Analysis And Design Of RCC And Pre-stressed Concrete Elevated Storage Water Tank

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Abstract: Each and every design comes out when we encounter problems. These designs can be used to solve the current problems. Specially people in some regions where there is scarcity of water, don't get enough flow and speedy discharge exceptionally for those living in elevated floors in a multi-storied buildings. In this way people suffer some lack of water due to insufficient supply of water for their basic needs. Instant solution for this type of problem is to construct or develop water storage projects. We need to have the knowledge of structural aspects as well as all the practical knowledge in terms of experience, bye-laws and design codes. The motive of this standard is to ensure safety and steadiness in economy. Therefore, the water storage tank should be constructed in proper maintenance and care. By conducting normal designs and calculations it requires more time than expected time so, we adopted different softwares to obtain the results. For this reason analysis and design of water tank is carried out by "STAAD.Pro V8i". Comparison of RCC circular water tank and RCC intze water is carried out in the following paper. In the last, we have compared RCC circular water tank and PSC circular water tank.

Key words - Problem, design, tank.

I. INTRODUCTION

Elevated Storage Tank

An elevated water tank is constructed for the purpose of holding water supply at certain height to pressurization in water distribution system. Water tanks are classified into two types based on position and shapes of tanks:

- 1. Based on position- Underground water tanks, tanks resting on ground, elevated overhead water tanks.
- 2. Based on shapes- Circular tanks, rectangular tanks, intze tanks, square tanks.

We have selected elevated water tank ie. INTZE water tank. Water tanks are used to provide storage of water. It can be used in many applications such as:

- Drinking water
- Irrigation and agriculture
- Fire suppression
- Chemical manufacturing
- Food preparation and so on.

Water tank parameters include the general design of the tank, choice of construction materials, linings etc. Water tanks are an efficient way to help developing countries to store clean water. A variety of materials can be used to construct a typical water tank; steel and reinforced or pre-stressed concrete are most often used (with wood, fiber glass, or brick also in use). Water tanks are tall and are often placed on high ground, so that they can provide sufficient pressure to deliver water to homes in case of an emergency. While elevated tanks provide the best pressure, they are far more expensive and generally, only used where supply is in high demand.

II. COMPARISON BETWEEN PSC AND RCC WATER TANK

PSC	RCC
More durable	Less durable
No tensile cracks	Tensile cracks are unavoidable
As high strength concrete is used,	Dead load of RCC member is
dead weight of PSC member is less	more
Material cost is less	Material cost is more
Deformation of PSC member is less	Deformation of RCC member is
	more
Fatigue strength is very good	Fatigue strength is bad

Table 1.1: Comparison between PSC and RCC Water Tank

III. METHODOLOGY



A. Data Collection

Various methods can be adopted for estimating future populations. I have chosen Geometric Increase Method to calculate the population forecast. The formula used to calculate population forecast is: Pn = P(1 + Ig/100)

where,

Pn = population forecastP = present population

Ig = present population Ig = present growth

n = number of decades

B. Modelling

The modelling is done by using STAAD.Pro V8i software.









Fig 2.1: 3D Model of Intze Water Tank

Fig 2.2: 3D Model of Circular water Tank

C. Description of Models For Analysis of Elevated Storage Water Tank NOTE:- Design is done for the population of 1400.

Sr.	Description	Circular Water Tank	Intze Water Tank
No.			
1.	Diameter of the column	550mm	550mm
2.	Staging height	12m	12m
3.	Height of wall	3m	3m
4.	Hopper height	NA	2m
5.	Bracings	300*600mm	300*600mm
6.	Thickness of roof slab	300mm	300mm
7.	Floor slab thickness	550mm	550mm
8.	Material	M20 grade concrete and	M20 grade concrete and
		Fe415 steel	Fe415 steel
9.	Soil type	Medium soil	Medium soil
10.	Type of bracing	Normal	Normal
11.	Unit weight of concrete	25 KN/m ³	25 KN/m ³
12.	Bottom diameter of tank	NA	2m
13.	Diameter of water tank	10m	10m
14.	Diameter of ring beam	10m	8m
15.	Height of conical dome	2m	2m
16.	Rise of top dome	1.8m	1.8m
17.	Rise of bottom dome	1.6m	1.6m

Table 1.1: Description for RCC Circular Water Tank and RCC Intze Water Tank

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Sr. No.	Description	Circular Water Tank
1.	Volume of tank	378m ³
2.	Height of tank	12.5m
3.	Depth of wall	3.15m
4.	Grade of concrete	M40
5.	Allowable tensile strength	13N/mm ²
6.	Soil type	Medium

Table 1.2: Description for PSC Circular Water Tank

IV. RESULT AND DISCUSSION

TOP DOME:		
Tank	Dimensions (mm)	Reinforcement Details
Intze Water Tank	100	8mm dia bars @ 160mm c/c in both directions
Circular Water Tank	100	8mm dia bars @ 160mm c/c in both directions
TOP RING BEAM:		
Tank	Dimensions (mm)	Reinforcement Details
Intze Water Tank	360*400	Main reinforcement- 4nos. 20mm dia bars Stirrups- 8mm dia bars @ 200mm c/c

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Circular Water Tank	360*400	Main reinforcement- 4nos. 20mm dia bars Stirrups- 8mm dia bars @ 200mm c/c
CYLINDRICAL WALL:		
Tank	Dimensions (mm)	Reinforcement Details
Intze Water Tank	260 (Avg)	Main reinforcement:Upto 2m from top- 12mm dia @170mm c/cFrom 2m to 4m- 12mm dia @ 80mm c/cDistribution Steel:8mm dia bars@150mm c/c
Circular Water Tank	100	Main reinforcement:
	JETI	Upto 2m from top- 16mm dia @280mm c/c From 2m to 5m- 16mm dia @110mm c/c Distribution Steel: 8mm dia bars @150mm c/c
BOTTOM RING BEAM:		
Tank	Dimensions (mm)	Reinforcement Details
Intze Water Tank	100*600	Main reinforcement: 6 nos. of 30mm dia bars with nominal stirrups 8mm dia bars @200mm c/c
Circular Water Tank		
CONICAL DOME:	31. ~~	
Tank	Dimensions (mm)	Reinforcement Details
Intze Water Tank	500	Main reinforcement: Provide 20mm dia bars @ 250mm c/c in both directions Distribution Steel: 12mm dia bars @170mm c/c
Circular Water Tank	500 (Slab)	Radially at top- 20mm dia @100mm c/c at bottom- 20mm dia @200mm c/c in both directions
BOTTOM DOME:		
Tank	Dimensions (mm)	Reinforcement Details
Intze Water Tank	250	12mm dia bars @ 160mm c/c in both directions

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Circular Water Tank

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BOTTOM CIRCULAR BEAM:

Tank	Dimensions (mm)	Reinforcement Details	
Intze Water Tank	700*1200	Main reinforcement:At support- 8 nos. 25mm dia barsAt top- 8 nos. 25mm dia barsAt bottom- 4 nos. 25mm dia bars <u>Transverse Reinforcement:</u> At support- 4L12mm dia bars@170mm c/cAt mid span- 4L 12mm dia bars@300mmc/c	
Circular Water Tank	-	-	
COLUMN:			
Tank	Dimensions (mm)	Reinforcement Details	
Intze Water Tank	700	Main reinforcement: 12 nos. 30mm dia bars <u>Stirrups:</u> 12mm dia bars @250mm c/c	
Circular Water Tank	700	Main reinforcement: 12 nos. 30mm dia bars <u>Stirrups:</u> 12mm dia bars @250mm c/c	
BRACINGS:			
Tank	Dimensions (mm)	Reinforcement Details	
Intze Water Tank	300*750	Main reinforcement: 4 nos. 20mm dia bars @ top and bottom <u>Transverse Reinforcement:</u> 2L 12mm dia bars @ 230mm c/c	
Circular Water Tank	300*750	Main reinforcement:	
		4 nos. 20mm dia bars @ top and bottom <u>Transverse Reinforcement:</u> 2L 12mm dia bars @ 230mm c/c	

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Table 2.1: Comparison between RCC Circular and Intze Water Tank

RCC Circular Water Tank	PSC Circular Water Tank
Diameter of tank = 10m	Diameter of $tank = 12.5m$
Height of the tank $= 5 \text{ m}$	Height of the tank $= 3.15$ m
Thickness = 100mm	Thickness = 80mm

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Top dome: 100mm, 8mm dia bars @ 160mm c/c in both directions	Circumferential wire winding = 32 wires/m (5mm diameter wire)
Top ring beam: 360*400mm, Main reinforcement- 4nos. 20mm dia bars Stirrups- 8mm dia bars @ 200mm c/c	Vertical spacing of cables = 610mm (8mm dia, 12 wires)
Cylindrical wall: 260mm, 16mm diameter @ 110mm c/c	-
Slab: 550mm, Radially at top- 20mm dia @100mm c/c at bottom- 20mm dia @200mm c/c in both directions	-

Table 2.2: Comparison Between RCC and PSC Circular Water Tank

V. CONCLUSION

- 1. The geometric progression method provides qualitative support to design the water tanks.
- 2. Compare to RCC circular water tank we can reduce the percentage of steel in the RCC intze tank at bottom slab (dome). The steel requirement for other components are almost same. Hence for the required demand RCC intze tanks are more economical.
- 3. Water tanks are analysed and designed for the same capacity then seen that thickness of RCC circular water tank is more than pre-stressed concrete circular water tank and other design details are different.
- 4. By the following results PSC circular water tanks is economic when compared RCC circular water tank.
- 5. For material cost, Steel has the greatest effect on tank and supporting structure while concrete has the greatest effect on foundation.
- 6. RCC Circular water tank is more economic than RCC Intze water tank.
- 7. Under wind loading Intze water tank is recommended.

VI. REFERENCES

- 1. "PLANNING, ANALYSIS AND DESIGN OF A OVER HEAD CIRCULAR WATER TANK USING STAAD.Pro V8i" software by Mareddy Arun Kumar, O. Sriramulu, N. Venkateswarlu [Vol 5: Issue 5, May-2018].
- 2. "ANALYSIS AND COMPUTATIONAL DESIGN OF WATER TANK STRUCTURE" by Prof. Mainak Ghosal, Septmeber-2019.
- 3. "DESIGN AND ANALYSIS OF WATER TANKS USING STAAD.Pro V8i" International Journal of Pure and Applied Mathematics by Mr. Manoj Nallanathel, Mr. B. Ramesh, L. Jagadeesh [Volume 119 No.17 2018,3021-3029].
- "ECONOMIC DESIGN OF WATER TANK OF DIFFERENT SHAPES WITH REFERENCE TO IS:3370-2009" International Journal Of Modern Engineering Research by M. Bhandari, Karan Deep Singh [Volume 4, Issue 12, December 2014].
- "DESIGN OF CIRCULAR OVERHEAD WATER TANK" International Journal Of Engineering Research In Mechanical And Civil Engineering by Neha. S. Vanjari, Krutika. M. Sawant, Prashant. S. Sisodiya, S.B. Patil (Volume 2, Issue 7, July 2017).
- 6. "PRESTRESSED CONCRETE" text book by N. Krishna Raju.
- 7. "REINFORCED CONCRETE DESIGN" text book by N. Krishna Raju.
- 8. "RCC DESIGNS" by Dr.B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain.
- 9. IS CODES:
 - 1S 3370 2009 (part 1,2 and 4)
 - IS 456 2000