International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 06 | June 2019 www.irjet.net p-ISSN: 2395-0072

# Comparison of Ductility of M20 and M25 Concrete in Elevated Tank Staging

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***ABSTRACT:- Overhead elevated water tanks are required to fulfill the need of the society. The design of the stage of the water tank is paramount important, as it takes the load of the water container. In the current paper the ductility of M20 and M25 are evaluated for a INTZE elevated tank having capacity of 1000kilo-litres. Pushover analysis is carried out by considering various parameters like water storage capacity and staging height which are constant, modulus of elasticity of the concretes. Ten columns are used to design the staging. The pushover curve which is a plot of base reaction versus roof displacement, gives the actual capacity of the structure in the nonlinear range. The structural behavior remains same for, different water storage capacity, plastic hinge formation staging heights and different number of columns.***

**Keywords:** ***Pushover analysis, INTZE, Staging, ductility, strength, elastic modulus***

## 1. INTRODUCTION

Large capacity elevated intze tanks are used to store a variety of liquids, e.g. water for drinking and fire fighting, petroleum, chemicals, and liquefied natural gas. The liquid storage tanks are particularly subjected to the risk of damage due to earthquake-induced vibrations. A large number of overhead water tanks damaged during past earthquake.

Majority of them were shaft staging while a few were on frame staging. Muzaffarabad earthquake 2005 and Bhuj earthquake 2001 also represented similar damage. Most of the damage was caused because of the tanks were either designed without considering the earthquake forces or inadequate seismic design considerations. To cope with this need the seismic design codes for over head water tanks have been revised and upgraded. Two types of elevated water tanks namely intze tank supported by frame staging and shaft staging have been considered in this study. These elevated water tanks are first conventionally designed and then seismic analyzed

Their strength and ductility have also been evaluated and compared.

It has been observed that time period in frame staging is higher than the shaft staging since the lateral stiffness of shaft staging is much larger. The tank supported on shaft staging has higher strength as compare to tank supported on frame staging but the ductility is low that may be the return of frequent failure of elevated water tank supported on shaft staging.

The non-linear static procedure or simply push over analysis is a simple option for estimating the strength capacity in the post-elastic range. This procedure involves applying a predefined lateral load pattern which is distributed along the structure height. The lateral forces are then monotonically increased in constant proportion with a displacement control node of the building until a certain level of deformation is reached.

The applied base shear and the associated lateral displacement at each load increment are plotted. Based on the capacity curve, a target displacement which is an estimate of the displacement that the design earthquake will produce on the building is determined. The extent of damage experienced by the building at this target displacement is considered representative of the damage experienced by the building when subjected to design level ground shaking. A limiting damage state or condition described by the physical damage within the building, the threat to life safety of the building's occupants due to the damage, and the post earthquake serviceability of the building. A building performance level is that combination of a structural performance level and a non-structural performance level. There is

## 2. METHODOLOGY

For designing the stage it is assumed that the container (including liquid) is rigid and all weight of the container is applied at Centre of Gravity of the container. Table-1 and Table-2, shows the mixture proportion of M20 and M25 concrete respectively.

| materials | Proportions for Conventional ($kg/m^3$) | Proportions for No fines concrete ($kg/m^3$) |
|---|---|---|
| Cement | 380 | 380 |
| Fine aggregates | 563.06 | 0 |
| Coarse aggregates | 1113.75 | 1113.75 |
| Water cement ratio by mass | 0.3 | 0.3 |
| Admixture(ml) | 76 | 76 |

**Table 1 Mixture Proportion of M20Concrete**

| materials | Proportions for Conventional ($kg/m^3$) | Proportions for No fines concrete ($kg/m^3$) |
|---|---|---|
| Cement | 452.38 | 452.38 |
| Fine aggregates | 503.2 | 0 |
| Coarse aggregates | 1113.75 | 1113.75 |
| Water cement ratio by mass | 0.3 | 0.3 |
| Admixture(ml) | 90.47 | 90.47 |

**Table 2 Mixture Proportion of M25 Concrete**

| Grade Of Concrete | Density Of Concrete ($kg/m^3$) | |
|---|---|---|
| | Conventional Concrete | No Fines Concrete |
| M15 | 2340 | 1612 |
| M20 | 2375 | 1656 |
| M25 | 2394 | 1685 |

**Table 3 Concrete Density**

Density of M15, M20 and M25 grade concrete is shown in Table-3.Modulus of elasticity is calculated by the formula:

$E = 5000\sqrt{fck}$ ……..eq. 1

Where, fck is characteristic compressive strength of the concrete.

The ductility of the concrete is defined as:

$\mu = \Delta ultimate/\Delta yield$ ……..eq. 2

Where, Δultimate = deflection at ultimate point

## 3. RESULTS

Modulus of elasticity of the M20 concrete is 22360MPa and M25 grade concrete is 25000Mpa.

Ductility of M20 concrete is 3.47 and M25 concrete is 1.7

The behavior of M25 concrete is stiffer than M20. It can take more loads. The deflection is less as compared to M20 concrete as shown in fig. 1.

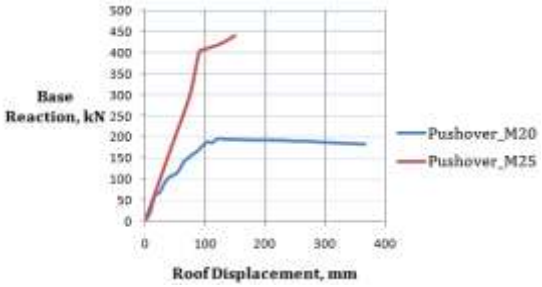


**Fig. 1 Pushover curve for M20 and M20**

## 4. CONCLUSION

Design of staging is an important step in designing the elevated water tank. The design is majorly affected by the container capacity, load and the types of concrete and steel materials, used to build the column and braces. There is a significant increase in ductility of the staging if M20 concrete material is used. If all other design parameters are constant then there is around 50% reduction of force from M25 to M20 and also there is significant increase of ductility. This study helps for researchers for designing frame staging for elevated water tanks.

## REFERENCES

[1] Chintha. R., Ingle R. K. "Analysis Of Cylindrical Water Tanks- Wind Or Earthquake", ISBN:978-93-85465-11-6, 10th May 2015.

[2] Ali A. Q., Telang D. P., "A Survey on Dynamic Analysis of Elevated Water Tank for Different Staging Configuration", ISSN 2320–088X, Vol. 6, Issue. 5, Pg.194 – 201, IJCSMC, May 2017

[3] KODE V. L. S., and RAMAKRISHNA R., "Performance of Elevated Circular Water Tank in Different Wind Zones", ISSN 2319-8885, Vol.06, Issue.11, IJSETR 2017.

[4] Hirde S. K., Bajare A. A., Hedaoo M. N., "Performance Of Elevated Water Tanks Subjected To Wind Forces", E-Issn 0976-3945, Vol.II/ Issue II, IJAET, April-June, 2011.

[5] More V. K., More V. T., "Comparative Study on Dynamic Analysis of Elevated Water Tank Frame Staging

and Concrete Shaft Supported", e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 14, Issue 1 Ver. I, IOSR, 2017.

[6] Nitesh J S and, Mohammad I., "Design Analysis & Comparison Of Intze Type Water Tank For Different Wind Speed And Seismic Zones As Per Indian Codes", Eissn: 2319-1163, P-ISSN: 2321-7308, Volume: 04 Issue: 09, IJRET, 2015.

[7] Ghadage V. J., Kumbhar A. H. and Mujawar T. F, "Soil Structure Interaction Analysis of Elevated Water Storage Tank", ISSN (online): 2321-0613, Vol. 4, Issue 05,IJSRD - International Journal for Scientific Research & Development, 2016.

[8] Kondepudi, S. K., Reddy R. S. K. K. and, Kaviti H, "Analysis and Design of Elevated IntzeWatertank and its Comparative Study in Different Wind Zones - using SAP2000", ISSN (online): 2349-784X, Volume 2, Issue 2,IJSTE - International Journal of Science Technology & Engineering, August 2015.

[9] Musa A., Aboshosha H. and Damatty A. E., "Effect Of Wind Speed And Terrain Exposure On The Wind Pressures For Elevated Steel Conical Tanks" NDM-536-1, Resilient Infrastructure, June 1–4, 2016.

[10] Kumar B. D. and Swami B.L.P., "Wind effects on water towers-influence of various dynamic parameters", ISSN: 0974- 6846, Vol. 3 No. 8, Indian Journal of Science and Technology, Aug 2010.