Storage Facilities

The storage facility should be able to provide water for the average and peak demands and should help maintain adequate pressure throughout the system. Other purposes of water storage include meeting the needs for fire protection, industrial requirements, and reserve storage.

Water storage facilities are found at one or more locations in areas closest to the ultimate users, at elevations to provide appropriate water pressure (typically a minimum of 25 pounds per square inch [PSI] and a maximum of 80 psi) and where land is available. If the tank cannot be sited at an elevation to provide the correct system pressure, pressure reducing valves or hydropneumatic or pressure tanks can be added. As a minimum, the storage tank sizing should be based on § 64554 of Title 17 of the California Code of Regulations. The selection of the type of storage facility or tank depends on the system's individual needs and the type of terrain where it is to be installed. An elevated tank is used primarily to supply adequate pressure to a relatively flat service area where a ground tank cannot be sited at an elevation to provide needed pressure.

A hydropneumatic tank is commonly used with smaller water systems as a necessary component to maintain pressure without the use of a large storage tank, if demands are small. A hydropneumatic tank can also be used in conjunction with a large storage tank to provide system pressures when the tank is at the same elevation as the water system.

Operation of storage systems can cause water hammer; which is a pressure surge or wave caused when the water in motion is forced to stop or change direction suddenly; a momentum change. This phenomenon commonly occurs when a valve need to close suddenly at an end of a pipeline system, and a pressure wave propagates in the pipe, causing vibrations that can be strong enough to damage equipment. The potential for water hammer is typically addressed through the use of a surge tanks, which provides a space for the pressure wave to dissipate. Descriptions of common tank types are presented in the table below. This is followed by a description of the most common types of ground-level storage tanks and features of each.

Type Storage/ Support Equipment	Benefits	Challenges
Ground-Level Reservoirs	• Can be sited to provide necessary system pressure. • Can be combined with other system to provide necessary system pressure • Can be buried	• Must be protected from contamination and unauthorized entry
Elevated Tanks	• Useful in flat terrains	• Can be more costly to construct
Hydropneumatic Tanks	• Typically Used in smaller systems • Maintains water pressures in the system	• Extreme care is required during operation and maintenance • Does not provide much storage
Surge Tanks	• Used to control water hammer and to regulate flow	• Do not increase storage volume

Concrete Tank

Concrete can be configured in a variety of geometries and with a variety of reinforcing strategies. Concrete can be either coated or uncoated. Concrete tanks are typically cast-in-place, pre-stressed, and post tensioned. The roof can be either concrete, or fiberglass with stainless steel hardware. Corrosion mechanisms of concrete attack the concrete itself, and the reinforcing steel within the concrete. Corrosion of concrete results in chemical degradation of the Portland cement and exposure of aggregates. The potential for corrosion should be considered in the design of the tank. One simple design concept is to provide a slightly thicker wall section to allow for some concrete degradation over the long term. The steel in the concrete is subject to corrosion if exposed to oxygen and water. However, the Concrete is alkaline and forms a protective layer around the steel. This protective layer reduces corrosion potential. However if cracks develop which allow water to penetrate to the steel, the steel may corrode and expand further cracking and spalling of the concrete. The design should ensure adequate concrete cover over the steel. In addition, epoxy coated steel reinforcing can be used.

Epoxy Coated Steel Tank

Epoxy coasted steel tanks are typically field bolted which allows the tank to be coated at the factory, shipped to the site, and then installed on a prepared foundation. Epoxy coatings are applied to carbon steel plates and baked on at the factory. The most significant issue with steel is corrosion from both the interior and the exterior. The corrosion process requires both moisture and oxygen to be in contact with the steel. The coating system is intended to shield the steel plates from moisture and oxygen. However, the epoxy type coatings do require maintenance and such a tank will require field recoating during its useful life. Factory coated bolted steel tanks should conform to AWWA D103.

Cathodic protection systems can be installed and if properly maintained, such a system can help to reduce the potential for corrosion of the steel. The initial coating of the plates is critical to protecting the steel from corrosion. This process entails proper surface preparation as well as application of an appropriate coating system with sufficient thickness. It is particularly difficult to coat edges of plates and therefore the edges tend to be the area showing the first signs of corrosion. Plates can by damaged during shipping and installation as well, and should be properly repaired to provide the required protection. Bolts can also corrode and so stainless steel bolts are often considered as an alternative to galvanized steel bolts, although plastic bolt caps and other approaches are used to extend bolt life as well. Regular inspection, cleaning, and maintenance of epoxy coated steel tanks will help maintain the useful service life.

Welded Steel Tank

Welded steel water tanks, are crafted in the field from heavy gauge steel. Certified welders then fuse the sheets of steel together. The tank is then coated in the field. The tank coating is then applied in the field. This method prevents some of the issues associated with the edge coating on the epoxy coated steel tanks. However, careful attention to detail during the coating process is needed to ensure appropriate environmental conditions. Welded steel water tanks should conform to American Water Works Association (AWWA) Standard D100.

Glass Fused to Steel Tank

Glass fused to steel tanks are similar to epoxy coated steel insofar as the approach uses bolted plates that are factory coated. The main difference is that glass fused to steel uses a glass based coating similar to ceramic glaze that is fired in a furnace to melt to glass and firmly chemically and mechanically bond it to the steel plates. A glass fused coating is extremely durable and does not require field recoating and requires very little maintenance. If plates are damaged, they can be repaired with field touch up coating or plates can be removed and replaced.
Such tanks have been very commonly used for 70 years. They are widely used in the agricultural industry for grain and water storage and are broadly used in the municipal industry for water storage where a smaller tank size is needed and reducing corrosion potential and maintenance costs is a concern. Although initially slightly more expensive than epoxy coated steel, glass fused to steel has lower ongoing maintenance costs offsetting the higher capital cost. Although not common on glass fused to steel tanks, cathodic protection systems can be installed to provide added corrosion resistance.

Stainless Steel Tank

Stainless steel can also be used to fabricate tanks. Although commonly used in the food, beverage, and chemical industries, stainless steel is not commonly used in the municipal water industry. Although the corrosion resistance and low maintenance requirements of stainless steel are attractive, the high cost of stainless steel is usually only warranted for specialty applications. However, there have been a small number of stainless steel water tanks installed for municipal use, but other tank options are more commonly selected for cost and performance reasons.

Common Suppliers

National Rural Water Association Online Buyer's Guide - http://nrwa.officialbuyersguide.net/

Source

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- Water Programs Sacramento State University. ”Water Distribution System Operation and Maintenance” https://www.owp.csus.edu/courses/drinking-water/water-distribution-system-operation-and-maintenance.php