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DESIGN OF AN INTZE TANK FOR AXIS COLLEGES KANPUR

[1] Neelesh Kumar Verma. [2]Prashant Kumar, [3]Mohd Salman, [4]Mohd Zaid Sabir, [5]Mohd Shariq
[1] Student, [2]Student, [3]Student, [4]Student, [5]Asst.Professor

[1]Department of civil engineering

[1]Axis institute of technology and management, Rooma, Kanpur.

ABSTRACT

Due to huge need of water in the campus, water has to be stored and supplied according to their needs, water demand is not constant throughout the day, and it fluctuates hour to hour. In order to supply constant amount of water, we need to store water so to meet the campus water demand, water tank need to be designed.

The elevated tanks are very important structures and are considered as the main lifeline elements that should be capable of keeping the expected performance during its lifespan. In this paper we have discussed about the design aspects and to calculate the entire Elevated Liquid Reservoir geometrical characteristics by taking into considerations 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 "AXIS COLEGES, (ROOMA) KANPUR" according to respective standard data provided by the college.

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

OBJECTIVE

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

INTRODUCTION

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.

Generally, there are three kinds of water tanks:

i) Tanks resting on ground.

ii) Underground tanks.

iii) Elevated tanks.

The tanks resting on ground like settling tanks, aeration tanks etc.

are Supported on the ground directly. The walls of these tanks are subjected to pressure and the

Base is subjected to weight of liquid and soil pressure. The tanks may be covered on

Top.

From design point of view, the tanks may be classified as per their shape as following:

i) Rectangular tanks

ii) Circular tanks

iii) Over Head Service Reservoir (OHSR)

iv) Intze Tank i.e. OHSR for large capacity.

Our research deals with the study of INTZE- TYPE water tank.

INTZE TYPE TANK

This is a very unique kind of elevated tank used for very large quantities. Circular tanks for large quantities are prove to be expensive when flat bottom slab is provided. Intze type tank consist of top dome supported on a ring beam which rests on cylindrical wall. These walls are supported on ring beams and conical slab. Bottom dome will also be provided which also supported by ring beam. The conical and bottom dome are made in such manner that the horizontal thrust from the conical base is balanced by that from the bottom dome. The conical and bottom domes are supported on circular beam which is in turn, supported on a number of columns. As for large quantities the tank is divided in two compartments by means of partion walls supported on a circular beam.

Fig 1 Intze type water tank

1-Top dome:-
The top dome is about 100mm to 150mm thick with reinforcement along the meridians and latitudes. usually 1/5 of the span.

2-Ring Beam supporting the top dome:-
The ring beam is required to resist the horizontal component of the thrust of the dome. The ring beam is designed for the tension induced.

3-Cylindrical wall:- it is designed hoop tension caused due to horizontal water pressure.

4-Ring Beam at the junction of the cylindrical wall and the conical shell:-
The ring beam is provided to resist the horizontal component of the reaction of the conical wall on the cylindrical wall. The ring beam also designed for the induced hoop tension.

5-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.

6-Bottom Dome:-
The floor can be either circular or domed ,The slab is supported on the ring girder.

7-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.

8-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.

9-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.

LITERATURE REVIEW

Thalapathy. M and et.al: Storage reservoirs are used to store water, petroleum products and similar liquids. The tanks are designed as crack free structures to minimize leakage. This report provides the detailed analysis of the design of liquid retaining structure using working stress method. The project deals in the design of reservoir in 1) Underground Tank, 2) Tank Resting on ground and 3) Overhead water tank. The paper gives information for safe design with minimum cost of the tank. In order to make design of tank more economical, reliable and simple. The paper taught us about the design philosophy for the safe and economical design of water tank.

SK.NASEEMA and et.al:. As from past records, most of the reinforced concrete elevated water tanks were collapsed or highly damaged during the earthquakes all over the world. Common study in this field is pointing out the reasons towards the failure of supporting system which reveals that the supporting system of the elevated tanks has more critical importance than the other structural types of tanks. The present work aims at checking the compatibility of water tank supported on shafts. The result shows that structure response influenced by different capacities of water tank.

Bugatha Adilakshmi and et.al:. Baiscally tanks are designed as crack free structures to eliminate any leakage. Here, Working stress method is used to design an INTZE tank and Elements of the tank are designed by limit state method. Usually, for a given capacity, circular shape is preferred because stresses are uniform and low when compared to other shapes.. This project deals in theory, design and analysis of the INTZE type water tank. The main point of this paper is to give best estimates of the required quantity of concrete and steel for a given water capacity.

Ranjit Singh Lodhi and et.al: Intze type tank is mostly used overhead water tank in India. These tanks are designed according IS: 3370 i.e. Code of practice for concrete structures for storage of liquids. BIS carried out the revised version of IS 3370 (part 1& 2) after a long time from its 1965 version in year 2009. Currently,large number of overhead water tanks is used to distribute the water for public utility, where most of the water tanks were designed as per old IS Code: 3370-1965 without considering earthquake forces. The objective of this study is to shed light on the difference in the design parameters of (a) intze water tanks without considering earthquake forces (b) intze water tanks designed with earthquake forces. Initially design is based on Indian standard code: 3370- 1965 and second design is based on Indian standard code: 3370-2009 and draft code 1893-Part 2, (2005) considering two mass modal i.e. impulsive and convective mode method.

METHODOLOGY ADOPTED

We are carrying our work by using "Working Stress Method"

And M-20 Grade of Concrete and HYSD Steel Bars.

1.1POPULATION FORECASTING

- **ARITHMETICAL INCREASE METHOD**

This method is suitable for large and old city with significant development. Incase, it is used for small, average or comparatively new cities then it will give low result than existing value. The average increase in population per decade is calculated as per the past census report. This increased value is added to the present population to find out the population of the next decade. Thus, it is assumed that the population is increasing with a constant rate.

Hence, dP/dt = C i.e. rate of change of population with respect to time is almost constant. Therefore, Population after n (number) of decade will be $P_n = P + n.C$

Where, P_n is the population after n (number) of decade and P is present population.

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

S NO	DEPARTMENTS	POPULATION	IS RECOMMENDATION WATER (L/P/D)	WATER DEMAND
1	Teaching Staff	200	45 l/p/d	9000 liter
2	Non-Teaching Staff	200	45 l/p/d	9000 liter
3	4th Class Staff	100	45 l/p/d	4500 liter
5	Students	5310	Depends upon hosteller or Day- scholars	
6	Hosteller	600	135 l/p/d	81,000 liter
7	Day –Scholars	4710	45 l/p/d	2,11,950 liter
	TOTAL	5810		3,15,950 Liter

FUTURE DEVELOPMENTS OF THE AXIS COLLEGES AND THEIR WATER DEMAND-

POPULATION INCREASED BY 20 % (Table 2)

S NO	DEPARTMENTS	POPULATION	IS RECOMMEND (L/P/D)	WATER DEMAND
1	Staff Residences	40	135 (l/p/d)	5,400 liter
2	Students	1062	Depends upon they are Hostellers or Day-Scholars	
3	Hosteller	120	135 (l/p/d)	16,200 liter
4	Day – Scholars	942	45 (l/p/d)	42,390 liter
5	Hospital Beds	20	340 (l/p/b)	6,800 liter
	TOTAL	1122		70,790 Liter

FIRE DEMAND- (Table 3)

S NO	METHOD	FORMULA	WATER DEMAND
1	Kuching's method	$3182\sqrt{P}$	2,64,929 liter
2	Freemen's method	$1136\left[\frac{P}{10}+10\right]$	7,98,835 liter
3	Buston's method	$5663\sqrt{P}$	4,71,493 liter
	TOTAL		$\left[\frac{2,64,929+7,98,835+4,71,493}{3}\right] = 5,11,752\ Liter$

No of Total Population = 1122+5810 = 6932

Water required for the 1000 m garden = 3,500 liter.

- **TOTAL WATER DEMAND FOR AXIS COLLEGES-**

(3, 15,450 + 70,790 +5, 11,752 =8, 97,952 = 9 lac liter)

1.2 SITE SELECTION

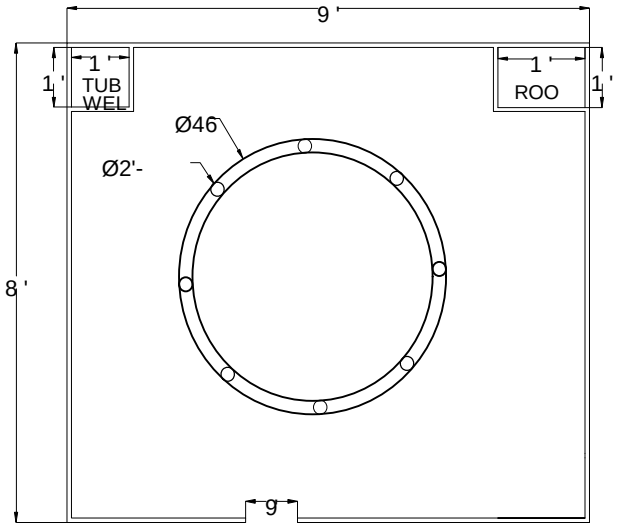
We have chosen the land mass available in front of boy's hostel for the tank.

(Fig 2) Satellite Image of Intze Tank Site

1.3 SOFTWARE USED

AUTOCAD is a reknowned and essential computer-aided design (CAD) and drafting software application. It was Developed and marketed by Autodesk, AutoCAD was first released in December 1982 as a desktop app running on microcomputers with internal graphics controllers. The former is computer-aided design (CAD) software on which architects, engineers and construction professionals rely on to create precise 2D and 3D drawings. Draft, annotate and design 2D geometry and 3D models with solids, surfaces and mesh objects .With the help of AutoCAD the designing work can be done precisely and accurately in a short time.

1.4 SITE PLAN



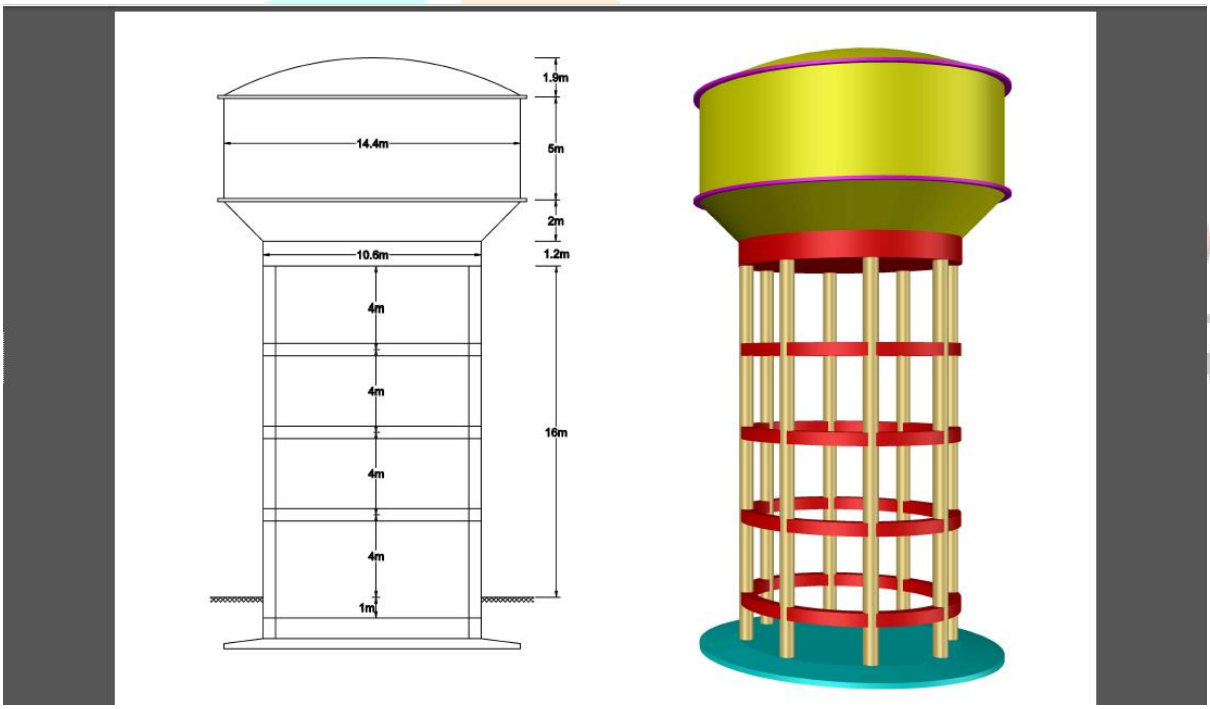
(Fig 3) Site Plan of Intze Tank

1.5 STRUCTURAL DESIGN AND CALCULATION (Table 4)

S NO	COMPONENTS OF INTZE TANKS	REINFORCEMENT DETAILS	MATERIAL USED
1	Top dome	8 mm Ø bars @160 mm c/c both way	M20,Concrete HYSD Bars
2	Top Ring Beam	8 mm Ø bars @300 mm c/c	M 20, Concrete and HYSD Bars.
3	Cylindrical Wall	Provide rings @ 120 mm c/c for next 1 m height. in the last 1 m height (4 m to 5 m) provide rings 95 mm c/c as found earlier	M 20, Concrete and HYSD Bars
4	Middle Ring Beam	8 mm Ø distribution bars (vertical bars) provided in the wall @ 150 mm c/c.	M 20, Concrete and HYSD Bars
5	Conical Section	10 mm Ø bars @ 175 mm c/c on each face provide a clear cover of 25 mm.	M 20, Concrete and HYSD Bars
6	Bottom Spherical Dome	10 mm Ø bars @ 120 mm c/c in both the direction. Also provide 16 mm Ø bars	M 20, Concrete and HYSD Bars

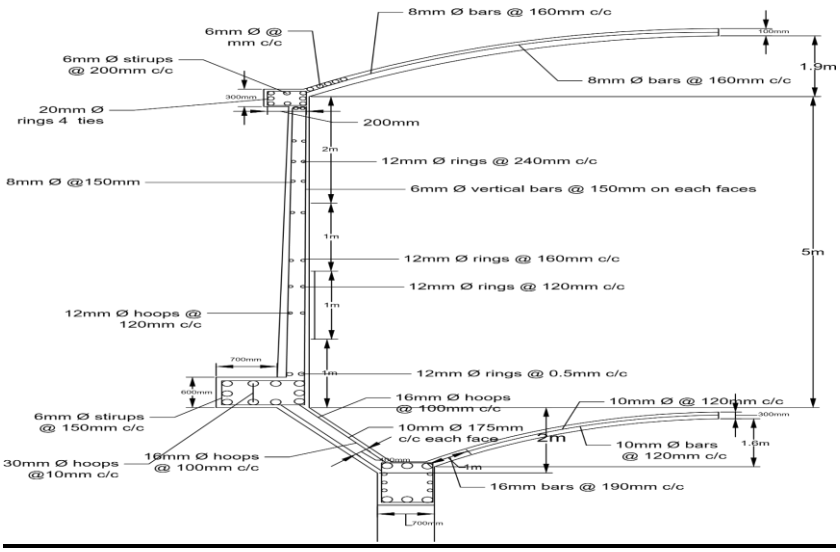
		meridional bars @ 100 mm c/c.	
7	Bottom Circular Beam	10 mm Ø 4 lgd stirrups @ 300 mm c/c	M 20, Concrete and HYSD Bars
8	Column	10 mm Ø wire ring of 250 mm to tie up the main reinforcement. Since the column are of 700 mm diameter	M 20, Concrete and HYSD Bars
9	Braces	2-10 mm Ø bars at each face.	M 20, Concrete and HYSD Bars
11	Foundation	10 mm Ø lgd stirrups @ 300 mm c/c	M 20, Concrete and HYSD Bars

1.6 DESIGNG OF INTZE TANK ON AUTOCADD



(Fig 4) 2-D and 3-D Images of Intze Tank

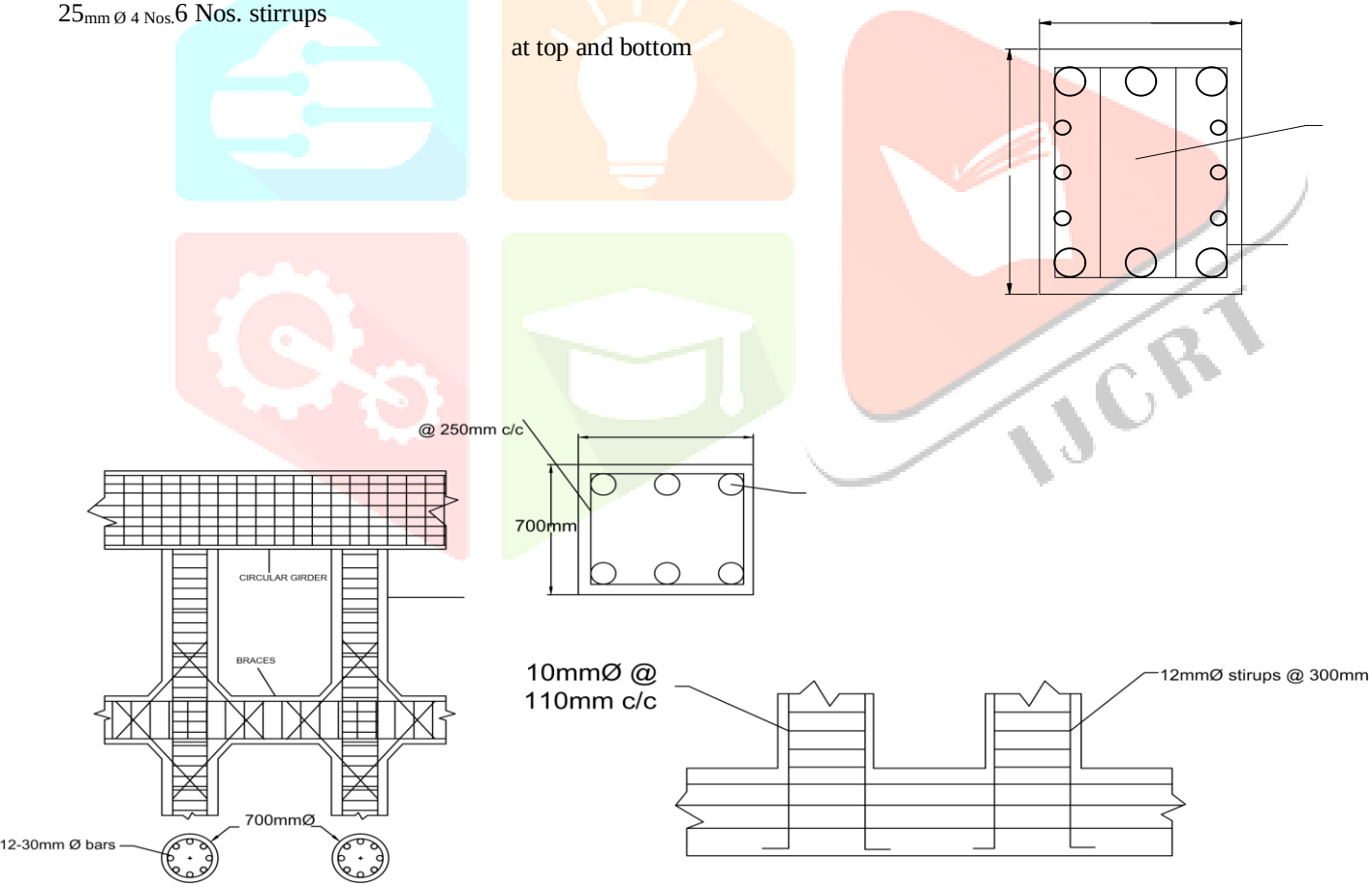
1.7 REINFORCEMENT AND FOUNDATION DETAILS



(Fig 5) Reinforcement Details

12mm Ø 2 lgd stirrups 300mm

25mm Ø 4 Nos. 6 Nos. stirrups at top and bottom



(Fig 6) Foundation Details

CONSLUSION

Storage of water in the form of tanks for drinking and washing purposes, swimming pools for exercise and enjoyment, and sewage sedimentation tanks are gaining increasing importance in the present day life. For smaller quantity of storage we provide rectangular water tanks, while for bigger quantity we provide circular water tanks. Intze tank is a modified circular

tank. Intze tank is constructed to minimize the project cost because lower dome in this construction resists the horizontal thrust.

Design of Intze water tank is a very tedious method. The whole structure is designed manually by using "Working Stress Method" considering M20 grade of concrete and HYSD bar of Steel.

Detailed drawings have been prepared in the AutoCAD software, which are shown in necessarily. The staging has been designed with maximum safety and effects due to seismic force and wind force are also taken into account.

So, this proposed site will work to fulfill the present need demands as well future needs also.

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