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REVIEW PAPER ON ANALYSIS, DESIGN AND COST ESTIMATION OF RCC AN STEEL CHIMNEY

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Abstract - This review paper examines a landmark research project on the analysis and design of RCC and steel chimneys. When analysing chimneys, the main loads to consider are wind loads and seismic loads. cost estimate was done for both steel and RCC chimney. Finally, a comparison was made between RCC and steel chimney.

***Key Words*:** chimney, Lining Materials, loads, estimate.

1.INTRODUCTION

Chimneys are tall and slender structures used to remove waste/flue gases at higher altitudes with sufficient exit velocity so that the gases and undissolved solids (ash) are dispersed into the atmosphere in a defined dispersion such that their concentration on reaching the ground is within the acceptable limits set by the. pollution control regulatory authorities. In a coal-fired power plant, the flue gases from each boiler are fed into a chimney where they are dispersed into the atmosphere. Industrial chimneys are vertical structures created for the purpose of reducing the impact of greenhouse gases and other industrial substances on its immediate surroundings. These stone (brick), concrete or steel structures are used to expel gases generated by industries after their production processes are completed. The aim is to reduce the impact of these sub-products on the environment and on people. Some reduce pollutant levels while others reduce gas temperature. A chimney is a tall, slender structure through which waste gases are discharged into the external atmosphere at a sufficiently high height through the chimney effect. Chimneys are typically vertical or as close to vertical as possible to ensure that the gases flow smoothly, under the influence of what is known as the stack effect or stack effect. The space inside the chimney is called the flue. The height of the chimney significantly affects its ability to remove flue gases to the outside environment through the chimney effect. The function of the chimney is to conduct and divert the flue gas or flue gases away from the operating area of the industry and also from the human habitation. The cross-section of the chimney is generally hollow circular, from an aerodynamic point of view, and tapered, from the point of view of structural economy and aesthetics. The stack is exposed to wind gusts in the downwind direction due to aerodynamic forces as well as possible vortex shedding in the upwind direction. Tall reinforced concrete chimneys form an important part of large industries and power plants. Chimney damage from wind or earthquake loads can shut down power plants and important industries.

2. LITERATURE REVIEW

1. Analysis Of Tall RC Chimneys as Per Indian Standard Code(2016).Amitha Baiju ,Geethu S.
   According to the research conducted in this paper in areas with low wind speeds, downwind effects are a critical factor for RC chimney design. From the calculated wind load and temperature load, it is clear that wind effects are the main component compared to temperature effects. It was also found that the lateral deflection at the top of the chimney increases with the height of the slender structure

2. Analysis And Comparison of Steel And RCC Chimney(2016)P Hariprakas ,et,.al
   The project studied the process of stimulation and design of 90 meters high, steel and RCC chimneys. From this analysis, it follows that the stability of the chimney is probably most affected by the wind load and the temperature of the gases that are released. The total weight of the stack is higher for RCC than steel for a given height. The maximum heel moment is higher for steel chimney as compared to RCC chimney. While the shear force is higher in RCC chimney than steel chimney. Abstract cost estimate is slightly higher for steel chimney RCC chimney. RCC chimneys are more suitable for chimneys up to 300 meters in height. In stark contrast, steel chimneys are limited to a lower height, such as 60 to 90.

3. Study of RCC chimney
R.kalaimugil (2016)

Chimneys are tall structures and bear the main load dead weight of the structure, wind load, earthquake load and temperature load. In this document on the steel chimney is designed with wind load and earthquake load in mind. The geometry of a self-supporting steel chimney plays an important role in its structural behavior under the crossbar dynamic load. This is because geometry is primarily responsible for stiffness chimney parameters.

4. Comparative Analysis of RCC & Steel Chimney with Varying the Height of Stack (2019).
Shubham Baghel, Dr. J.N Vyas

This paper has been published by International Research Journal of Engineering and Technology (IRJET). This paper considered three various heights of chimneys i.e. 60,55 and 50m with top and bottom diameter 3 and 4.4m respectively. They compared RCC and steel chimney of these heights with grade of concrete M35 and Fe500. From the analysis this paper concluded that the node displacement and Maximum support Reactions in vertical direction will increases with increasing the H/D ratio. Also this paper concluded that Increase in weight of the structure increases the wind moments, whereas increase in height of the structure and height to the base diameter ratio increase the wind moments, also maximum support moment in all three directions i.e. X,Y,Z will increase with increase in H/D ratio in both RCC and steel chimney.

5. Comparative Analysis of Steel Chimney Subjected Dynamic Load Using STAAD .(2018)
Prof. V.G. Patwari

This paper has been published by Journal of Emerging Technologies and Innovative Research (JETIR) .This paper analyse two types of chimneys one with using guyed wire and another without using guyed wire, and on the basis of that they concluded that the stress concentration for guyed wire is more as compared to that of without guyed wire. One with guyed wire can bear more tension as compared to without guyed wire. Also this paper concluded that for dynamic analysis shear force and bending moment values decreases as the height of chimney increases from top to bottom and also mentioned that STAAD-PRO is an efficient tool for analysis of chimney.

6. Governing Loads for design of a 60 m Industrial RCC Chimney**(**2018**)**
K. Anil Pradeep et al

This paper has been published by International Journal of Innovative Research in Science, Engineering and Technology(IJIRSET). This paper has considered a 60m Industrial RCC Chimney where both wind forces and earthquake forces are taken into consideration and compared each other on STAAD PRO software. For earthquake analysis,3 zones have been taken into consideration where it is concluded that for each zone there is 50%increase in moments compared to previous zones. For wind analysis across winds, along winds and combination of two winds are being used for analysis. It has concluded that across wind effect has more significance as compared to wind effects.

7. Cost optimization of Reinforced Concrete Chimney **(**2013**)**
Prof . Wakchure et al

This paper has been published by International Journal of Civil Engineering and Technology (IJCET). This paper has considered a 66 m Industrial RCC Chimney whose cost optimization has been done. The height of RCC Chimney has been divided into 3 segments whose outer diameter is kept constant and thickness varies from top to bottom. A function is being used to calculate optimal values of concrete, steel and cost and is being compared with original values . Shuttering, Centering is included in the cost calculation . Later this cost optimization is performed by breaking the height of chimney in 6 segments and later in 11 segments. Total cost has been compared with conventional cost by plotting the graphs which concluded at the end that as no. of segments goes on increasing the overall cost of structure gets optimized.

8. Parametric Study of Industrial Chimneys (2022).
Prof. Sumit Shamlal Deore, Prof. Nikam Pravin Ankushrao, et al

This paper has been published by International Research Journal of Engineering and Technology(IRJET).The analysis shows that the node displacement increases as the H/D ratio increases, and the RC steel chimney is more accurate than the steel chimney when the chimney peak value increases. While the weight of the structure increases with the wind moment, the increase in the height of the structure and the height relative to the diameter increases the static and dynamic wind moments.

9. Comparison between Steel Chimney and R.C.C. Chimney (2016)
Bhagyashree Vananje Namrata Shinde, et .al

This paper has been published by International Journal on Recent and Innovation Trends in Computing and Communication.We looked at the chimney from a simple perspective. For this reason, we think the steel stove woul d be more desirable than the R.C.C. oven.The chimney fa cilitates the evacuation of the smoke**.** Due to cost analysis problems, it depends on the pile height as well as the met al rise area in the RCC. It depends on the size of the grou p. Also, going forward**,** both groups are cautious.

3. SUMMARY FROM LITERATURE REVIEW

The downwind effects are a critical factor for RC chimney design in areas with low wind speeds. Wind effects are the main component compared to temperature effects, and the lateral deflection at the top of the chimney increases with the height of the slender structure. The steel chimney is designed with wind load and earthquake load in mind, and its geometry plays an important role in its structural behavior. The RCC and steel chimneys of different heights are compared, with RCC chimneys being more suitable for chimneys up to 300 meters in height. The node displacement and maximum support reactions in vertical direction increase with increasing the H/D ratio. The stress concentration for guyed wire is more as compared to that of without it, and for dynamic analysis, shear force and bending moment values decrease with increasing chimney height. STAAD-PRO is an efficient tool for analysis of chimney.

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