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PARAMETRIC STUDY OF INDUSTRIAL CHIMNEYS

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Abstract Chimneys or stacks are significant industrial structures that allow harmful gases to be emitted at a higher elevation, away from the surrounding atmosphere. These constructions are typically tall, slender, and have circular cross sections. Chimneys are built with a variety of materials, including concrete, steel, and brick. Wherever a quick heat-up quantity and low thermal capability area unit is required, a steel chimney is attached to work methodically. Steel chimneys are also considered capable and cost-effective for heights up to 45 m. For the design of independent industrial steel chimneys, there are numerous standards available: Commonplace in India IS6533:1989 is a standard that was published in 1989. (Part-1 andPart-2). An independent steel chimney's geometry is critical to its structural response under lateral dynamic loading. This is because the stiffness parameters of the chimney are mostly determined by the shape. The key geometrical features of the steel chimney, on the other hand, are related to the associated environmental circumstances (e.g., overall height, diameter of the exit, etc.). On top of that, the design code (IS-6533: 1989 part 2) imposes a slew of requirements on the geometry of steel chimneys in order to ensure that the specified failure mode is achieved. The following are two important IS-6533: 1989 geometrical constraints for designing self-supporting steel chimneys:

Keywords: study object, scope, wind profile, basic wind speed study Discussion

INTRODUCTION :- Chimneys, also known as stacks, are crucial industrial structures that allow harmful gases to be emitted at a higher elevation, away from the surrounding atmosphere. These constructions are typically tall, slender, and have circular cross sections. Chimneys are built with a variety of materials, including concrete, steel, and brick. Steel chimneys are well-suited to work in a systematic manner when a quick heat-up time and low thermal capability area unit are required. Steel chimneys are also considered capable and cost-effective for heights up to 45 m. For the design of independent industrial steel chimneys, there are numerous standards available: Commonplace in India IS 6533:1989 is a standard that was published in 1989. (Part-1 andPart-2). An independent steel chimney's geometry is critical to its structural response under lateral dynamic loading. This is because the stiffness is mostly determined by the geometry.

Objective of Study:

1. The heights of the industrial chimneys chosen for analysis are 50, 55, and 60 meters, with height to base diameter ratios of 11, 12, and 13 for both RCC and Steel Chimneys.
2. The optimum top diameter to base diameter ratio is 0.6. These characteristics were used to a total of 6 chimneys for wind speeds of 39 m/s in order to evaluate wind response and stiffness criteria.
3. Chimneys are modeled using a fixed-base linear element in STAAD PRO to calculate mode shapes and frequencies.

1. SCOPE:-

i. The current study takes into account self-supporting flaring steel and RCC chimneys.

ii. Chimneys are permanently attached to their supports. In the current investigation, the soil elasticity was examined.

iii. All of the chimneys considered are single-flue.

iv. Over the entire height of the chimney, uniform thickness is regarded.

v. For the design of the chimneys, the only wind load is taken into account.

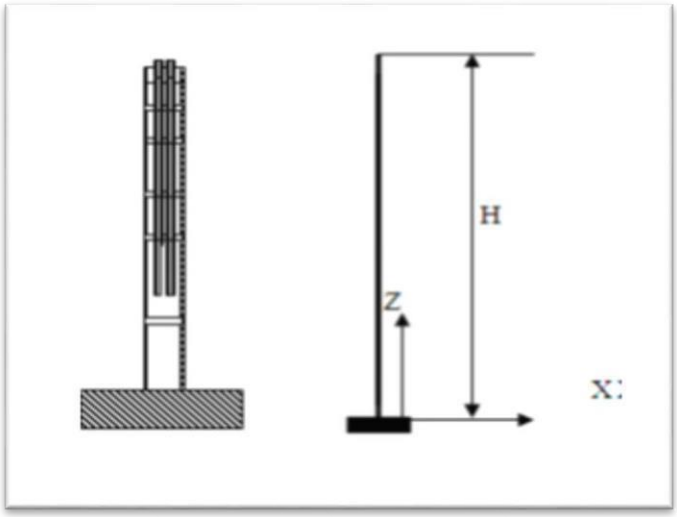

Figure:-Line Diagram of Chimney

LITERATUREREVIEW:-

A.Dhandapani. N.V. (2018) Chimneys serve as landmarks for power plants and industrial installations when modeling them with the FEM method. Chimneys are vertical structures that vent gaseous combustion products, chemical waste gases, and exhaust air into the atmosphere. RC chimneys have become a typical construction in modern situations because to the rapid rise of and the growing necessity for air pollution management.

B.Siva Rama Prasad.C. V. (2017) Industrial chimneys have long been used by enterprises to dissipate hot flue gases into the atmosphere, reducing pollution and ensuring that air quality regulations are met. Pollutant impact on the environment can be mitigated by distributing pollutant latitudes. In the case of a chimney draught, air quality is usually poor.

1. METHODOLOGY

A. Basic Design

Wind speed

One of the most important phases in designing the along-wind load is determining the fundamental design wind speed. The basic wind speed is taken into account while calculating the effective wind pressure. The basic winds peed (V b) is defined (by the CICIND code) as an hourly wind speed at 10m above the ground level in open flat country with no impediments. This means that the wind speed is measured at a height of ten feet above the ground level at the chimney's location and averaged over an hour.

B. Wind Profile

Frictional contact with the earth's surface slows wind movement. Turbulence in wind flow across a region known as the 'atmospheric boundary layer' is a subtle outcome of this retardation. The thickness of this physical phenomena is determined by the roughness of the terrain and the angle of latitude. The steeper the topography, the greater the mean flow and, as a result, the gradient height.

1.STAADMODEL

The model was created in STAAD Pro with a four-nodded plate element and a line model. The deflection of these two types was evaluated under the same load and found to be identical. As a result, the linear element model was chosen since it is simple to produce and get mode-shapes.

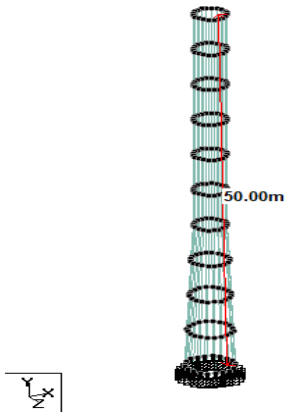

Figure2-3Chimneywith50meterheight

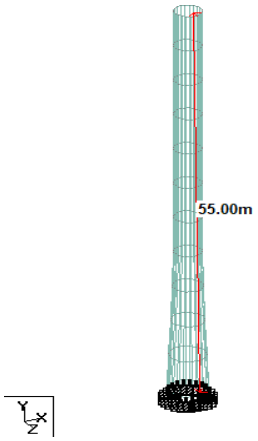

Figure2-2Chimneywith55meterheight

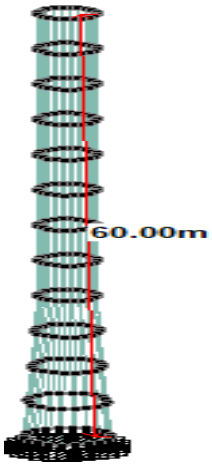

Figure2-1Chimneywith60-meterHeight

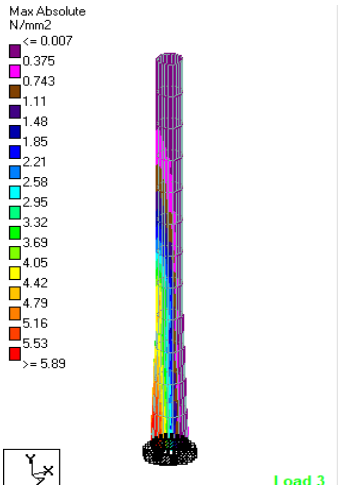

Figure2-6StressesonChimney

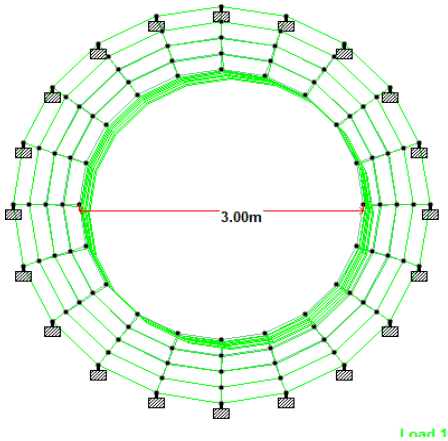

Figure2-4TopDiameterofchimney

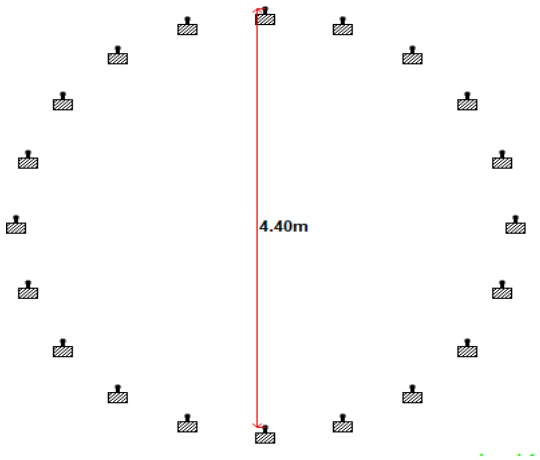

Figure2-5BaseDiameterofChimney

Result & Discussion:- Only wind force on sides for both RC and Steel Stack analyses with varied H/D ratios, and their results are compared in terms of Node displacement, Support reaction, Support moment, plate stresses, and other factors.

Node Displacement for RC Stack

Table3-1NodeDisplacementinSteel Stack

Node Displacement in X & Y direction(mm)	**H/D=11**	**H/D=12.5**	**H/D=13**
	312.709	483.763	721.576

Node Displacement for Steel Stack

Table3-2NodeDisplacementinSteel Stack

Node Displacement in X & Y direction(mm)	**H/D=11**	**H/D=12.5**	**H/D=13**
	107.753	166.731	248.74

Comparison between RC & Steel Chimney

Table3-3ComparisonofRC&Steel Chimney

Node Displacement in X & Y direction(mm)	**Concrete H/D=11**	**Steel H/D=11**	**Concrete H/D=12.5**	**Steel H/D=12.5**	**Concrete H/D=13**	**Steel H/D=13**
	312.709	107.753	483.763	166.731	721.576	248.74

Discussion

When the height of the RC chimney is increased by 35 percent and 56 percent, the maximum node displacement increases by 35 percent and 56 percent, respectively. When compared to a 50 m chimney, the lengths increase to 55 m and 60 m, respectively. Similarly, Maximum Node Displacement increases with steel chimney height, increasing by 35 percent and 56 percent respectively. When compared to a 50 m chimney, the lengths increase to 55 m and 60 m, respectively. When compared to RC chimney, the maximum Node displacement in Steel chimney is 65 percent lower.

CONCLUSION

o The main goal of this thesis was to compare the geometrical constraints of self-supporting RC and steel chimneys in terms of analysis. Here, we examine and evaluate steel and concrete chimneys, taking into account lateral forces and the results produced in terms of Node Displacement.

o The analysis concluded that as the H/D ratio increases, node displacement increases, and RC steel chimneys are more exact than steel chimneys when the peak of the stack is increased.

o An increase in the structure's weight increases wind moments, whereas an increase in the structure's height and the height to bottom diameter ratio increases both static and dynamic wind moments.

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