ELEVATED WATER TANK INCLUDING BOLTED PANEL SUPPORT PEDESTAL

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ABSTRACT
An elevated water tank utilizing an integrated field erected and bolted panels, such as, by way of example, steel rolled tapered panels (RTP) having epoxy powder-coated construction. The outer bolted steel reinforced panels are integral and co-linear with the preferably cylindrically shaped exterior reservoir walls thereabove providing reservoir perimeter structural support. The bolted steel reinforced panels are to provide support of a reinforced interstitial steel floor to grade, and either both or only one of an inner support pedestal of a transverse dimension less than that of the reservoir, or an outer support pedestal having substantially the same cross sectional configuration and size as the reservoir thereabove, may be so constructed. The reservoir and pedestal structure preferably use factory epoxy coated steel construction and are most preferably field installed utilizing synchronized hydraulic screw jack or traditional elevated field construction techniques.
Fig. 10.
ELEVATED WATER TANK INCLUDING BOLTED PANEL SUPPORT PEDESTAL

[0001] This application claims the benefit of U.S. Provisional Patent Application Ser. No. 61/120,266 filed Dec. 5, 2008, the entire disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention concerns an elevated tank having a bolted panel support pedestal and associated method of construction for holding liquids above a surface. More particularly, it is directed to a water tank structure and associated method wherein metal panels are assembled by bolting the panels together and which may be progressively elevated or formed at the intended elevation, either with an integrated water-holding tank or reservoir as a supporting pedestal for a tank or reservoir of different construction.

[0004] 2. Description of the Prior Art

[0005] As used herein, elevated water tanks refer to tanks or reservoirs supported by a pedestal above the surrounding ground intended for large industrial water storage or for use by municipal or other governmental bodies such as rural water districts. Elevated water storage has been and continues to be in high demand worldwide as urban sprawl necessitates increased water storage capacity and infrastructure standards are continually updated and developed. Elevated water storage is ordinarily used when ground elevation storage in reservoirs and the like is insufficient to ensure distribution of water at suitable pressures by gravity. A variety of water tank constructions are well known to those skilled in the art, ranging from concrete and masonry structures to more contemporary field welded constructions. One type of construction is shown in U.S. Pat. No. 5,029,426, which includes precast concrete panels as a support pedestal below a steel storage tank or reservoir. This construction, however, is heavy and requires the use of keys and keyways and staggering of the precast concrete panels.

[0006] Currently, the American Water Works Association (AWWA) is the governing body in the United States for establishing standards and specifying water storage vessels, and also categorizes elevated tanks as welded vessels which have two distinct components: the tank and the supporting structure (AWWA M42).

[0007] Variations exist for welded storage vessels and their respective supporting methodologies and are typically categorized by their storage capacities and support styles. Small, medium and large capacity elevated tanks and multiple support leg or single pedestal support styles are common. All current designs for elevated tanks use a concrete support pedestal, field-welded steel support pedestals, or multiple field-weld support assemblies.

SUMMARY OF THE INVENTION

[0008] It is a goal of the present invention to provide an economical and efficient elevated water tank having a bolted panel support pedestal which may be mass produced and having the ability for safe, efficient construction in the field. Such an elevated tank can use an integrated bolted panel support pedestal and elevated water reservoir, or a bolted panel support pedestal below a tank or reservoir of different construction.

[0009] The elevated water tank of the present invention has a support pedestal and an elevated reservoir. The pedestal of the elevated water tank uses an integrated field erected construction where the support pedestal is assembled using threaded fasteners (such as bolts and nuts rather than welded construction) and reinforced panels. These panels are preferably rolled tapered panels (RTP) which are reinforced and have epoxy powder coating. The outer bolted steel reinforced panels are thus capable of being integral, that is bolted together as a unitary, integral unit, for both the support pedestal and the reservoir. The support pedestal and tank may be in a variety of shapes, such as polygons, ovals or irregular shapes, but one economical shape is that of a generally cylindrical configuration and providing reservoir perimeter structural support. Also, an inner pedestal of bolted steel reinforced panels may be provided for support of a reinforced interstitial steel floor to grade, i.e. the level of the supporting surface. The reservoir and outer support pedestal structure are provided as one integrated unit and most preferably utilize factory epoxy coated steel panel construction and will be field installed by bolting. The installation most preferably utilizes synchronized hydraulic screw jack or traditional field construction techniques.

[0010] The elevated water tank and method hereof provides the capability to produce tank capacities in a wide range of sizes, for example 100,000 gallons to 2,000,000 gallons. Pedestals may be of a variety of heights depending on design considerations, such as from about 30 feet up to 110 feet in height. Preferably, all pedestal construction will be bolted RTP construction with vertical structural supports and when viewed in plan, the outer support pedestal will be substantially congruent with the outer wall of the reservoir in shape and size, so that in a cylindrical water tank, the outer wall of the reservoir is in registry with the wall of the outer support pedestal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. 1 is a front elevational view of the water tank of the present invention having an elevated water reservoir atop an outer support pedestal;

[0012] FIG. 2 is a front elevational view of the water tank similar to FIG. 1, but with portions of the outer support pedestal broken away to show an inner pedestal for additional support of the elevated water reservoir;

[0013] FIG. 3 is a plan view illustrating the position of the inner pedestal, the outer support pedestal, and the supports for the interstitial floor of the water tank hereof;

[0014] FIG. 4 is an enlarged, fragmentary cross-sectional view taken along line A-A of FIG. 3 showing the RTP outer pedestal and RTP inner pedestal and interstitial floor assembly;

[0015] FIG. 5 is an enlarged perspective rear view showing the bolted connection between four RTP as used in the tank and pedestals of the water tank hereof;

[0016] FIG. 6 is an enlarged perspective front view showing the interior appearance of the bolted RTP of FIG. 8;

[0017] FIG. 7 is a perspective view of a jack and showing a panel for use in the water tank of the present invention temporarily supported on the jack for field erection of the tank;
FIG. 8 is a perspective view showing a foundation structure on grade, a base band formed of panels, and jacks to which the RTP of the outer support pedestal are carried for bolting;

FIG. 9 is a perspective view showing a tank which is in the process of field erection including bolted RTP's around the pedestal stiffeners and without the internal pedestal;

FIG. 10 is a perspective view of a tank having bolted RTP panels as a part of the integrated tank wall;

FIG. 11 is a top plan view of a tank having a central pedestal and a plurality of peripheral pedestals interconnected by pedestal stiffeners;

FIG. 12 is an elevational view of the tank of FIG. 11, showing the pedestal stiffeners;

FIG. 13 is a top plan view of another tank having a central pedestal and a plurality of peripheral pedestals interconnected by pedestal stiffeners;

FIG. 14 is an elevational view of the tank of FIG. 13, showing the pedestal stiffeners;

FIG. 15 is a top plan view of another tank having a central pedestal and a plurality of peripheral pedestals interconnected by pedestal stiffeners;

FIG. 16 is an elevational view of the tank of FIG. 15, showing the pedestal stiffeners;

FIG. 17 is a perspective view of a tank in accordance with the present invention looking upwardly from the bottom of the pedestal wherein scaffold construction techniques are employed to erect the pedestal and reservoir; and

FIG. 18 is a perspective view looking upwardly to show a portion of the reinforced interstitial floor of the reservoir during construction and bolted panels supported thereon for forming the outer wall of the reservoir, with the bolted panels of the support pedestal not shown for clarity.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, an elevated water tank 10 in accordance with the present invention includes an elevated reservoir 12 and an outer support pedestal 14 as shown in FIGS. 1, 2, 3, and 4. The reservoir 12 and outer support pedestal 14 are integrally constructed using bolted panels 16 such as, by way of example, rolled tapered metal panels (RTP) or API 12B panels, such panels 16 being fastened together using threaded connectors as shown in FIGS. 5 and 6, such as bolt and nut pairs through holes around the perimeter of the metal panels 16. In this manner, the RTP's 16 may be combined and assembled in an integrated outer wall 18 of the reservoir 12 and outer support pedestal 14 during assembly in order to provide an integrated structure for the elevated water tank 10. As may be seen in FIGS. 1 and 2, and detailed further in FIGS. 5 and 6, the RTP's 16 are bolted together arranged in side-by-side circumferencing bands, with the side margins of the panels substantially in vertical alignment whereby the panels 16 of a lower band are aligned with those of an upper band above. Thus, the appearance of the panels 16 is an arrangement in aligned rows making up the bands, and columns.

In greater detail, the elevated water tank 10 is constructed with outer wall 18 forming both the outer, water-containing wall 20 of the reservoir 12 and a skirt wall 22 of the pedestal 14 which supports the water-containing wall 20, as best seen in FIGS. 1, 2 and 4. While the outer wall 18 may be of various shapes when viewed in plan, most preferably the water-containing wall 20 and the skirt wall 22 are continuous, cylindrical and co-planar, and constructed of bolted RTP's 16. The tank 10 includes a penthouse 24, a sloping roof 26 extending downward and radially outward from the penthouse 24, an outer access staircase 28 leading from a lower access platform 30 to an upper access platform 32. The outer wall 18 also has an access door 34 leading to the lower access platform 30, which is itself accessible by inner spiral staircase 36. A reinforced interstitial floor 38 of the reservoir 12 is elevated relative to the lower access platform 30 and encloses the bottom of the reservoir 12 to contain the water received therein. As seen in FIG. 4, the skirt wall 22 of the pedestal 14 is preferably reinforced by pedestal stiffeners 40 which may be steel I-beams or the like. The RTP's 16 of the skirt wall 22 may be bolted to the pedestal stiffeners 40 as shown in FIG. 4.

An inner support pedestal 42 may also be constructed of bolted RTP within the skirt wall 22 and also supports the reinforced interstitial floor 38. The inner support pedestal 42 is preferably reinforced with pedestal stiffeners 44 such as steel I-beams or the like to provide additional structural support. The area between the skirt wall 22 and the inner pedestal 42 provides a space for the inner spiral staircase 36 and an interior mechanical operation room 46. In the reinforced interstitial floor 38 as seen in FIGS. 3 and 4, a plurality of floor spores 48 extend radially from the inner support pedestal 42 to the skirt wall 22 as a spoke floor assembly 50, and sit atop and are bolted to the pedestal stiffeners 40 and 44. The floor spores 48 are, for example, steel I-beams and may be circumferentially arrayed and extend radially from the inner support pedestal 42 wall. These floor spores 48 may further be braced against lateral movement by tie braces 52 which are arranged as a tie brace array 54 intermediate the inner support pedestal 42 and the outer support pedestal 14, and in the configuration illustrated in FIGS. 3 and 4, the tie braces 52 are arranged as chords of a circle positioned between the floor spores 48. Another alternative for supporting the reservoir wall 18 is to use structural steel beams arranged as an external frame 53 with tie braces 52 as shown in FIG. 18. Depending on the size and design, several such tie brace arrays 54 may be used for reinforcing the spoke floor assembly 50. Additional steel beams 55 may be positioned to extend generally horizontally across the top of the inner support pedestal for additional reinforcement.

The interstitial floor 38 divides the reservoir 12 from the pedestals 14 and 42 and helps to support the reservoir therein. As shown in FIGS. 3 and 4, it may include a support floor 56 which is supported atop and preferably bolted to the spoke floor assembly 50, the tie brace array 54, the pedestal stiffeners 40 and the pedestal stiffeners 44. The support floor 56 may be provided of steel panels including RTP when bolted construction is used, or alternatively of reinforced concrete or other suitable materials. The support floor 56 can be provided with structural angles 58 which may be bolted to the RTP's of the outer support pedestal 14 and the inner support pedestal 42. A water tank bottom 60 is typically provided atop the support floor 56 of bolted steel panels, which may be RTP but not necessarily of RTP construction, or poured concrete. The water tank bottom 60 can be provided with a synthetic sealant material atop the support floor.

Figs. 5 and 6 illustrate a precision taper and mitered corner construction of four RTP 16. The RTP 16 are bolted together using bolts 62 and nuts 64 and sealant 75 of a gasket or edge seal to provide leak resistant construction, and the use of epoxy powder-coated RTP 16 resists corrosion and leakage. In the present invention, the reservoir 12 and the pedestal
are formed and connected by RTP bolted construction to provide an integrated construction.

FIG. 7 illustrates a typical jack 66 useful in field erection of the tank 10 using RTP 16. As shown in FIG. 7 and with further reference to FIGS. 8, 9, and 10, a plurality of jacks 66 are circumferentially spaced around the foundation 68 of the tank 10. Pedestal stiffeners 40, here shown as steel beams, are also installed. The RTP are supported on the jacks and assembled to prevent a continuous circumferentially extending bolted band 70. As each band 70 is assembled, the jacks 66 operate synchronously to raise the band 70 (and those bands previously constructed which lie thereabove and form a part of the respective wall). This permits additional RTP to be positioned and bolted to the band thereabove and also to the pedestal stiffeners 40, thereby forming the respective outer wall 18 of the reservoir 12 and outer support pedestal 14, or alternatively of inner support pedestal 42. Once the outer wall 18 is completed, the outer wall 18 of both the pedestal 14 and the reservoir 12 is unitary and self supporting, and integrally connected to the inner pedestal 42 by the reinforced interstitial floor 38 which maybe also be of bolted RTP construction and reinforced by steel beams and the like as described herein. Alternatively, the RTP may be assembled in an elevated position—that is, lifted into the desired location by cranes or the like and then bolted in their respective final positions.

At the base of the skirt wall 22, which in this instance forms an outer support pedestal, a lower access door 72 is provided. Access to the mechanical operation room 46, the inner spiral staircase 36, and the access platforms and upper spiral staircase is thus provided.

Among the several unique aspects of the present invention are that the skirt wall 22 of the pedestal 14 may be of bolted construction using factory coated RTP or other metal panels 16. In addition, the inner support pedestal 14 may also be of bolted construction using RTP 16. The use of factory coated RTP which are bolted in mass, mass produced, and shipped worldwide for assembly greatly increases the efficiency of construction. The use of synchronized jacking equipment makes the operation more efficient. However, as shown in FIG. 17, the tank may be built using scaffold construction techniques. As shown in FIG. 17, scaffold support brackets 74 may be fastened by bolts or the like to the panels during construction. In FIG. 17, the overlap 76 of the panels 16 does not result in vertical alignment of the overlap 76 between successive vertical bands 70, so that the overlaps 76 are staggered. Alternatively, the tank 10 hereof maybe of a hybrid construction, including bolted RTP pedestals 14 and/or 40 and conventional construction methods for other parts of the water tank 10. The invention also is not limited to RTP, but extends to any bolted panel support pedestal for an elevated water tank, and is not limited to any particular panel shape or size. Thus, while RTP 16 construction is one preferred embodiment, other panels whether or not rolled or tapered, and including flanged panels such as those known as API 12B flanged panels or flat panels may be bolted together and used in the support pedestal(s) of the present invention.

FIGS. 11 through 16 show alternative configurations of the tank 10 hereof where a plurality of discrete support pedestals 14 are used to support the reservoir thereon. In FIGS. 11 through 16, a central support pedestal 78 has pedestal walls of panels 16 for bolted panel construction as described above, along with peripheral pedestals 80 situated radially outwardly therefrom, the support pedestals 80 also having walls of panels 16 for bolted panels construction as described above. The central support pedestal 78 may include the mechanical operation room, stairways or other features, and be provided with suitable access doors to gain entry. The peripheral pedestals 80 would typically not require access or house an equipment room. The peripheral pedestals 80 may be arranged in a circular pattern to be substantially equidistant from central support pedestal 78 as shown in FIGS. 11 and 12, and also in FIGS. 15 and 16, or be positioned in a rectangular orientation as shown by the central pedestal 78 and support pedestals 80 of FIGS. 13 and 14. The central pedestal 78 may be larger in diameter than the support pedestals 80, as shown in FIGS. 11 and 12, or be of substantially the same diameter as shown in FIGS. 15-16. A support grid 82 maybe provided of diagonally oriented pedestal stiffeners 84 to help reinforce and strengthen the plural pedestal construction. The pedestal stiffeners 84 may be bolted to the panels 16, or in addition or alternatively bolted to other pedestals stiffeners 84 intersecting therewith, and to pedestal stiffeners 44 within the pedestal walls. The pedestal stiffeners 84 maybe of structural members such as I-beams or structural angles.

Bolted water tank technology is thus advanced by using specialized powder coating RTP which provides extended service life to steel storage tanks for storing potable water, or other panels which may be bolted together. The resistance to corrosion and extended service life provided by powder coated panels enables constructors to provide extended reservoir and pedestal warranties. The construction method of the present invention avoids the necessity of field construction personnel to work at elevated heights. The use of bolted technology and integrated construction of the elevated water tank 10 of the present invention, and in particular the outer pedestal 14 and the inner pedestal 42 permits construction almost entirely at grade level using synchronized hydraulic screw jacks and associated equipment such as jacks 66, which also provides a safer construction workplace than typical elevated construction techniques. Alternatively, the elevated water tank 10 of the present invention can be erected from RTP using traditional elevated construction methods. In either event the elevated water tank hereof provides the ability to mass produce elevated water tanks having long life coating protection, modular construction, and safe, fast and efficient construction methods.

The bolted panel pedestal construction hereof permits the invention to be used with virtually any type of elevated reservoir 12 located above the pedestal. Thus, the present invention provides a flexible and efficient method of construction for the pedestal regardless of whether bolted RTP construction is used for the reservoir or precast panels or other types of construction are used.

Although preferred forms of the invention have been described above, it is to be recognized that such disclosure is by way of illustration only, and should not be utilized in a limiting sense in interpreting the scope of the present invention. Obvious modifications to the exemplary embodiments, as hereinabove set forth, could be readily made by those skilled in the art without departing from the spirit of the present invention.

The inventor hereby states his intent to rely on the Doctrine of Equivalents to determine and assess the reasonably fair scope of his invention as pertains to any apparatus not materially departing from but outside the literal scope of the invention as set out in the following claims.
1. An elevated water tank comprising:
   a foundation;
   a reservoir for holding water therein; and
   a support pedestal positioned on the foundation for supporting the reservoir thereabove, said support pedestal including a plurality of metal panels and bolts coupling said plurality of metal panels together.
2. An elevated water tank as set forth in claim 1, wherein said metal panels are of rolled tapered panel construction having surrounding margins, the margins of one of said panels overlapping at least one adjacent panel, and having a sealant between overlapping panels.
3. An elevated water tank as set forth in claim 1, wherein said metal panels are arranged side-by-side in bands, a plurality of said bands being arranged one atop another with the panels of a lower band being in substantial vertical alignment with the panels of a band immediately thereabove.
4. An elevated water tank as set forth in claim 1, wherein said pedestal includes a plurality of substantially upright stiffeners extending upwardly from said foundation and wherein said metal panels are bolted to said upright stiffeners.
5. An elevated water tank as set forth in claim 1, wherein said reservoir is constructed of a plurality of metal panels which are bolted together and together with the pedestal has a continuous, integral outer wall.
6. An elevated water tank as set forth in claim 1, wherein said pedestal support includes an outer pedestal substantially in vertical alignment with an outer, water-containing wall of the reservoir.
7. An elevated support tank as set forth in claim 6, wherein said pedestal includes an inner support pedestal located interiorly of and spaced inwardly of said outer pedestal.
8. An elevated support tank as set forth in claim 1, wherein said pedestal is an inner pedestal located below and radially inward of an outer, water-containing wall extending upwardly from the foundation to a support floor of the reservoir.
9. An elevated support tank as set forth in claim 1, wherein said panels are substantially arcuate in plan and form an arcuate outer wall of the pedestal.
10. A method of constructing an elevated water tank, comprising the steps of:
    providing a foundation;
    bolting together a plurality of metal panels to form a support pedestal; and
    constructing a reservoir atop the support pedestal.
11. A method of constructing an elevated water tank as set forth in claim 10, including the step of providing a plurality of circumferentially spaced upright stiffeners and supporting said stiffeners on said foundation, and bolting said panels to said stiffeners.
12. A method of constructing an elevated water tank as set forth in claim 10, including the step of placing at least some of said panels in overlapping relationship to one another, and providing a sealant between said overlapping panels.
13. A method of constructing an elevated water tank as set forth in claim 10, including the step of bolting the panels together to provide circumferentially extending bands, bolting a lower band of said panels to a next upper band of said panels, and then raising said lower band of said panels and said upper band of said panels and bolting a further band of said panels to said lower band of panels.
14. A method of constructing an elevated water tank as set forth in claim 10, wherein said pedestal is an outer pedestal, and including the step of bolting together a plurality of metal panels to provide an inner pedestal positioned interiorly of said outer pedestal.

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