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COMPARISON AND DESIGN OF WATER TANK REST ON GROUND BY LSM AND WSM – A REVIEW

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ABSTRACT:

In the new version of the IS 3370-2009 Code of Practice for concrete structures for the storage of liquids that has adopted the widely used limit state method. According to the provisions of the previous version of the Code (IS 3370-1965), design of water tanks is only allowed by the work effort method. The study was conducted to compare the design provisions of IS 3370 (1965) and IS 3370 (2009). In this study, a comparison of water design reservoirs using Stress Limiting Worker methods is performed. In order to carry out the comparative design of the study, the three types of water tanks set up a circular reservoir with a capacity of 500 kl, an elevated square reservoir of the tank with a capacity of 250 kl and a rectangle of groundwater 250 kl of its capacity. The quantities of materials were calculated for each problem. The results are presented as graphs and tables and noted that the state water tank design method is more economical since the amount of material required is less compared to the work effort method.

KEYWORDS: working stress method, limit state method, effective cost.

1. INTRODUCTION

Water is seen as the source of every creation and is, therefore, a very important element for a man to live a healthy life. High demand for clean, safe drinking water increases day by day as no one can live without water. It becomes necessary for the storage of water. Water is usually stored in concrete tanks and then pumped water into different areas to serve the community.

Water tanks can be classified as overheads, based on ground or underground depending on your location. Tanks can be made of steel or concrete. Tanks resting on the ground are usually circular or rectangular in shape and used when needed to store large amounts of water. The water tanks above are used to deliver water directly through gravity flow and are typically fewer capacities. As above the water, tanks are open to the public, its shape is influenced by the aesthetic aspect of the environment.

Water storage tanks are designed in accordance with the IS 3370 This code has been revised in 2009. In the pre-updated version, tanks are designed with the process of tension and work philosophy no cracking. In accordance with IS 3370: 2009, it has authorized the limit states method. Therefore, this study was to compare the rules of IS 3370: 1965 and IS 3370: 2009 and analyzes the profitability with respect to the amount of steel and concrete reinforcement, comparing the design effects of various types of reservoirs Water pressure Methods Design work.

2. GENERAL REQUIREMENTS ACCORDING TO (IS: 3370-1965):

CONCRETE - In the construction of concrete structures for the storage of liquids, impermeability of concrete is an important basic requirement. Aggregates and Cement must be provided to produce high-quality concrete. The permeability of any uniformly compacted concrete and the mixing ratio depends largely on the water-cement ratio. While an increase in the ratio of water cement leads to an increase in intrinsic permeability, a very low water-cement ratio a mixture with a given cement can cause compression content difficulties and can thus be equally harmful. The mixture must be designed so that the resulting concrete has a high degree of sealing. They should minimize honeycomb and separation aggregate, as these lead to defects that are responsible for leakage water storage structures.

For a given mix of specific materials, there is one under water-cement that can be used economically at any work-related boundary. It is necessary to choose a compatible mixture rich with available agglomerates, whose particle shape and classification have an important role in workability being sufficient for the selected compacting media.

The minimum cement content, maximum water cement ratio and a minimum grade of concrete are tabulated below.

Table 2.1

Minimum Cement Content, Maximum water- Cement Ratio and Maximum Grade of Concrete

Sl No.	Concrete	Minimum cement content	Maximum free water cement Ratio	Minimum Grade of Cement
1	Plain concrete	250	0.5	M20
2	Reinforced cement concrete	320	0.45	M30
3	Prestressed concrete	360	0.4	M40

For small tanks with a capacity of up to 50 m3 in places where there is difficulty in providing specific M30 grades, the minimum amount of concrete can be taken as M25 in different areas of coastal areas.

3.1 COMPARISON IN MINIMUM REINFORCEMENT:

A comparison of provisions regarding minimum reinforcement is shown below in Table 3.1.

Table 3.1
Comparison of Minimum Reinforcement Provisions

IS : 3370 – 1965	IS : 3370 -2009
Minimum Reinforcement **A)** The minimum reinforcement in walls, floors and roofs in each of two directions at right angles shall have an area of **1.** 0.3 % of cross sectional area of sections thickness < 100 Mm **2.** Linearly varying from 0.3 % to 0.2% for thickness 100 mm to 450 mm. **3.**0.2 % for section of thickness > 450mm **4.** In concrete sections of thickness > 225 mm,	**Minimum Reinforcement** **A)** The minimum reinforcement in walls, floors and roofs in each of two directions at right angles within each surface zone shall not be less than **1.** 0.35 % of surface zone as shown in for HYSD bars. **2.** 0.64 % of surface zone for mild steel bars. **B)** The minimum reinforcement can be further reduced to **1.** 0.24 % for HYSD bars. **2.** 0.40 % for mild steel

3.2 COMPARISON IN PERMISSIBLE STRESSES:

Provisions regarding permissible stresses in steel reinforcement different conditions have been tabulated for the two codes.

Table 3.2 Comparison of Provisions for Permissible Stresses in Steel

Type of Stress	Permissible Stresses in N/mm² IS 3370 -1965		Permissible Stresses in N/mm² IS 3370 -2009	
	Plain round mild steel bars	High strength deformed bars	Plain round mild steel bars	High strength deformed bars
Tensile stress in members under direct Tension	150	150	115	130
Tensile stress in members under direct Tension a)On liquid retaining face b)on face away from liquid for members less than 225 mm c)on face away from liquid for members more than 225 mm	150 150 125	150 150 190	115	130
Compressive stress in Columns subjected to direct load	125	175	125	140

3.3 DESIGN ON BASIS OF CRACK WIDTH:

According to IS 3370:2009 following assessment is given,

$$\textbf{Pcrit} = \frac{fct}{fy}$$

Where, Pcrit = critical steel ratio, that is, The minimum ratio of the steel surface to the total surface of the entire concrete section to distribute the cracking;

fct = direct tensile strength of the immature concrete Maximum spacing of crack SMax shall be given by the formula:;

$$SMax = \frac{fct}{fy} \times \frac{\phi}{2\rho}$$

Where, fct/fb = ratio of the tensile strength of the concrete (fct) to the average bond strength between

Concrete and steel which can be taken as 2/3 for immature concrete ø = size of each reinforcing bar, and

ρ = steel ratio based on the gross concrete section.

The width of a completely developed crack due to ventilation shrinkage and 'heat of hydration' contraction in lightly reinforced restrained walls and slabs may be obtained from:

$$WMax = SMax\ X\ \frac{\alpha}{2}\ T1$$

Where , α = coefficient of thermal expansion of mature concrete, = 1×10^{-5}

T_1 = fall in temperature between the hydration peak and ambient. = 30^0 C

4.1. DESIGN METHODS:

A thorough study through both the versions of IS: 3370 reveals the following four methods of designs:

1. Working stress method in accordance IS 3370 (1965).
2. Working stress method in accordance IS 3370 (2009).
3. Limit State method and then checking cracking width by limit state of serviceability IS 3370 (2009).
4. Limit state design method by limiting steel stresses in accordance IS 3370 (2009) (Deemed to be satisfied).

The tank portion of tanks of different capacities was designed by the above mentioned four methods as per the provisions of IS 3370:1965 and IS 3370:2009.

A comparison of design according to the work effort method as IS 3370-1965 and IS 3370-2009 shows that the amount of concrete remains unchanged. The quantity of steel increased slightly at IS 3370-2009, as the allowed trends are slightly lower than those adopted by 3370-1965. It is further noted that the quantity of steel is significantly reduced as it is the members when the amount of aid is less than the minimum planned aid. This is due to the fact that IS 3370-2009, the minimum aid is calculated on the basis of the cross-sectional area of the areas and not on the basis of the entire cross-section such as IS 3370 to 1965. The quantities of steel and concrete for the method of calculating the state threshold according to IS 3370-2009 decreased significantly compared to methods work stress is and IS 3370-1965 3370-2009 is allowed because higher voltages are allowed and check the width of the crack. It was found that the steel quantities for all tanks in this study were the maximum for design according to the limit state method based on criteria to be met.

5.CONCLUSIONS:

The State Limit method found it more economical to design water tanks, as the required amount of steel and the concrete is less than the method of working pressure.

• There were no changes in the number of affiliates of the working method stress IS: 3370 (1965) and IS: 3370 (2009). However, the demand for steel rose to IS: 3370 (2009) overhead circular type, overhead square type, and rectangular underground water tanks, since the admissible tensions in the steel were lower.

• The size of the members remains the same for the calculation methods of the IS limit state: 3370 (2009), as well as the fulfillment of the criteria for the three tank designs. However, steel demand in the region decreased IS: 3370 (2009) to limit state design method and bred in conditions that were considered to meet the criteria for the three tank designs as the permissible stresses on steel were lower.

• It was found that aid projections across surface areas in IS: 3370 (2009) provide method state limit amplification economically and efficiently.

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