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Study on Shallow and Deep Bin for a Constant Volume at Same Loading Condition a Review

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INRODUCTION

The bunkers and silos made of reinforced concrete have almost replaced the steel storage structures. Concrete bins possess less maintenance and other architectural qualities greater than steel storage tanks. They are used to store materials like grain, cereals, coal cement etc. They both serve the purpose of bins.

Concept and difference between bunkers and silos are explained in the following sections:
Bunkers are mainly employed for storage of underground dwellings. These are mainly related to emergency conditions during wars. The main two characteristics that make a bin to act as a bunker is based on the

- Depth (H)
- Angle of rupture

Vertical walls
Hopper Bottom
Edge Beam (At the top level)
Supporting Columns

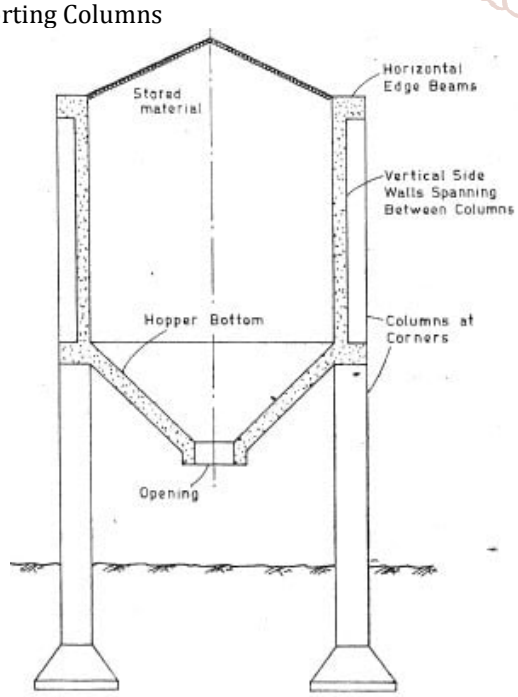

Fig.1.1 Structural Elements

LITERATURE REVIEW

1. **Adem Dogangun et al.2013,** studied, reviewed and discussed the main factors which cause damages to the silos. They have presented the unusual modes of failure due to different unconventional loading and some escalating failures such as loss of the container, contamination of material it contains, environmental damage, replacement cost, possible injury and loss of life that occurred in various regions of the world. They also provided a review of specific silo failures due to explosion and bursting, asymmetrical loads imposed during filling or discharging, large & non uniform pressure under soil, corrosion and deterioration of silos, internal structural collapse and failures from several earthquakes. They made a unique research about silo failures and factors along with failures. They invented the reasons and causes for failures and suggested some remedial measures to prevent from failure. Some of the solutions are, a) To prevent explosion and bursting, monitor the internal pressure and gasses produced by the stored bulk material. b) To prevent the silo from dent, buckling and collapse, the potential asymmetric flow patterns caused by rat holes, flow channels, asymmetric loading patterns created during filling or discharging are to be considered in the design. c) Apart from that, while designing non uniform base pressure resulting from lateral loads, earthquake loads, potential asymmetrical material loads should be considered. d) For empty and light silos, the wind load may be effective and for heavier and tall silos, the horizontal seismic loads may be more critical. e) Finally poor insufficient reinforcement in supports or columns, corrosion of metal silos and deterioration of concrete silos due to silage acids aggravate the damage and lead to failure.

2. **Mohamed T. Abdel Fattah et al.2013,** made analysis of elevated concrete silos using finite - element solution. They have considered the filling process of saturated solids. In their analysis axis symmetric finite – element model is used to signify both the solids and structure. An elasto - plastic model is used for modelling of bulk solids and linear elastic model is used for modelling of structure. In their design to demonstrate both undrained

and drained conditions, the filling process is idealized via multistage numerical technique. They found out that the effect of filling process is time – dependant and excess pore water pressure caused by filling process might control the magnitude of internal forces. According to their study, number of solutions can be obtained for combination of materials, geometry and loading conditions. They gave one key point regarding drained and undrained condition which is the maximum tension would be in contact with the undrained condition and the maximum compression would be in contact with the drained condition while designing the silo wall or hopper for hoop forces. They also considered the permeability of the filling material since the process is time dependant. The results of their investigation may be helpful for field testing program and evaluation of existing concrete silos.

3. **Sachidanandam. K and Jose Ravindra Raj. B 2014,** studied the causes for failure of bunkers and silos and illustrated them as, due to design, fabrication & erection error, improper usage and maintenance. They have studied about the powder flow and used that gathering in design of silos and bunkers which can discharge the material free from hang-up. Based on their study and learning from many projects, they listed some practical approach to the upcoming researchers. They are, a) requirement of flow pattern, b) measurement of powder properties, c) Based on the material to be handled and operational requirements, design models should be utilized. Also they evaluated the problems in silage juice level which means fermented green forage fodder stored in a silo, loading problems and measurement techniques for effective design.

4. **Suvarna Dilip Deshmukh and Rathod S. T 2014,** made a comparative study on the design and seismic behaviour of RCC silo. They have studied about the unusual failure modes and their causes. They have analyzed and designed as per IS 4995, Euro code (EN 1998- 4:1999 and EN 1991-4:2006) and ACI code. For the design they have considered static and dynamic pressure exerted by stored materials & seismic loads. Based on their study they have been concluded that while designing silo wall, pressure due to seismic action must be considered. In their analysis they found out that varying reinforcement along depth of wall & more on the middle portion of wall could perform well.

5. **Sivabala. P et al.2015**, analyzed the effect of shear wall panels on the dynamic response of a silo. They done a dynamic analysis of a typical silo and during that the effect of extra plates between the columns was evaluated. Their analysis showed significant change in the frequency and mode shape of the structure. Also they proved that the stability of structure increased with the presence of extra plates between supporting columns. Finally they concluded that by providing plates between columns, stability of structure can be increased in earthquake prone areas, stresses in structure can be decreased around 40%, and displacement of structure can be reduced around 25%.

6. **Ramakrishna Vemula and Venkateswara Rao. K 2015**, dealt with the cross sectional distortion phenomenon of circular cylindrical silo using Finite element model in ANSYS. They carried out a case study using pressure and wind load distribution based on the recommendations of IS codes. Also they carried out a three dimensional numerical simulation in detail on steel and concrete silo structure. For their analysis they have applied large internal loads internally & externally for static, modal, harmonic and buckling conditions. They made the following conclusions from their work. 1) The structure might fail at the centre portion of the legs. 2) Estimated cost of concrete reinforcement silo structure is more than the steel structure. 3) Concrete reinforcement structure might compete with the steel structure in many positive aspects.

7. **Rajani S Togarsi analyzed 2015**, the seismic response of reinforced concrete silo supported with shear walls and supported on only columns with no change in dimensions. The author modelled the structures using Finite element method package software SAP 2000 for soil type II located in the Zone II and considered the conditions such as empty silo, partially filled and fully filled with storage material. Load combinations were based on the IS 1893:2002 (part-I). The author found out the lateral displacement of reinforced concrete silo for both conditions which was mentioned earlier. Conclusion of the research was increased mass and stiffness lead to the increased lateral displacement and silo with full filled materials caused high lateral displacement when compared to the partially filled silo& empty silo. Also shear wall supported silo undergone less lateral displacement than silo supported on only columns.

8. **Nateghi. F and M. Yakhchalian 2015,** investigated the seismic behaviour steel silos with different height to diameter ratios with granular material – structure interaction. They have considered the complex dynamic behaviour of silos under seismic load. For the analysis they used Euro code, ABAQUS finite element package and applied hypo plasticity theory to describe stress rate as a function of stress, strain rate and void ratio. Shell elements were used to model silo wall and solid elements were used to model granular material. They have applied Coulomb friction law to model the interaction between wall & material. According to them the seismic behaviour of silos was influenced on the height to diameter ratio of silo

9. **Ashwini Bindari and K. N. Vishwanath 2017, analysed the** effect of seismic and wind loads on steel silo structures. They compared the steel silos and concrete counterparts and listed the merits of steel silos such that it has high strength per unit weight and high ductility. Due to the ductile property the steel silo might give sufficient warning before failure by the way of increased deformations. They made analysis on high rise steel building frame with braced and unbraced supports with the help of SAP 2000 software package. For the dynamic analysis under the selected earthquake zone V, equivalent static method and response spectrum method were implemented. Based on their study, they made following conclusions, a) Base shear was more for seismic effect when compared to wind effect. b) Displacement of structure generally found to be reduced by providing braced frame for supporting silo structure. c) Braced system gave economical results compared to unbraced system in terms of frequency and displacement.

10. **Indrajit Chowdhury and Raj Tilak 2018,** suggested a procedure to incorporate the dynamic pressure due to earthquake in the analysis of circular silos. They carried out this analysis using conventional Jansen's method with some modifications and they did parametric study about dynamic pressure on wall of silo with different structural configuration. They proposed new mathematical model to apply within a design office frame work which did not need an elaborate FEM analysis and could well adapted in a spreadsheet or mathcad shell. They insisted that usual ignorance of vertical component of earthquake in structural design would encourage the lateral dynamic pressure and should not be ignored particularly for the huge capacity silo. Finally they concluded that ignorance of seismic effect would considerably under design the silo wall design procedure.

11. **Dr. Amit Bijon Dutta 2018,** The demand for Storage Structures has increased due to increase of population. To provide storage for materials like grains, cereals, coal, cement etc, industries would prefer the structures called as Bins. The Bin can be termed as a Bunker whose diameter is large when compared to its height. Similarly, when the height of the container is larger than its diameter it is termed as a Silo. In recent times the Steel storage structures have replaced by the Reinforced concrete bins because of their simple maintenance and better architectural qualities. As per today's scenario, industries habitually go for single or multiple compartments of bunkers or silos to store the manufactured materials.

12. **Dr. Kameshwari. B et al. 2019**, studied the dynamic response of high rise structures under the influence of discrete staggered shear walls. Due to the restriction in the architectural design to adopt shear wall, they have introduced the new concept of discrete shear wall panels. They have analysed the various configurations of shear wall panel such as conventional shear wall, alternate arrangement of shear walls, diagonal arrangement of shear walls, zigzag arrangement of shear walls and influence of lift core walls. Out of these five configurations studied they found that zigzag arrangement system might control the response to earthquake loading and also diagonal shear wall configuration would be effective in earthquake prone areas. Apart from this shear walls placed along shorter plan gave better results than that in larger plan dimension.

OBJECTIVES

- To Study the factors to be considered while design, erection and fabrication of the same.

CONCLUSION

- Silo can be preferred over bunkers.
- More storage capacity of silos structure then bunker in a given land space, bunker is prefer more land space then silo.

REFERENCES

[1] Alan W. Roberts, "Review of Silo Loadings Associated with the Storage of Bulk Granular Materials".

[2] IS:5503(Part I)-1969, Indian Standard- "GENERAL REQUIREMENT FOR SILOS FOR GRAIN STORAGE" , Bureau of Indian Standards., New Delhi, 1970.

[3] IS:875(Part-II)-1987, "Indian Standard Code of Practice for Design Loads(other than earthquake)for Building and Structures", Bureau of Indian Standards, New Delhi, 1997.

[4] IS:875(Part-III)-1987, "Indian Standard Code of Practice for Design Loads(other than earthquake)for Building and Structures" ,Bureau of Indian Standard,. New Delhi, 1997.

[5] Jim Durack, (2010),"A challenge for designers of steel silo"

[6] John W. Carson and Tracy Holmes (2003), "SILO FAILURE:WHY DO THEY HAPPEN?"

[7] Kameshwari. B, G. Elangovan, P. Sivabala and G. Vaisakh, "Dynamic Response of High Rise Structures under the influence of Discrete Staggered Shear Walls", International Journal of Engineering, Science and Technology, Vol.3, No.10, ISSN: 0975-5462, October 2011.

[8] Karthiga Shenbagam. N, Mahesh, Loganayagan. S, N. V. Manjunath and A. S. Ramesh, "Studies on Economical Design of Bunkers", International Journal of Advanced Research in Computer Science and Software Engineering, Vol.4, Issue 9, ISSN: 2277-128X, September 2014.

[9] Krishna Raju. N, Advanced Reinforced Concrete Design, 2nd ed, CBS Publishers & Distributors(P) Ltd, 2005.

[10] Krishna T. Kharjule and Minakshi B. Jagtap, "Seismic Analysis of R.C.C and Steel Silo", International Journal of Computation and Engineering Research, Vol.5, Issue 7, eISSN: 2250-3005, July 2015.

[11] Maher FJ(1966), "Wind loads on dome-cylinders and dome-cone shapes", Journal of the Structural Division, ASCE, Vol 91(3),pp 79-96.

[12] P Patra, Non-member, A K Samanta, Member, P Ray, Fellow," Assessment of Transverse Deformation of Wall of Elevated RC Cylindrical Empty Silo under Wind Load", Vol 91, pp 9-17.

[13] Prerna Nautiyal, Saurabh Singh and Geeta Batham, "A Comparative Study of the Effect of Infill Walls on Seismic Performance of Reinforced Concrete Buildings", International Journal of Civil Engineering & Technology (IJCIET), Volume 4, Issue 4, 2013, pp. 208 - 218, ISSN Print: 0976 – 6308, ISSN Online: 0976 – 6316.

[14] Rish R. F (1967),"Forces in cylindrical shells due to wind", Proc. Institution of Civil Engineers, 36, pp 791-803.