Analysis And Design Of Storage Bins Using Staddpro

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June 23, 2021

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ABSTRACT

Storage bins have been used since a very long time for the purpose of storing of various materials such as wheat, rice husk, cement and fly ash. Reinforced cement concrete (RCC) is an ideal structural material for building of permanent bulk storage structures. Storage Bin can be flat bottom type or hopper bottom type. Flat bottom bins are easier to built than hooper bottom bins but it is desirable that bottom is self cleaning. This is why hooper bins are preferred. For the designed components (ring girder dimensions, column cross-section, thickness of wall), depending upon diameter & height of the bins, influence coefficient of matrix is then generated. The parameters such as fundamental natural frequency and other frequencies in first 3 modes for bin full and bin empty conditions have been computed and the normalized Eigen values have been computed corresponding to first three modes. Then static & dynamic analysis of bins has been carried out by taking elements at 2m interval both in bin (full & empty) conditions. Then, the values of natural frequencies and elemental matrices along with normalized mode shape values are used in carrying out dynamic analysis

Keywords: Definition, Objective, Application of Bin, Literature Reviews, Design Considerations, Load Calculation, Wind Load

I. INTRODUCTION

Definition RCC BIN is a bulk storage structure. It is used to store large quantities of materials like grains, coals etc.

Applications of Bin

- BIN can be used in the industry to store coals.
- It is used to store food grains

The purpose of this project is to introduce Grain Storage Bins and compare with other bins available to avoid grain wastage. Grain storage facilities take many forms depending on the quantity of grain to be stored, the site of the store and the purpose of storage. In general grain for food purposes to be stored in containers provides some protection against insects and helps prevent quality deterioration. The needs for a good storage system include Prevention of moisture re-entering the grain after drying, Protection from rodents, insects and birds. The project aims to develop strategies that improve food security of poor households through increased availability and improved quality of cereals and pulse foods and better access to markets. The project is focused on providing technical support to village-level food security project and to improve it .

- The building should be elevated and away from the moist places in the house; 4
- So far as possible, the structure should be airtight, still at loading and unloading ports.
- Rodent-proof materials should be intended for construction of rural storages;
- The region surrounding the building should be clean to reduce the insect breeding;
- The building should be plastered with an impervious clay layer to keep away from termite attack, or attack by other insects.

II. METHODS AND MATERIAL

In this project we are designing a 3 compartment Bin using Stadd pro and analysis is done with ACI 313_97, IS 4995.1.1974

The following section includes the detailed analysis and design of the silo and its various components and the procedures and methodologies involved above. The various code books are also involved in the design procedures and have been mentioned. An appropriate site corresponding to all the requirements have been chosen. After initializing calculations, the silo dimensions have been found and finalized and show

III. RESULTS AND DISCUSSION

Design of Outer Wall of Compartment Silo:

Considered Width (b)	1000
Thickness or Overall Depth (D)	550
Clear Cover, C	40
Assumed Circumferential Bar Diameter (db_1)	25
Assumed Vertical Bar Diameter (db_2)	20
Effective Cover (d')	52.5
Effective Thickness or Depth (Circumferential) (d)	497.5
Effective Thickness or Depth (Vertical) (d)	475
Grade of Concrete	35
Grade of Steel	500
Characteristic Compressive Strength of Concrete, fck	35 Mpa
Characteristic Tensile Strength of Reinforcing Steel, fy	500 Mpa

Minimum Circumferential Reinforcement:

The Minimum Circumferential Reinforcement shall be 0.25 % of Cross-Sectional Area of the Wall when Deformed Bars are used.

Pt min= 0.25% of Cross Sectional Area of Wall

Ast min = 1375mm^2

Minimum Vertical Reinforcement:

The Minimum Vertical Reinforcement shall be 0.2 % of Cross-Sectional Area of the Wall.

The Vertical Reinforcement shall preferably be provided in 2 Layers, Half near the Inside and Half near the Outside Face of the Wall.

Pt min= 0.10% of Cross Sectional Area of Wall in each Layer

Ast min= 550mm^2

A. Hoop Tension in the Outer Wall

Height from Top, Y	Max. Hoop stress (sx)	Permissible Stress	Check
m	(N/mm2)	(N/mm^2)	(kN)
0-5	1.56	9.0	OK
5-10	1.74	9.0	OK
10-15	2.10	9.0	OK
15-20	2.28	9.0	OK
20-25	2.46	9.0	OK
25-30	2.73	9.0	OK
30-35	2.44	9.0	OK

Bending Moment in the Outer Wall

Height from Top, Y	Maximum Moment Mx	
	(+ve)	(-ve)
m	(kN.m)	(kN.m)
0-5	203.452	-233.236
5-10	316.848	-360.453
10-15	378.744	-432.669
15-20	407.774	-475.766
20-25	412.083	-498.078
25-30	401.262	-498.222
30-35	262.461	-414.203

REINFORCEMENT DETAIL:

Height from Top, Y	Lateral Pressure		
	ACI Code	IS Code	EN Code
m			
0	0.0	0.0	0.0
5	42.4	36.2	65.9
10	72.5	55.4	97.6
15	88.4	65.5	115.4
20	97.8	70.8	126.5
25	110.5	73.6	134.0
30	121.3	75.1	139.2
35	123.5	75.9	143.0

Height from Top, Y	Max Ast		Pt		Min. Ast
	Inner	Outer	Inner	Outer	
m	(mm2)	(mm2)	(%)	(%)	(mm2)
0-5	4488	4488	1.00	1.00	1375
5-10	7239	7239	1.61	1.61	1375
10-15	8698	8698	1.93	1.93	1375
15-20	9475	9475	2.11	2.11	1375
20-25	9763	9763	2.17	2.17	1375
25-30	9755	9755	2.17	2.17	1375
30-35	7961	7961	1.77	1.77	1375

Bending Moment (My) (kN.m)

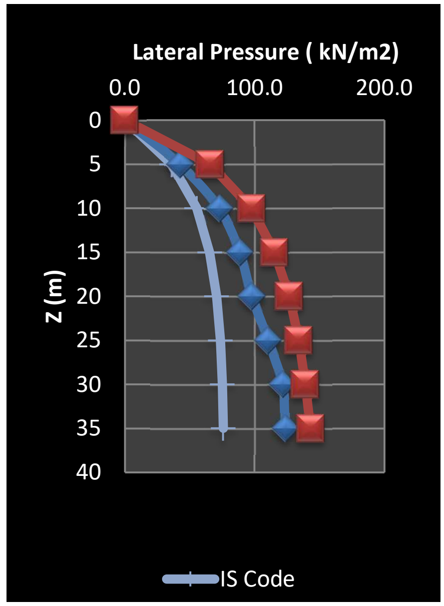
Height from Top, Y	Max (My)
m	
0-5	49.508
5-10	63.813
10-15	76.305
15-20	83.902
20-25	89.064
25-30	89.682
30-35	642.797

Vertical Reinforcement:

Maximum Moment in the Vertical Direction obtained from STAAD.Pro V8i

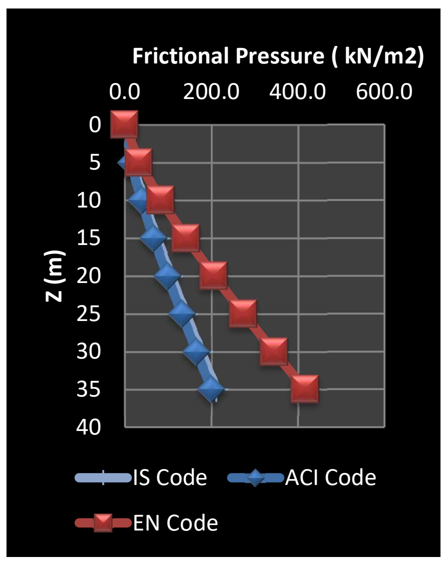
Shear Reinforcement:

Height from Top, Y	Max. SQX	Max. SQY	Permissible Shear Stress
m			
0-5	0.20	0.22	1
5-10	0.27	0.056	1
10-15	0.32	0.03	1
15-20	0.36	0.016	1
20-25	0.40	0.024	1
25-30	0.49	0.091	1
30-35	0.50	0.971	1

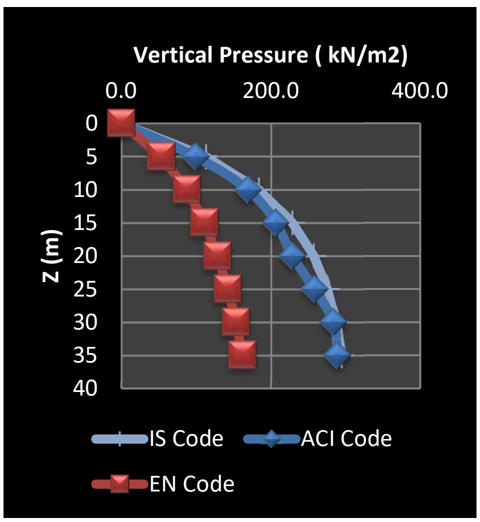


comparison

Height from Top, Y	Frictional Pressure		
	ACI Code	IS Code	EN Code
m			
0	0.0	0.0	0.0
5	14.7	16.9	33.5
10	38.0	42.7	83.1
15	66.4	73.2	141.7
20	97.8	106.3	206.0
25	131.1	140.6	274.0
30	165.3	175.6	344.7
35	200.2	211.0	417.3

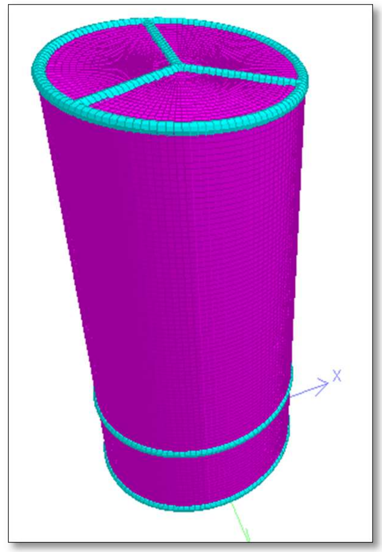


Height from Top, Y	Vertical Pressure		
	ACI Code	IS Code	EN Code
m			
0	0.0	0.0	0.0
5	99.2	112.4	53.8
10	169.5	183.7	87.7
15	206.7	228.9	111.3
20	228.7	257.5	128.8
25	258.3	275.7	142.4
30	283.7	287.2	153.3
35	288.9	294.5	162.2

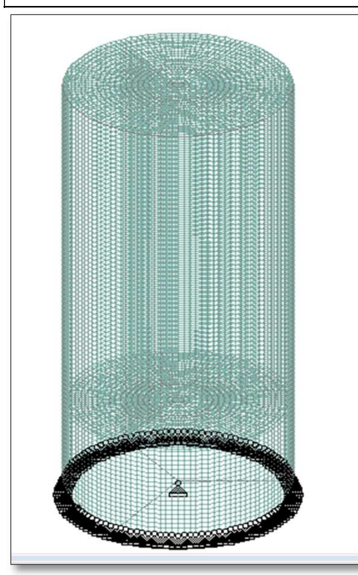


A. **Figures and Tables**

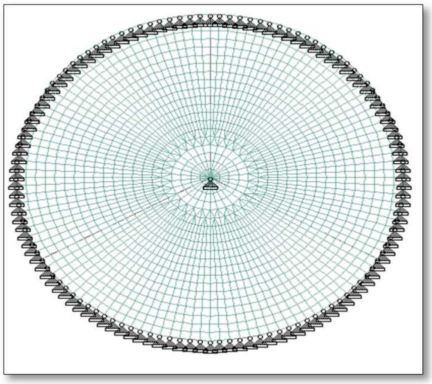
ANALYSIS IN STAADPRO



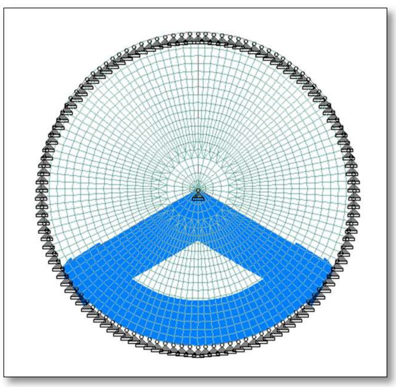
3D View, 3 Compartment Bottom 9 m clear space



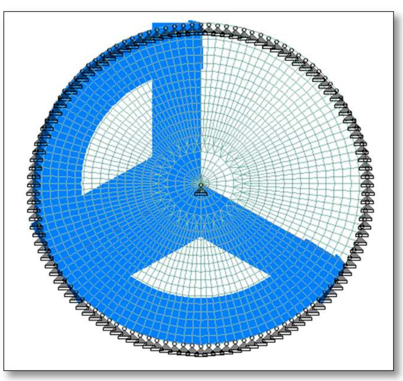
3 Compartment with Centre Column



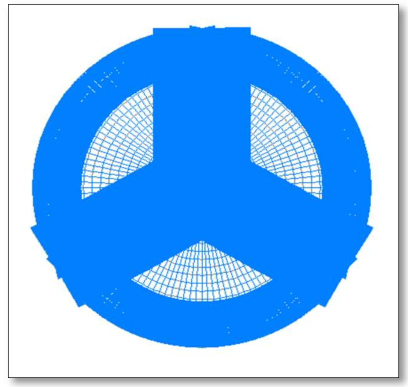
Plan
Hinge supports considered



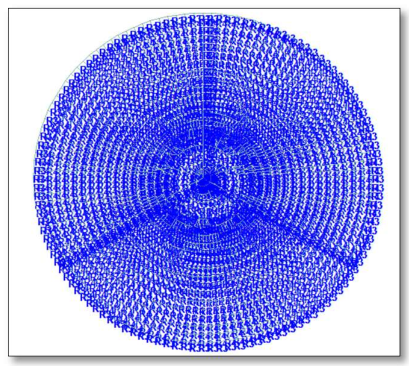
One Compartment Filled



Two Compartment Filled



Three Compartment Filled



Bottom Slab- 900 mm thick

IV. CONCLUSION

To perform the Analysis of silo using Equivalent lateral force method and to study the performance of structure located in all 4 seismic regions.

Comparison of different models of concrete silo for earthquake in terms of nodal displacement, stress and vertical or horizontal pressure on walls etc.

The comparable results were obtained to assess their potentiality and suitability in understanding the true behaviour of such a structure.

- The max lateral displacements obtained for the critical load case/combination for each model at different heights, the Zone V Node Displacements are 9.357 mm at 36 Mts height of the silo which is more compared with other seismic zones.
- The Maximum Absolute stresses of silo at different zones are represented as 1.28 N/mm2 in Zone II, 1.37 N/mm2 in Zone III, 1.48 N/mm2 in Zone IV, 1.67 N/mm2 in Zone V.
- The Maximum Shear stresses of silo at different zones are represented as 0.649 N/mm2 in Zone II, 0.693 N/mm2 in Zone III, 0.753 N/mm2 in Zone IV, 0.841 N/mm2 in Zone V.
- The concrete design is done with reference to the aspects of IS 456-2000, the area of steel required for different elements in all the models were presented.

V. REFERENCES

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