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COMPARISON BETWEEN RCC AND STEEL HOPPER WITH WIND AND EARTHQUAKE ANALYSIS USING STAAD- PRO

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Abstract

The Silos are structures utilized for the storage of materials, for example, wheat, grains, cement, carbon black, wood chips, food products, and sawdust, and so forth in enormous amounts. Silos are reinforced concrete structures designed to oppose the acting loads on it. The storehouse depth is more than twice the breadth or diameter. The storehouse for the most part comprises of a storage bin, which is utilized to store enormous amounts of materials like grains, coal, wheat, cement, and so forth., Hopper is the real storage area, where unloading of materials is completed. The vital target of this venture is to compare RCC Hopper and Steel Hopper with wind and earthquake analysis utilizing STAAD Pro. STAAD Modeling, Analysis of the hoppers because of the impact of Wind and Seismic load is completed. 3-D model of Hopper has been created in STAAD Pro to break down the conduct of reinforced concrete hopper and steel Hopper structure. The design techniques utilized in STAAD Pro analysis are Limit State Design adjusting to the Indian Standard Code of Practice IS 456:2000. The design includes load calculations and investigating the entire structure by utilizing STAAD Pro. Loading and the thickness esteems are alloted lastly, the outcome from the comparison is made.

Keywords: *Silos, Hopper,Comparison between RCC Hopper and Steel Hopper,STAAD Pro, Limit State Design,load calculations, Thickness;*

INTRODUCTION

Silos are structures that are utilized as storage tanks for the storage of different materials. They are utilized in the storage of food materials, substance businesses to store plastic gums, cement industrial facilities to store cement, calcium oxides enacted carbon, and so on., Storage silos are built utilizing wood, concrete, RCC, Stainless steel, and so on., The shelters and silos made of reinforced concrete have nearly supplanted with the steel storage silos these days. In view of the materials put away silos are delegated Bunker silos, tower silos, Bag silos, and so on., Tower silos have a diameter of about 4m to 48m and sack silos have diameter of about 2m to 21m. Storage silos devour less storage space and costs less compared to flat storage stockrooms and other storage alternatives. A portion of the bad marks incorporate inebriation and suffocation.

Hopper is a silo bottom with slanted walls where α > 20° as appeared in figure 1. Hopper is utilized for seeds storage (sunflower seeds, soya, maize, sorghum, rice, cement, carbon black, wood chips, etc.,). Imbue drying plant can likewise give brief storage of wet grain. The design of silos and their supporting structure includes three significant components like mass material, geometric, and auxiliary contemplations. The fundamental target of this venture is to make a similar investigation of RCC hopper and STEEL hopper. for example geometry and basic contemplations. In this, we not just think about the vertical powers (Dead load and live load) yet in addition consider the laterals powers like wind load and Seismic loads for basic analysis and design. The design includes load calculations and dissecting the entire structure utilizing STAAD Pro programming as per the Limit State Method adjusting to the Indian standard Code of Practice.

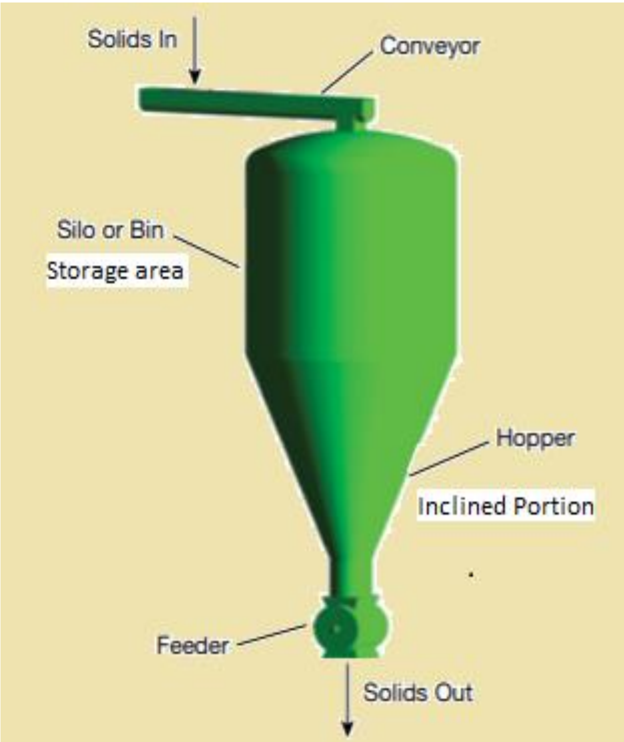

Figure 1.Overall view of silo

LITERATURE REVIEW

RiniRiyansi.E [2019] In this Paper, breaking down, designing and relative investigation on silo supporting structure utilizing RCC and Steel are finished. The General Arrangement (GA) drawings are readied, the auxiliary demonstrating, analysis and design is finished utilizing STADD PRO .The basic analysis is finished utilizing solidness lattice technique and the design will be done dependent on IS code standards.

Silvestri et al. [2019] portrayed different research center tests with silo led so as to acquire test esteems to check them with the built up code arrangements. The outcomes shows that in all the cases, the powerful mass is lower than the Euro code particular.

Muhammad UmairSaleem (2018) RCC silos are usually utilized structures for the storage of various materials. The structures are exceptionally defenseless whenever exposed to serious seismic powers.

Riya Dey (2015) Wind and Earthquake impact on RCC and steel structure this undertaking is to compare among RCC and Steel Structures. To design a multistoried structure utilizing STAAD Pro. In this design load calculations and investigating the entire structure is finished by STAAD Pro. Indian Standard Codes of [456,1893 Part - II,875,800] , IS: 1893, Criteria for earthquake safe design of structures – general arrangements for structures, Part 1, Bureau of Indian Standards, New Delhi, 2002, IS: 875, code of training for design load (other than earthquake) for structures and structures Bureau of Indian Standards, New Delhi, 2002,IS: 800, Code of training for general development in steel, Bureau of Indian Standards, New Delhi, 2007, IS: 1893, 2002 Part – II , Code for Seismic Load are alluded for designing the hopper.

PROPOSED METHODOLOGY

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STAAD or (STAAD.Pro) - Structural Analysis And Designing Program is a 3D structural analysis and design programming used to examine and design spans, pinnacles, structures, and other utility structures. In this paper, a 3-D model utilizing STAAD professional is created to examine the conduct of RCC hopper and steel hopper under wind and earthquake loads.

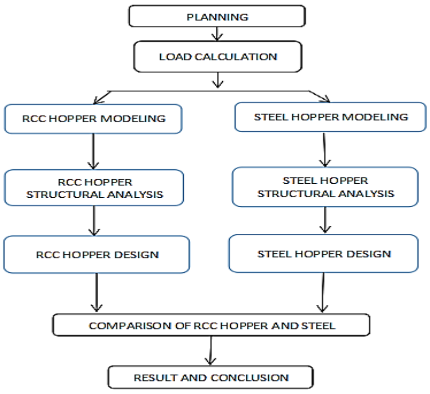

Figure 2. Proposed flow

At first, analysis is accomplished for both RCC and Steel hopper utilizing STAAD Pro. This paper clarifies quickly likewise the impact of wind or earthquake loads on the hopper for the near examination among wind and earthquake consequences for RCC and steel hopper. Definite displaying of the product and allocating the properties for the product model is completed.

The model is exposed to a various types of loadings, for example, Dead loads, Live loads, Earthquake loads, and the Wind loads with the different combinations as referenced underneath. In the wake of appointing the loads the distinctive load combinations are alloted in the STAAD PRO. The Hopper is broke down and compared for pivotal loads. The Hoppers are compared for the Bending second and shear power. The avoidances are obviously watched and checked the distinction for the Rigid and adaptable case for both the RCC and steel hoppers.

They are analyzed for various instances of gravity loads, for example, dead load and live load, the horizontal load, for example, earthquake and wind load and essential load cases according to IS 875 (part1,2&3) and IS 1893(part1)2002. Comparison is made in viewpoints, for example, loading, bowing second, fix works, recycling capacity, cost, toughness, fire-resistant properties and so forth., Our motivation is to Analyze and design both the hopper and study the impact on costing of material for development reason. Conclusive outcome and end is given .Based on the reasonableness the sort of hopper can be chosen and received.

MODELLING

The modeling and analysis of RCC hopper and steel hopper is carried out by using STAAD PRO v8i.

Figure 3. RCC SILO

Figure 4. STEEL SILO

LOADING COMBINATION

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Dead Load (DL) + Live Load(LL) + Material Load (ML)

Dead Load (DL)+ Live Load (LL)+ Material load (ML) + Wind Load (WL)

Dead Load (DL) + Live Load (LL) + Material Load (ML)+ Seismic Load (SL)

Dead Load (DL) + Wind Load (WL)

Dead Load (DL) + Seismic Load (SL)

In case of Steel hopper the thickness varies and is assumed to be about 10 mm.

On taking care of these parameters in STAAD Pro we can see the loading themes for both the RCC Hopper promotion Steel Hopper. Then again according to Seems to be (875 Part-1) the Self-weight of the hopper is naturally processed by the STAAD programming. The thickness of the plate ought to be alloted. Accordingly we relegate the thickness of the chunk to be 10mm.

Table 1. WIND PARAMETERS

Wind Zone	Zone I
V_b	30 m/s
Terrain category	Category-1
Greatest horizontal or vertical dimension	16 m < 20 m. - Class A
Risk Coefficient factor k_1	1
Terrain & Height factor k_2	1.14 up to 28 m
Topography factor k_3	1
Design Wind Speed V_z	V_z= 30 x 1 x 1.14 x 1 = 34.2 m/s
Design Wind Pressure [p_d]	P_d= 0.6 $(V_z)^2$ .6(34.2x34.2) = 701.784 N/m^2

Table 2 SEISMIC PARAMETERS

Zone and Intensity of Earthquake	Zone –II / Low
Zone factor, Z	0.1
Importance factor, I	1
Response reduction factor, R	3.0 for (OMRF)
% Live loads considered during seismic weight calculation	30
Shaking Intensity	VI or lower
Soil Type	Hard- Medium
Fundamental Time Period is based on the assumption of "with-out infill walls" i.e.	= 0.075 x $h^{0.75}$ where h = 5 m
(T)	Hence T=0.251 s

Hopper and bottom loads

Level bottoms are characterized as hopper bottoms where α< 20°. The vertical weight (pv) shifts over the bottom however for thin holders, it is sheltered to expect that the weight is steady and equivalent to:

p_v = [gA/UmK$_s$][1 - e$^{-KsmzU/A}$]- Janssen equation

p_v -vertical pressure

Z - depth

K_s -ratio of horizontal to vertical pressure

m-coefficient of wall friction

Manual check can be done is required using above method.

STAAD PRO RESULTS

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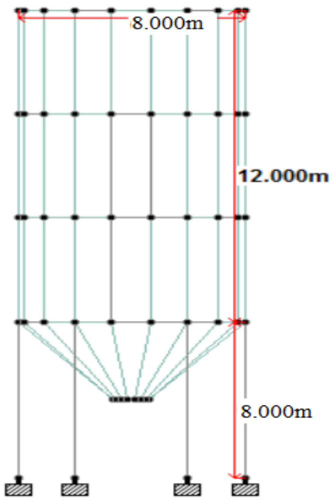
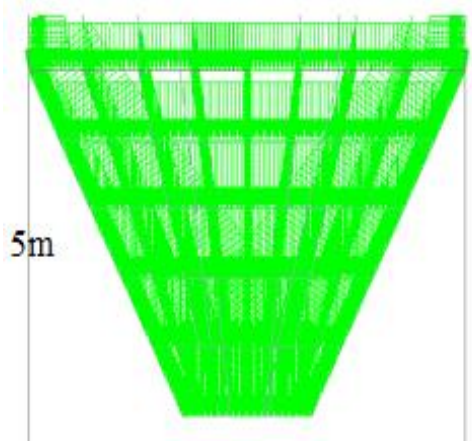
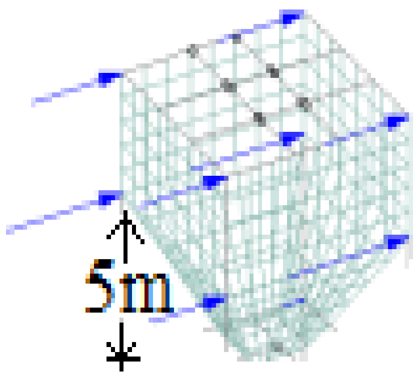


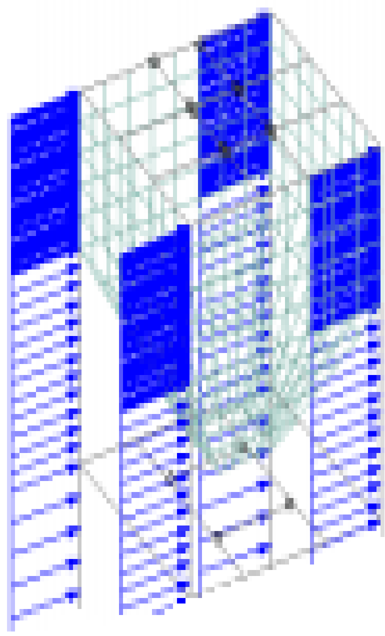
VARIATIONS DUE TO LOADING



VARIATIONS DUE TO SEISMIC LOAD



VARIATIONS DUE TO WIND LOAD



COMPARISON BETWEEN RCC HOPPER AND STEEL HOPPER

S. No	Description	Concrete(RCC) Hopper	Steel Hopper
1	Thickness of Hopper wall	250 mm	10 mm
2	Cost Estimate	Approx 15.50 lakhs	17 lakhs
3	Durability	More Durable than steel	Less durable than concrete
4	Repair works	Easier and cheaper	Costlier
5	Recycling	Not possible except some reinforced bars	Most of them can be recycled
6	Fire Resistant	More	Less
7	Foundation Size	2.5*2.5*0.40 Approx. Concrete	1.75 X 1.75 X 0.40 APPROX

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		quantity for 4 FDN – 10.0 Cu.m	CONCRETE QTY FOR 4 FDN = 5.0 Cu.m
8	Dead Weight	More	Less
9	Bending Moment due to wind force	Less	More
10	Bending Moment due to seismic force	More	Less

CONCLUSION

Generally cost is lesser in RCC hopper in comparison to Steel Hopper. Despite the fact that RCC hoppers are increasingly steady and strong its dead weight is more than steel hopper yet thinking about different elements, RCC hopper is better compared to steel hopper. Concrete silos have less support work and other design characteristics more noteworthy than steel silos. Then again, the Steel hoppers are anything but difficult to move and transport. Therefore dependent on the site conditions and financial conditions hoppers can be introduced reasonably.

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