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ANALYSIS AND DESGIN OF INDUSTRIAL RCC CHIMNEY

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Abstract: Chimneys are usually designed for loads produced by seismic effect and wind. So, it is inevitable to analyse the dynamic response of chimney due to effect of earthquake and wind loads. On account of changes in geometry of the chimney, structural analysis such as response to earthquake and wind oscillations becomes more critical. The prime focus of this paper is to compare the wind analysis results with seismic analysis results of a 100m reinforced concrete chimney. Earthquake analysis is carried out as per IS 1893(part 4): 2005 and wind load analysis is carried out as per draft copy CED38(7892):2013 (third revision of IS 4998(part 1):1992). Finally, the maximum values acquired in wind analysis and seismic analysis are compared for deciding the design values.
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Index Terms **–** Rcc chimneys, wind loads, earthquake loads, combined design loads, wind analysis, seismic analysis.

I. INTRODUCTION

Chimneys are tall and slender structures which are used to discharge waste/flue gases at higher elevation with sufficient exit velocity such that the gases and suspended solids (ash) are dispersed into the atmosphere over a defined spread such that their concentration, on reaching the ground is within acceptable limits specified by Pollution Control Regulatory Authorities. In a coal-based power plant, flue gases from each boiler are fed to a chimney, for dispersion into atmosphere.
Industrial chimneys are vertical constructions created to reduce the impact of greenhouse gases and other industry substances on its immediate surroundings. This stonework (brick), concrete, or steel structures are used to eject gases generated by industries after completing their production processes. The objective is to reduce the impact these sub-products have on the environment and on humans. Some reduce levels of pollutants while others reduce gas the temperature of the gas.A Chimney is a tall slender structure by means of which the waste gases are discharged into the outside atmosphere at a high enough elevation via stack effect. Chimneys are typically vertical or as near as possible vertical, to ensure that the gases flow smoothly, under the influence of what is known as stack or chimney effect. The space inside the chimney is called a flue. The height of the chimney greatly influences its ability to transfer flue gases to the external environment via stack effect. The function of a chimney is to convey and discharge combustion or flue gases away from the operating area of the industry as well as the human occupancy. The cross-section of the chimney is generally hollow circular, from aerodynamic considerations, and tapered, from considerations of structural economy and aesthetics. The chimney is subject to gust buffeting in the along-wind direction due to drag forces, and also to possible vortex shedding in the across-wind direction. Tall reinforced concrete chimneys form an important component of major industries and power plants. Damage to chimney due to wind or earthquake load may lead to shut down of power plants and important industries.

GENERAL SPECIFICATIONS OF RCC CHIMNEY:

- A Reinforced concrete chimney is generally circular in shape with a rigid concrete shell cast with a rich concrete of mix of M20 to M 25 grade and provided with longitudinal and vertical reinforcement and horizontal hoop reinforcement.
- A fire brick lining 100 to 150 mm thick is provided inside the concrete shell with an air gap of 80 to 150 mm thick to reduce the temperature gradient from the interior surface of fire brick lining to the exterior surface of concrete shell.
- The fire brick lining is supported by reinforced concrete brackets provided at regular intervals of 4-6m.
- RCC chimneys of height 50-100m are commonly used.

LOAD COMBINATIONS:

- Dead load + Wind load.
- Dead load + Seismic load.
- Dead load + Temperature load.
- Dead load + Wind load + Temperature load.
- Dead load + Seismic load + Temperature load

OBJECTIVES:

- To analyze and design industrial RCC chimney.
- To construct a stable superstructure considering in mind various load considerations.
- To decide the size and structural parameters governing the chimney.

METHODOLOGY:

We have done this project by taking reference of code books and some RCC design textbooks.

- The analysis and design of chimney is done by staad pro.
- First off all the chimney model is to be prepared.
- The applications of load are assigned to model.
- The analysis of the model is carried out.
- Next the design part is to be done by giving certain required data
- Finally the analysis and design of chimney is done and the output file gives us results and various details related to chimney.

MODELING OF CHIMNEY IN SOFTWARE:

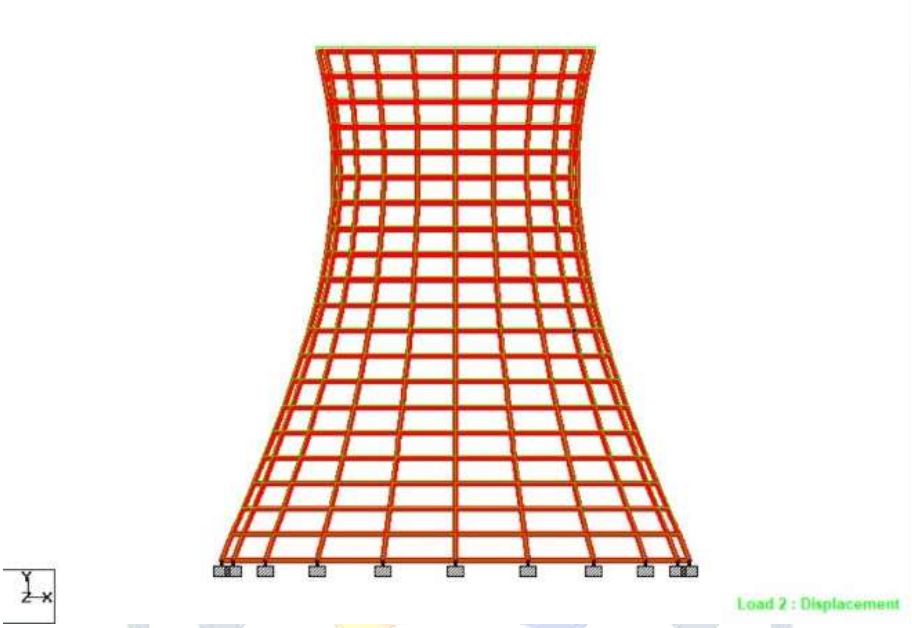

Fig-1.0: Modeling of chimney

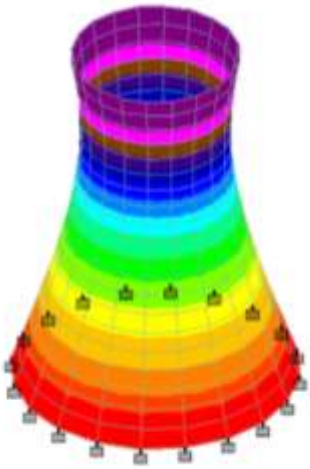

Fig-2.0: **Stress Of Dead Load On The Model**

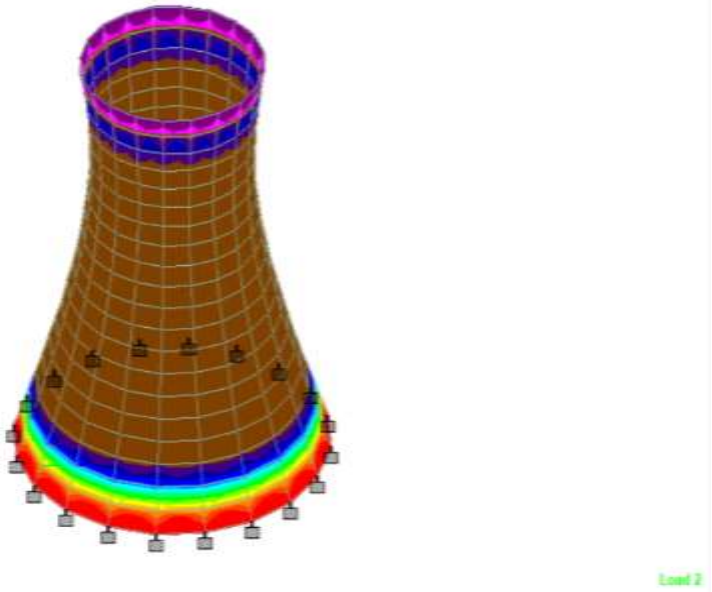

Fig-3.0: **Stress Of Temperature On The Model**

RESULTS AND DISSCUSSIONS:

The analysis and design of industrial Rcc chimney is done and the results are obtained from staad output file and from post processing mode in staad pro,The post processing mode includes each and every plate details.

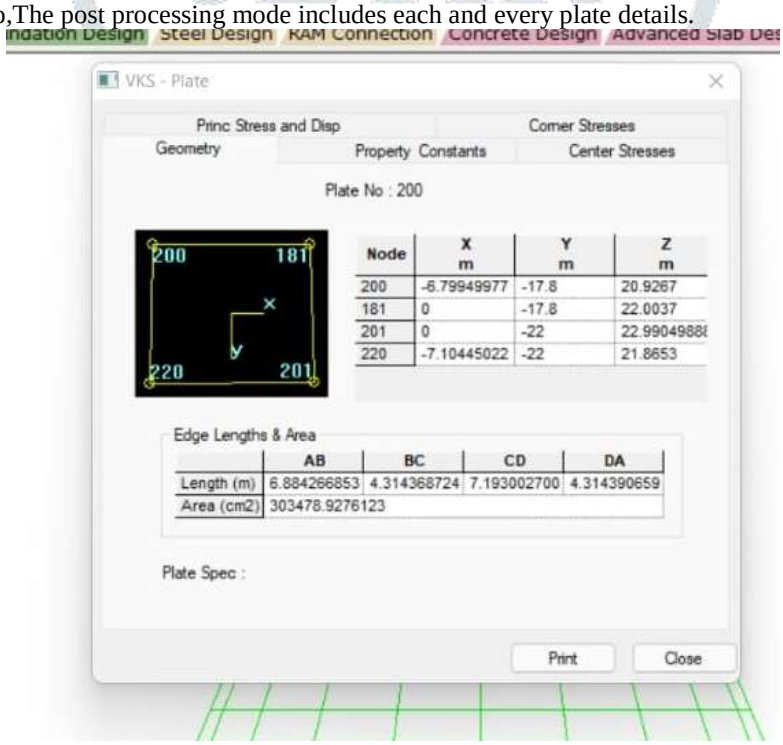

Fig-4.0: Geometry Of The Plates

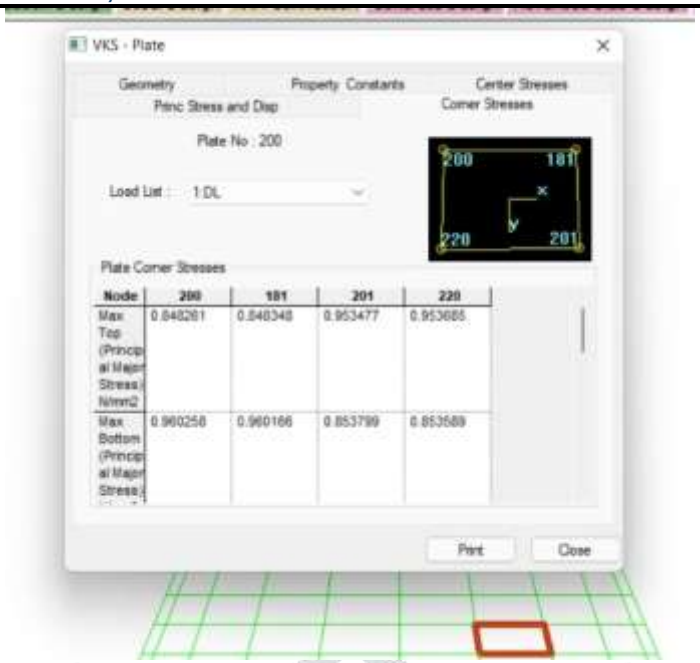

Fig-5.0: **Results Of A Plate Due To Dead Load**

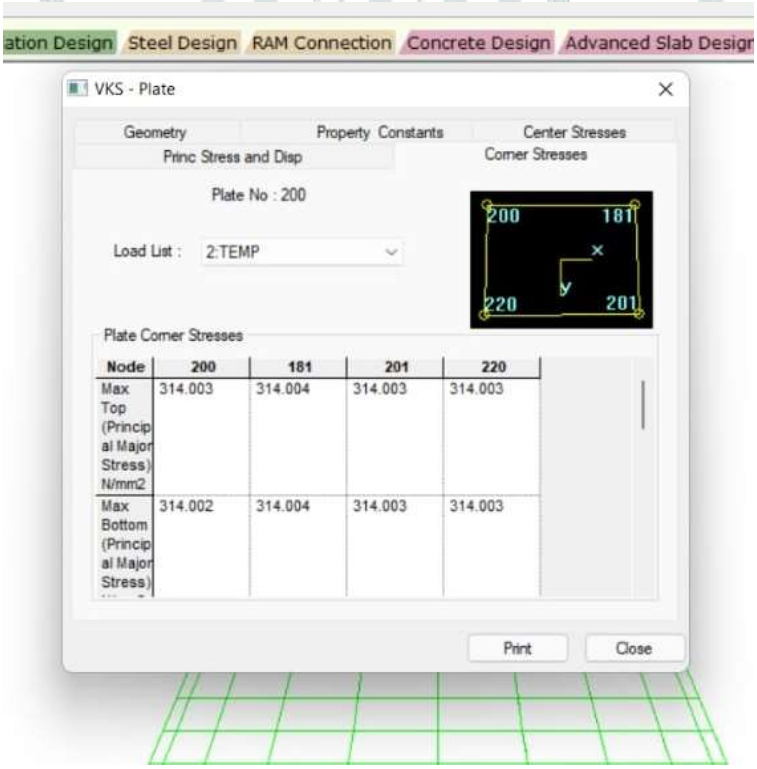

Fig-6.0:Results Of A Plate Due To Temperature Load

Table-1: Dead load values

Plate Num	Area (m^2)	Thickness (m)	Elasticity KN/mm^2	Poisson's ratio	Centre stress Moments		Corner stresses		Cover	
					Mx (KNm)	My (KNm)	Max Top (N/mm^2)	Max bottom (N/mm^2)	Top (mm)	Bottom (mm)
20	29.62	0.5	21.71	0.17	0.815	4.02	0.257	0.227	19.05	19.05
40	28.29	0.5	21.71	0.17	0.072	0.204	0.066	0.236	19.05	19.05
43	27.28	0.5	21.71	0.17	0.0013	0.149	0.204	0.310	19.05	19.05
220	32.05	0.5	21.71	0.17	0.0172	0.134	0.918	1.031	19.05	19.05
237	33.97	0.5	21.71	0.17	0.0197	0.117	0.983	1.098	19.05	19.05
182	30.34	0.5	21.71	0.17	0.0157	0.151	0.848	0.960	19.05	19.05
382	53.88	0.5	21.71	0.17	0.5645	3.738	1.254	1.666	19.05	19.05
380	51.12	0.5	21.71	0.17	0.655	3.231	1.283	1.568	19.05	19.05
344	48.41	0.5	21.71	0.17	0.120	0.607	1.301	1.447	19.05	19.05

CONCLUSIONS:

- Analysis and design of industrial RCC chimney of M25 grade concrete and Fe415 steel by considering dead load (self-weight) and temperature load is completed by using staad pro v8i (ss6) software.
- The results which are obtained from the above analysis is safe for construction.
- Realistic view of chimney is shown by using sketchup 2018 software.
- It is observed that the stresses and moments due to dead load are less when compared to temperature loads.
- The chimney is designed by number of plates in staad and the plate details are shown in post processing mode.

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