NOVATEUR PUBLICATIONS
International Journal of Research Publications in Engineering and Technology [IJRPET]
ISSN: 2454-7875
VOLUME 3, ISSUE 6, Jun.-2017

STABILITY ANALYSIS OF GROUND BASE 250 MLD BALANCING TANK

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ABSTRACT:

Balancing tank is a structure which is utilized to store water & supply it to villages for drinking purpose, where there is scarcity of water during summer season. Here I have considered a balancing tank which is a ground base tank used to store water of capacity 260 ML per day for the purpose of supplying water to six villages. In this paper I have studied the causes of failure of balancing tank by comparative analysis of stability against overturning and sliding with & without considering IS 456-2000 code clause of stability. It is also check for safe bearing pressure of soil. As the capacity of tank is 250 MLD the wall of water tank is analyzed as ground base water retaining structure rather than considering water tank cases which have different methods of analysis.

KEYWORDS: Water tank, stability criteria, IS 456-2000, water retaining structures, tank capacity.

1. INTRODUCTION:

Water tank are liquid storage container. These containers are usually storing water for human consumption. The need for water tank system is as old as civilized man. In this case it is regional ruler water scheme constructed under Maharashtra Jeevan Pradhikaran circle, Ahmednagar which is used to supply water to the six villages namely as Bhenda [KD], Bhenda[BD], Kukana, Tarwadi,Chilenkhadi & Antrawali. Source of water to this balancing tank is Mula right canal. The wall is provided in folded plate shape having 3m center to center distance. For stability analysis only cross section of wall is considered. The line diagram of water tank is as shown in below fig.1. Shows the shape of balancing tank.

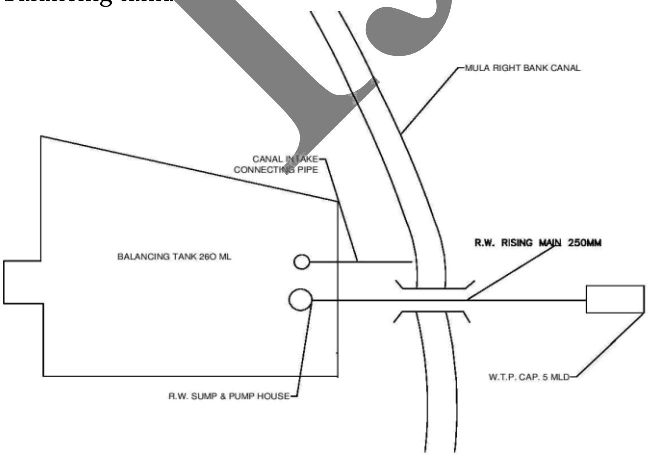

Fig. 1

2. DETAILS OF EXISTING STRUCTURE:

Top water elevation: FSL 514.4m
Free board in tank: FB 0.5m
Depth of water retained: H 5.62m
Bottom elevation: LWP 505.55m
Capacity (For 60 day's storage): 260 ML
Basin Area: 46000 Sq. m.
Type of retaining wall: Folded plate wall
Width of heel slab: 2.70m
Width of toe slab: 0.45m
Height of soil above raft toe: Hs 5m
Population (1991): 20328
Projected Population: 44000
Rate of water supply: 55 LPCD
Daily water demand: 3.025 MLD
Source of water: Mula Right Bank Canal

With this above details stability of the wall is checked with & without considering IS 456-2000 clause of stability.

3. STABILITY ANALYSIS OF STRUCTURE:

Following factors are considered while calculating stability of water retaining wall.

Moment in tank wall is calculated using table no. 10 and hoop tension is calculated using table no. 9 from IS 3370 part – iv.

Density of water: 10KN/cum

Rankin Coefficient of active pressure: 0.333

C/C distance between folded plate works: 3 m

The C/S of the wall for stability analysis is as shown in fig. 2

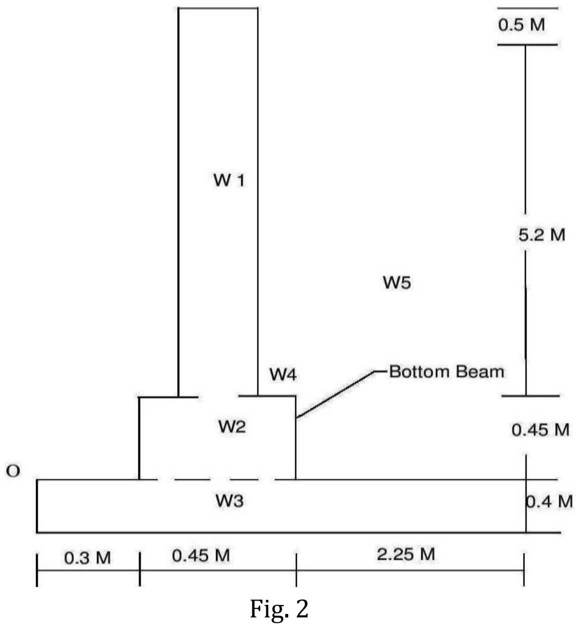

Fig. 2

By considering above details in the cross section the following table shows the stability calculation.

Type of Force	Magnitude of force (kN)	Position of force from toe end O (m)	Bending Moment at to end (kNm)
(1)Overturning force Pah	$0.5\times10\times6.05^2$ = 183.013	6.05/3 = 2.0167	369.1
(2)Restoring Forces			
(a)Weight of rectangular portion (W1)	0.28×5.7×25 = 39.9	0.3+0.085+0.4 5/2 = 0.525	20.9475
(b)Weight of bottom beam(W3)	0.45×0.4 ×25 = 5.0625	0.3+ 0.45/2 = 0.525	2.66
(c)Weight of base Slab	3×0.4×25 = 30	3/2 = 1.5	45
(d) Weight of water column(W4)	0.085×5.2×10 = 4.42	0.3+0.085+0.2 8+0.085/2 = 0.7075	3.13
(e)) Weight of water column(W5)	2.25×5.65×10 = 127.125	0.3+0.45+ 2.25/2= 1.875	238.36
	∑W= 176.51		$\sum M_R$ = 265.102

4. STABILITY CHECKS:

A) WITHOUT CONSIDERING IS CRITERIA:

(1) OVERTURNING:

$$\frac{M_R}{M_O} = \frac{265.102}{369.1}$$

= 0.72 < 1.4 Unsafe

(2) SLIDING:

$F_R = \mu \times \sum W$
= 0.6×176.51
= 105.91

F_s = Pah = 183.013

$$\frac{F_R}{F_S} = \frac{105.91}{183.13}$$

= 0.58 < 1.4 Unsafe

B) CONSIDERING IS CRITERIA:

(1) OVERTURNING:

$$\frac{0.9 \times M_R}{F_S} = \frac{0.9 \times 265.102}{369.1}$$

= 0.65 < 1.4 Unsafe

(2) SLIDING:

$F_R = \mu \times \sum W$
= 0.6×176.51
= 105.91

F_s = Pah = 183.013

$$\frac{0.9 \times F_R}{F_S} = \frac{0.9 \times 105.91}{183.13}$$

= 0.52 < 1.4 Unsafe

(3) BASE PRESSURE:

Resultant moment at toe end O
= $M_R - M_o$
= 265.102 – 369.1
= -104
The resultant vertical load = 105.91

$$x = \frac{-104}{176.51}$$

= - 0.59 m

$$e = \frac{b}{2} - x$$

$$e = \frac{3}{2} - (-0.59)$$

= 2.1m

$$\frac{b}{6} = \frac{3}{6}$$

= 0.5 m

As e > b/6 the resultant will not lie within middle third of base.

5. RESULT:

Table 1: Stability Analysis Results

Sr. No.	Stability Checks	Without IS Code Criteria	With IS Code Criteria
1.	Overturning	0.72	0.65
2	Sliding	0.58	0.52
3.	Base Pressure	e = 2.1 > 0.5	(e > b/6)

6. CONCLUSION:

From the above results the wall of balancing tank is not safe against stability criteria i.e. overturning & sliding as factor of safety is less than 1.4 by considering & non considering IS code stability criteria. Also resultant is not lie within middle third so it will fail in base as tension is created on base. From the above results I will suggest that the dimensions of wall should be recalculated for stability requirements and said capacity of water demand.

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