A REVIEW ON SEISMIC BEHAVIOUR OF INTZE TANK WITH VARYING DIFFERENT SEISMIC ZONES & DIFFERENT SOIL CONDITION

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Abstract-In case of large diameter elevated circular tanks, thicker floor slabs are required resulting in uneconomical designs. In such cases intze type tank with conical and bottom spherical domes provides an economical solution. The proportions of the conical and spherical dome are selected so that the outward thrust from the bottom dome balances the inward thrust due to the conical domed part of the tank floor. Most of the designers consider the wind effect and neglect the seismic effect on the structure which might be disastrous sometimes.

Proper seismic analysis of intze tank in different soil condition makes the structure more safe and durable. This paper present literature review on Study of seismic behavior of Intze tank in different seismic zones and different soil condition which includes current and future trends of research.

Keywords- Seismic study, different seismic zones, Different soil condition

I. INTRODUCTION

Tanks are the storage structures which are used to store the important liquids like water and other important things like grains etc. For its economical design and when tank of large diameter required Intze tanks are preferred. Earthquakes are one of the major natural calamities which have a potential to paralyze human life by causing disturbance to infrastructure and lifeline facilities Water tanks are considered to be a part of crucial life services in most of the cities. Their safety and behavior is critical during strong earthquakes as they contribute for essential requirements viz. drinking water, fire fighting's in case of fire accidents, etc. Hence, these structures should not collapse even after an eventual earthquake. Elevated Intze tanks are somewhat critical and strategic structures; damage happening
of these structures during earthquakes, endangers drinking water supply, cause to fail in preventing large fires and may cause substantial economic loss.
Intze tank behaves differently in different seismic zones and different soil condition and they need to be study in . For modeling and study of Intze tank STADD Pro V8i 2007 is used.

II. REVIEW OF ARTICLES

Dhanya Johnson & Dr. M. Sirajuddin (2018) The main objective of this paper is to study the performance of reinforced concrete elevated water tank under dynamic load. In addition, the variation of dynamic responses such as base shear, overturning moment, displacement with change in height of staging, capacity of water tank, seismic zone, soil conditions etc. were also studied. [1]

M. Moslemi et al. (2011) This study shows that the proposed finite element technique is capable of accounting for the fluid structure interaction in liquid containing structures. Using this method, the study of liquid sloshing effects in tanks with complex geometries such as conical tanks is made possible. The results of this study show that the current practice predicts the response of elevated tanks with reasonable accuracy. [2]

Nitesh J Singh & Mohammad Ishtiyaque(2015) Most of the designers consider the wind effect and neglect the seismic effect on the structure. The Indian Standard Code IS 875(Part-3) 2003 and IS 1893-2000 for Wind & Seismic effect is used in this study. The Elevated Structure is designed for various Wind forces i.e. 39 m/s, 44 m/s, 47 m/s & 50 m/s and the same is cross checked with different Seismic Zones i.e. Zone-II, Zone-III, Zone-IV, & Zone-V by 'Response Spectrum Method' and the maximum governing condition from both the forces is further used for design & analysis of staging. It is found from the analysis that the Total load, Total moments and Reinforcement in staging i.e. Columns, Braces & also for Raft foundation varies for Case-1, Case-2, Case-3 & Case-4. [3]

Halil Sezen et al. (2007) The vulnerabilities of the structural system, the observed performance, and damage pattern are discussed by comparing the dynamic analysis results with the strength and deformation capacity of the support columns. The dynamic analysis results from a simplified three-mass model and a finite element model confirmed that the axial and lateral strength of the columns supporting the two nearly full tanks were not sufficient to resist the demand imposed during the earthquake. Consistent with the observed structural performance, an elastic response is predicted for the columns supporting the undamaged 25% full identical tank. [4]

Zhi-Rong Yang et. al(2011) Based on response spectrum theory, the earthquake response of the spherical tank with seismic isolation is investigated. Characteristics and calculation model of a laminated rubber bearing are introduced. In order to determine dynamic magnification factor, the dynamic behavior and the earthquake response of the seismic isolation spherical tanks are analyzed. The results show that the spherical tank of a key point displacement decreases and the control effect of velocity and acceleration is more obvious. The structural seismic performance of spherical tank can be improved significantly by applying seismic isolation. [5]

Dr. Suchita Hirde et. al (2011) This paper presents the study of seismic performance of the elevated water tanks for various seismic zones of India for various heights and capacity of elevated water tanks for different soil conditions. The effect of height of water tank, earthquake zones and soil conditions on earthquake forces have been presented in this paper with the help of analysis of 240 models for various parameters. [6]

Shubham Gautam et. al (2017) The reason for damage of the water tank is due to lack of knowledge about staging or bracing part of the tank which play important part during earth quake. The staging or bracing plays a very important role which provides more stiffness and safety to structure and as well as to control the storey displacement of the structure. Angle of dome is also play important role in the seismic analysis, hence this paper also concern with the study of bottom dome angle deviation in which the angle of bottom dome selected are 35 and 50 degree for same capacity of water tank 1000 m3 . So the elevated intze water tank is analyzed for all seismic zones as per IS: 1893 and also analysis with different staging pattern like octagonal, octagonal and plus, octagonal and cross with under different filling conditions, analysis has been done using STAAD.Pro software. [7]

Joseph W. Tedesco et. al (1988) This paper summarizes the results of a comprehensive analytical investigation concerning the seismic analysis of ground supported, circular cylindrical liquid storage tanks subject to a horizontal component of earthquake ground motion. A procedure to evahrate the dynamic seismic response of a wide range of cylindrical liquid storage tanks is developed. The procedure, which is applicable to tanks both completely full and partially full with liquid, has been incorporated into a BASIC computer program. Several numerical examples are presented which illustrate application of the procedure and verify its accuracy. [8]

Kamila Kotrasová(2017) Liquid-containing tanks are used to store variety of liquids. This work considers the theoretical background of seismic response of liquid storage ground-supported tanks, i.e. hydrodynamic effect of fluid on solid wall of rectangular endlessly long tank fixed to rigid foundation. For numerical analysis of hydrodynamic pressure was used Finite Element Method (FEM) and as loading was considered as horizontal ground motion the accelerogram Loma Prieta was considered. [9]

Jure Radnićet. al (2018) Liquid storage tanks are widely used structures in industry. Their safety during an earthquake is important because damage to or the collapse of these structures can cause substantial material damage and human losses. In this paper, the behaviour of small scale open rectangular water tanks with water sloshing during dynamic excitation was experimentally investigated. The effects of several parameters were studied using a shake table (tank wall stiffness; tank water level; dynamic excitation type; and period, amplitude and duration of the harmonic ground excitation). The most important conclusions of the investigated effects are presented. It is expected that the experimental database can be useful for the verification and calibration of numerical models used to simulation liquid– structure coupled problems. [10]

Prashant A Bansode & V. P. Datye (2018) The objective of this study is, to understand the behavior of different staging system, under different tank conditions. Response Spectrum Analysis is carried out on three different types of bracing systems of elevated water tank in all zones by using STAAD Pro V8i 2007. Comparison of base shear and nodal displacements of elevated water tank for empty and full condition is done. The spring mass model as per IS 1893:2002 Part 2 has been used for the analysis. [11]

Rajkumar & Shivaraj Mangalgi(2017) In this present study twelve number of elevated circular and Intze water tanks of 2L litres capacity supported on RCC frame staging under earthquake loads as per draft code Part II of IS 1893: 2002 are considered out of which six models are Intze type and six models of circular type. Response spectrum analysis for elevated circular and Intze water tanks with empty, half-filled and full condition in seismic zones II and V is Carried out using STAAD Pro V8i SS6. [12]

R. Livaoglu& A. Dogangunb (2007) This paper investigates the effects of foundation embedment on the seismic behavior of fluid elevated tank-foundation–soil system with a structural frame supporting the fluid containing tank. Six different soil types defined in the well known seismic codes were considered. Both the sloshing effects of the fluid and soil-structure interaction of the elevated tanks located on these six different soils were included in the analyses. Fluid-elevated tank-foundation–soil systems were modeled with the finite element (FE) technique. The fluid-structure interaction was taken into account using Lagrangian fluid FE approximation implemented in the general purpose structural analysis computer program, ANSYS. FE model with viscous boundary was used to include elevated tank-foundation–soil interaction effects. The models were analyzed for the foundations with and without embedment. It was found that the tank roof displacements were affected significantly by the embedment in soft soil, however, this effect was smaller for stiff soil types. Except for soft soil types, embedment did not affect the other response parameters, such as sloshing displacement, of the systems considered in this study. [13]

Abbas Maleki & Mansour Ziyaeifar(2007) The effect of baffles in reducing earthquake responses of seismically isolated cylindrical liquid storage tanks is investigated in this study. Seismic isolation is a well-known approach to reduce the earthquake effects on structures by lengthening their fundamental natural periods at the expense of larger displacements in the structural system. To reduce such effects in a system a higher damping ratio is required. The results show that the average damping ratio of sloshing mode due to ring baffle increases with a decrease in liquid height and highest damping may be achieved for height to radius ratios of between 1.0 and 1.5. In addition, for reasonable ring baffle dimensions, an average reduction of 6% in base displacement of base isolated tanks and an average reduction of more than 30% in the sloshing height of base isolated and fixed base tanks may be achieved. To study the effect of baffles on the distribution of hydrodynamic and tank body forces with height, a simple dynamic model is proposed. The results of analyses using this model indicate a constant reduction in sloshing forces and different reductions in moment and shear forces for different heights. This happens because contribution of the sloshing force to the total hydrodynamic force varies with height. [14]

Mahmood Hosseiniet. al (2011) In this paper a simplified method is presented for modeling the floating roof and its interaction with the tank wall, making it possible to use Finite Element Analysis (FEA) for calculating the seismic response of tank-floating roof system. In the proposed method, assuming that the sloshing phenomenon is mainly suppressed by the floating roof, the seal between the roof and the tank's wall is modeled by introducing some radial pre-compressed 'only-compression elements' all around the roof, itself substituted by a rigid disk, and the tank's wall is modeled by 3-dimensional shell elements. The dynamic effect of the impounded oil in the tank is taken into account by the use of added mass concept. If during the time history analysis the maximum relative displacement between the roof disk and the tank's wall in any radial direction exceeds the initial length of the pre compressed only-compression springs the tank is considered to be vulnerable. The proposed method has been applied to a tank sample in Kharg (southern Iran) island. [15]

Kaviti Harshaet. al (2015) The objective of this dissertation is to shed light on the Intze water tank designed considering the earthquake forces according to Indian standard code: 3370-2009 and draft code 1893-Part 2, (2005) considering two mass modal i.e. impulsive and convective mode method. Intze tank supported on frame staging .Also this report includes analysis by STAAD Pro for wind and seismic forces .Finally the results are validated with the results of manual calculation From the present study, it was observed that, for elevated tanks the two degree of freedom idealization of tank have shown better results when compared to single degree of freedom of idealization. [16]

III. CONCLUSION

The review of earlier studies related to Study of seismic behaviour of Intze tank with varying different seismic zones and different soil condition reveals that earthquake forces decreases with increase in staging height and increases with increase in zone factor for soft, medium and hard soil conditions for tank empty and tank full condition. Earthquake forces for zone II is about 37-38% less than zone III, about 58-59% less than zone IV and about 72-73% less than zone V. Earthquake forces for zone III is about 33-34% less than zone IV and about 55-56% less than zone V. Earthquake forces for zone IV is about 33-34% less than zone V. Previous studied also shows that Earthquake forces for soft soil is about 18-19% greater than that of medium soil, Earthquake forces for medium soil is about 26-27% greater than that of hard soil, Earthquake forces for soft soil is about 40-41% greater than that of hard soil for all earthquake zones and tank full and tank empty condition.

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