

# Analysis of Water Tank on Sloping Ground

Thorat Yogesh., Kadam Yogesh., Kute Sagar, Kashid Sanchit

**Abstract**— Storage reservoirs and water tanks are used to store water, liquid, petroleum products and similar any other liquids. The force analysis of their tanks is about the same of the chemical nature of the product. All tanks are designed as free structures from crack to reject any leakage. This project gives the complete analysis of the design of liquefied retaining structure. The project takes into reflection the design of tank for the following case underground Tank, tank resting on ground and overhead water tank. The investigative design has been made with Microsoft Excel sheet. The paper is helpful for safe design with smallest cost of the tank and gives the trendy relationship curve between design flexible. Thus design of tank can be more cheap, consistent and modest. Providing elevated water tanks on sloping ground is quite a classic and interesting job. Forces advance on structure resting on sloping ground are extra simple than those resting on leveled surface. Detailed analysis is vital in case of elevated storage reservoir (ESR) which is provided on inclined surfaces. A special care need to be taken for quaking & breeze forces. Comparison of unlike forces made in many members of tank on leveled surface & with growing slope for different heights has been thoroughly studied. Axial force, shear force & bending moment are related for unlike structural components of tank viz base beams, pillars & bracings. The current study goals at approximating the effect of sloping ground on pillar and struts at unlike bracing level. The adjusted column section for unlike slopes is estimated.

**Keywords :** Axial force, shear force & bending moment

## I. INTRODUCTION

For storage of huge quantity of fluids like water, oil, petroleum, acid and sometime gases also, flasks or tanks are essential. These structures are ready of masonry, steel, steel-clad existing and pre stressed concrete. Out of these, masonry and steel tanks are used for minor sizes. The rate of steel tanks is great and hence they are hardly used for water storages. Reinforced concrete tanks are actual general because, besides the structure and design being simple, they are low-cost, massive in nature and can be made leakage proof. Generally no crashes are allowed to take place in any portion of the structure of Liquid Retaining RCC tanks and they are made water fitted by using richer mix (not > M 30) of concrete. In addition occasionally water proofing resources also are used to make tanks water fitted.

Storage of water in the system of tanks for drinking and washing purposes, swimming pools for

workout and fun and sewage sedimentation tanks are purchase increasing importance in the current day life. A

water tank is used to stock water to tide over the daily necessities. Elevated tanks are supported on production which may involve of masonry walls, RCC columns braced together, counter walls subjected to water pressure. In water supply scheme, water tanks usually account for 10% to 20% of the total cost. This is fairly substantial proportion and thus, there is a essential to achieve low-cost in construction of water tanks. The mountainFor storage of huge quantity of fluids like water, oil, petroleum, acid and sometime gases also, flasks or tanks are essential. These structures are ready of masonry, steel, steel-clad existing and pre stressed concrete. Out of these, masonry and steel tanks are used for minor sizes. The rate of steel tanks is great and hence they are hardly used for water storages. Reinforced concrete tanks are actual general because, besides the structure and design being simple, they are low-cost, massive in nature and can be made leakage proof. Generally no crashes are allowed to take place in any portion of the structure of Liquid Retentive RCC tanks and they are made water fitted by using richer mix (not > M 30) of concrete. In addition occasionally water proofing resources also are used to make tanks water fitted.

Storage of water in the system of tanks for drinking and washing purposes, swimming pools for workout and fun and sewage sedimentation tanks are purchase increasing importance in the current day life. A water tank is used to stock water to tide over the daily necessities. Elevated tanks are supported on making which may include of masonry walls, RCC columns fixed together, counter walls exposed to water force. In water supply scheme, water tanks usually account for 10% to 20% of the total cost. This is fairly substantial proportion and thus, there is a essential to achieve low-cost in construction of water tanks. The mountainous seismic areas of our country ranges from J and K, HP, Manipur, Tripura, Mizoram. The Western Ghats better famed as Sahara are a hilly range running similar to the coast. Kasugai, a peak in the Sahyadris is the extreme elevated point in Maharashtra.

Due to rapid urbanization and economic growth, it is important to make the positive combinations of structure on sloping ground.

us seismic areas of our country ranges from J and K, HP, Manipur, Tripura, Mizoram. The Western Ghats better famous as Sahara are a hilly range running similar to the coast. Kasugai, a peak in the Sahyadris is the maximum elevated point in Maharashtra.

Due to quick urbanization and economic growth, it is important to make the positive combinations of structure on sloping ground.

## 1. CLASSIFICATION OF R.C.C. TANKS

In common they are categorized in three types depending on the position.

- Tanks resting on ground.
- Tanks above ground level (Elevated tanks).
- Underground tanks.

### A. Tanks Resting On Ground

These are used for strong water reservoirs, settling tanks, aeration tanks etc. these tanks indirectly rest on the ground. The walls of these tanks are exposed to water pressure from inside and the base is exposed to weight of water from inside and soil reaction from under the base. The tank may be exposed at upper or covered. Water tank is completed of lined carbon steel, it may accept water from a water well or from surface water permitting a large volume of water to be placed in inventory and used through peak demand series.

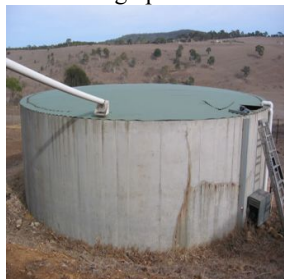


Fig. Tanks resting on ground

### B. Elevated Tanks

These tanks are reinforced on staging which may involve of masonry walls, RCC tower or RCC column braced together. The walls are exposed to water pressure from inside. The base is exposed to weight of water, wt- of walls and wt. roof. The performance has to carry load of whole tank with water and is also subjected to wind loads.



Fig. Elevated water tank

### A. Underground Tanks

These tanks are made below the ground level such as clarifiers' filters in water action plants, and septic tanks. The walls of these tanks are exposed to water pressure from inside and earth pressure from outside. The base of the tanks is exposed to



Fig. Under ground water tank

Water burden from inside and soil reaction from underneath. Always these are enclosed at top. These tanks should be designed for loading which gives the worst effect. The design principles of underground tanks are same as designed for tanks resting on the ground. The walls of the underground tanks are exposed to internal water pressure and outside earth pressure. The segment of wall is designed for water pressure and earth pressure acting alone as well as acting instantaneously.

## II. TYPE OF TANKS

From the design thought storage tanks are further categorized according to their shape and design principles as

- Circular tanks
- Rectangular tanks
- Itzel type tanks
- Spherical tanks
- Conical bottom tanks

## III. OBJECTIVES

- To study the various types of water tank.
- Study and design of water tanks.
- Analyse the guidelines for the project of liquid retaining structures
- To know about the design philosophy for the harmless and cheap design of water tank.
- To compute base shear and base moment for sloshing result, and earthquake result.
- Evaluation of structural design, between kanis method and E-TAB software design result.

## IV. LITERATURE REVIEW

Elevated tanks are supported on performance which may involve of masonry walls, RCC columns braced together, security walls exposed to water pressure. In water supply system, water tanks usually account for 10% to 20% of the general cost. This is fairly substantial amount and thus, there is a need to achieve economy in construction of water tanks. The hilly seismic regions of our country ranges from J and K, Himachal Pradesh, Manipur, Tripura, Mizoram. The Western Ghats well known as Sahyadri are a mountainous range running similar to the coast. Due to quick urbanization and economic development, it is vital to make the optimistic mixtures of structure on sloping ground. These are the assumptions of the journal papers which are used for this report.

## V. METHODOLOGY

### A.KANIS METHOD OR ROTATION CONTRIBUTION METHOD OF FRAME ANALYSIS

This method may be considered as a further generalization of moment distribution method where in the problems including sway were tried in a tabular form thrice and two shear co-efficient had to be determined which when injected in end moments gave us the last end moments.

All this control can be cut short very significantly by using this method. Frame analysis is accepted out by solving the slop deflection equations by succeeding guesstimates. Useful in situation of side sway as well. Method is simple, as it is accepted out in a specific direction. If some mistake is committed, it will be removed in subsequent cycles if the restraining moments and distribution aspects have been determined correctly. Please note that the process does not give open results in cases of columns of weak heights within a store and for pin finished columns both of these cases are in fact really rare even in real practice. Even codes propose that RC columns enfolding into footings or members overhead may be considered extra or less as fixed for analysis and design determinations.

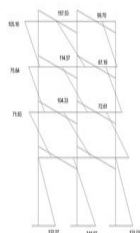
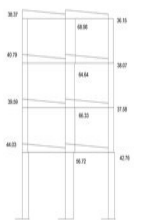
These process is use for design of vertical and lateral forces these method is application of slope deflection method and moment distribution method these method is period overriding but very valued for calculation of building edges these method is like as additional frame proces. these process is also about as Rotation contribution technique of frame analysis.

### B. DESIGN PROBLEM

The results of analysis& design of ESR having a size of 40000 liters resting on soil having safe bearing size of 200N/mm<sup>2</sup> for 9m and 12m staging heights are temporarily related in parametric work.

Details of sizes of various mechanisms and geometry are shown

Component	Size (mm)
Roof Slab	120 thick
Wall	200 thick
Floor Slab	250 thick
Gallery	110 thick
Floor Beams	250 x 600
Braces	200 x 450



### VI. COMPARISON OF RESULTS

**On the source of detailed parametric study presented above, following are the discussion on results.**

- As we change from right to left column the shear force increases from 15% to 85% for 9m height of tank wheres for 12m height of tank it increases from 10% to 85%. This shows that as the height of staging increases shear force increases.
- As we change from right to left column the bending moment increases from 14% to 44% for 9m height of tank wheres for 12m height of tank it increases from 12% to 24%. This shows that as the height of staging increase bending moment decrease.
- The shear force variation is up to 85% at the ground bracing level for different sloping ground as related to level surface for 9m height wheres for 12m height it increases to 85%. Therefore, there is no chief increase in shear force with increasing staging height.
- The bending moment modification is up to 40% at the ground bracing level for unlike sloping ground as related to level surface for 9m height wheres for 12m height it decreases to 27%. Therefore, there is chief decrease in bending moment by increasing staging height.
- It is observed that the result of shear force on columns of higher side on the sloping ground is far more meaningfully higher as associated to the columns on lower sides of sloping ground.
- It is observed that the result of bending moment at the ground bracing level on the higher side of the sloping ground is nearly double in evaluation with frames on level ground. It is also observed that the result of increase in bending moment due to sloping ground becomes slighter with growing story height.
- It is observed that as the height of column staging increases area of column necessary also increases

### VII. CONCLUSION

As height of water tank increases max.nodal shift increases. Water tank height gives least nodal shift. all the models of analysis, maximum nodal shift is least for WT and extreme. Current study will be beneficial to Civil Engineers to know the performance of elevated water tank for several heights and also to grow the sensation of effect of earthquake zones of India on earthquake forces and nodal modification. For the ESR on sloping ground, it is observed that both shear force and bending moment increase suddenly in the column resting on the advanced side of the sloping ground. However the rise in Shear force & Bending Moment becomes negligible as one goes near downward side of slope. It is also observed that as one moves near higher levels, effect of rising in shear force & bending moment due to sloping ground becomes quiet slight. There is no important modification in axial force with respect to change of slope of ground. For the rise height of staging, the cross segment of important area of column also increases.

### REFERENCES

- [1] V. S. Bachal, Dr. S. N. Tande, ISSN : 0975-5462 Vol. 6 No 6, June 2014. Effect of sloshing on analysis and design of service reservoirs. International Journal of Engineering Science and Technology (IJEST).
- [2] Dr. S. A. Halkude, A. A. Perampalli ,Volume 3, Issue 5, November 2013 analysis of water tank on sloping ground,

- International Journal of Engineering and Innovative Technology (IJEIT).
- [3] Krishna Rao M.V, Rathish Kumar. P, DivyaDhatri. K  
Volume: 04 page 74-83 Special Issue: 01 |  
NCRTCE-2014 | Feb-2015 eISSN: 2319-1163 | pISSN:  
2321-7308 Seismic analysis of overhead circular water  
tank. IJRET.
- [4] Yonghuiwang, ming-xiangxiong , international journal of  
impact engineering 86(2015) 167-178 analysis of axially  
restrained water tank under blast loading, science direct.
- [5] IITK-GSDMA (2007) guidelines for seismic design of  
liquid storage tanks provisions with commentary and  
explanatory examples National information.
- [6] Sachin U Pagar , Prof. P. R. Mehete. International Journal  
Of Engineering , Education and Technology, ISSN  
2320-883X, volume 03 issue 03, (2015). Earthquake  
analysis and earthquake resisting design of elevated water  
tank.
- [7] 7.Thalapathy.M, Vijaisarathi.R.P, Sudhakar.P,  
Sridharan.V, Satheesh.V.SUG student, Department of  
Civil Engineering,AdhiyamaanCollege of Engineering,  
HosurTamilnadu,India Assistant professor, Department  
of Civil Engineering,Adhiyamaan College of  
Engineering, Hosur, Tamilnadu, India.