Impact Factor (SJIF): 4.542

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444

Volume 4, Issue 6, June-2017

"ANALYSIS OF THE EFFECT OF TAPERING AND SLENDERNESS RATIO OF STEEL CHIMNEY FOR LATERAL LOADS"

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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 the structural behaviour of the 40m above height bio medical waste disposal steel chimney in trichy sengipatti has been investigated. This report summarizes results collected from about 6month of continuous measurement and regular observations of the chimney. Steel chimneys are designed considering dead load, 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. To ensure a desired failure mode design code (IS-6533: 1989 Part 1 and part 2) imposes several criteria on the geometry of steel chimneys.

Keywords- *Chimney, Design, Modelling, Review, GUEST Factor*

I. INTRODUCTION

A Structure which provides ventilation for hot flue gases or smoke from a boiler, stove, furnace or fireplace to the outside atmosphere is known as CHIMNEY. Chimneys may be found in buildings, steam locomotives and ships. During the last few decades the use of reinforced concrete chimneys in place of brick masonry and steel chimneys have become very popular due to their low cost and durability. Composite material like reinforced concrete is eminently suited for chimney stacks.

The height of a chimney influences its ability to transfer flue gases to the external environmental via stack effect. The maintenance of steel chimneys are minimum in the case of concrete stacks. The thickness of the concrete shell generally varying from 120 to 300 mm is considerably smaller than that required in the case of brick chimneys. Concrete stacks with lesser maintenance costs are architecturally superior to masonry and steel chimneys.

Fig1- Industrial Chimney

1.1 OBJECTIVES

- To study the effect of tapering and slenderness ratios in steel chimney.
- Lateral response of steel chimney due to geometrical variations in terms of displacements, base shear, thickness of steel chimneys due to moment and stress.
- Thickness V/s deflection ratios.
- Finding the effects of tapering in steel chimney.
- Assess the geometry limitations imposed by IS 6533:1989 for designing self supporting steel chimney.
- GUEST Factor analysis.

II. METHODOLOGY

IS:6533 (Part-1 & 2): 1989, IS 875 (Part-3 & 4): 1987, and IS 1893 (Part-4):2005 will be used as the basis for design, which gives detailed procedure to determine static, dynamic and seismic loads coming on the structure.

2.1 Assumptions

1. The wind pressure varies with the height. It is zero at the ground and increase as the height increases. For the purpose of design it is assumed the wind pressure is uniform throughout the height of the structure.

2. For the purpose of calculations, it is assumed that the static wind load (projected area multiplied by the wind pressure) is acting at the centre of pressure.

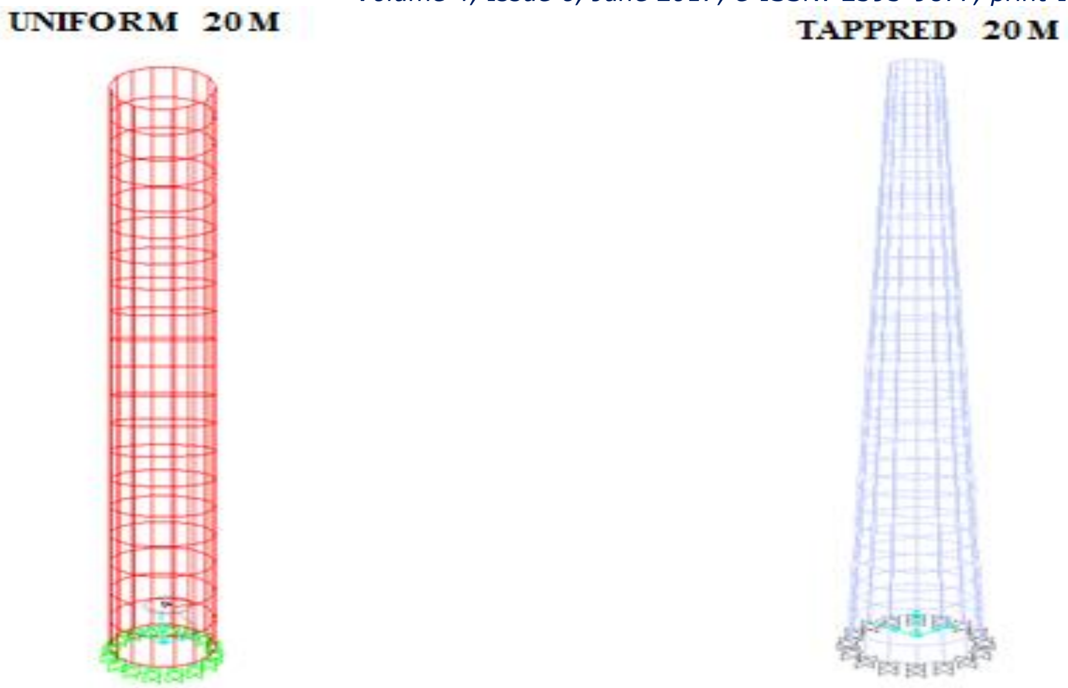
3. Earthquake causes impulsive ground motions, which are complex and irregular in character, changing in period and amplitude each lasting for a small duration.

4. Earthquake is not likely to occur simultaneously with maximum wind or maximum flood or maximum sea waves.

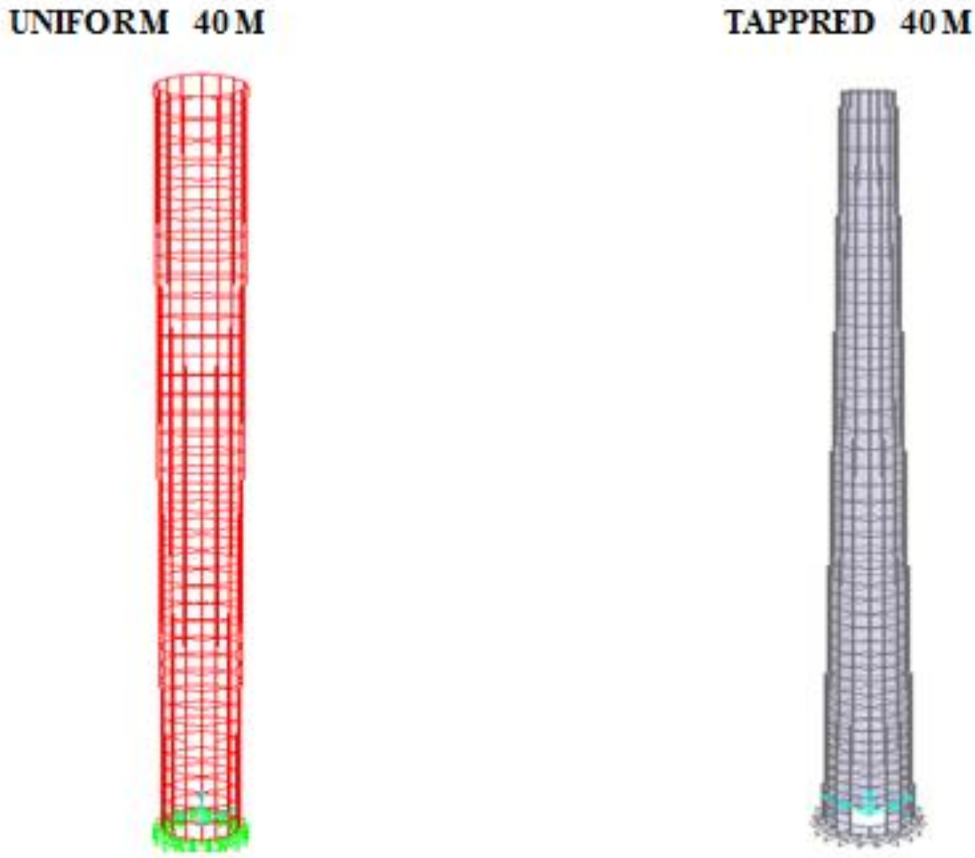
III. ANALYSIS

An independent 3D analysis was carried out using structural analysis software SAP Version. The structure was analyzed as a three dimensional frame for dead load, live load, and wind loads, seismic loads and their combinations.The Yield strength considered for the design of structural steel members 250 N/mm2.The forces and moments obtained from the critical combination of loadings are considered for design.

Location	:	Bangalore
Type	:	self supporting Chimney
Design Codes	:	IS: 6533 Part 1 & 2, IS: 875 (Part 3), IS: 800, **IS: 1893**
Material of construction	:	Mild steel for chimney structure
Height of Chimney	:	20.0mts
Diameter of chimney OD	:	3 mt through out
Basic wind speed V_b	:	33 m/sec
Probability factor K_1	:	1.05
Terrain factor K_2	:	1.05
Topography factor K_3	:	1.0
Design wind velocity V_2	:	$V_b \times K_1 \times K_2 \times K_3$ = 36.3 m/sec
Design wind pressure	:	$0.6V_2^2 = 0.6 \times 36.3^2 = 794.2\ N/m^2$
Shape factor for exposed surface	:	0.7



(a)



(b)

Fig 2 steel chimney models (a) 20m (b) 40 m

IV. RESULTS

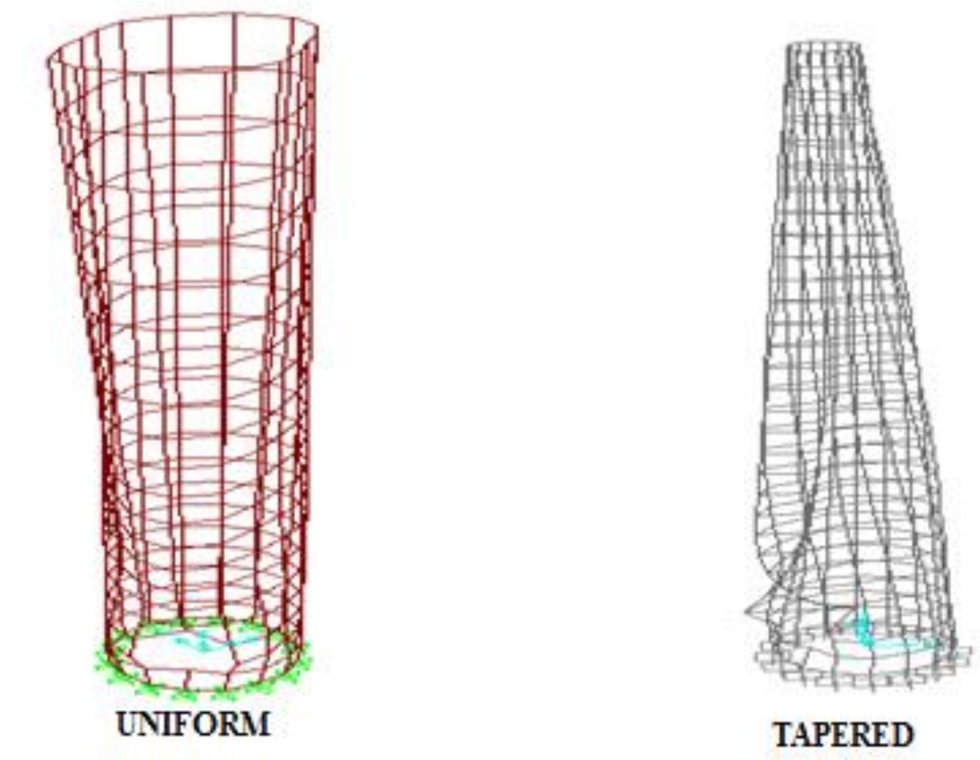


Fig 2 Deformed shapes under dead load

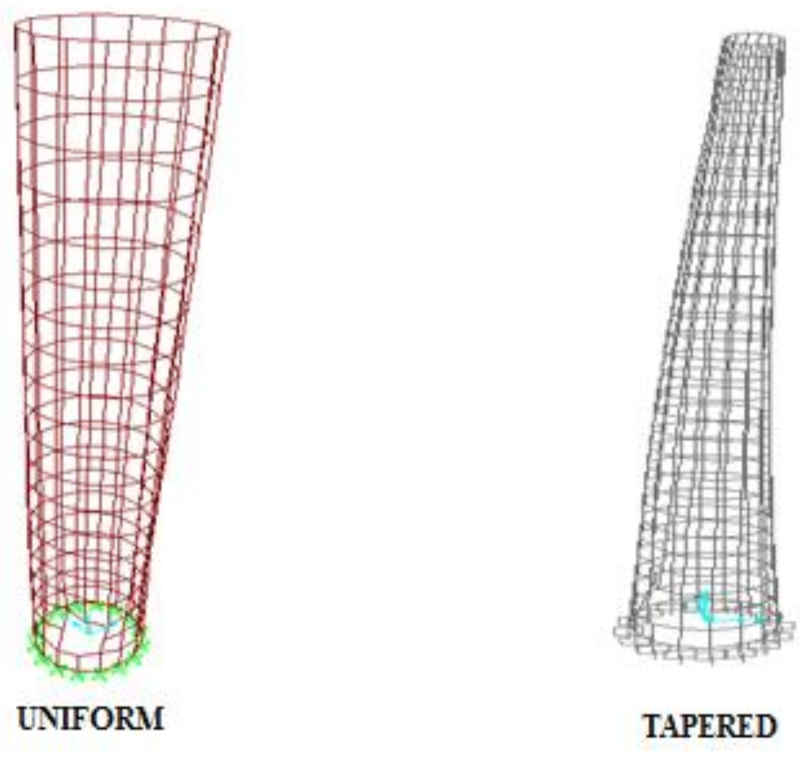
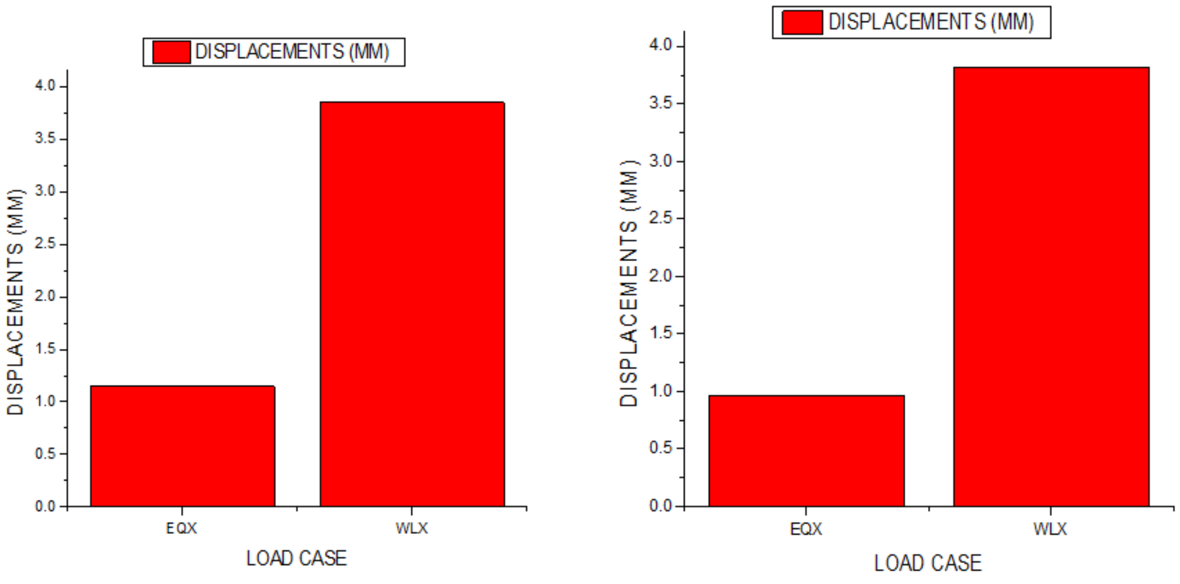
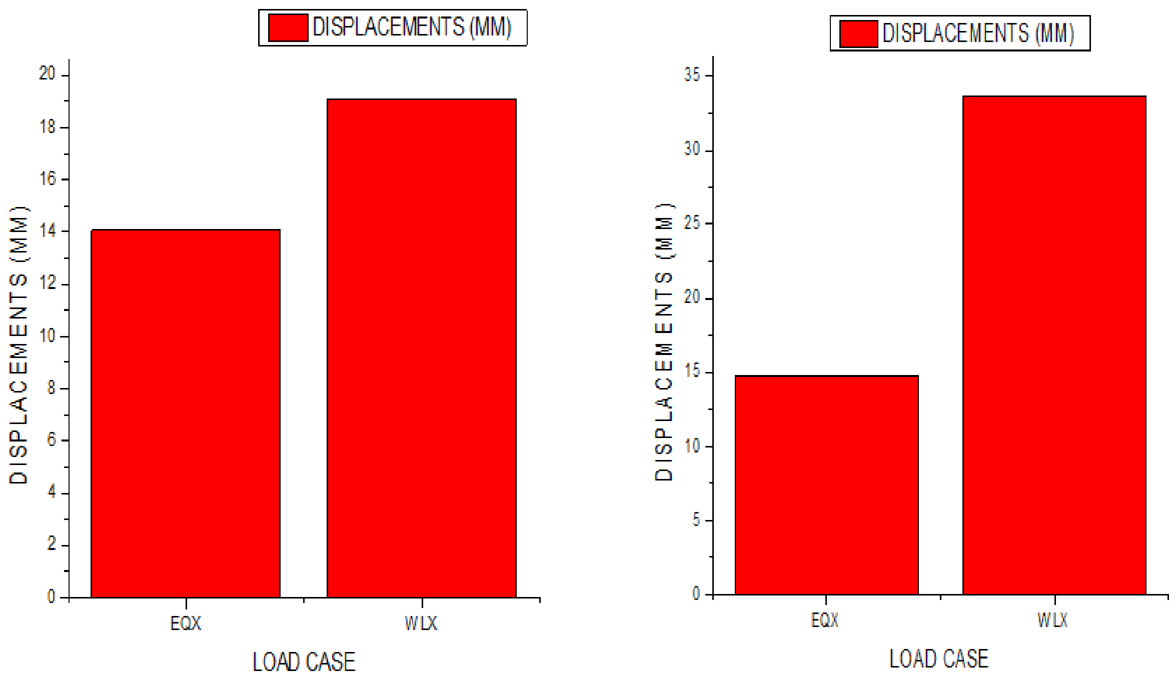


Fig 3 Deformed shapes under seismic load



UNIFORM -20 M **TAPERED 20 M**

Fig 4 Displacement vs load case graph for 20 m chimney



UNIFORM -40 M **TAPERED 40 M**

Fig 5 Displacement vs load case graph for 40 m chimney

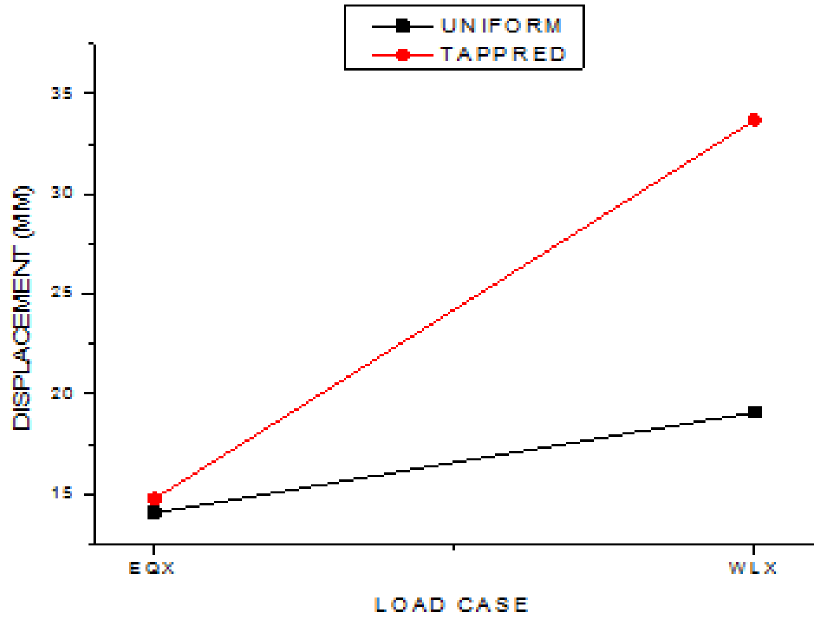


Fig 6 Comparitive Graph Load Vs Displacement

V. CONCLUSION

It is found from these analyses that maximum moment and the maximum bending stress due to dynamic wind load in a self supporting steel chimney are continuous function of the geometry (top-to-base diameter ratio and height-to-base diameter ratio). This study does not support the IS 6533 (Part-2): 1989 criteria for minimum top diameter to the height ratio of the chimney and minimum base diameter to the top diameter of the chimney.

- The Modelling of chimney (superstructure) involves accurate analysis, design and practice, since it is subjected to various loading. The design involves various parameters which should be carried out with standard code of practices.
- The Industrial chimney is greatly influenced by dynamic loadings. The earthquake and wind being major dominant loads, the analysis must be made for all possible critical loads and load combinations.
- The thickness is found to be same for all the chimneys even the basic wind speed is varying.

REFERENCE

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.

5. CICIND, "Model code for steel chimneys (Revision 1-December 1999)", Amendment A, March 2002.

6. **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.

7. **DE Newland (1981),** “Factors in the design of resilient seating's for steel chimneys and masts”, Soc. Environmental engineers conference on structural methods of controlling wind excited vibration, Loughborough.

8. **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.