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ANALYSIS THE EFFECT OF WIND AND SEISMIC LOAD ON STEEL CHIMNEY

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***ABSTRACT*-Chimneys are tall structures and the major loads acting on these are self-weight of the structure, wind load, earthquake load & temperature loads. In this paper a steel chimneys is designed considering wind load and earthquake load. Geometry of a self-supporting steel chimney plays an important role in its structural behavior 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.**

I. 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.

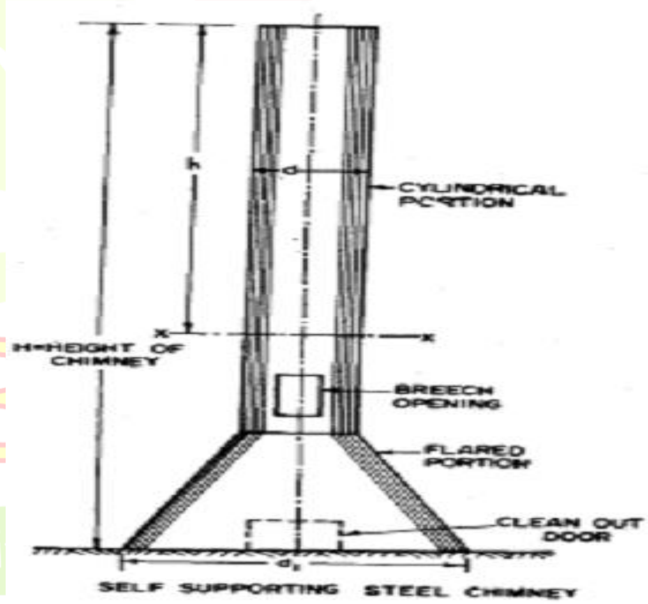

Fig:1.1 Self Supporting Steel Chimney

II.STEEL PLATES FOR CHIMNEY

The width of steel plates required for the steel chimney varies from 0.9 m to 2.5 m. The steel plates of 1.50m width are most

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commonly used. The thickness of steel plates should not be less than 6 mm. The thickness of steel plates in the two upper sections of the chimney should not be less than 8 mm to resist more corrosion likely at the top of chimney.

The thickness of steel plate in the flared portion should not be less than the thickness at the lowest section of the cylindrical portion. The steel plates are available in thickness of 5, 6, 8, 10, 12, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 56 and 63 mm. For the ease in construction, the upper diameter of plates forming the side of chimney is kept less than the lower diameter. Each course fits telescopic over the lower course.

III. BREECH OPENING

The breech opening is also known as *flue opening*, The flue opening is provided for the entrance of flue gases. The flue gases come from furnaces of the boilers. A breech opening is provided in the steel chimney as shown in Fig. The area of breech opening is kept about 20 percent larger than the internal cross-sectional area of the chimney.

IV.PURPOSE OF STEEL CHIMNEY

A Steel chimney is a structure which provides ventilation for hot flue gases or smoke froma boiler,stove, furnace or fireplace totheoutside atmosphere. Chimneys are typically vertical, or as near as possible to vertical, to ensure that the gases flow smoothly, drawing air into the combustion in what is known as the stack, or chimney, effect. The space inside a chimney is called a flue. Chimneys may be found in buildings, steam locomotives and ships. In the United States, the term smokestack (colloquially, stack) is also used when referring to locomotive chimneys or ship chimneys, and the term funnel can also be used.

The height of a chimney influences its ability to transfer flue gases to the external environment via stack effect. Additionally, the dispersion of pollutants at higher altitudes can

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reduce their impact on the immediate surroundings. In the case of chemically aggressive output, a sufficiently tall chimney can allow for partial or complete self-neutralization of airborne chemicals before they reach ground level. The dispersion of pollutants over a greater area can reduce their concentrations and facilitate compliance with regulatory limits.

V. METHODOLOGY

- First create the modal using Pro-E software
- Save to IGES(Initial graphics exchange system) format
- Import to an IGES file into ANSYS software
- Specify the element type
- Specify the material type
- Provide the meshing
- Provide wind loading
- Analysis
- Create Taguchi technique using mini tab software
    - 3 parameters
    - 9 combinations
- Analysis the Taguchi technique
    - Equivalent stress and S/N ratio graph plot
- Evaluate results
- Find the suitable foundation parameter of modals
- Defining the Earthquake loads in Selected modals
- Determining time limits
- Evaluation of dynamic results

VI. TAGUCHI TECHNIQUE

One method presented in this article is an experimental design process called the Taguchi method. Similar to DOE , the Taguchi method is a technique for optimizing a process or design using multiple parameters. A researcher should always fully understand the various

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experimental methods in order to properly apply them to individual studies to maximize both the efficiency and the result of a study.

The complete Taguchi methods are actually comprised of three main phases , which are all intended to be conducted offline . These three phases include system design , parameter design, and tolerance design. The Taguchi parameter design stage , which is the phase used in study, is commonly referred to here. This phase requires that the factors are known ant that production should be in progress. The major goal of this phase is to increase the performance of the production process by adjusting the controlled factors.

VII. A TYPICAL ORTHOGONAL ARRAY

While there are many standard orthogonal arrays available, each of the arrays is meant for a specific number of independent design variables and levels . For example, if one wants to conduct an experiment to understand the influence of 4 different independent variables with each variable having 3 set values (level values), then an L9 orthogonal array might be the right choice. The L9 orthogonal array is meant for understanding the effect of 4 independent factors each having 3 factor level values. This array assumes that there is no interaction between any two factor. While in many cases, no interaction model assumption is valid, there are some cases where there is a clear evidence of interaction. A typical case of interaction would be the interaction between the material properties and temperature.

VIII. WIND LOAD ANALYSIS

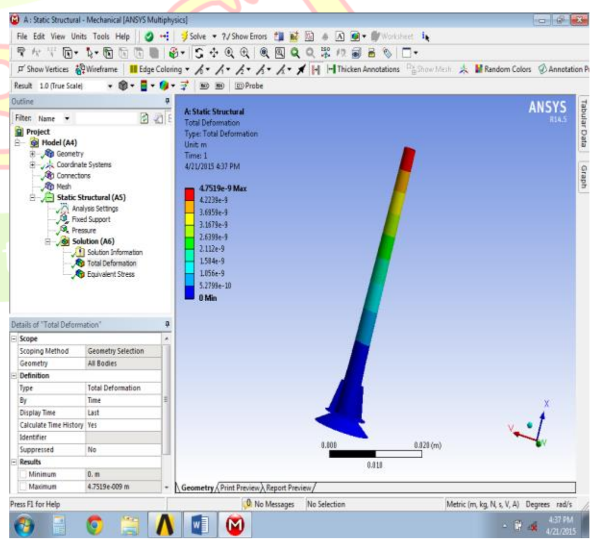

Fig 8.1 -Equivalent Stress drawing

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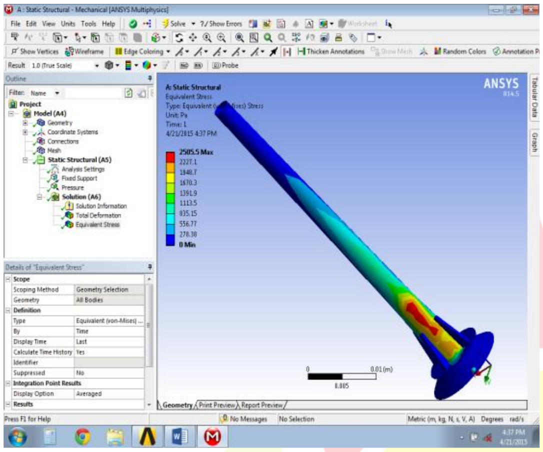
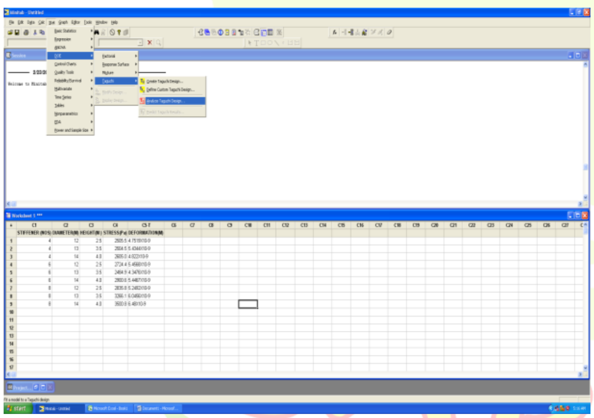
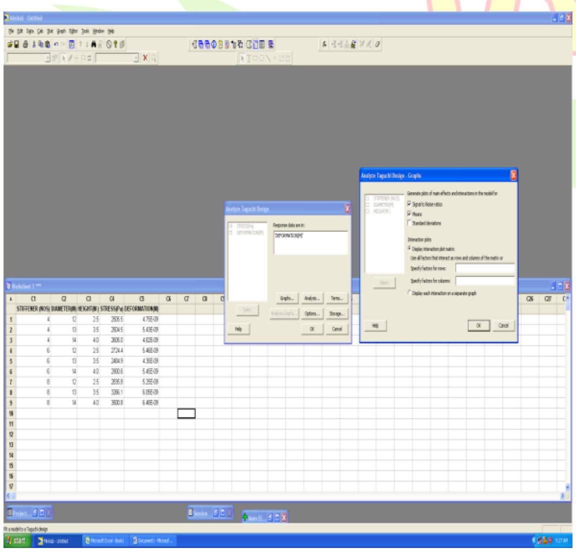


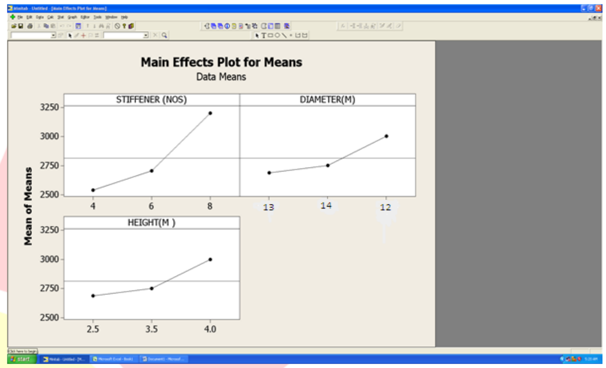
Fig 8.2 -Total Deformation drawing

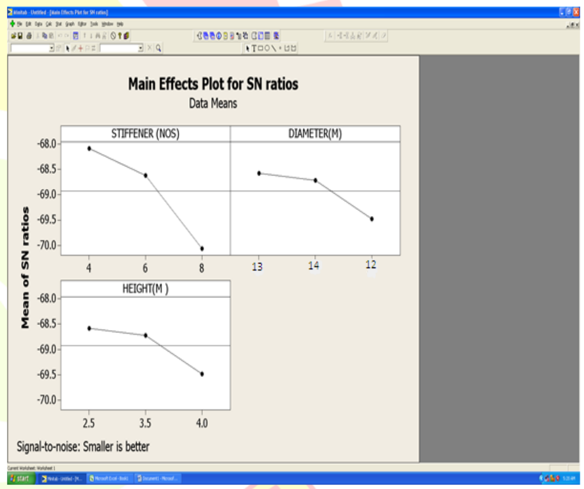
IX. STEPS FOR ANALYSIS THE TAGUCHI DESIGN



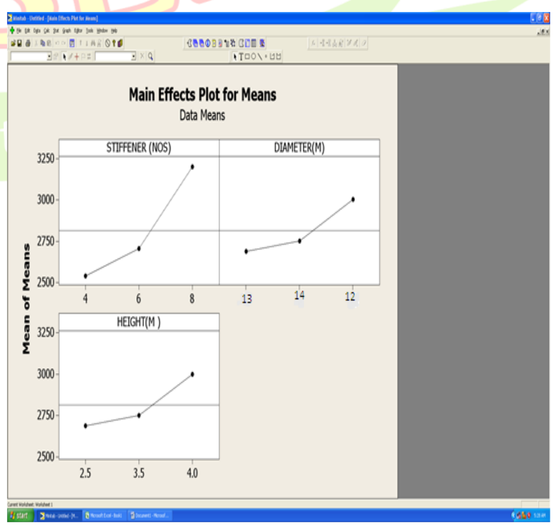


X. STRESS GRAPH





XI. DEFORMATION GRAPH



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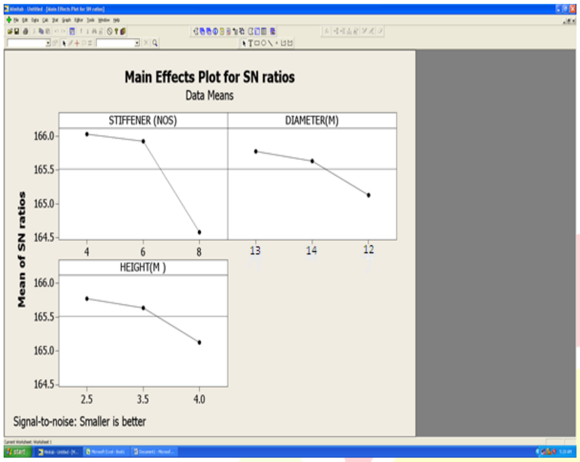
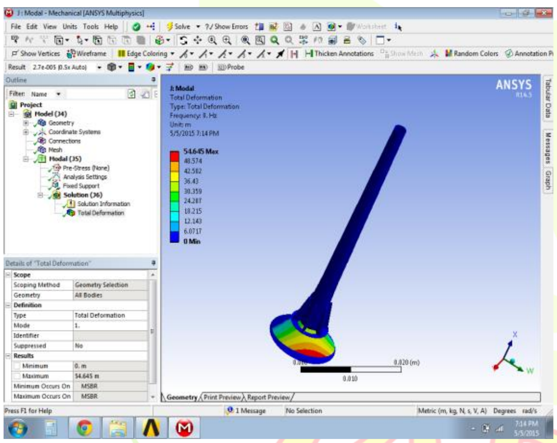
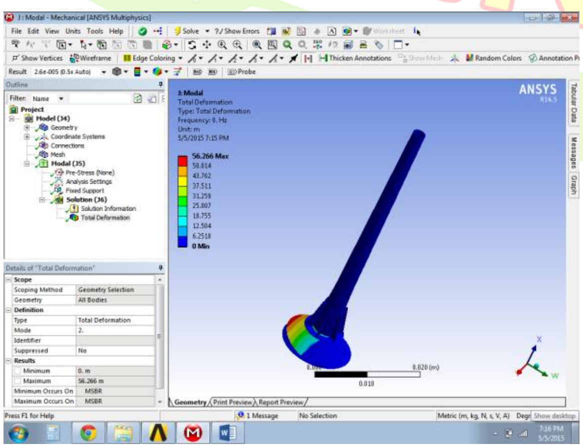


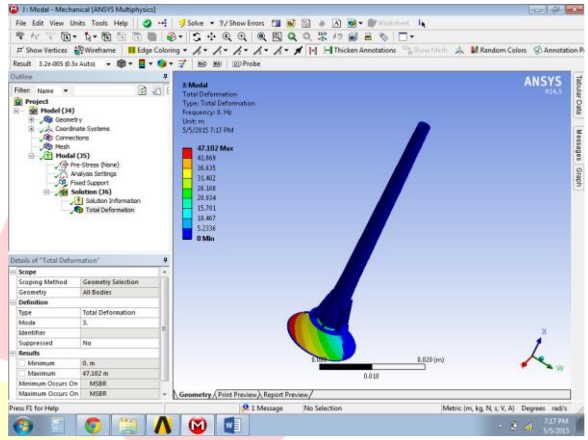
XII. MODAL ANALYSIS UNDER SEISMIC LOADS



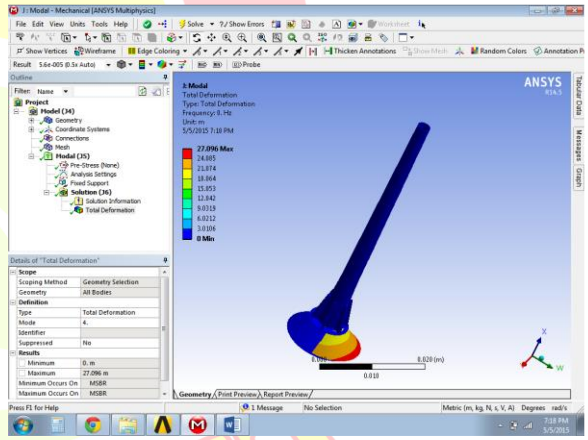
Mode 1 diagram



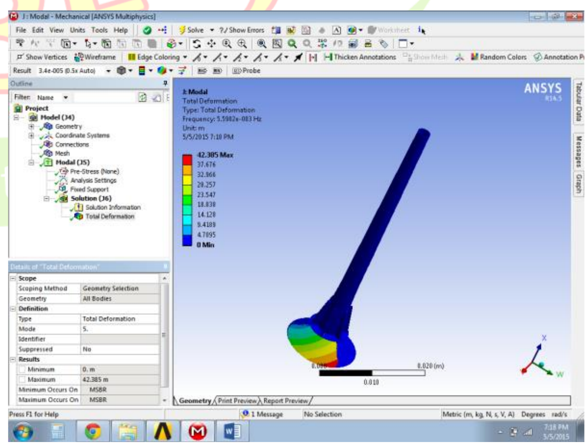
Mode 2 diagram



Mode 3 diagram



Mode 4 diagram



Mode 5 diagram

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XIII.CONCLUSION

It is found from these analysis that gives maximum deformation and maximum equivalent stress due to wind load in a self supporting steel chimney with different combinations of foundation parameters. Three parameters consider for my project. And also in my project report present a step by step procedure for designing self supporting Steel chimney using IS:875(Part 3):1987, IS 1893 part 4:2005 and IS 1893 part 1:2002 standards.

The relation between the different foundation parameter and corresponding deformation and stress compared by mini tab software. These analysis gives maximum mean result and minimum SN ratio result for best one and evaluate from the modal analysis due to seismic load in a self supporting steel chimne.

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