons of potable water per week = 1000g/7days =**143gpd**.
4) Buildings and grounds maintenance uses 500 gallons of potable water per day = **500gpd**.
5) Cafeteria potable water uses 500 gallons of potable water per day = **500gpd**.

Total potable water per day = 6,543gpd (6,543gpd) x (3days) = 19,629gallons.

The capacity of the potable water tank to cover three consecutive days is **20,000 gallons**.

Potable Water Tank Designing Considerations

The steel core water tank design and fabrication will be performed following the American National Standards Institute (ANSI), fabricated by a certified potable water tank fabrication company. The tank fabricator vendor will submit a shop drawing document for the tank requester's acceptance. Below is the user requirement list for the tank fabrication:

- One (1) 20,000-gallon nominal capacity, steel core potable water tank, 12’-00” diameter x 24’-00” shell height.
- The tank will have a vertical self-stand-up configuration with a bolted flat bottom and a conical roof.
- The tank shall be designed and fabricated in accordance with the American Water Works Association (AWWA D100-21). The tank will have the following connections and/or accessories:
  - One (1) shell manhole 30” diam.
  - One (1) shell manhole 24” diam.
  - One (1) roof hatch 24” diam.
  - One (1) 3” diam. pump suction RFSO nozzle w. antivortex plate.
  - One (1) 4” diam. drain RFSO nozzle.
  - One (1) 3” diam. inlet RFSO nozzle.
  - One (1) 4” diam. overflow nozzle w. weir box & pipe up to 18” to concrete pad.
  - One (1) 3” diam. return RFSO nozzle.
  - One (1) 6” diam. roof vent (mushroom type).
  - One (1) external liquid level indicator (aluminum board type).
  - One (1) S.S. Nameplate.

- Four (4) S.S. grounding lug.
- Three (3) lifting lugs.
- One (1) exterior vertical ladder with a fall arrest system, in accordance with OSHA 1910.29.
- All-around roof safety railing system, 42” high, and a self-closing safety swing gate, per OSHA and A&C standards.
  - Anchor chairs by A&C design.
  - 12 Anchor bolt plates.
  - One (1) 12 anchor bolt template.
  - Two (2) 3” diam. roof spare RFSO nozzle.
  - One (1) 4” diam. shell spare RFSO nozzle.
- Exterior support brackets for inlet, return, overflow pipe, and roof spare nozzles.
- Materials: Bottom plates – carbon steel, A36 Shell plates – carbon steel.
- A36 Roof plates – carbon steel.
- A36 Paint: Interior Surface – shotblasted to a near-white grade as per SSPC-SP10, one (1) coat of Corothane I Galvapac and two coats (2) Macropoxy 5500 Low VOC Epoxy, for a total of 12 mils DFT minimum.
- Exterior Surface – Shotblasted to a commercial grade as per SSPC-SP6, one (1) coat of Corothane I Galvapac, one (1) coat of Macropoxy 646, and one (1) coat of Acrolon 218 HS from Sherwin-Williams, for a total of 12 mils DFT minimum.
- Wind Velocity Design – 175 MPH
- Risk Category – III
- Seismic Group – II
  - Seismic Importance Factor – 1.25
  - Seismic Factors – Ss= 131.3% & S1= 49.6%
  - Site Class – D
  - Site Exposure – C
  - Corrosion Allowance – None

Potable Water Infrastructure Design

The industrial manufacturing potable water infrastructure needs to be designed, taking into consideration:

- Steel core tank associated weights.
- Tank-footing design analysis.
- Bearing pressure results.
- Overturning resistance moments.
- Overturning safety factors.
- Tank sliding verification.
- Horizontal forces analysis.
- Eccentricity bearing pressure analysis.
- Tank concrete base structural design.

Steel Core Tank Associated Weights

Below is the steel core potable water tank, water weight, and concrete footing associated weights:

- Full Tank Water Weight: 150,120lbs.
- Empty Tank Weight: 10,484lbs.
- Concrete Footing Weight: 67,515lbs.
- Total estimated maximum load: **228,119lbs**.

Tank-Footing Design Analysis

We are going to calculate the allowable design capabilities based on the considerations below:

- Using allowable soil bearing of 4,000psf.
- Square Footing Dimensions of 14ft×18ft driven by tank diameter using a rectangular footing, considering:
  - Vertical Load (W): **228,119lbs**
  - Lateral Load (H): **8,000lbs**
  - Tank height: **24ft**
  - Soil Bearing Capacity: **4,000psf**
  - Friction coefficient (μ): **0.5**
  - Tank Up-lift Force: **6,655lbs**
- Assume that the dimension of 18 ft aligns with the wind direction.

Bearing Pressure (No Eccentricity) Results

Below is the bearing pressure resulting from the maximum loads applied to the soil:

- **905.23psf** (✓ well below 4,000psf of soil bearing capacity).

Overturning Resisting Moment Results

The overturning resisting moment is important for the evaluation of the tank stability. Below are the results for full and empty tank scenarios:

- Full Tank Mrf = **1,449,000 ft-lbs**
- Empty Tank Mre = **495,445 ft-lbs**

Overturning Safety Factor Verification

This safety factor evaluates the resistance moment (full tank, empty tank vs overturning moment) with the tank anchored to the concrete base:

Full Tank: SF = Mr/Mo (1)

=(1,449,000ft-lbs)/(96,000ft-lbs) ≈ **15.09** times (✓ Excellent)

- Empty Tank: SF = Mr/Mo
- = (495,445ft-lbs)/(96,000ft-lbs) ≈ **5.16** times (✓Excellent)

Wind Tank Sliding Verification

In this verification, we are going to evaluate the lateral force and uplift forces exerted by the hurricane winds on the tank itself:

- Full Tank analysis:

F(resist) = μ x W (2)

= 0.5 x 161,000lbs = 80,500lbs ⇒ FS(sliding) = (μ x W)/F(wind) = 80,500lbs/8,000lbs = **10.06** times bigger (**OK**)

- Empty Tank Analysis:

Wind Up-lift, Ul = 6,655lbs

F(resist) = 10,484lbs-6,665lbs = 1,914lbs ⇒ SF(sliding) = 1,914lbs/8,000lbs = **0.24** times (**Fail**)

- Horizontal Forces Analysis

∑ Fx = (μ)N – Fw = 1,914lbs–8000lbs = **-6,083lbs**

Note: The tank needs to be anchored for sliding avoidance due to horizontal hurricane winds.

Soil Bearing Pressure Analysis by Eccentricity

In this evaluation, we are going to include the effect on the bearing capacity of the soil caused by eccentricity:

Eccentricity e = Mo/W (3)

=96,000ft-lbs/228,119lbs = 0.42 ft

- Allowable eccentricity (for 18 ft length): e(max) =18ft/6 = 3 ft, e = 0.42 ft < 3 ft (Ok)
- Max and Min Bearing Pressures:

q(max) = (W/A) x (1+6eL) (4)

= (638.1psf) x (1+0.1987) = **765.6psf (max)**

q(min) = (W/A) x (1-6eL) (5)

= (638.1psf) x (1−0.1987) = **510.6psf (min)**

Both are below 4,000psf — footing is in full contact, no tension.

Tank Concrete Base-Footing Structural Design

Below are the data and considerations for the design of the tank's concrete footing base [2]:

- Footing Size: **14 ft (B) × 18 ft (L)**.
- Load: **228,119lbs**.
- Soil Bearing Capacity: **4,000psf**.
- Max Bearing Pressure: ≈ **766psf**.
- Load assumed concentric for reinforcement.
- Concrete: **f'c = 3,000 psi**.
- Steel: **fy = 60,000 psi**.
- Cover: 3" (exterior footing).
- Load from circular tank assumed distributed (not a point column) → uniform load.
- Assume bending along the shorter direction (14 ft).

Determine Required Footing Thickness

The footing thickness is based on the punching shear resistance and flexure analysis. We'll check both:

- Punching shear around tank base (assume 12 ft diameter tank).
- One-way shear and flexure along the short span.

Punching Shear Check

The punching shear check will evaluate the necessary concrete thickness for the shear force resistance [3].

Tank Perimeter:

p = π·d = π·(12ft) (5)

= 37.70ft Allowable shear stress: Vc = 2√f'c (6)

= 2 x √3000 =109.5 psi ⇒ **Vc = 15,768psf**

Estimated required concrete depth (d):

V=161,000lbs, V= (Vc)·(b_0)·(d) (7)

⇒ d=V/(Vc·b_0) =161,000/(15,768 x 37.7) ≈ 0.271ft = 0.271ft x 12 in/ft = **3.25in**

Add concrete cover and bar size → 3.25+3+1 = **7.25in**. Min thickness ~ **12 in** (standard min for durability + shear).

Use: **12"** overall thickness, effective depth **d** ≈ **9 in.**

Concrete Footing Base Self-Weight

We are taking into consideration the entire concrete footing base weight, the weight of the square footing section, and the weight of the round footing section:

Concrete Base Weight

(14ft)x(18ft)x(1ft)x150lbs/F^3 = **37,800lbs**

Concrete Base Perimeter Weight

((14ftx2x1.5ftx1ft)+(18ftx2x1.5ftx1ft))x150lbs/F^3 = **14,400lbs**

Bolts Development Footing Weight

Perimeter = (π).(d).(ρ) (8)

= (π).(13ft).(150lbs/F^3 =

(40.84ft).(2.5ft).(150lbs/F^3) = **15,315lbs**

Total Concrete Base Weight = **67,515lbs**

Bending Moment (Flexure) – One-Way

Worst-case bending is along the short direction (14 ft span) under uniform pressure:

Uniform pressure: Q = 766psf

Moment (one-way slab strip, fixed-free assumption conservative):

M = (q·L2)/8 (9)

= (766·142)/8 = **18,788 ft-lb/ft**

Flexural Reinforcement Verification

The flexural steel reinforcement amount is calculated by applying the following formula [4]:

As = (Mϕ)/(d·fy) (10)

=(18,788ft-lb/ft) x(12in/ft)x(0.9))/(9in·60,000lbs/in^2) = **0.376 in²/ft**

Minimum Steel Requirement

Below are the minimum reinforcement steel requirements for the base footing sections [4]:

Square footing

As(min) = 0.0018·b·d (11)

= 0.0018·12in·9in = **0.194 in²/ft**

- 1 bar #4/ft = 0.20 in²/ft > 0.194in²/ft (minimum).
- 1 bar #6/ft = 0.44 in²/ft > 0.376in²/ft (flexural required).

Circular footing

As(min) = 0.0018·b·d (11)

= (0.0018)·(12in)·(30in) = **0.648 in²/ft**

- 2 bar #6 = 0.88 in²/ft > 0.648in²/ft (minimum)

Reinforcement Summary

Below is the concrete reinforcement summary for the concrete base footing design:

14ft x 18ft concrete base, Long (18 ft) direction:

Reinforcement: **#4@12"** c/c (bottom)

Area provided: 0.20 in²/ft

Required Area: 0.194 in²/ft (min)

Concrete base: Short (14 ft) direction:

Reinforcement: **#6 @ 12"** c/c (bottom)

Area Provided: 0.40 in²/ft

Required Area: 0.376 in²/ft (flexural)

13ftdia x 3ft x 1ft circular bolt embedment footing:

Bottom:

Reinforcement: **2#6** continuous (bottom)

Area Provided: 0.88 in²/ft

Top:

Reinforcement: 2#6 continuous (Top)

Area Provided: 0.88 in²/f

Hooks:

#3 hooks @ **12in**

Required Anchor Bolt Embedment

This is the required concrete embedment to ensure the anchoring bolts have the required friction development length [5].

- Bolt type: standard **ASTM F1554 Grade 55**.
- Ultimate tensile strength: **55ksi**.

- Bolt size: assume **1.25"** diameter anchor bolts (or tell me the size).
- Development length for straight embedment (no hook), the required embedment increases.

Use a conservative:

$$L_d \approx 16-20 \times \text{bolt diameter} \quad (12)$$

= 20×1.25in = **25in** of development

Minimum Bolts Development Length

This is the verification of the tank anchoring bolts' force development length, plus the reinforcement cover and reinforcement diameter clearance:

Required Thickness = (Embedment)+(Bottom cover)+(Clearance) = 25"+3"+1" = 29in, use **36in**

Round up to standard: 36-inch **(3 ft)** thick footing for bolt development at the tank perimeter. This allows:

- Full bolt development straight length of **25in**.
- Clearance space for the bottom mat of rebar coverage.
- Using **48in** of bolt length will let **12in** of free length for tank to base anchoring.

Determine Seismic Base Shear (V)

Use ASCE 7-22 seismic design base shear equation:

$$V = (Cs)\cdot(W), \quad (13)$$

Where:

V = seismic base shear

Cs = seismic response coefficient

W = effective seismic weight = 161 kips

Determine Cs — Simplified Estimate:

$$Cs = (SDS)R/Ie \quad (14)$$

Assume:

1) SDS =1.09 (site-specific, conservative for Puerto Rico).
2) R= 3 (for anchored tank per ASCE 7 for nonbuilding structures).
3) Ie=1.5 (importance factor for essential facility like water tank).

Cs = (1.09)·(3)/1.5 = 2.18

V = (2.18)·(161kips) **= 351 kips**

Anchoring Bolt Shear Resisting Value

The verification below is to determine the shear force resisting value per anchoring bolt:

$$V_n = \phi(F_y)(A) \quad (15)$$

= (0.75)(55ksi)($1in^2$) = **33kip/bolt**

- Shear Load Verification:
  V= 351kip/12bolts = 29.25kip/bolt
  $V_n > V$ (Ok)

Check Seismic Sliding Resistance

Below is the seismic sliding resistance verification from the concrete base and the soil:

$$F(resist) = \mu N \quad (16)$$

Where:

μ = coefficient of friction (concrete on soil ≈ 0.5)

N = vertical load = 161 kips

F(resist) = (0.5)·(228.119kips) = **80.5kips**

Sliding Check:

- Resisting force = Seismic shear → **OK** at friction limit.
- You should add **keying** or **shear lugs** to resist sliding conservatively.

Overturning Moment (M_o) Check

This is to verify if the soil's friction force moment can resist the overturning moment created by seismic events without anchoring. Assume the center of mass is at 12 ft height (half tank height):

$$Mo = V\cdot h = (80.5kips)\cdot(12ft) = \quad (17)$$

966 kip-ft.

Overturning Restoring Moment (Mr.)

The following analysis is for the calculation of the overturning restoring moment, which will act opposite to the overturning moment:

Mr = W·B2 = (228.119)·(6.5/2) = (228.119)·(3.25) = **721.38kip-ft**

Overturning Check

Currently, the overturning moment (Mo) is bigger than the overturning resisting moment (Mr); this condition is not acceptable. The possible solutions are:

- Increase footing width for stability.
- Increase dead weight (e.g., add a concrete collar or ballast).

Overturning Moment Correction

The overturning moment correction will be implemented by increasing the most critical tank footing length of 14ft to 18ft. It will increase the overturning restoring moment as follows:

$Mr = W \cdot B2 = (228.119) \cdot (9/2) = (228.119) \cdot (4.5) =$

Mr = **1026.54kip-ft**.

Currently: Mo < Mr =

(**966Kip-Ft** < **1026.54 Kip-Ft**) → **OK**

Anchor Bolts Design

Tank uses 12 anchors around the perimeter, 6 will resist uplift → T (bolt) = 161kips/6 ≈ 26.8 kips per bolt.

Choose Anchor Type

Use **ASTM F1554 Grade 55** anchor bolts (Fy = 55ksi) [5].

Required Steel Area:

$As = T(bolt)0.9 \cdot Fy = (26{,}800) \cdot (0.9) \cdot (55{,}000) \approx 0.54\ in^2$

- Use (**⅞″ diameter**) x (**48in length**) anchoring **ASTM F1554 Grade 55** steel bolts (area = 0.60 in^2) → (OK)

Conclusion

Based on the results obtained from industrial potable water demand, tank concrete base structural analysis, and the hazard avoidance design results, we conclude the following statements:

- The selection of a steel-core potable water tank is crucial to ensure resilience against weather exposure, hurricane wind, and seismic protection against potential hazard events for Aguadilla, Puerto Rico industry location.
- The 20,000-gallon tank capacity analysis demonstrates that it will cover the potable water demand for three consecutive days due to a major potable city water disruption event.
- The potable water inlet and distribution piping, in combination with an electrical 40gpm potable water tank distribution skid, will meet the user's potable water demand, complying with the Puerto Rico Aqueduct and Sewer Authority (PRASA) requirements.
- The analysis of the width increment to the concrete footing base width from 14ft to 18ft brings the solution to avoid the overturning moment effect. The final dimensions of the tank's concrete base footing are 18ft x 18ft.
- The analysis of the installation of the tank anchoring base bolts demonstrates that this is a fundamental action for meeting hurricane wind resistance, seismic sliding displacements, tank base shear forces resistance, uplift forces resistance, and tank overturning avoidance.
- After the evaluation of the obtained results, below we have the tank anchoring top-view perspective and the tank footing base side-view (see Figure 5). Additionally, we are continuing to show the concrete tank footing top view perspective with the steel-core tank location, and the concrete steel reinforcement detail (see Figure 6). Then, we are showing the piping distribution and equipment arrangement for a light manufacturing industrial potable water site (see Figure 7).

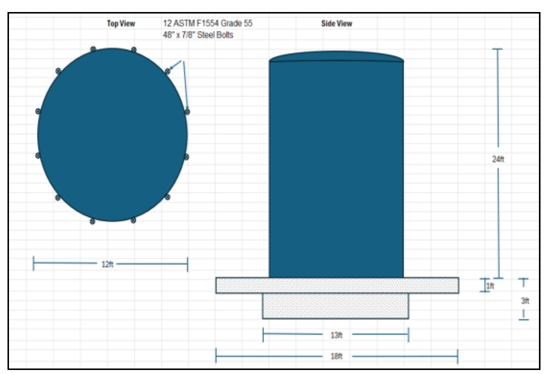


Figure 5

Steel-Core Tank, Anchoring Bolts, and Concrete Footing

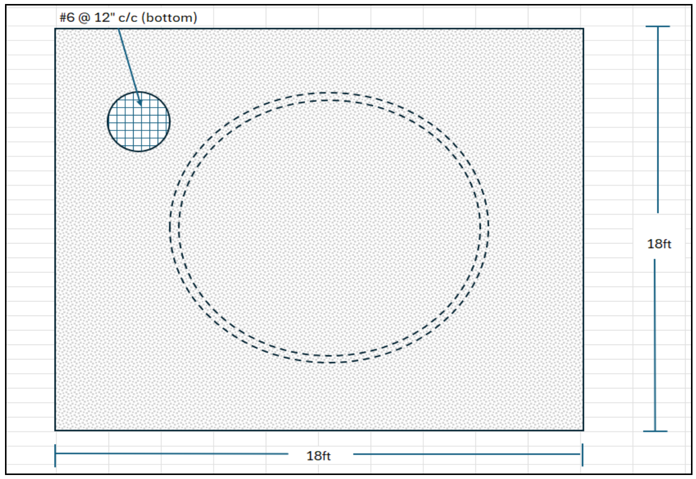


Figure 6
Concrete Footing (Top View)

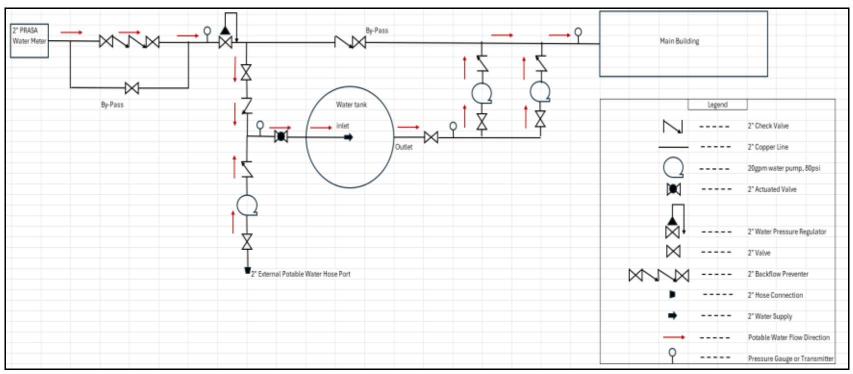


Figure 7
Piping Distribution Schematic

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