Design of different Shape of Water Tank by using Indian Code

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***Abstract*- Limit state method is widely used at present in comparison to working stress method with the following advantages:**

- **Materials are treated according to their properties**
- **Loads are treated according to their nature.**
- **Structures generally fail when they reach their limit state, not their elastic state.**

However, when structures reach to their limit state, the cracking width in the structure may be significantly higher comparative to a structure designed by working stress method at the same stage. IS: 3370 i.e. the Indian Standard specifications for construction of liquid retaining structures did not adopt limit state design method for long. However, IS:3370 has adopted the limit state design method after considering checks over the cracking width Design of ESR of using IS:3370:2009 concrete structures for storage of liquids.

Index terms- Different shape of ESR, IS 3370:1965, IS 3370:2009(new version), Limit State Method and Working State Method

I. INTRODUCTION

Design of Water Tank is very mush important in our life. Beacause Water Tank is carrying load of live we are design of elevated Storage Reservoir. Design of Water Tank with IS 3370:1965(old versin) and IS 3370:2009(new version). For this we are consider different shapes and different condition of water tank such as square, circular, rectangular, Over Head Service Reservoir (OHSR), Intz i.e. OHSR FOR large storage. With two different methods

II. OJECTIVE OF STUDY

1. To compare the design of RCC water retaining structures done by WSM & LSM in reference to IS 3370 – 1965 and IS 3370 – 2009 (new version).
2. To analyze which method is more economical and efficient.

III. IS CODE USED

The water tanks designs are designed by the following IS code.
1. IS 3370 (1965). (Old Version)
2. IS 3370 (2009). (New Version)

IV. METHODS

The three Water Tank Design are designed by the following methods.
1. Working stress method with respect to new and old version of IS code
2. Limit state design method with respect to new and old version of IS code

V. PROCEDURE

The three water tank design are designed by the following four design methods.

1. Working stress method in accordance IS 3370 (1965).
2. Working stress method in accordance IS 3370 (2009).
3. Limit state design method with crack width calculations and check in accordance IS 3370 (2009).
4. Limit state design method deemed to satisfy (limiting steel stresses) in accordance IS 3370 (2009).
5. Ratio of quantities and units. For example, write- Temperature (K), not –Temperature /K.

Multipliers can be especially confusing. Write—Magnetization (kA/m) or

VI. COMPARATIVE STUDY OF THREE WATER TANK USING WAORKING STRESS METHOD AND LIMIT STATE METHOD

1.Comparative Result of INTZ Type Water Tank

Structural Element	Working Stress Method		Limit State Design Method	
	IS 3370 – 1965	IS 3370 - 2009	Crack Theory	Deemed to Satisfy
TOP DOME				
Area of Steel Required	300 mm^2	175 mm^2	120 mm^2	-----
%age Change	---	- 41.66 %	- 60%	
Thickness Required	100 mm	100 mm	100 mm	100 mm
%age Change	--	Nil	Nil	Nil
TOP RING BEAM				
Area of Cross Section	62623 mm^2	62623 mm^2	34500 mm^2	34500 mm^2
%age Change	--	Nil	-45%	-45%
Area of Steel Reqd.	780 mm^2	820 mm^2	445 mm^2	820 mm^2
%age Change	-----	+ 5.12 %	- 43%	+ 5.12 %
CYLINDRICAL TANK WALL				
Base Level Thickness	350 mm	350 mm	140 mm	140 mm
%age Change	-----	0 %	- 60%	- 60%
Steel at base	3200 mm^2	3700 mm^2	1995 mm^2	3700 mm^2
%age Change	-----	+15.6 %	- 37.65%	+15.6 %
Top Level Thickness	200 mm	200 mm	100 mm	100 mm
%age Change	-----	+0 %	- 50%	-50%
Steel at top	800 mm^2	925 mm^2	500 mm^2	923 mm^2
%age Change	-----	+15.62 %	- 37.5%	+15.37%
BOTTOM RING BEAM				
Area of C/S	720000 mm^2	720000 mm^2	540000 mm^2	540000 mm^2
%age Change	-----	+0 %	- 25%	-25%
Steel	5320 mm^2	6140 mm^2	3315 mm^2	6140 mm^2
%age Change	-----	+15.41 %	- 37.68%	+15.41 %
CONICAL DOME				
Thickness	600 mm	600 mm	500 mm	500 mm
%age Change	-----	+0 %	- 20%	- 20%
Steel	5100 mm^2	5890 mm^2	3180 mm^2	5885 mm^2
%age Change	-----	+15.5 %	- 37.64%	+15.40 %
BOTTOM SPHERICAL DOME				
Thickness	300 mm	300 mm	200 mm	200 mm
%age Change	-----	+0 %	- 33.33%	-33.33%
Steel	900 mm^2	525 mm^2	1506 mm^2	642 mm^2
%age Change	-----	-41.66 %	+67.33%	-28.66%

2. Comparative Result of Rectangular Water Tank Situated on ground Structural Element

Structural Element	Working Stress Method		Limit State Design Method	
	IS 3370 – 1965	IS 3370 - 2009	Crack Theory	Deemed to Satisfy
ROOF SLAB				
Thickness	250 mm	250 mm	154 mm	154 mm
%age Change	-----	-0 %	- 38.4%	- 38.4%
Steel	1260 mm^2	1260 mm^2	Not Applicable	Not Applicable
COLUMNS				
Area of Cross Section	122500 mm^2	122500 mm^2	40000 mm^2	40000 mm^2
%age Change	-----	-0 %	- 67.34%	- 67.34%
Area of Steel Reqd.	980 mm^2	980 mm^2	1206 mm^2	2387 mm^2
%age Change	-----	-0 %	+ 23 %	+ 143 %
VERTICAL WALL				
Wall Thickness at bottom	520 mm	520 mm	230 mm	230 mm
%age Change	-----	-0 %	- 55.76 %	- 55.76 %
Wall Thickness at mid height	190 mm	190 mm	180 mm	180 mm
%age Change	-----	-0 %	- 6 %	- 6 %
Steel at Base	1300 mm^2	1925 mm^2	1570 mm^2	3900 mm^2
%age Change	-----	+48 %	+21 %	200 %
Steel at Mid Height	4185 mm^2	4830 mm^2	904 mm^2	4830 mm^2
%age Change	-----	+15.4 %	- 78 %	+15.4 %
BASE SLAB				
Thickness	230 mm	230 mm	230 mm	230 mm
%age Change	-----	+0 %	+0 %	+0 %
Steel	2790 mm^2	3220 mm^2	1950 mm^2	4137 mm^2
%age Change	-----	+15.4 %	- 30.1 %	+48.2 %

3.Comparative Result of Square Water Tank Situated on ground

Structural Element	Working Stress Method		Limit State Design Method	
	IS 3370 – 1965	IS 3370 - 2009	Crack Theory	Deemed to Satisfy
TANK WALL				
Thickness	530 mm	530 mm	160 mm	160 mm
% age change	-----	Nil	-69.8%	-69.8%
Steel	1000 mm^2	875 mm^2	783 mm^2	1082 mm^2
%age Change	-----	- 12.5 %	- 21.7%	+ 8.2 %
BASE SLAB				
Thickness	280 mm	280 mm	150 mm	150 mm
%age Change	-----	Nil	- 46.42%	- 46.42%
Steel	875 mm^2	810 mm^2	1130 mm^2	1236 mm^2
%age Change	-----	- 7.42 %	+ 29.15 %	+41.25 %

VII. CONCLUSION

Based on the results and discussions following conclusions are arrived at:

1. The size of members remained same for working stress method by IS: 3370 (1965) and IS:3370 (2009). However, the requirement of area of steel increased in IS:3370 (2009) for Intz type and rectangular water tanks as the allowable stresses in steel were lower. The steel required in square tank was approximately same in both the cases. However, the change in the clause of requirement of minimum steel decreased the steel required in bottom spherical dome in intz type of tank.
2. The size of members remained same for limit state design methods by IS:3370 (2009) in limit state of collapse as well in deemed to satisfy criteria for all the three tank designs. However, the requirement of area of steel increased in IS:3370 (2009) in serviceability design method as well in deemed to satisfy criteria for all the three tank designs as the allowable stresses in steel were lower.
3. The size of members as well as the requirement of steel decreased for limit state design method by IS: 3370 (2009) in comparison to working stress design methods of both IS: 3370 (1965) and IS : 3370 (2009) provisions for all the three type of tanks taken in study.

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