.

A STUDY ON DESIGN OF R.C.C. OVERHEAD TANK

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ABSTRACT

Due to the high demand for water on campus, water must be stored and delivered according to their demands; however, water demand does not remain constant throughout the day and varies hourly. We need to store water in order to supply a continuous volume of water, so a water tank must be developed to match the campus water demand.
Elevated tanks are very essential structures that are considered to be the key lifeline elements that must work as expected throughout their lifespan. In this study, we explored the design issues as well as how to calculate the whole Elevated Liquid Reservoir geometrical properties using the standard IS codes.
. Hence, we can revise our work based on design perspective and complete the calculated results for the tank. This project deals with the theory behind the design of liquid retaining structure (elevated circular water tank with domed roof and conical base) via "working stress method". Initially, the project explores design of water tank for "ITM, GIDA, GORAKHPUR" according to respective standard data provided by the college.
Materials such as concrete and pvc Galvanized Tanks are made from iron and fibre. Pumps from a source are used to move water through pipe. Water can be supplied by gravity or by pump to reach each individual at the required pressure and velocity. The population, as well as their usage and demand, are used to compute volume. The need for water varies from hour to hour. Water tanks are the greatest option for a continuous supply. To accommodate the demand for water, public water tanks will be built. The design and analysis are the same for any liquid in a water tank, but it must be free of cracks to avoid leakage.

Keywords*: - Intze type Water Tank, Population, Water Demand, Elevated Storage Reservoir, and Working Stress Method*

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1. OBJECTIVE

To determine the daily water demand for ITM. The design an intze type tank for calculated water demand of the ITM.

2. INTRODUCTION

A German hydraulic engineer is given the name tank as Intze. The water have to be stored in today's time as water is becoming a scarce commodity. For storing water and its distribution, water tank are largely used. Reservoir is a general tenure used to liquid storage structure and it can be below or above the ground level. Water tanks are very absolute an essential for public and for industrial structure. Water tanks are very significant components of lifeline. They are grave elements in municipal water supply systems and in many industrial amenities for storage of water.

This is a one-of-a-kind raised tank for extremely huge volumes. When a flat bottom slab is provided, circular tanks for big volumes tend to be costly. The top dome of an Intze tank is supported by a ring beam that rests on a cylindrical wall. Ring beams and a conical slab support these walls. A bottom dome will be installed, which will be supported by a ring beam. The conical and bottom domes are designed so that the horizontal thrust from the conical base is matched by the bottom dome's push.

3.LITERATURE REVIEW

Thalapathy. M and et.al: Water, petroleum products, and other liquids are stored in storage reservoirs, . To reduce leakage, the tanks are built as crack-free constructions. This study examines the design of a liquid retention structure utilising the working stress approach in depth. The project focuses on reservoir design for overhead water tanks.
The document provides information about safe tank design at a low cost. To make tank design more cost-effective, dependable, and simple. The study explained the design philosophy for a safe and cost-effective water tank.

SK.NASEEMA and et.al: According to historical records, most reinforced concrete elevated water tanks around the world fell or were severely damaged during earthquakes. A common study in this subject identifies the causes of supporting system failure, revealing that the supporting system of elevated tanks is more crucial than the supporting systems of other structural types of tanks. The purpose of this study is to see if a water tank supported on shafts is compatible. The results reveal that varied water tank capacities alter structural response.

Bugatha Adilakshmi and et.al: To prevent leaking, basically tanks are designed as crack-free constructions. The working stress approach is used to construct an INTZE tank, while the limit state method is used to create the tank's elements. When compared to alternative shapes, circular shapes are usually favoured for a given capacity since stresses are consistent and low. The theory, design, and analysis of the INTZE type water tank are all covered in this project. The major goal of this study is to provide the most accurate estimations of the amount of concrete and steel necessary for a particular water capacity.

Ranjit Singh Lodhi and et.al: In India, the Intze type tank is the most common overhead water tank. These tanks are built in accordance with IS: 3370, which is a code of practise for concrete buildings for liquid storage. In 2009, BIS completed the revision of IS 3370 (parts 1& 2), which had been in the works since 1965. Currently, a vast number of overhead water tanks are utilised to transport water for public utilities, with the majority of the tanks being designed according to the old IS Code: 3370-1965.

4. COMPONENTS OF INTZE TYPE TANK

a-Top dome: The top dome is roughly 100mm to 150mm thick, with meridians and latitudes reinforced. 1/5 of the span is typical.
b- Ring Beam supporting the top dome:- The ring beam is necessary to resist the horizontal component of the dome's thrust. The ring beam is made to withstand the tension.
c- Cylindrical wall: This wall is meant to relieve hoop strain induced by horizontal water pressure.
d- Ring Beam at the junction of the cylindrical wall and the conical shell:- The ring beam is used to resist the horizontal component of the conical wall's response on the cylindrical wall. The produced hoop stress was also designed into the ring beam
e- Conical Slab:- Designed for hoop tension due to water pressure. This slab designed as a slab spanning between the ring beam at top and the ring girder at bottom.
f- Bottom Dome:- The floor can be either circular or domed ,The slab is supported on the ring girder.
g-The Ring Girder:- Designed to support the tank and its components. The girder is supported on columns and braced at intervals that are designed for resolving bending moment and torsion.

h- Columns Braces:- Designed for the total load transferred on them. Those columns be braced at regular intervals and designed for wind pressure or seismic loads whichever applies.
i-Foundations:- A combined footing foundation is usually provided for all supporting columns.It is usual to make the foundation consisting of a ring girder and a circular slab.

5- METHODOLOGY ADOPTED

We are carrying our work by using "Working Stress Method" And M-30 Grade of Concrete and HYSD Steel Bars

5.1 POPULATION FORECASTING-

- ARITHMETICAL INCREASE METHOD

This strategy is appropriate for huge, historical cities that have undergone tremendous development. If it is utilised for tiny, average, or relatively new cities, the outcome will be lower than the current figure. According to the last census report, the average increase in population each decade is determined. The population of the future decade is calculated by adding this increased value to the current population. As a result, it is thought that the population is growing at a steady rate. As a result, dP/dt = C, indicating that the rate of population change through time is nearly constant. As a result, after n (number) decades, the population will be Pn= P + n.C. Pn represents the population after n (number) decades, while P represents the current population.

Calculation of future population

(a) Arithmetical progression method

$$P_n = P_0 + n\bar{x},$$

where,

P_0 - last known population

P_n - population (predicted) after 'n' number of decades,

n - number of decades between Po and Pn and,

x̄ - the rate of population growth.

P_{2035} = 4000+1.5(200)

= 4300

(b) **Geometrical progression method**

$$P_n = P_0 \left(1 + \frac{r}{100}\right)^n$$

Where,

P = Present population

n = no. of decades.

r = geometric mean (%)

$$r = (r1 \times r2 \times r3 \times \ldots\ldots \times rn)^{1/n}$$

$$= (0.069 \times 0.148 \times 0.097 \times 0.081)^{1/4}$$

= 0.09463 ∴

$P_{2035} = P_{2020}(1+r_g)^n$

$=4000(1+0.09463)^{1.5}$

=4378.576

(c) Incremental increase method

$$P_n = Po + n\bar{x} + \frac{n(n+1)}{2}\bar{y}$$

x̄ = average increase of population of known decades

ȳ = average of incremental increases of the known decades

$$\therefore P_{2035} = 4000+1.5(200)+1.5\frac{(1.5+1)}{2}125 = 4034.37$$

Therefore, the actual population is the average of the above method = 4404

THE POPULATION OF ITM AND THEIR WATER DEMAND- (Table 1)

- For current population of the college campus upto 2020

S.No.	Department	Population	IS Recommended Draft (LP/D)	Total Water Demand
1	Faculty	200	45	9000
2	Day Scholar	4000	45	180000
3	Hosteller & Residential	250	135	33750
		4450		222750

- For future population of the college campus upto 2035

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S.No.	Department	Population	IS Recommended Draft (LP/D)	Total Water Demand
1	Faculty	221	45	9945
2	Day Scholar	4405	45	198225
3	Hosteller & Residential	276	135	29835
		4902		245338

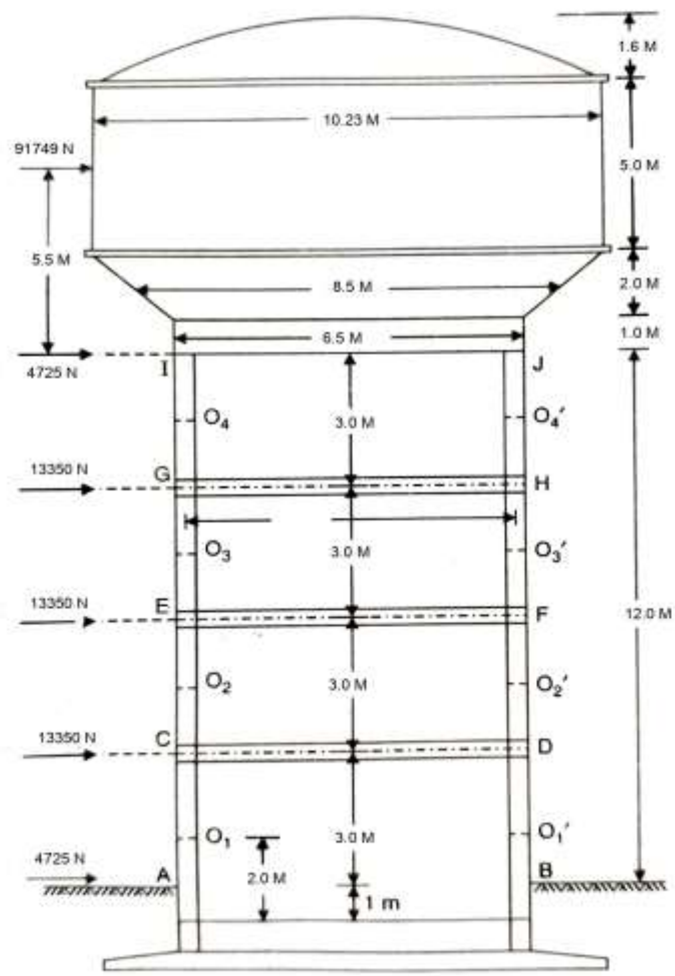
6- SITE SELECTION

Site of Intze type water tank

7- STRUCTURAL DESIGN AND CALCULATION

S NO	COMPONENTS OF INTZE TANKS	REINFORCEMENT DETAILS	MATERIAL USED
1	Top dome	8 mm Ø bars @160 mm c/c in both direction	M30, Concrete HYSD Bars having weight 1542261.55 N
2	Top Ring Beam	8 mm Ø bars – 2 legged vertical stirrups @150 mm c/c	M30, Concrete HYSD Bars having weight 1542261.55 N
3	Cylindrical Wall	Provide ring of 10 mm Ø bar of spacing 300,200 and 150 mm at 2m, 3m, and 4m below top respectively	M30, Concrete HYSD Bars having weight 1542261.55 N
4	Bottom Ring	Provide 30 mm Ø - 4 Nos.	M30, Concrete HYSD Bars
5	Conical Dome	Provide 18mm Ø bar@ 150 mm c/c on each face with distribution bar of 10 mm Ø @120 mm c/c	M30, Concrete HYSD Bars having weight 888576.5876 N
6	Bottom Spherical Dome	10 mm Ø bars @ 130 mm c/c	M30, Concrete HYSD Bars having weight 220893.2335 N
7	Bottom Circular Beam	Provide 12 mm Ø bar 2 legged mm stirrups @110 mm c/c	M30, Concrete HYSD Bars having weight 392699.082 N
8	Column	10 mm Ø bar ring of 250 mm c/c	M30, Concrete HYSD Bars
9	Brace	20 mm Ø bar 4 Nos each at the top and bottom	M30,Concrete HYSD Bars
10	Foundation	18 mm Ø bar @105 mm c/c at the bottom of slab with distribution bar of 10 mm Ø 145 mm c/c at support and 200 mm at the edge	M30, Concrete HYSD Bars

8- DESIGN OF INTZE TANK



CONCLUSION:

In today's world, water storage in the form of tanks for drinking and washing, swimming pools for exercise and recreation, and sewage sedimentation tanks are becoming increasingly important. We provide rectangular water tanks for modest amounts of storage and circular water tanks for larger amounts. The Intze tank is a circular tank with modifications. Because the lower dome in this design resists horizontal force, the Intze tank is built to save money on the project. Capacity of this reservoir is 1.5 times the demand of water i.e. 450000 litres to meet Maximum Daily Demand.

The design of an Intze water tank is a time-consuming process. The entire construction was developed manually using the "Working Stress Method" with M20 concrete and HYSD steel bars. The staging has been constructed for optimal safety, taking into account the effects of seismic and wind forces.

As a result, the planned site will be able to meet both current and future needs.

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