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Dynamic Analysis on the High Varying Chimney for the Fix and Flexible Base

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ABSTRACT: Chimneys or stacks are very essential industrial structures used for the emission of toxic gases or smoke from a boiler, stove, furnace or fireplace to a larger elevation such that the gases should not contaminate the surrounding environment. These structures are generally tall, slender in nature and consist of circular or cylindrical cross-sections. Different types of construction materials, such as concrete, steel, brick masonry, are used to construct chimneys. Steel chimneys are preferably suited for process works where a short term heat-up period and inadequate thermal capacity are required. Chimneys are usually designed for loads produced by seismic effect and wind. So, it is inevitable to analyses the dynamic response of chimney due to effect of earthquake. The prime focus of this research is to conduct the seismic analysis of a reinforced concrete chimney. For this analysis Chimneys with fixed and flexible base subjected to seismic forces were analyzed under different soil condition like hard, soil strata for 100, 120 And 180m of height.

KEYWORDS: Chimney, Fix and Flexible Base, Response Spectrum, 100, 120 And 180m Height.

I. INTRODUCTION

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 stack. Brick chimneys are very heavy requiring expensive foundation. In contrast to the steel chimneys, the maintenance costs are minimum in the case of concrete stacks. Also the development silp form method of constructing cylindrical stacks as resulted in rapid construction in the case of concrete chimneys. The thickness of the concrete shell generally varying from 120 to 300mm 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. A reinforced concrete chimney is generally circular in shape with a rigid concrete shell cast with a rich concrete mix of M-20 to M-25 grade and provided with longitudinal 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 to reduce the temperature gradient from the interior surface of fire brick lining to the exterior surface of the concrete shell. Reinforced concrete brackets with holes are provided at regular intervals to support the fire brick lining. At the bottom of the chimney, provision is made for a flue opening. The chimney is generally made to rest on a circular raft foundation.

A.Types of Chimneys

1. Concrete chimney

The quality of the concrete shows deterioration when there are implementation defaults. Since concrete is not as homogeneous and isotropic as steel, the static calculations depends on acceptances. The margin of error is a lot more and this causes additional high costs

2. Steel chimney

The quality of steel construction components are always under control. They are produced in factory conditions according to the standards in proper sizes and proportions. As it is a homogeneous and isotropic material it reacts as expect

3. Brick chimney

The white material which appears on brick is a powdery mass of minerals called efflorescence. Efflorescence occurs when moisture moves through concrete or other masonry

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II. PROBLEM STATEMENT

Chimneys are usually designed for loads produced by seismic effect and wind. So, it is inevitable to analyses the dynamic response of chimney due to effect of earthquake. The prime focus of this research is to conduct the seismic analysis of a reinforced concrete chimney. For this analysis Chimneys with fixed and flexible base subjected to seismic forces were analyzed under different soil condition like hard, soil strata.

MODEL	H/D = 4	H/D = 6	H/D = 8
Fix Base	100 m	120	180
Flexible Base	100 m	120	180

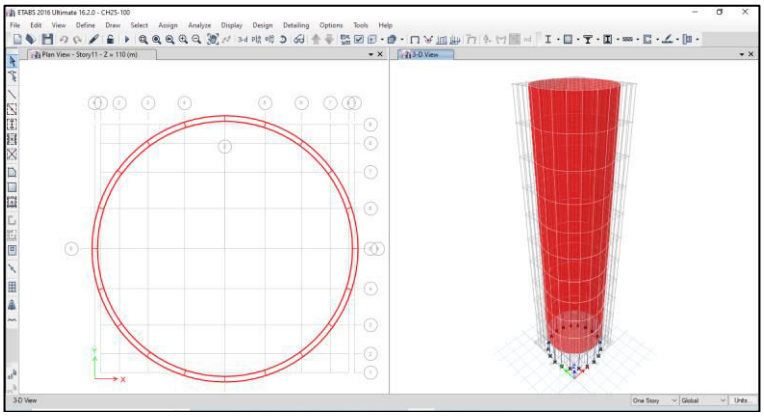

Fig 1 Chimney Model H/D – 4

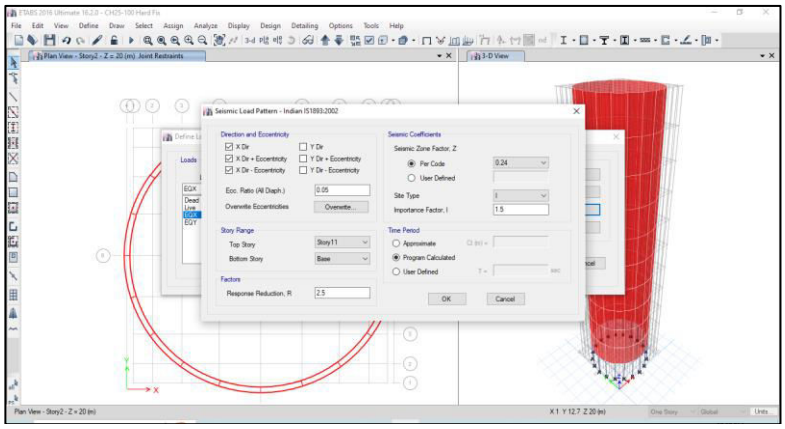

Fig 2 Chimney Model 1 H/D – 4 - Hard Soil

III. RESULT AND DISCUSSION

After evaluating the stiffness values for the footing of the chimney with soft, Medium and Hard soil type of condition, apply values of the Ky, Kx, Kz, krx, krz, Kry in models to create a flexible base structure.

Table 1 Model with Fix and Flexible Base

MODEL	Fix Base	Flexible Base
Model 1	Chimney With Soft Soil	Chimney With Soft Soil
Model 2	Chimney With Medium Soil	Chimney With Medium Soil
Model 3	Chimney With Hard Soil	Chimney With Hard Soil

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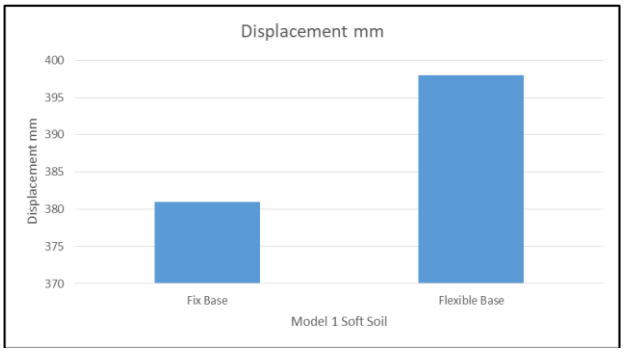
A. Results for Fix and Flexible Base

Table 2 Displacement Model 1 - Soft Soil

Displacement mm		
Soil	**Fix Base**	**Flexible Base**
Soft	381	398

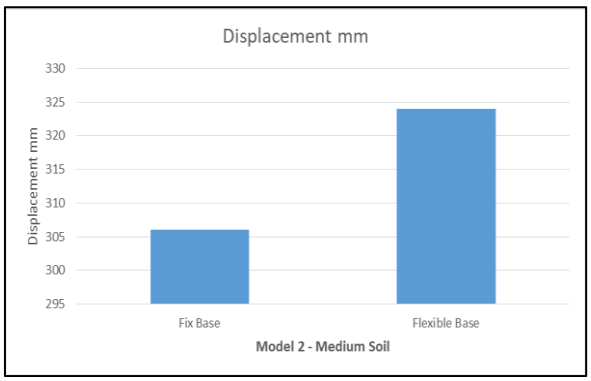


Graph 1 Displacement Model 1 - Soft Soil

Above graph shows the result for Displacement of Fix and flexible base for Soft Soil, Due to the flexible base displacement is more than the fix base model, Displacement of flexible base mode increases by 17 mm.

Table 3 Displacement Model 2 - Medium Soil

Displacement mm		
Soil	**Fix Base**	**Flexible Base**
Medium	306	324



Graph 2 Displacement Model 2 - Medium Soil

Above graph shows the result for Displacement of Fix and flexible base for Medium Soil, Due to the flexible base displacement is more than the fix base model, Displacement of flexible base model increases by 18 mm.

Table 4 Displacement Model 3 - Hard Soil

Displacement mm		
Soil	**Fix Base**	**Flexible Base**
Hard	219	238

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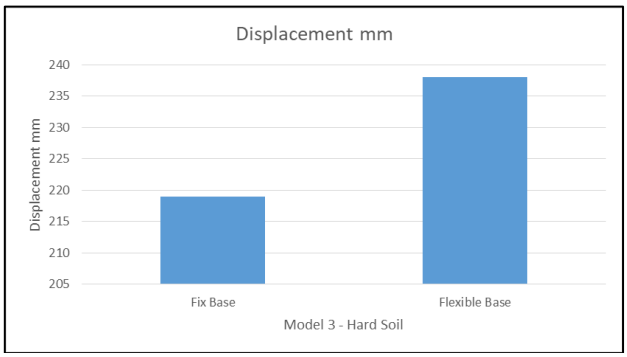

Graph 3 Displacement Model 3 - Hard Soil

Above graph shows the result for Displacement of Fix and flexible base for Hard Soil, Due to the flexible base displacement is more than the fix base model, Displacement of flexible base model increases by 19 mm.

IV. CONCLUSION

In this analysis Chimneys with fixed and flexible base subjected to seismic forces were analyzed under different soil condition like hard, medium and soft soil strata. Seismic response of tall chimneys is influenced greatly by soil supporting its base and nature of earthquake excitation's striking the base. The all results conclude by the following results.

- For the Analysis of the 100 m chimney model after applying the soil changing condition, As comparing the results for the Hard, Medium, And soft soil condition, **Displacements** for hard soil gives maximum displacement as compare to Soft and medium by the 5-10%.
- For the Analysis of the chimney model after applying the 20 m dia and having 140, 180, 220 m of height changing conditions, **Displacements** for soft and medium soil condition with having height 140 m 180m gives minimum displacement difference as compare to 220m by the 75-80%.

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