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ANALYSIS OF SELF SUPPORTING STEEL CHIMNEY AS PER INDIAN STANDARD- A REVIEW

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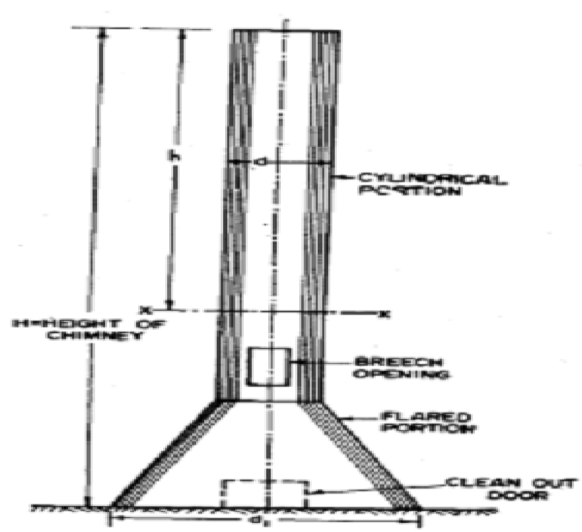
Abstract – *This paper represents the study of the various research papers on the all type of chimney which is present in the chronological order. It has been undergone a considerable development of industrial chimney in past few years in terms of structural system as well as method of analysis. Also the height of chimney has been increased for the better control of environment pollution in populated areas. With the increase in height, the wind forces have become predominant forces while analyzing and designing such structures. Here in this paper, an attempt has been made to analyze the industrial steel chimney for the prevailing wind forces and seismic forces considering chimney with and without guyed ropes.*

Key words- *environment pollution, wind force, seismic force, deflection, guyed ropes etc.*

(1). INTRODUCTION-

Chimneys or stacks are very important industrial structures for emission of poisonous gases to higher elevation such that the gases do not contaminate surrounding atmosphere. These structures are tall, slender and generally with circular cross- sections. Different materials such as concrete, steel or masonry, are used to build chimneys. Steel chimneys are ideally suited for process work where a short heat-up period and low thermal capacity are required. Steel chimneys are also economical, for height up to 45m. Although chimneys do not cause a great hazard to life and limb as buildings with high human capacity, damage to chimneys may result in shut down of plants and industries. The chimney may be self supporting or guyed chimney. In this paper, an attempt has been made to analyze the industrial steel chimneys with and without guyed ropes for prevailing wind conditions and forces.



SELF SUPPORTING STEEL CHIMNEY

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(2). LITRATURE REVIEW-

B.Tharun Kumar Reddy and S M Abdul,
Mannan Hussain," (2014)
presents the analysis and design of self-supported steel chimneys. The chimney is considered as a cantilever column with tubular cross section for analysis. Wind load, Temperature effects, seismic load and dead loads are considered for design. But apart from these loads they have considered wind load as most vital load due to height of the structure. The effect of wind can be divided into two components: (a) Along wind effect (b) Across wind effect. But the across wind effect is most critical and unpredictable. Design force in a chimney is very sensitive to its geometrical parameters such as base and top diameter of chimney, height of the flare, height of chimney and thickness of the chimney shell. Manholes are provided at the bottom in the chimney for inspection purposes. Two chimney models, one with the manhole and other without manhole, have been analyzed using finite element software ANSYS for static wind load.

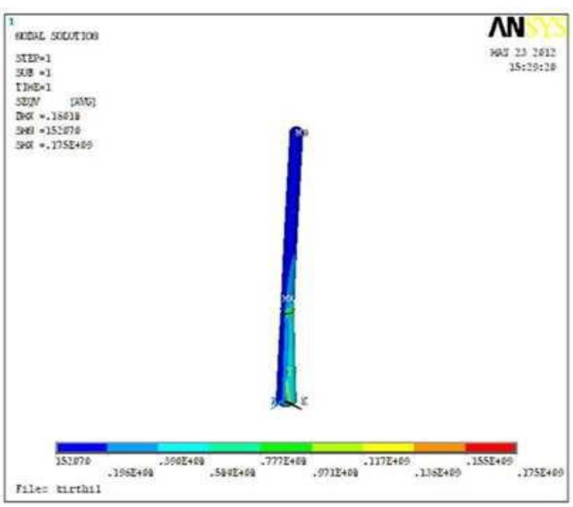

Figure 1-Von-Misses stress without manhole

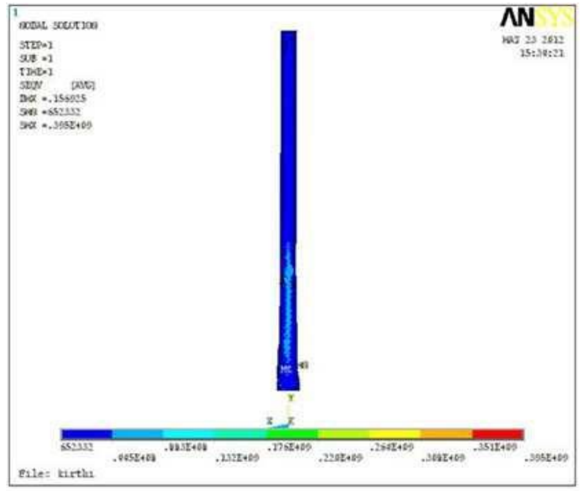

Figure 2-Von-Misses stress with manhole

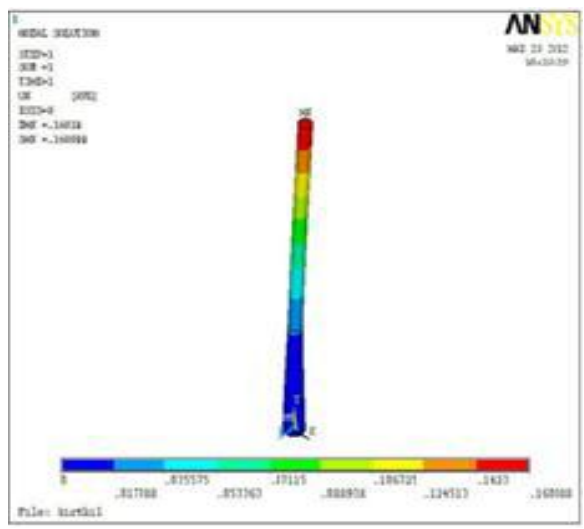

Figure3-Top deflection without manhole

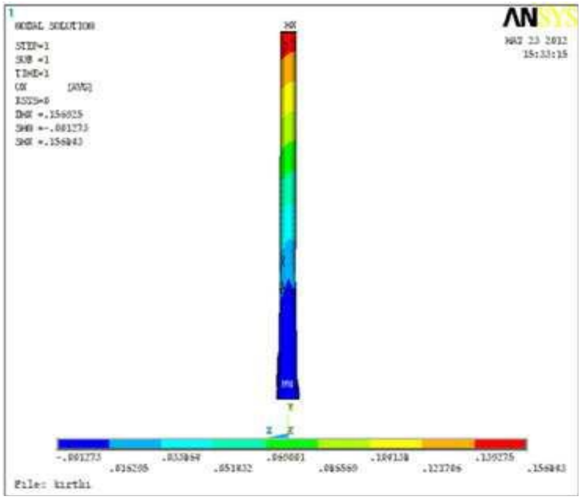

Figure 4-Top deflection with manhole

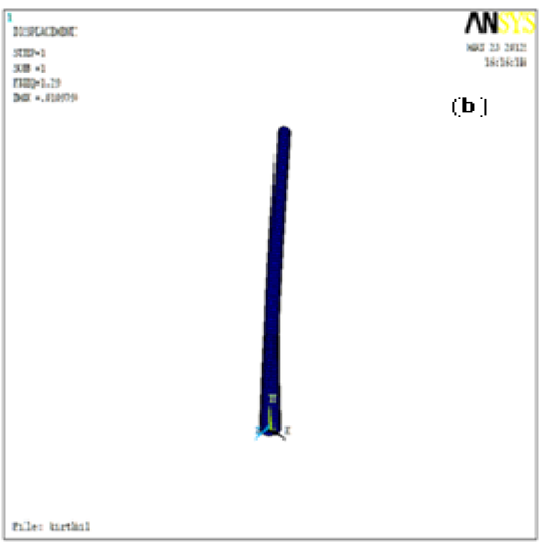

Figure 5-Mode shape without manhole

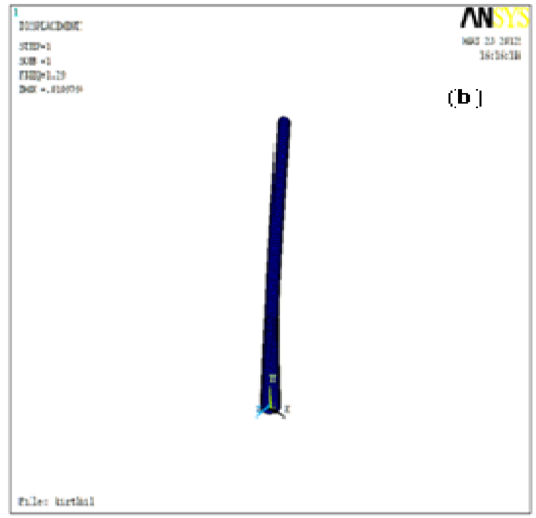

Figure 6- Mode shape with manhole

The results show that the maximum stress in the chimney with manhole is increased by 55.6% as compared to the maximum stress in the chimney without manhole. The top deflection is marginally equal.

Pradip Sarkar and Robin Davis,"(2013)

Present study investigates the stresses, deflection and mode shapes of the chimney
due to the presence of an inspection manhole. Maximum Von- Mises stress, top deflection and mode shapes were calculated using finite element software ANSYS.
The results show that, the due to the presence of manhole, the stresses are increased by approximately 1.5 times and frequency is decreased by approximately 1.12 times.

Rajkumar, Vishwanath. B. Patil," (2013)

The main objective of this paper is to get the comparative study of seismic, along wind and across wind effects on a varying height from 150m to 250m at an interval of 5m, for Zone II, Hard soil & Critical Zone of Zone V, Soft soil with wind speed varying from 33 meters/sec to 55 meters/sec with a internal temperature of 100 degree Celsius. The chimney is lined with mild steel and stainless steel whose unit weight is 78.5 KN/m^3.

On comparison of the wind loads with that of the earthquake loads, the following conclusions are -

The wind loads are always governing the design of RC Chimney.

The stresses induced in chimney due to Earthquake at Critical zone of Zone V, Soft soil is almost equal to the stresses induced by wind at minimum basic speed i.e., 33 meters/sec. This concludes that the seismic

vortex induced Oscillation depends upon wind speed & Slenderness ratio of chimney.

If the aspect ratio of the chimney is greater than 28 then the design of chimney is to be checked for higher modes of oscillation.

The minimum grade of concrete to be used for Chimney should be greater than M25 since lower grades fail below the permissible stresses.

G. Murali, B. Mohan, P. Sitara And P. Jayasree," (2012)

This paper reveals the study of three chimneys 55m high above ground level. These chimneys were designed as per **IS: 6533–1989** and wind load was calculated as per **IS: 875–1987.** Three different wind speeds were considered for the design of chimneys viz., 47m/s, 50m/s & 55m/s respectively. They considered parameter for study of static forces, the static moment, dynamic moment and thickness of chimney shell were compared to three chimneys. However these three chimneys are divided into six zones, the height of zone1, 2, 3, 4, 5 and 6 is to be 10m, 10m, 9m, 9m, 9m, and 8 respectively.

Table 1- Geometry of chimney

Chimney	Basic Wind Speed (m/s)	Height (m)	Top diameter (m)	Bottom diameter (m)
1	47	55	1.6	3
2	50	55	1.6	3
3	55	55	1.6	3

This indicates the basic wind speed is directly proportional to the dynamic forces on chimney.

Sules, S. Nwofre T.C," (2012)

In this paper, the vortex induced vibration of a 50m steel chimney under wind excitation is discussed. A steel chimney of length 50m is modeled as a cantilever structure subjected to two degrees of freedom.

Table 2- Wind pressure at different height of chimney

Chimney	Height from bottom(m)	Wind Pressure(KN/m^2)	Wind Load(KN)
1	10	0.208	1.17
2	20	0.304	1.70
3	30	0.390	2.18
4	40	0.467	2.62
5	50	0.519	2.91

The results of the analysis showed that the fundamental frequency of vibration of the chimney was much lower in value than the frequency of the vortex shedding showing the possibility of the chimney going into resonance resulting in large displacement and stresses which may cause fatigue failure during the expected lifetime of the chimney.

(3). CONCLUSION OF LITRATURE REVIEW-

All the above reviews conclude that the wind effect on steel chimney is most critical and unpredictable as compared to earthquake loading. For designing of steel chimney, height of chimney, base diameter, top diameter and thickness of chimney are most critical parameters.

(4). ACKNOWLEDGEMENT-

I would like to express our sincere thanks towards researchers **Mr. Abhishek kumar** and **Mohd. Afaque** who gives us a valuable information which is useful in proposed project.

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