



# Design Of Circular Water Tank

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**Abstract:** The design of circular water tanks plays a crucial role in ensuring the efficient storage and distribution of water in various industrial, residential, and agricultural applications. This abstract provides an overview of the key considerations and principles involved in the design of circular water tanks.

The abstract begins by discussing the importance of water storage and the advantages of circular tank designs over other shapes. It highlights the need to optimize the tank's structural integrity, cost-effectiveness, and space utilization while meeting specific requirements such as capacity, safety, and durability.

Abstract outlines the fundamental design parameters for circular water tanks, including the tank's diameter, height, and wall thickness. It emphasizes the significance of selecting appropriate materials, such as reinforced concrete or steel, to ensure structural stability and longevity. The abstract further explores essential design elements such as the tank's foundation, base slab, walls, roof, and access points. It emphasizes the importance of engineering considerations like seismic design, wind loads, and temperature effects to ensure the tank's stability under various environmental conditions.

Moreover, the abstract discusses the hydraulic design aspects of circular water tanks, including inlet and outlet arrangements, overflow and drain systems, and the provision of adequate circulation to maintain water quality. It highlights the need for hydraulic modelling and simulation to optimize flow patterns, minimize energy losses, and prevent sedimentation and stagnation. Furthermore, the abstract addresses the

**Keywords:** Cost-effectiveness, Space utilization, Materials Selection, Reinforced Concrete,

Steel, Foundation Design, Base Slab, Wall Thickness, Roof Design, Access points, Seismic Design

## Introduction:

Water is a vital resource for various sectors, including industry, agriculture, and residential use. Efficient storage and distribution of water are essential for ensuring its availability and accessibility. Circular water tanks have emerged as a popular choice due to their numerous advantages over other tank shapes. The design of circular water tanks requires careful consideration of structural integrity, cost-effectiveness, and space utilization while meeting specific requirements such as capacity, safety, and durability.

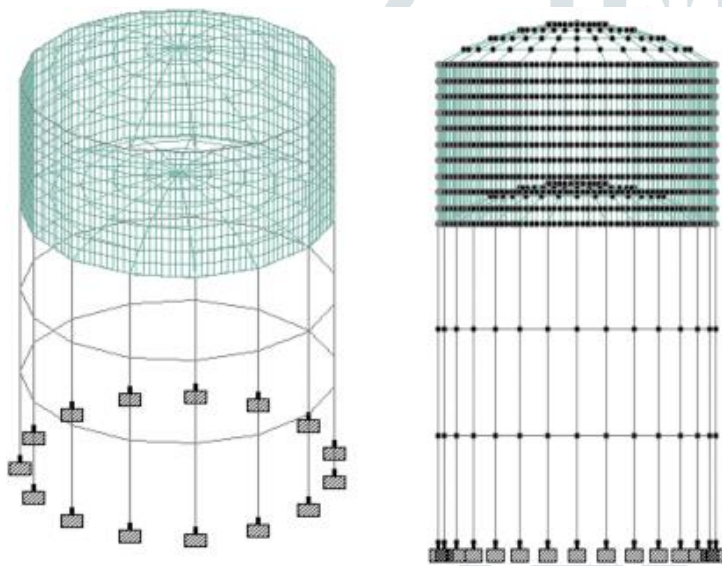
In this paper, we present an overview of the key considerations and principles involved in the design of circular water tanks. We discuss the importance of water storage and highlight the advantages offered by circular tank designs. Furthermore, we delve into the fundamental design parameters, including diameter, height, and wall thickness, along with the selection of appropriate materials such as reinforced concrete or steel for ensuring the tank's structural stability and longevity. Additionally, we explore important design elements such as the tank's foundation, base slab, walls, roof, and access points. We emphasize the significance of engineering considerations such as seismic design, wind loads, and temperature effects to ensure the tank's stability under various environmental conditions.

Hydraulic design is another crucial aspect that we address, focusing on inlet and outlet arrangements, overflow and drain systems, and the provision of adequate circulation within the tank to maintain water quality. We highlight the importance of hydraulic modelling and simulation in optimizing flow patterns, minimizing energy losses, and

preventing issues like sedimentation and stagnation. Furthermore, we discuss the maintenance and operational aspects of circular water tanks. Regular inspection, cleaning, and repair are essential to ensure the long-term functionality of the tank and prevent water contamination.

We touch upon the integration of advanced technologies such as remote monitoring systems and smart controls, which can enhance the efficiency, safety, and reliability of circular water tanks.

By providing a comprehensive overview of the key design considerations and principles, this paper aims to assist engineers, architects, and professionals in making informed decisions and achieving optimal performance in water storage and distribution systems.



Plan view

### Geology:

Geology plays a significant role in the design of circular water tanks, particularly in relation to the tank's foundation and the surrounding geological conditions. Understanding the geology of the site is crucial for ensuring the stability and long-term functionality of the tank.

During the site investigation phase, geotechnical studies are conducted to assess the soil composition, strength, and stability. This information helps in determining the appropriate foundation design for the circular water tank. The geotechnical investigation also considers factors such as soil bearing capacity, settlement analysis, and groundwater conditions.

The geology of the site influences the selection of suitable foundation types, such as shallow

foundations or deep foundations, based on the soil's load-bearing capacity. It also affects the design of the base slab, which provides stability and distributes the loads evenly to the underlying soil.

Moreover, geological conditions can influence the potential for ground movement, including landslides, subsidence, or expansive soils. Such conditions must be carefully evaluated to ensure the tank's structural integrity and prevent any adverse effects on the tank's stability.

In areas prone to seismic activity, geology becomes even more critical. Seismic design considerations involve understanding the local seismicity and determining appropriate measures to mitigate the effects of earthquakes. This includes designing the tank to withstand seismic forces, incorporating proper reinforcement techniques, and considering soil liquefaction potential.

Furthermore, geological conditions can impact the groundwater level and flow patterns around the tank. This information is crucial for designing an effective drainage system and preventing issues such as water accumulation, uplift pressures, or soil erosion.

### Types of Circular Water Tanks:

Circular water tanks can be classified into different types based on various factors such as their construction material, installation method, and usage. Here are some common types of circular water tanks:

1. **Reinforced Concrete Circular Tanks:** These tanks are constructed using reinforced concrete, which provides strength and durability. Reinforced concrete circular tanks are widely used in various applications due to their robustness and ability to withstand the demands of water storage.
2. **Steel Circular Tanks:** Steel circular tanks are constructed using steel plates or panels. These tanks are known for their strength, versatility, and ease of assembly. They are often used in industrial and commercial settings where high-capacity water storage is required.
3. **Elevated Circular Tanks:** Elevated circular tanks are mounted on support structures or towers, raising them above the ground level. These tanks utilize gravity to create water pressure for distribution, eliminating the need for additional pumping systems. They are commonly used in areas with uneven terrain or to provide water supply in elevated locations.

#### 4. **Underground Circular Tanks:**

Underground circular tanks are installed beneath the ground surface, offering a space-saving solution. These tanks are suitable for applications where space constraints or aesthetic considerations make above-ground tanks impractical. Underground tanks provide efficient water storage while minimizing the visual impact on the surroundings.

#### 5. **Pre-fabricated Circular Tanks:**

Pre-fabricated circular tanks are factory-built and delivered to the site in ready-to-assemble components. These tanks offer advantages in terms of ease of installation, reduced construction time, and cost-effectiveness. They are available in different materials, such as concrete, steel, or fiberglass, providing flexibility in meeting specific project requirements.

#### 6. **Modular Circular Tanks:**

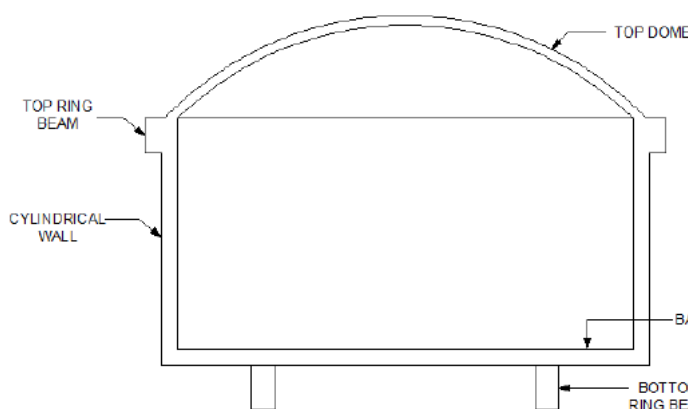
Modular circular tanks consist of individual modules or sections that can be assembled and interconnected to create larger water storage capacities. These tanks offer scalability and flexibility, allowing for easy expansion or reconfiguration based on changing needs. They are commonly used in situations where water storage requirements may vary over time.

#### 7. **Fire Protection Circular Tanks:**

Fire protection circular tanks are specifically designed to provide a reliable water source for fire fighting purposes. These tanks have high-capacity storage and are often equipped with specialized fire protection systems, such as sprinklers or foam suppression systems.

tank's layout and features. It allows for a clear understanding of the tank's shape, dimensions, and the arrangement of various components. Here are the key elements typically depicted in a plan view of a circular water tank:

- **Tank Outline:** The plan view illustrates the circular shape of the tank, displaying the perimeter or circumference of the tank at the ground level.
- **Diameter and Radius:** The plan view often includes measurements indicating the diameter and radius of the circular tank. These dimensions help in accurately assessing the size and scale of the tank.
- **Access Points:** The plan view shows the location of access points such as entrances, manholes, or hatches. These access points facilitate entry for maintenance, inspection, and cleaning purposes.
- **Inlet and Outlet Arrangements:** The plan view displays the positioning of inlet pipes and outlet pipes, which are responsible for the flow of water into and out of the tank. The arrangement of these pipes ensures efficient water supply and distribution.
- **Overflow and Drainage System:** The plan view illustrates the placement of overflow pipes and drainage systems, which prevent the tank from overflowing and facilitate the controlled discharge of excess water.
- **Internal Divisions (if applicable):** In some cases, circular water tanks may feature internal divisions or compartments. These divisions are typically depicted in the plan view, providing a clear understanding of how the tank is internally partitioned.
- **Internal Components (if applicable):** If the tank includes additional internal components such as baffles, screens, or filters, the plan view may show their placement and arrangement.
- **Surrounding Environment:** While primarily focused on the tank itself, the plan view may also include relevant elements of the surrounding environment, such as nearby structures, access roads, or landscaping features.



#### Plan View:

A plan view of a circular water tank provides a bird's-eye view or a top-down representation of the



## Design Components:

The design components of a circular water tank encompass various elements that ensure its structural integrity, functionality, and efficiency. Here are the key design components of a circular water tank:

- **Tank Shape and Dimensions:** The circular water tank is characterized by its circular shape, with a defined diameter and height. These dimensions determine the capacity of the tank and are based on the specific water storage requirements.
- **Tank Walls:** The walls of the circular water tank provide the structural support and containment for the stored water. They are typically made of materials such as reinforced concrete or steel, chosen for their strength and durability.
- **Wall Thickness:** The wall thickness of the circular water tank is determined based on structural considerations, including the tank's capacity, hydrostatic pressure, and load-bearing requirements. It is designed to ensure the structural stability and integrity of the tank under various operating conditions.
- **Foundation Design:** The foundation of the circular water tank provides stability and supports the tank's weight. The foundation design takes into account factors such as soil conditions, load-bearing capacity, and potential settlement. It ensures that the tank is securely anchored to the ground and can withstand the applied loads.
- **Base Slab:** The base slab of the circular water tank forms the bottom surface that supports the stored water. It is typically reinforced concrete, designed to distribute the load evenly and resist any uplift forces. The base slab is carefully constructed to be level and properly sealed to prevent water leakage.
- **Roof Design:** The roof of the circular water tank provides protection against external elements and helps maintain the water quality by preventing debris, contaminants, and evaporation. The roof may be constructed using materials such as reinforced concrete, steel, or specialized membranes, depending on the specific requirements of the tank.

- **Inlet and Outlet Arrangements:** The circular water tank is equipped with inlet and outlet pipes to facilitate the flow of water into and out of the tank. The design and placement of these arrangements ensure efficient water supply and distribution.
- **Overflow and Drainage Systems:** To manage excess water and prevent overflowing, circular water tanks incorporate overflow pipes and drainage systems. These components allow controlled discharge of excess water, ensuring the integrity of the tank and preventing potential damage.
- **Access Points:** Circular water tanks include access points such as manholes, hatches, or openings for maintenance, inspection, and cleaning purposes. These access points provide convenient entry into the tank for personnel and equipment as needed.
- **Safety Features:** Safety features may be integrated into the design of circular water tanks, including ladders, handrails, and safety signage. These features ensure safe access, operation, and maintenance of the tank.

## Facilities for Tank:

Facilities associated with a circular water tank include various components and features that support its operation, maintenance, and safety. These facilities are designed to enhance the functionality, efficiency, and longevity of the tank. Here are some common facilities associated with a circular water tank:

- **Access Platform:** An access platform is typically provided around the tank, allowing easy and safe access for maintenance, inspection, and repair activities. It may include stairways, ladders, or catwalks to ensure convenient and secure access to different parts of the tank.
- **Manholes:** Manholes are designed within the tank structure to provide entry points for personnel to access the interior of the tank. They allow for inspections, cleaning, and maintenance of the tank's internal components.
- **Ventilation Systems:** Proper ventilation systems are installed within the tank to maintain air circulation and prevent the buildup of gases or odors. These systems

- help ensure a safe working environment inside the tank.
- **Internal Ladders and Platforms:** Circular water tanks may include internal ladders and platforms to facilitate access to different levels or compartments within the tank. These features assist in maintenance tasks and provide safe working areas.
  - **Instrumentation and Monitoring Systems:** Advanced tanks may be equipped with instrumentation and monitoring systems to track parameters such as water level, temperature, pressure, and water quality. These systems help in monitoring and controlling the tank's operations efficiently.
  - **Overflow and Drainage Systems:** To manage excess water or prevent overflowing, overflow pipes and drainage systems are incorporated. These facilities ensure controlled discharge of water and prevent potential damage to the tank.
  - **Security Measures:** Depending on the location and requirements, security measures such as fencing, gates, and surveillance systems may be implemented to protect the tank from unauthorized access and vandalism.
  - **Fire Protection Systems:** In certain applications, circular water tanks may require fire protection systems such as sprinklers or foam systems to mitigate the risk of fire and ensure the safety of the tank and its surroundings.
  - **Lighting:** Adequate lighting facilities are provided in and around the tank to enable safe access and visibility during maintenance activities conducted during low-light conditions.
  - **Signage:** Clear and informative signage is installed to indicate safety instructions, emergency procedures, and warnings for personnel working in or around the tank.
- b. Clear the site from any obstructions, debris, or vegetation that may hinder the installation process or affect the tank's operation.
2. **Foundation Preparation:**
    - a. Excavate the foundation area according to the tank's specifications and the recommendations of a geotechnical engineer.
    - b. Level the foundation surface and compact the soil to provide a stable base for the tank.
    - c. Install any required reinforcement, such as rebars or anchor bolts, within the foundation for anchoring the tank securely.
  3. **Base Slab Construction:**
    - a. Construct the base slab of the tank using appropriate materials, such as reinforced concrete.
    - b. Ensure the base slab is level, properly cured, and meets the specified thickness and design requirements.
  4. **Tank Assembly:**
    - a. Begin assembling the tank components, starting with the bottom ring or panel.
    - b. Gradually add the subsequent rings or panels, aligning them properly to ensure a seamless and secure connection.
    - c. Use appropriate sealing materials or gaskets between the panels to prevent leaks.
  5. **Roof Installation:**
    - a. Install the roof structure according to the tank design, ensuring proper alignment and fastening.
    - b. Consider factors such as ventilation requirements, access points, and any additional components like roof supports or inspection hatches.
  6. **Inlet and Outlet Connections:**
    - a. Install the necessary pipes and fittings for the inlet and outlet connections, ensuring proper alignment and sealing.
    - b. Consider the hydraulic design requirements, including flow rates, valves, and overflow or drain systems.
  7. **Tank Testing and Inspection:**
    - a. Conduct a thorough inspection of the installed tank to ensure all components are securely fastened and sealed.
    - b. Test the tank for any potential leaks or structural deficiencies by filling it with water gradually and monitoring for any signs of leakage or deformation.
    - c. Address any issues identified during the testing and inspection phase promptly.

### Installation of Water Tank:

The installation of a circular water tank involves several key steps to ensure proper positioning, stability, and functionality. The following is a general guideline for the installation procedure:

#### 1. Site Preparation:

- a. Select a suitable location for the tank, considering factors such as proximity to water sources, accessibility, and soil stability.

**8. Backfilling and Site Restoration:**

- a. Once the tank installation is complete and successfully tested, backfill the surrounding area using suitable materials and compact it properly.
- b. Restore the site to its original condition or as per the project requirements, including any necessary landscaping or site improvements.

**9. Commissioning and Operational Checks:**

- a. Perform operational checks to ensure the tank is functioning as intended, including testing the inlet and outlet systems,

monitoring water levels, and verifying proper flow and pressure.

- b. Integrate any required control systems, instrumentation, or monitoring devices as per the project specifications.

It is important to note that the installation procedure may vary depending on the specific design, material, and size of the circular water tank. Consulting the manufacturer's guidelines and working with experienced professionals are crucial for a successful installation process.

**Defects:**

Circular water tanks, like any other structure, can experience various defects that may affect their performance, durability, and safety. Identifying and addressing these defects in a timely manner is crucial to maintain the integrity and functionality of the tank. Here are some common defects that can occur in circular water tanks:

- **Leakage:** One of the most common defects in water tanks is leakage. It can occur due to improper sealing between tank panels, deteriorated seals or gaskets, cracks in the tank walls or base, or damaged inlet/outlet fittings. Leakage not only results in water loss but can also lead to structural damage and water contamination.
- **Corrosion:** Circular water tanks made of steel can be susceptible to corrosion, especially in environments with high moisture or aggressive chemicals. Corrosion weakens the tank's structural integrity, reduces its lifespan, and can lead to leakage. It is important to regularly inspect and maintain the tank's protective coatings or consider alternative materials resistant to corrosion.
- **Cracking:** Cracks can develop in the tank walls or base due to various factors such as poor construction practices, settlement of the foundation, seismic activity, or temperature fluctuations. Cracks compromise the structural strength of the tank and increase the risk of leakage or collapse if left unaddressed.
- **Structural Deficiencies:** Improper design or construction practices can result in structural deficiencies such as inadequate reinforcement, insufficient wall thickness, or inadequate support for the tank's load. These deficiencies can lead to excessive deflection, bulging, or even failure of the tank under load conditions.

- **Poor Water Quality:** Water quality issues can arise if the tank is not properly maintained or if there are defects in the inlet or outlet systems. These defects can lead to stagnant water, insufficient circulation, or the entry of contaminants, affecting the quality and suitability of the stored water.

- **Settling or Tilting:** Improper foundation preparation or uneven soil settlement can cause the tank to settle or tilt. This can result in uneven loading, distortion of the tank structure, and potential leakage or instability.

- **Insufficient Ventilation:** Inadequate ventilation within the tank can lead to the accumulation of gases, unpleasant odors, or the growth of bacteria. Poor ventilation can compromise the safety of personnel entering the tank for maintenance activities.

- **Inadequate Maintenance:** Neglecting regular inspection, cleaning, and maintenance can lead to a range of defects in circular water tanks. Without proper maintenance, issues such as sedimentation, biofilm growth, mechanical failures, or deterioration of materials may arise, compromising the tank's performance and longevity.

**Repair Works:**

To address the defects that can occur in circular water tanks, various remedial measures can be implemented. Timely identification and appropriate actions are essential to ensure the integrity, functionality, and longevity of the tank. Here are some remedies for common defects in circular water tanks:

**1. Leakage:**

- Inspect the tank thoroughly to identify the source of leakage.
- Repair or replace damaged seals, gaskets, or faulty fittings.



- Apply suitable sealants or coatings to seal any cracks or gaps.
  - Consider implementing a regular maintenance schedule to monitor and address potential leakage points.
2. Corrosion:
- Regularly inspect the tank for signs of corrosion.
  - Clean and treat corroded areas, removing any rust and applying appropriate protective coatings.
  - Consider using corrosion-resistant materials or linings during tank construction or retrofitting.
  - Implement a routine maintenance program to monitor and address corrosion issues.
3. Cracking:
- Assess the extent and cause of cracks to determine the appropriate repair method.
  - Repair minor cracks with suitable sealants or epoxy-based solutions.
  - For larger or structural cracks, consult a structural engineer to assess and recommend repair options, which may involve reinforcing the affected area or replacing the damaged panels.
  - Address the underlying cause of cracking, such as foundation settlement or temperature effects, to prevent future cracks.
4. Structural Deficiencies:
- Conduct a structural assessment to identify deficiencies and consult with a structural engineer for appropriate remedial measures.
  - Reinforce the tank structure as recommended, which may involve adding additional reinforcement or strengthening existing components.
  - Rectify any design or construction errors to ensure compliance with structural requirements.
5. Poor Water Quality:
- Implement a regular cleaning and maintenance schedule to prevent sedimentation and biofilm growth.
  - Improve the tank's circulation and ensure proper inlet and outlet arrangements to maintain water quality.
  - Install appropriate filters or screens to prevent the entry of contaminants.
  - Conduct water testing periodically to monitor and maintain water quality within acceptable standards.
6. Settling or Tilting:
- Assess the foundation and soil conditions to determine the cause of settling or tilting.
  - Consult with a geotechnical engineer for appropriate remedial measures, which may involve soil stabilization or foundation underpinning.
  - Level and stabilize the tank using appropriate techniques, such as installing additional supports or adjusting the foundation.
7. Insufficient Ventilation:
- Improve ventilation within the tank by installing proper ventilation systems, such as vents or fans, to ensure adequate air circulation.
  - Conduct regular inspections and cleaning to prevent the emission of gases or odours.
  - Implement safety protocols for personnel entering the tank, including proper ventilation and monitoring systems.
8. Inadequate Maintenance:
- Develop and implement a comprehensive maintenance plan, including regular inspections, cleaning, and repair activities.
  - Train personnel on proper maintenance procedures and ensure adherence to the schedule.
  - Document maintenance activities, including repairs and replacements, for future reference.

#### Purpose:

The purpose of a circular water tank is to provide efficient storage and distribution of water for various applications. Circular water tanks are designed to fulfil several important objectives:

- **Water Storage:** The primary purpose of a circular water tank is to store a significant volume of water. These tanks are capable of holding large quantities of water, ensuring a continuous and reliable water supply for various purposes.
- **Water Distribution:** Circular water tanks facilitate the distribution of water to meet the demands of different sectors such as residential, commercial, industrial, and agricultural. The stored water can be distributed through pipelines or gravity-fed systems to ensure a consistent and adequate water supply.
- **Water Conservation:** Circular water tanks play a crucial role in water conservation efforts. They allow for the collection and storage of rainwater or other water sources, which can be used during periods of water scarcity or drought. By storing and utilizing available water resources efficiently, circular

water tanks contribute to sustainable water management practices.

- **Emergency Water Supply:** Circular water tanks serve as essential infrastructure during emergencies or natural disasters. They provide a readily available water source for disaster relief operations, firefighting, or other emergency situations where access to clean water is critical.
- **Water Pressure Management:** Circular water tanks can be strategically located at higher elevations to create water pressure through gravity. This pressure allows for the efficient distribution of water without the need for additional pumping systems, reducing energy consumption and operational costs.
- **Backup Water Supply:** Circular water tanks serve as backup storage for areas with intermittent water supply or unreliable water sources. They help maintain water availability during system maintenance, repairs, or temporary water source disruptions.
- **Fire Protection:** Circular water tanks are often utilized as a vital component of fire protection systems. They provide a readily available water source for fire fighting purposes, ensuring a sufficient water supply for extinguishing fires and protecting lives and property.
- **Agricultural Use:** Circular water tanks play a significant role in agricultural activities, especially in areas where irrigation is necessary. They store water for irrigation purposes, enabling the controlled supply of water to crops, promoting agricultural productivity, and reducing dependence on natural water sources.

### Summary:

Circular water tanks serve a vital purpose in storing, distributing, and managing water for various applications. These tanks are designed to hold large volumes of water, ensuring a continuous and reliable water supply. They play a crucial role in water conservation efforts, allowing for the collection and storage of rainwater or other water sources. Circular water tanks also serve as emergency water supplies during natural disasters or disruptions in water sources.

Additionally, they contribute to water pressure management by creating gravity-based pressure for efficient water distribution. These tanks serve as

backup storage for areas with intermittent water supply and are essential for fire protection systems. In agriculture, circular water tanks store water for irrigation purposes, supporting agricultural productivity. Overall, circular water tanks are versatile structures that facilitate sustainable water management practices, emergency preparedness, and meet the diverse water needs of different sectors.

### Final Statement:

Circular water tanks serve as vital infrastructure for the efficient storage, distribution, and management of water. With their large storage capacities, they provide a reliable water supply for various sectors and applications. By promoting water conservation, supporting emergency preparedness, and contributing to sustainable water management practices, circular water tanks play a crucial role in ensuring water availability, resilience, and optimized resource utilization. These structures are essential for meeting the diverse water needs of communities and industries, making them an indispensable component of water infrastructure systems.

### Conclusion.

In conclusion, circular water tanks are fundamental components of water infrastructure systems, serving a crucial role in efficiently storing, distributing, and managing water. With their large storage capacities and ability to provide a continuous water supply, these tanks are essential for meeting the diverse water needs of residential, commercial, industrial, and agricultural sectors. Circular water tanks contribute to water conservation efforts, support emergency preparedness, and promote sustainable water management practices. Their significance in ensuring water availability, resilience, and optimized resource utilization cannot be overstated. As a key element of water infrastructure, circular water tanks play a vital role in maintaining a reliable water supply and addressing the challenges of water management in various communities and industries.

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