Evaluation of Planning, Designing & Estimation of Overhead Circular Water Tank

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Abstract - Establishing a clean water supply is one of the main factors that greatly promote the country's socio-economic transformation by improving health, improving living standards and socio-economic productivity. However, most of the developing country like India has still low drinkable water supply and sanitation treatment that effect the peoples to be suffered from water scarcity, water born and water linked diseases. A good water supply distribution infrastructure plays a key role for any kind progress for a locality. The project evaluated the theoretical framework for the design of elevated storage tanks. The goal of the urban water supply plan project is to provide drinking water for current and future needs, thereby improving the existing local water supply system. Determine the current and future population of the study area, and determine the daily water demand.

We have designed the circular overhead tank of 4.5 lakh capacity for a locality Jiamau colony. Due to covid-19 pandemic, we weren't able to take data physically so that we have assumed some data.

The design and analysis of the circular overhead water tank are carried out using STAAD.Pro software and the estimates are done on MS EXCEL sheet.

***Key Words*:** Evaluation, Planning, Design, Analysis, Estimation, study

1.INTRODUCTION

The project for overhead water tank has been prepared with an objective of storing and providing safe and sufficient drinking water to the people on the sustainable basis.

The provision of clean Water Supply is one of the major factors that greatly contribute to the socio-economic transformation of a nation by improving the health thereby increasing life standard and economic productivity of the locality. A good water distribution infrastructure plays a key role for any kind development for a town.

This project evaluates the theoretical framework for the design of overhead circular water tank. The aim of this water supply project is to provide potable water for present and future demand which improve the existing water supply system of the town. The current and future population of the study zone make up my mind and therefore the water demand per day well-known. The hydrologic, hydro earth science and geographics knowledge fashioned the idea of the look whereas birthing stress on models and theories of overhead tank performance.

Lack of access to safe water undermines the health and well-being of the people. The poor and economically weaker section deserve better socio-economic upliftment and enhances productivity to sustain the economy of the area in particular and the country, in general. It is imperative to provide safe and adequate drinking water supply facilities to the public on sustainable basis. This project has, therefore, been prepared with an objective evaluation of storing and providing safe and adequate drinking water supply system for the people with a view to facilitate health improvement, ease in obtaining water and improved living standard.

IMPORTANCE AND NECESSITY FOR PLANNED WATER SUPPLIES

Next to the air, the other essential requirement for human lifestyles to exist is water. Water is to be had in diverse bureaucracy such as rivers, lake, streams and so forth. The development of civilization the software of water quite extended and now such a level has come that without well-organized public water supply scheme, it is impossible to run the existing civic life and the increase the towns. The significance of water from best a quantity point of view become diagnosed from the earliest days and the importance of quality emerge as identified step by step within the later days. It offers with storage of ingesting water in copper vessels, publicity to daylight, filtering through charcoal, sand and many others.

RCC WATER TANK

Reinforced concrete water tanks are constructed for storage of water. The look of concrete tank is predicated on IS 3370: 2009 (Parts I – IV). The appearance depends on the placement of tanks (overhead, on ground or underground water tanks). The tanks may be created in numerous shapes sometimes circular and rectangular shapes are principally used. The tanks may be product of concrete or maybe of steel. The overhead tanks (elevated tanks) are occasionally elevated from the top through column within the different hand the underground tanks are rested on the stimulus.

Types of RCC water tank

Based on the tank location and their shapes, they are classified as

Based on water tank location

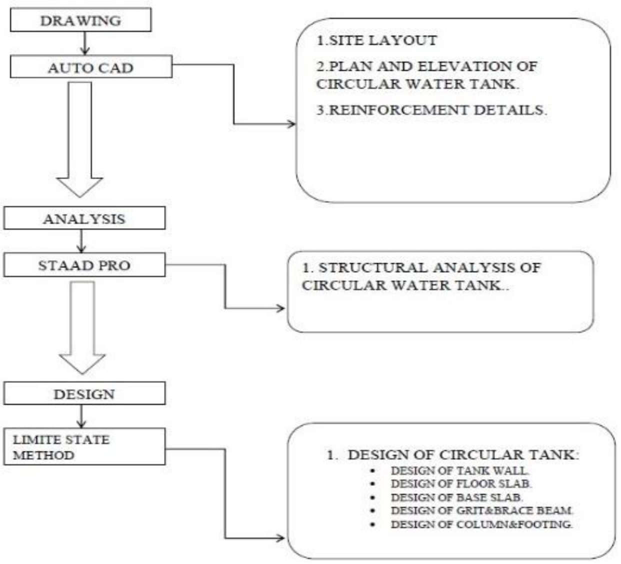
Underground tanks
Tank resting on grounds
Overhead tanks*
Intze tank

Based on water tank shape
Rectangular tank
Circular tank
Spherical tank

OVERHEAD CIRCULAR WATER TANK: When water is stuffed in circular tank, the hydrostatic water pressure can attempt to increase in diameter at any section. However, this will increase within the diameter all long the peak of the tank can rely upon the character of the joint at the junction of the wall and bottom block. If the joint is versatile, it'll be unengaged to move outward. the hydrostatic pressure are going to be zero and thus there'll be no amendment in diameter and hydrostatic pressure at very cheap are going to be most, leading to {the most the utmost the most} increase within the diameter and maximum movement, if joint is versatile. once the joint between the wall and floor is rigid, no horizontal displacement of the wall at the joint is feasible. The deflected form of the wall is going to be on deflected. The higher half can have hoop tension, whereas the lower half can bend like cantilever mounted at joint at very cheap.
For shallow tanks with massive diameter, hoop stresses area unit terribly tiny and therefore the wall acts a lot of like cantilever. For deep tanks of tiny diameter, the cantilever action thanks to mounted at the bottom are going to be tiny and therefore the hoop action are going to be predominant.

VARIOUS COMPONENT OF OVERHEAD TANK
The various components of elevated tank are as follows
a. Top Roof Dome: The dome at top generally 100mm - 150mm thick with reinforcement along the meridian and latitudes. The rise is usually 1/5th of the span.
b. Ring Beam: The ring beam is essential to resist the horizontal component of the thrust of the dome. The ring beam will be designed for hoop tension induced.
c. Circular Wall: This has to be designed for hoop tension caused due to horizontal water pressure and to resist bending moment induced to wall by fluid load.
d. Bottom Slab This will be designed for total load above it. The slab will also be designed for the total load above it. The slab will also be designed as a slab spanning in both directions.
e. Bottom Beams the bottom beam will be designed as continuous beam to transfer all the load above it to the columns.

2. METHODOLOGY



SITE STUDY
site study is done by us very accurately. We should visit different locations to gather all the relevant information regarding the ward. We should examine all data carefully. Following are helpful data that will be collected by the site study:

1. Data regarding the leveling of the site.
2. Area usage for the overhead tank and pumps.
3. Unavailability of surface source of water.
4. Pattern of distribution system.
5. Plotting of site area.
6. Prediction of the population on the basis of live population density at the site.
7. Predicted water demand on the basis of population.
8. Requirement of pipeline.

POPULATION FORECASTING & DESIGN PERIOD
The economic design period of the components of a Storage tank varies on their life, initial cost, rate of interest on loan, the ease with which they can be expanded of the likelihood that they will be rendered absolute by technological advances. In order to design the parts of water system, the flow at the end of design period must be estimated.
It is necessary to fix the design period and forecast the population of the area in the design of any water supply scheme. Water tank projects are usually designed for a certain period after the completion of construction works in order to satisfy the population demand.
DESIGN PERIOD - Design period is the number of years for which the design of water works has been done. Before designing & construction of overhead tank, it is necessary to assure that the water works have sufficient capacity to meet the future water demand of the town for the fixed design period. Therefore the number of years for which the design of the water works has been done is called design period. The design period, however, should neither too long or too short. Mostly water supply schemes have design period of 20-30 years.
The different elements of the treatment & distribution systems may approximately be designed for different flow criteria as shown in the table below.
The design period of a water supply scheme can be limited by the following factors:
1. Funds available for the completion of the project.
2. Life of the structural materials used in the water supply scheme.
3. Rate of interest on the loans taken to complete the project
4. Anticipated expansion rate of the town

METHODS OF FORECASTING POPULATION
By considering growth rate of the town we use the following different methods of population forecasting to asses and estimate the future population of the town.
The following are the standard methods by which the forecasting population is done:
i. Arithmetical Increase Method
ii. Geometrical Increase Method
iii. Incremental Increase Method
iv. Simple Graph Method
v. Decrease Rate of Growth Method
vi. Comparative Graph Method

vii. The Master Plan Method

WATER DEMAND ASSESSMENT

Design of water systems require estimation of expected water demands applicable to size the pumping equipment, transmission and distribution pipe lines and storage facilities. As a matter of fact the first duty of the engineer is to determine the water demand of the town and then to find suitable water sources from where the demand can be met. But as there are so many factors involved in demand of water, it is not possible to accurately determine the actual demand.

Following are the various types of water demands of a city or town:

i. Domestic water demand
ii. Industrial demand
iii. Institution and commercial demand
iv. Demand for public use
v. Five demand
vi. Loses and wastes

PER CAPITA DEMAND

If 'Q' is the total quantity of water required by various purposes by a town per year and 'p' is population of town, then per capita demand will be

Per capita demand = Q/(Px365)

1.	Domestic purpose	135
2.	Industrial use	40
3.	Public use	25
4.	Fire Demand	15
5.	Losses, Wastage and thefts	55
	TOTAL	270

DESIGNING OF OVERHEAD TANK

PRESENT DAY POPULATION

Number of houses in jiamau colony =350
Assumed 5 person per house
Population= no. of houses * No. of person per house
=350*5
=1750

POPULATION FORECASTING

Present population Po=1750
Geometrical mean , r=38%
By geometric progression method,
P=Po(1+r/100)^n
Design period=20 years
n= 2
Estimated population after 20 years= 1750(1+38/100)^2
=3333

WATER DEMAND

Domestic use per capita per day =135L
Water demand = estimated population *per capita per day water demand
=3333*135=449955L
Daily Water demand=4.5 lakh litre

CODES AND STANDARDS

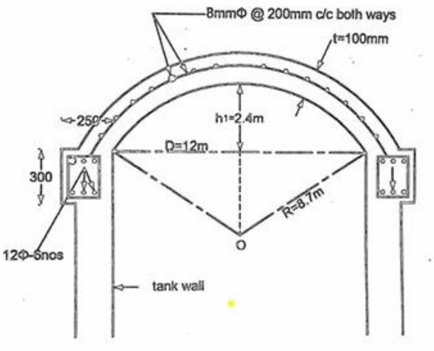
a. IS3370(PART I,II,IV) (code of practice for concrete structures for the storage of liquids)
b. IS456:2000 (code of practice for plain and reinforced concrete)
c. SP 34-1987 (handbook on concrete reinforcement and detailing)

ASSUMPTIONS

a. grade of concrete = M30
b. grade of steel = Fe 415
c. unit weight of reinforced concrete =25KN/m3
d. unit weight of water =10KN/m3
e. load factor =1.5
f. exposure condition is severe
g. nominal cover =50mm

DIMENSION OF CIRCULAR TANK

Capacity of tank = 4.5 lakh litre
Use M30 concrete and Fe415 steel
V=π/4 x D2 X H
450 = π/4 x 12 x 12 x H
H=3.97 m
Take H=4 m



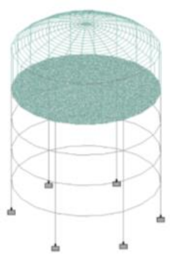
ANALYSIS

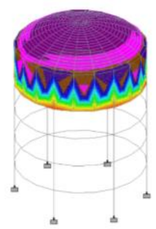
The analysis of the structure that is evaluation of the internal forces like BM,SF in the section members, for which these members have to be designed, under the action of given loads. This process requires the knowledge of structural mechanics which includes mechanics of rigid bodies, mechanics of deformable bodies and theory of structures. A brief evaluation is taken of structural analysis to revive the basic philosophies. The framing of a overhead circular water tank consist of columns, top domes, beams ,bottom slab and footing which support stored water.

In addition to gravity forces the tower and the tank are subjected to wind and seismic forces depending upon the location of the tank. The wind pressure at a site is determined as per IS : 875 Part III provision. The wind force on a surface is the product of pressure per unit area and projected area normal to the direction of wind. Intze tanks offer relatively smaller resistance and a reduction factor of the order 0.7 is used to arrive at effective pressure.

The horizontal and vertical components of the seismic forces depend upon the total effective eight of the tank and stiffness of the staging . thus, the overhead tank located in seismically active areas should be analyzed and designed for seismic forces both under tank full and tank empty condition. When empty the effective weight of tank system used in the analysis Consist of dead weight of tank and one third weight of staging , When full the weight of contents is to be added to the weight under tank empty condition.

DESIGN AND ANALYSIS ON STAAD PRO





ESTIMATION OF TANK

Detailed estimation: Detailed estimate is Associate in Nursing correct estimate and consists of understanding the quantities of every item of works, and dealing the price. the size, length, breadth and height of every item square measure taken out properly from drawing and quantities of every item square measure calculated, and abstracting and asking square measure done. The elaborate estimate is ready in 2 stages: Details of activity and calculation of quantities. the small print of activity of every item of labor square measure taken out properly from arrange and drawing and quantities below each item square measure calculated in an exceedingly tabular kind named as details of measurement kind.

Abstract of estimated cost: The cost of each item of work is computed in a tabular form the quantities already calculated and total cost is worked out in abstract estimate form. The rates of different items of work are taken as per schedule of rates or current workable rates for finished item of work.

Total estimated cost will be around Rs 52 lakh. Total cost estimated by the reference of standard scheduled rates.

3. CONCLUSIONS

With the appropriate and successful execution of the Project the whole population of locality will be benefitted with safe, clean and healthy potable water, which is basic necessity of humanity.

The geometric mean method of population forecasting is selected with adequate data of central statically authority. Selection of potential water sources are made to determine which sources should satisfy the respective quantity and quality of the demand though our design period. Ground water is selected as a potential water source because of its adequacy and closeness to the town.

Storage of water within the type of tanks for drinking and laundry functions, swimming pools for exercise and pleasure, and waste deposit tanks area unit gaining increasing importance within the gift day life. for tiny capacities we tend to opt for rectangular water tanks, whereas for larger capacities we offer circular cistern.

Design of circular overhead water tank is a very tedious method. The whole structure is designed manually considering M30 grade concrete. The staging has been designed with maximum safety and effects due to seismic force and wind force are also taken into account.

➢ The proposed tank in jiamau will be designed in STAAD.Pro

➢ Design of tank is safe from the software design with respect to loads applied.

➢ For small capacities we have a tendency to select rectangular water tanks whereas for larger capacities we offer circular water tanks. Since our planned tank is of appropriate capability we are going to set up, analyse and style the circular over head tank in STAAD.Pro.

ACKNOWLEDGEMENT

The satisfaction and euphoria that accompany the successful completion of any task would be incomplete without the mentioning of the people whose constant guidance and encouragement made it possible. We take pleasure in presenting before you our project, which is result of studied blend of both research and knowledge. We hereby take this opportunity and thank all those related to this project and its making, as a project is never somebody's project alone. It is a combined result of innovation, efforts, guidance, ideas and inspiration.

We would like to thank our Project Guide **Prof. D.S. RAY (Head, department of Civil Engineering, BBDITM, Lucknow)** who guided us throughout the project and helped us in providing the necessary information whenever needed.

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