# Design of RCC Tanks And Its Material Used

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***Abstract***- *in this paper given emphasis on DESIGN OF RCC TANKS AND ITS MATERIAL USED rimary issues in water tanks, besides, electricity, are water tightness of tank. Complete water-tightness may be acquired via way of means of the usage of a excessive electricity concrete. In addition water proofing substances may be used to in addition beautify the water tightness.To make concrete leak evidence or water tight, inner water proofing or water evidence linings are regularly used. In the approach of inner water proofing, admixtures are used. The item of the usage of them is to fill the pores of the concrete and to achieve a dense and much less permeable concrete. Some of the maximum generally used admixtures are hydrated lime in amount various from eight to fifteen percent, via way of means of weight of cement of, powdered iron fillings, which expands upon oxidation and fills the pores of concrete. Other dealers like powdered chalk or talc, Sodium silicate Zinc sulphate, Calcium chloride etc.., also are maximum substantially used.In water-resistant linings, paints, asphalts, coaltar, waxes, resins and bitumens are used. These substances have a assets to repel the water.*

***Keywords***- admixtures ,asphalts, coaltar, waxes, resins

## I. INTRODUCTION

Containers or tanks are necessary for the storage of vast quantities of liquids such as water, oil, petroleum, acid, and even gases. Masonry, steel, reinforced concrete, and pre-stressed concrete are used to construct these structures. Smaller capacity are accommodated by masonry and steel tanks. Steel tanks are expensive, which is why they are rarely used for water storage. Reinforced concrete tanks are popular because, in addition to being straightforward to construct and design, they are inexpensive, monolithic in character, and can be made leak-proof. In general, no cracks in any area of the structure of Liquid Retaining R-C.C. tanks are allowed, and they are made watertight by utilising a richer concrete mix (not less than M 30).

## II. CLASSIFICATION OF R.C.C. TANKS

In general they are classified in three categories depending on the situation.

1. Tanks resting on ground.
2. Tanks above ground level (Elevated tanks).
3. Under ground tanks.

### *A. TANKS RESTING ON GROUND*

These are used for clear water reservoirs, settling tanks, aeration tanks etc. these tanks directly rest on the ground. The wall of these tanks are subjected to water pressure from inside and the base is subjected to weight of water from inside and soil reaction from underneath the base. The tank my be open at top or roofed.

Ground water tank is made of lined carbon steel, it may receive water from a water well or from surface water allowing a large volume of water to be placed in inventory and used during peak demand cycles.

**Fig No 1: . Tanks Resting On Ground**

### *B. ELEVATED TANKS*

These tanks are supported on staging which may consist of masonry walls, R.C.C tower or R.C.C. column braced together- The walls are subjected to water pressure from inside. The base is subjected to weight of water, wt- of walls and wt. roof. The staging has to carry load of entire tank with water and is also subjected to wind loads.Water tank parameters include the general design of the tank, choice of materials of construction, as well as the following.

1. Location of the water tank (indoors, outdoors, above ground or underground) determines color and construction characteristics.
2. Volume of water tank will need to hold to meet design requirements.
3. Purpose for which the water will be used, human consumption or industrial determines concerns for materials that do not have side effects for humans.
4. Temperature of area where water will be stored , may create concern for freezing and delivery of off setting heat.
5. Delivery pressure requirements, domestic pressures range from 35-60 PSI, the demand for a given GPM (gallons per minute) of delivered flow requirements.
6. How is the water to be delivered to the point of use, into and out of the water tank i.e. pumps, gravity or reservoir.
7. Wind and Earthquake design considerations allow a design of water tank parameters to survive seismic and high wind events.
8. Back flow prevention, are check valve mechanisms to allow single direction of water flow.
9. Chemical injection systems for algae, bacteria and virus control to allow long term storage of water.
10. Algae in water tanks can be mitigated by removing sunlight from access to the water being stored.

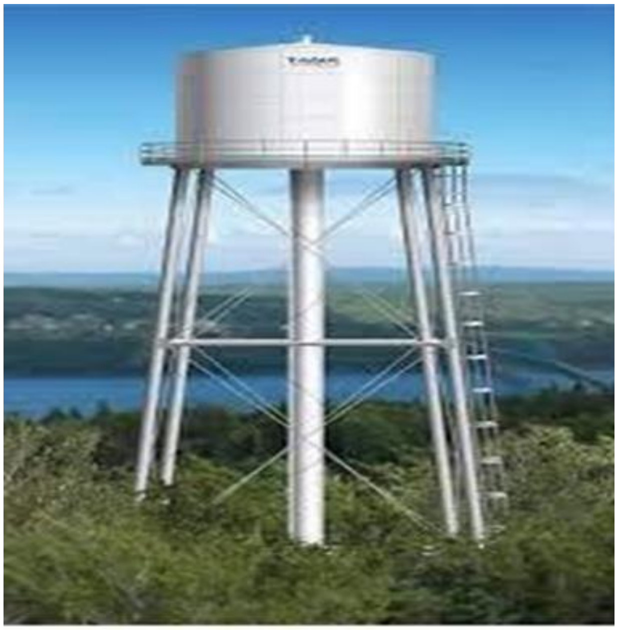

**Fig No 2: Elevated Tanks**

*C. UNDER GROUND TANKS*

These tanks are built below the ground level such as clarifiers filters in water treatment plants, and septic tanks .The walls of these tanks are subjected to water pressure from inside and earth pressure from outside. The base of the tanks is subjected to water pressure from inside and soil reaction from underneath. Always these are covered at top. These tanks should be designed for loading which gives the worst effect.

The design principles of underground tanks are same as for tanks resting on the ground. The walls of the underground tanks are subjected to internal water pressure and outside earth pressure. The section of wall is designed for water pressure and earth pressure acting separately as well as acting simultaneously.Whenever there is possibility of water table to rise, soil becomes saturated and earth.

**III. TYPE OF TANKS**

From the design consideration storage tanks are further classified according to their shape and design principles as

1) Circular tanks.
2) Rectangular tanks.
3) Intze type tanks.
4) Spherical tanks.
5) conical bottom tanks.
6) PSC Tanks.

*A. CIRCULAR TANKS*

*Circular tanks are usually elevated or rest on the ground. Circular tanks are also built underground. The circular tanks can be created with either a flexible base connection with the wall or a firm connection between the walls and the base. In the first instance, side walls can expand and contract, whereas in the later case, the walls are monolithic with the base. Tank walls are susceptible to hydrostatic pressure, which is greatest at the bottom and lowest at the top. Typically, the theory of thin cylinders is used to design the wall thickness and calculate the maximum hoop tension for circular tanks.*

**Fig No 3.1: Circular Tank**

Maximum hoop tension is given by formula P = ( WHD/2 )

And area of steel required for this tension is given by Ast = ( WHD / 2f)for the calculation of thickness of wall, the permissible tensile stress in concrete is equated to expression given below,

ct =( WHD / 2) 100t +(m-1) Ast In all the above cases
W = Wt. of water/Cu.m.
D =Diameter of Tank,
H =Height of the tank. Ast = Areaof steel required.
m =Modular ratio
t =Thickness of wall

f and ct are permissible tensile stresses in steel and concrete respectively. As the pressure is maximum at base and reduced to zero at the top, the reinforcement is also gradually reduced to a minimum requirement from bottom to top. The main reinforcement consists of circular hoops to take care of hoop tension and is placed on both faces of wall. The distribution steel is placed vertically and is tied to main reinforcement.

Though it is assumed that the connection between walls and base is flexible, in reality there is some moment at the joint- Hence it is impossible to get an ideal flexible joint. When the joint is not flexible and restricted up to certainheight from base, the wall acts as a cantilever and beyond that it acts as simply supported.

*B RECTANGULAR TANKS*

Circular tanks are uneconomical for lesser capacity, and their form work is expensive. When modest capacity tanks are required, rectangular tanks are built. They could be on the ground, elevated, or underground. Tanks should ideally be square in plan, with the bigger side not exceeding twice the smaller side, unless in the case of Rectangular tanks.

**Fig No 3.2 :Rectangular Tank**

**C.** *INTZE TANKS*

This is a special type of elevated tank used for very large capacities. Circular tanks for very large capacities prove to be uneconomical when flat bottom slab is provide.

Intze type tank consist of top dome supported on a ring beam which rests on a cylindrical wall .The walls are supported on ring beam and conical slab.

Bottom dome will also be provided which is also supported by ring beam. The conical and bottom dome are made in such a manner that the horizontal thrust from conical base is balanced by that from the bottom dome. The conical and bottom domes are supported on a circular beam which is in turn, supported on a number of columns. For large capacities the tank is divided into two compartments by means of partition walls supported on a circular beam.

Following are the components

1) Top dome.
2) Ring Beam supporting the top dome.
3) Cylindrical wall.
4) Ring beam at the junction of the cylindrical wall and the conical shell.
5) Conical shell.
6) Bottom dome.
7) The ring girder.

Columns braces.

8) Foundations.

*D. PRESTRESSED TANKS*

The pre-stressed water tanks are built to hold liquids in large quantities. In circular tanks circumferential pre-sstress is provided to resist hoop tension produced by internal liquid pressure.Pre-load Corporation of America has developed a system by which continuous pre-stressing can be done. It consists of a machine called marry-go-round which issupported by a trolley that moves at the top of the tank. The marry-go-round releases wire from a drum, tensions it through a die and wraps it round the tank walls. The wire is anchored at the bottom of the tank and the wrapping is done after pre-stressing the wall, the tank is filled and steel is covered by guniting.

The concrete is fully hardened in tank before the tensioned wire is wrapped around to cause hoop compression. The tank is covered with a dome of small rise. The ring beam is provided to support the dome. The dome may be also pre-stressed.

## IV. MATERIALS USED AND THEIR DESIGN REQUIREMENTS

Following are the materials which are used in the construction of R.C.C. Water Tanks.

Concrete.
Steel.
Water Proofing materials
Minimum Reinforcement.

### *A. CONCRETE*

The design of a liquid retention structure differs from that of a standard R.C.C. structure because the concrete must not fracture, must be of high quality and strength, and must be leak proof. The concrete mix must be designed in such a way that the resulting concrete is suitably impermeable. It is critical to achieve effective compaction, ideally using vibration. The water cement ratio affects the permeability of completely compacted concrete. The permeability of concrete increases as the water cement ratio rises, whereas concrete with a low water cement ratio is harder to compact.

Other faults in concrete that induce leaking include segregation and honeycombing. As these are possible sources of leakage, all seams should be made watertight.

*E.* The use of small size bars, when appropriately placed, results in cracks that are closer together but narrower in breadth. Limiting the fluctuations in moisture content and temperature to which the structure as a whole is exposed can reduce the likelihood of cracking owing to temperature and shrinkage effects.

*F.* By minimizing the limitation on the structure's free expansion using long walls or slabs built at or below ground level, the risk of cracking can be reduced. Restraint can also be reduced by providing a sliding layer.

*G.* Generally concrete mix weaker than M-30 is not used. To get high quality and impervious concrete, the proportion of fine and coarse aggregate to cement is determined carefully and water cement ratio is adjusted accordingly. Depending up on the exposure conditions, the grade of concrete is decided .

(a) Permissible tensile stresses in member in direct tension= 1500 Kg/Cm2
(b) Tensile stress in member in bendingon liquid retaining face of member = 1500 Kg/Cm2
(c) On faces away from liquid for members less than 225 mm thick= 1500.Kg/Cm2
(d) On faces away from liquid for members 225 mm. thick or more= 1900 Kg/Cm2

### *B. MINIMUM REINFORCEMENT*

The minimum reinforcement in each of two directions shall have an area of 0.24% of Cross-Sectional area of concrete up to 100 mm thick.For section of thickness greater than 100 mm and less than 450 mm. The reinforcement in each direction in shall be linearly reducing from 0.24% cross-sectional area to 0.16% cross-sectional area. For section greater than 450 mm thick reinforcement in each direction should be kept at 0.16% cross sectional area.

## V. CONCLUSION

There are several types of storage tanks, e.g., above-ground, flat-bottomed, cylindrical tanks forthe storage of refrigerated liquefied gases, petroleum, etc., steel or concrete silos for the storageof coke, coal, grains, etc., steel, aluminium, concrete or FRP tanks including elevated tanks forthe storage of water, spherical tanks (pressure vessels) for the storage of high pressure liquefiedgases, and under-ground tanks for the storage of water and oil. The trend in recent years is forlarger tanks, and as such the seismic design for these larger storage tanks has become moreimportant in terms of safety and the environmental impact on society as a whole.

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