INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)

e-ISSN : 2583-1062

Impact Factor: 5.725

www.ijprems.com
editor@ijprems.com

Vol. 04, Issue 05, May 2024, pp: 21-23

THERMAL ANALYSIS OF CHIMNEY

Umar Sheikh[1], Nitesh Rane[2]

[1]PG Scholar, MED, Dr. APJ Abdul Kalam University Indore, M.P., India.

[2]Assistant Professor, MED, Dr. APJ Abdul Kalam University Indore, M.P., India.

ABSTRACT

Steel Chimneys are frequently known as steel Stacks. The steel chimneys are made of steel plants and supported on foundation. The steel chimneys are cylindrical in shape. To provide larger base and greater stability, and to allow for easy entrance of flue gases, the lower portion of the steel chimney is widened or flared out. The widened section of the chimney at the base reduces the unit stresses in the steel at the base of the chimney. The steel chimneys are constructed for the emission of flue gases to such a height that the gases do not contaminate the surrounding atmosphere. The cross-sectional area of the steel chimney is kept large enough to allow the passage of burnt gases. The cross-sectional area of the steel chimneys depends on the type and quantity of fuels to be used in plant, available draft for carrying the burnt gases up the chimney.

The height of the steel chimney is kept to provide the required draft. "The draft is defined as the difference between the absolute gas pressure at any point in the steel chimney and the ambient atmosphere pressure." The draft depends on the height of the steel chimney above sea level, the type of fuel to be burnt, the type of furnace and the temperature of the burnt gas

When the gases in a steel chimney are heated, then the gases expand. The hot gases occupy larger volume than before. The weight of the gases per cubic metre becomes less. As a result of this, the unit pressure at the bottom of chimney due to weight of hot gases also becomes less than the unit pressure due to weight of cold air outside the chimney. The difference between two pressures results in the flow of the burnt gases up the chimney. For the purpose of structural design of steel Structures chimney, the height and the diameter of chimney at the top are known.

The loads acting on the steel chimney are transferred to the foundation easily by the widened section. The base of the chimney may be made conical or bell-mouthed. But the fabrication of bell-mouthed base does not have any advantage over the conical base and the fabrication is costly. So, generally the conical base is provided.Steel chimneys are structures with tall, slender and tapering with circular cross sections. They are ideally suited for process work where a low thermal capacity required and short heat-up period.

Keywords: Chimney, Concrete , Mix Design, OPC, New Technology

1. INTRODUCTION

Most of the industrial steel chimneys are tall structures with circular cross-sections. Such slender, lightly damped structures are prone to wind-exited vibration. Geometry of a self-supporting steel chimney plays an important role in its structural behaviour under lateral dynamic loading. This is because geometry is primarily responsible for the stiffness parameters of the chimney. However, basic dimensions of industrial self-supporting steel chimney, such as height, diameter at exit, etc., are generally derived from the associated environmental conditions. To ensure a desired failure mode design code (IS-6533: 1989 Part 2) imposes several criteria on the geometry (top-to-base diameter ratio and height-tobase diameter ratio) of steel chimneys.

The objective of the present study is to justify the code criteria with regard to basic dimensions of industrial steel chimney. During the past few years industrial chimneys have undergone considerable developments, not only in their structural conception, modelling and method of analysis, but also in the materials employed and the methods of construction. In this sense the outstanding increase in height should be highlighted as a consequence of a better control of environment pollution in populated areas.

With the increment in height the seismic action and wind have become important for working out actuating stresses on this particular type of continuous structures, making it necessary, for this reason, to study the vibratory nature by carrying out a dynamic analysis. Thermal analyses were carried out to study the effect of chimney shell thickness.

It was found that the reactions at the base of the chimney are proportional to the thickness of the shell, but the radial and vertical displacements are inversely proportional with the thickness of the shell, While the effect of changing thickness on the bending moments and membrane stresses was found to be small which indicates that increasing the thickness of shell chimney doesn’t lead to smaller thermal stresses.

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)

e-ISSN : 2583-1062

Impact Factor: 5.725

www.ijprems.com
editor@ijprems.com

Vol. 04, Issue 05, May 2024, pp: 21-23

2. OBJECTIVE OF THE WORK

The literature review presented above shows that there are a number of published work on steel and concrete chimneys. Experimental and theoretical studies are presented on the behaviour of tall chimneys subjected to wind and seismic force. It is found that majority of the research papers on chimney are concentrated on its response to vortex shedding. However, a very less research effort is found on the geometric limitations of the design code with regard to steel chimneys.

On the design and analysis of steel chimney with special interest on the geometrical limitations, a literature review is carried out. On the design and analysis of steel chimney, there are only two published literature found that deals with the geometrical aspects of steel chimney although a number of literature are available. On the literature reviewed as part of this project, this section presents a brief report. To show the earthquake response of column reinforced concrete chimney Wilson (2003) conducted the experimental program. To evaluate the inelastic response of column concrete chimney subjected to earthquake excitation a non-linear dynamic analysis procedure is developed. The results encourage reliance on the development of ductility in reinforced concrete chimneys to prevent the generate of brittle failure modes Based on experiments. By various codes generation such as IS 4998, ACI 307, CICIND, etcKiran (2001) shows design and analysis of concrete chimney. Numbers of published works are there on steel and concrete chimneys the literature review showed above show that. On the behavior of column chimneys subjected to wind and seismic force experimental and theoretical studies are presented. The majority of the research papers on chimney are concentrated on its response to vortex shedding it is found. On the geometric limitations of the design code with regard to steel chimneys, a very less research effort is found.

3. RESULT

- We have observed there the condition of the chimney which is not good and does not properly work.
- We have analysed the chimney and compare the data with ideal chimney.
- The Analysis results are described above.

As we have observe from the analysis of the steel chimney which we need done on Ansys software that the chimney has been made in tapered section up to a particular length after which the remaining part of the chimney is cylindrical throughout its length so when we done analysis that we observe that report and find that the whirl is being formed in the lower tapered section of the chimney due to its tapered portion after this taperd portion the gases are removing outside easily outside the chimney due to which the temperature is increasing very rapidly in lower section of chimney and the flue gases are not emerging outside properly form the chimney so from the achieved result we observe that whirl formation is happening due to the tapered portion so we are suggest to the industry to change the design structure of the steel chimney and make it tapered across its length.

According to the observation we made a new design of the chimney as per we analysis and want to increase the efficiency of the chimney.

4. CONCLUSION

The combustion flue gases inside the flue gas stacks are much hotter than the ambient outside

air and therefore less dense then the ambient air that causes the bottom of the vertical column of hot flue gas to have a lower pressure at the bottom of a corresponding column outside air that higher pressure outside the chimney is the driving force that moves the required combustion air into the combustion zone and also moves the flue gas up and out of the chimney. The movement or flow of combustion air and flue gases are called natural draft or natural ventilation also called as stake effect.

dueto the shape of bottom of the chimney the turbulence flow generated that causes back pressure on flue gases so it resists the smooth flow of flue gases from the chimney. So we are going to design a tapered shape chimney at the place of existing chimney having larger area at the bottom so that natural draft can be produced.

As we have observe from the analysis of the steel chimney which we need done on Ansys software that the chimney has been made in tapered section up to a particular length after which the remaining part of the chimney is cylindrical throughout its length so when we done analysis that we observe that report and find that the whirl is being formed in the lower tapered section of the chimney due to its tapered portion after this taperd portion the gases are removing outside easily outside the chimney due to which the temperature is increasing very rapidly in lower section of chimney and the flue gases are not emerging outside properly form the chimney so from the achieved result we observe that whirl formation is happening due to the tapered portion so we are suggest to the industry to change the design structure of the steel chimney and make it tapered across its length.

5. REFERENCES

[1] A Flaga and T Lipecki (2010), "Code approaches to vortex shedding and own model", Engineering Structures. 32, pp.1530-1536.

[2] A Kareem and J Hseih (1986), "Reliability analysis of concrete chimneys under wind loading", Journal of Wind Engineering and Industrial Aerodynamics. 25, pp. 93-112.

[3] A Hlaga (1983), "A analysis of along-across and torsional wind effect on slender engineering structures in stochastic formulation", Wydawnictwa politechniki, Monografia No 22, Krakow (in Polish).

[4] A. Castelani (1983), "Construzioni in zona sismica.Milano", Masson Italia Editori. CICIND, "Model code for steel chimneys (Revision 1-December 1999)", Amendment A, March 2002.

[5] D Menon and PS Rao (1997), "Uncertainties in codal recommendations for across-wind load analysis of R/C chimneys", Journal of Wind Engineering and Industrial Aerodynamics. 72, pp. 455-468.

[6] DE Newland (1981), "Factors in the design of resilient seatings for steel chimneys and masts", Soc. Environmental engineers conference on structural methods of controlling wind excited vibration, Loughborough.

[7] DJ Johns, J Britton and G Stoppard (1972), "On increasing the structural damping of a steel chimney", Int. J. Earth. Engg & Struct. Dyn. 1, pp. 93-100.

[8] FJ Pallare´s, A Aguero and M Martın (2006), "Seismic behaviour of industrial masonry chimneys", International Journal of Solids and Structures. 43, pp. 2076–2090.

[9] G Hirsch and H Ruscheweyh (1975), "Full-scale measurements on steel chimney stacks" Journal of Industrial Aerodynamics. 1, pp. 341-347.