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COMPARATIVE STUDY ON DESIGN AND ANALYSIS OF VARIOUS TYPES OF REINFORCED CONCRETE SILOS BY CONSIDERING DIFFERENT SEISMIC ZONES : REVIEW PAPER

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Abstract: This article Summaries a comparative study of seismic analysis of various types of reinforced concrete silo based on literature survey. We are analyzing such types of structures, while considering different seismic zones in our study. Whole Design and analysis of all Structures is going to be done in STAAD Pro Software. This report is purely based on study of literature papers related to design and analysis of different types of Silos structures.

Key Words – Reinforced Concrete Silos, Seismic analysis, Circular Silo, Rectangular Silo & Square Silo

I.INTRODUCTION

Silos are the structures use to store granular materials like food grains, cement, coal, crushed stone, etc., in large quantities. In general, bunkers or bins are used to store gravel, stone and coal whereas cement and grains are stored in silos. They will be constructed as either ground supported or elevated. The silo plays an important role in agricultural, industrial and military domain for the aim of storing materials. Silos are either made up of Steel or made up of reinforced concrete. Concrete silo is inherently durable than steel silo.

1.2 COMPONENTS OF SILO

Figure given below shows a typical reinforced concrete or steel silo consisting of a silo wall, a hopper, roof slab, ring girder, supporting columns and foundations.

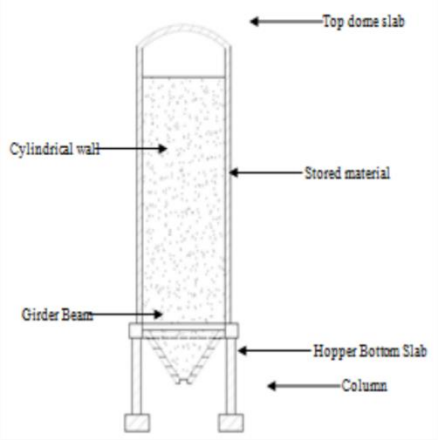

Fig.1 Components of a typical concrete silo.

II. Objective of Study

- To study the different types of Silos.
- To study the Design Methods of different types of Silos Structures in STAAD Pro software.
- To Study the Seismic Analysis of Structures Using STAAD Pro software.
- To Study the advance research in Silos Structure and its Design.
- Comparative study of Seismic analysis of various types of Silos.
- Comparative study of design of various Silos structures by considering different seismic zones.

III. Literature Review

3.1 Suvarna Dilip Deshmukh and Rathod (2008)

This paper describes, seismic behavior of reinforced concrete silos. They also investigate the cause of failure. In this Study it had been concluded that the pressure because of seismic activity must be taken into consideration during the construction of the silo wall. In their study, they found that that different strengthening's along the wall depth and more on the center wall are often effective.

3.2 Indrajit Chowdhury and Raj Tilak (2010)

In this Paper they used traditional Jansen method for designing the silos structures. They insisted that a Standard lack of understanding of the vertical aspect of the earthquake would promote side pressure and will not especially be ignored for giant silo capacities. Finally, they concluded that the silo wall design technique is significantly unknown about the seismic effect.

3.3 C.Y. Song (2004)

This paper describes, Investigation of the structural behavior of circular steel silos under patch load. The investigations reveal that the patch loads have an excellent effect on the stress states within the silo from the linear elastic analysis (LA). Geometrical non-linearity and primary pressures have beneficial effect. Fourier decompositions of the 2 square-shaped patch loads show that the effect of the shape of patch loads de- pends not only on the harmonic index, but also on particular stress component.

3.4 K. Guo, C. Zhou (2016)

In this paper, they conducted a seismic vulnerability assessment of reinforced concrete silo considering granular material structure interaction. The seismic fragility assessment of the chosen silo was performed using the incremental dynamic analysis. The analytical results showed that the hypo-plastic theory can be used to simulate the stored materials in the silo considering the collapse property.

3.5 Dinghua and Jiping (1995)

In this paper, they researched on the lateral pressure acting on the walls of the reinforced concrete silo. the strategy of calculating the fundamental further because the dynamic pressure acting on the wall of reinforced silo caused by the integral flow of granular material within the tower during discharge was also discussed.

3.6 F. Ayuga et al. (2005)

In this Study, they done experimental work on silo which was cylindrical of 1.9 m in diameter and 5 m tall of the vertical wall, with emptying hoppers designed with three different eccentricities. The wall has been made from smooth steel, with enough thickness and reinforcements to be considered rigid. Specially designed sensors are in these silos, so as to measure the horizontal pressure and the friction force between the wall and the bulk solid. The horizontal pressure cells measure the deflection of a circular thin plate by means of four strain gauges and the friction forces sensor measure the deformation of a small cantilever beam by two strain gauges.

3.7 Feat Tinis et al (2006)

In this study, they proposed that cylindrical silo walls are subjected to both normal pressures and vertical friction shear or traction due to stored material inside the silo which vary along the wall. The normal pressure on cylindrical walls causes circumferential stress and the vertical frictional shear will cause cumulative axial compressive stress. Because of the complexity of the matter, the finite element and numerical integration techniques are very widely used for buckling and collapse analysis.

3.8 D. Briassoulis (2000)

In this Study, they have done the analysis of the behavior and also the state of stress developing in a very silo shell under real asymmetric pressure distributions concerning both storing and discharge. The results obtained suggest that the design of such structures might not neglect the asymmetric features of the real pressures developed by the stored material.

3.9 Dr. John W. Carson (2000)

In this Study they found that, the foremost causes of silo failures are because of shortcomings in one or more three categories. Failures because of design errors, Failures because of construction errors & Failures because of usage. Silos and bins fail with a frequency which is far over almost the other industrial equipment. Sometimes the failure only involves distortion or deformation which, while unsightly doesn't pose safety or operational hazards in other cases failure involves complete collapse of the structure with accompanying loss of use and even loss of life.

IV. LITERATURE SUMMERY

- After all the detailed study of all the literature papers, research paper, it is seen that the Stress and the bending moment value are very low of circular silo and near same value of rectangular and square silo.
- Displacement and acceleration are also maximum on x direction as compared to y and z.
- As we know that the value of base shear is higher for higher zone therefore it is seen as expected that the Base Shear is going increasing with different seismic Zone from Zone-II to Zone-V.
- Lateral displacement increases with higher seismic Zone in all cases for R.C.C. Circular silo, Rectangular silo as well as Square silo, but it is getting comparatively more in square & rectangular R.C.C. silo in all seismic zone from Zone-II to Zone-V.

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