A Review on Analysis of RC Chimney

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Abstract- *Reinforced chimneys are used in Power plants to take the hot and poisonous flue gas to a great height designed mainly to resist the lateral forces like wind and earthquake as well the thermal stresses of the flue gas. An attempt is made to understand the variation of lateral deflection at the top level of the chimney, by varying the height of chimney above 275 m. A total of five models are selected for five different heights i.e 275m, 285m, 295m, 305m & 315m and the analysis is done. All the models were analyzed and the regarding lateral deflection is calculated. Code of practice for design of reinforced concrete chimney (Third revision of IS 4998:1992 [Part I]) is referred and used for the analysis purpose. STAAD PRO software is used to do the analysis. Further an attempt is done to understand the variation of lateral deflection at the top level of the chimney for different height level.*

Keywords- RC Chimney, Wind Analysis, Lateral Deflection, STAAD Pro

I. INTRODUCTION

Due to design & construction problems, lots of chimneys have failed in structure in the past few decades causing a heavy wind blow on the power production sector. RC Chimneys being tall and slender need to be treated as special structure during its design and construction phase, since their behavior under loading conditions is different from other structures. The considerations of various load combinations having static and dynamic effects make the analysis and design of RC Chimney complicated. Each of these cases is to be treated specifically, depending on the height of the chimney, its location, type of plant and that's why typical designs are not feasible.

II. REVIEW OF LITERATURE

Veena R N: Discussed about the limit state of serviceability of an RC chimney under different wind and earthquake conditions. This paper suggests that the moment due to earthquake in Zone III is almost equal to the combined moment due to wind speed of 55m/s.[1]

*Bashar Faisal Abdul Kareem:*Discussed the thermal analysis of chimneys on chimney shell thickness. The thermal loads considered were based on actual field measurements of temperature variation in Al-Dora chimney Baghdad. Thermal analyses were done as per ACI-307-08 provisions, and STAAD.Pro-V8i (3D – plate element). This paper suggested that, increasing the thickness of shell chimney doesn't lead to smaller thermal stresses. Also winter time is found to be more critical since it gives higher temperatures gradient. [3]

Rajib Sarkar: Studied Seismic Analysis of a 275 m Tall RCC Multi-flue Chimney: A Comparison of ISCode Provisions and Numerical Approaches. The variations in the design force values as compared to the simplified methods were discussed and the importance of the proper dynamic analyses in designing of multi-flue RCC chimney were highlighted[12]

Amit Nagar: discussed the effects of various profiles of chimney elevation i.e., uniform chimney, tapered chimney and uniform-tapered chimney. The dynamic behavior of chimney due to wind load in wind zone I and seismic analysis were studied. Height was varied from 150 to 300 m for this study. It was found that uniform tapered was the best section considering the wind and seismic analysis.[9]

K.R.C. Reddy: studied on wind and earthquake analysis of tall chimney. In the paper, two RC chimneys were analyzed for earthquake and wind loads as per IS 1893 (Part 4): 2005 and IS 4998 (Part 1): 1992 respectively. The comparison of wind loads with that of earthquake loads were made to decide the most critical loads for the design of the chimney shell. The design wind load was obtained by combination of along and across-wind response of the chimney. The combination was performed as per the procedure given in ACI 307-98 code. They came to a conclusion as; the wind loads are always governing the design of chimney shell. In the most critical Analysis of Self-Supporting Chimney earthquake zone with zone factor of 0.36 and response reduction factor of 1.5, the earthquake response is almost matching with that of wind response but never been crossing the wind response.[11]

*Lokeshwran N:*on their research paper discussed about "Effect of Dynamic Loads on Tall RCC Chmineys of different heights with Elliptical and Circular Cross sections". In this paper Chimneys with circular and elliptical cross sections of five different heights viz. 275m, 300m, 325m, 350m and 400m

with two different profiles in elevation– one tapering frombottom to top and the other tapering from bottom to 2/3 H and straight afterwards - has been analyzed for seismic and vortex shedding effects caused by wind forces; further, analyses had been carried out for three R/t ratios – 15, 20 and 25. In total 120 models had been analyzed 60 for seismic forces and 60 for vortex shedding effects. Analytical results in terms of stresses induced on the structure, earthquake base shear, joint acceleration, joint displacements and vortex shedding base shear are evaluated. The results indicated that output parameters for circular and elliptical cross-sections show significant variations.[7]

Vishwanath. B. Patil: "Analysis of Self-Supporting Chimney", discussed the parametric study of RC chimney which is made by obtaining the results from software for different heights, diameter, earthquake zones, wind zones, type of soils and various load conditions because of changes in the dimensions of chimney, structural analysis such as response to earthquake and wind oscillations have become more critical to influence on the response and design of chimney. [10]

T Subramani,:studied the "Seismic Analysis and Design of Industrial Chimneys by Using Staad Pro" [8]

Dr.K.Hari Krishna:Investigated on Chimneys Using Reinforced ConcreteStacks for Effective Construction and Economy". The methods suggested by the IS code were studied. The loads due to seismic action were found to be far less than that from the wind velocities, and hence it would not be a major consideration in design.[5]

*B K Gupta:***"**IS code provisions for seismic design for tall chimneys",studied the IS provisions and specified that given code provisions are overestimates base shear by 45% to 70%.[11]

*RajibSarkar:*in their paper "Seismic Analysis of a 275 m Tall RCC Multi-flue Chimney: A Comparison of IS Code Provisions and Numerical Approaches" studied chimney sections for different foundation types. A comparative study has been carried out for 275 m tall multi-flue RCC chimney for design forces in the chimney sections with different foundation types.[12]

T Soumya: Non Liner Dynamic Analysis of RCC Chimney, The uniform tapered section subjected to wind analysis exhibits more displacement as observed by the displacement graphs for all heights. And it can be concluded that the displacements obtained for chimneys increases with the increase in height of the slender structure. [8]

Ajay Gairola: "Design Wind Loads on Reinforced Concrete Chimney – An Experimental Case Study," Proceeding Engineering, Elsevier, Issue 14, 2011. [2]

AmithaRaju: in this paper Analysis of Tall RC Chimney as per Indian Standard Code is carried out. Anattempt is done to understand the variation of lateral deflection at the top of the chimney, by varying the height of chimney above 275 m. A totalof five models are selected for five different heights and the analysis and design are done. ANSYS software was used to do the analysis. All the models were analyzed and the lateral deflectionwas calculated. [6]

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IV. CONCLUDING REMARKS

From the review of various research papers, it can be stated that less emphasis is given by various researchers to the tall chimneys and very less literature is available on this topic. So, there is a need to study on analysis of tall chimney and various parameters and its behavior.

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