Comparative Analysis of Tall Building Using Moment Frame System & Structural Wall System Using E-Tabs

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***Abstract*- High-rise buildings are exposed to both static and dynamic loads. Depending on the method used and how the structure is modeled in E-Tabs software the results can vary. Some of the issues and modeling techniques, introduced below, are investigated in this Master's thesis. Dynamic effects such as resonance frequencies and accelerations are considered. The variation in static results from reaction forces, overturning moments, deflections, critical buckling loads, forces between prefabricated elements and force distributions between concrete cores are investigated with different models. The models are evaluated by different elements and methods, such as construction stage analysis, to study the impact these have on the results. Simplified calculations by hand according to different standards, regulations and codes such as SS-ISO, EKS and Euro code have been compared with finite element analyses.**

***Index terms*- Problems, High-rise buildings, Structural system, Structural wall system, Moment frame system and case study**

I.INTRODUCTION

Analyses of high-rise buildings consist of many stages and factors and to evaluate all of these are beyond the scope of the Master's thesis. For concrete, no effects from creep, shrinkage or temperature effects have been analyzed. The concrete have also been considered uncracked. Furthermore, no designs of element cross-sections have been made and the accelerations of the building are calculated according to Eurocode, hence, no time-history analysis is performed. A comprehensive literature study has been made in the area of high-rise buildings regarding the history, design process, code regulations, finite element modelling as well as static and dynamic response. This translated into a case study of a high- rise building on which analytical calculations of deflection, critical buckling load, resonance frequencies and shear flow were made. The analytical calculations have then been compared to structural system calculations in E-Tabs. Furthermore, an analysis of accelerations and overturning moment from wind-load were made and compared to the comfort requirements.

II. EFFECT IN TALL BUILDINGS

A. Problems

Tall buildings are extremely good ways of maximizing the space available. When the purchase of land is expensive, i.e. in major cities like London, New York or Mumbai, tall buildings provide a solution to the lack of space. Two factors limit the height of buildings.

B. Stabilization

The buildings behavior when excited to horizontal wind-load is described in this section, for more detailed information see. Knowledge, technology and construction materials are constantly evolving and so is the strife for constructing higher buildings. However, it does not go without some challenges and issues. First off, the vertical loads increase with the height of the building. There is also the large effect from horizontal wind-load on the building. The buildings behavior under the lateral loading can be seen as a cantilever fixed at the ground. If the wind is assumed to have a uniform distribution the base-moment increases quadratic with the height.

C. Wind Load Effect

As mentioned earlier wind-load has to be considered when designing high-rise buildings. Up to 10 stories the wind-load rarely affects the design. However, for taller buildings the effect is more crucial. Over the past years new materials with higher strength have been developed. This in combination with more innovations in architectural treatment and advances in methods of analysis have made high-rise buildings more efficient and lighter, which also means more prone to deflections and sway.

III. METHODOLOGY

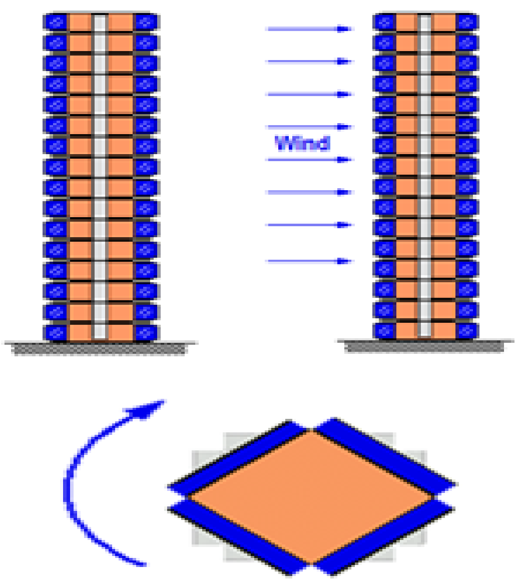

Figure 1: Problems in Design in tall building

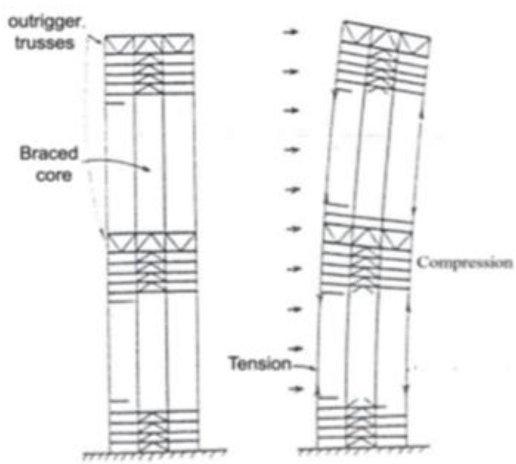

Figure 2: Outrigger Braced System

IV. DESIGN

Carry out analysis, and design of 10 story RC building as shown in following details using IBC2000 equivalent lateral force.

Figure 3: 3D View

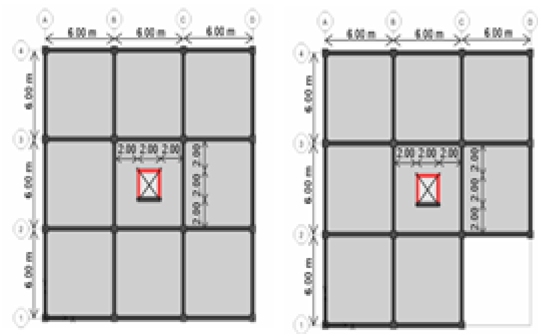

Figure 4: Plan View

A. [Base – Story 7]

B. [Story 8 – Story 10]

V. CALCULATION

A. Section Properties

Member	Dimension
Beam	30 x 60 cm
Column	50 x 50 cm
Slab Thickness	15cm
Shear Wall Thickness	20cm

B. Story Height Data

Story	Height
Typical Story	3.00m
Story at base of building	4.00m

C. Static load cases

Load Name	Load Type	Details	Value
		Self-Weight of Structural Members	-

DEAD	Dead Load	Calculate automatically using Self Weight Multiplier in ETABS	
		Uniform Load on Slabs: (Finishing + Partition Load)	0.20 t/m2
		Uniform Load on Beams: (Wall Load)	0.50 t/m
LIVE	Reducible Live Load	Uniform Load on Slabs: (Use Tributary Area: UBC97)	0.25 t/m2

D. Wind Load Cases

Parameter	Load Case	
	WINDX	WINDY
Wind Direction	X	Y
Wind Speed	90 mph	
Exposure Type	B (Suburban area)	
Importance Factor	1 (Building normal importance)	

E. Equivalent Static Force Parameters

Parameter	Values	Remark
Time Period (T)	1.47	Equation 16-39 (Ct = 0.020)
Response Modification Factor (R)	5.5	Table 1617.6 (Dual System: Ordinary RC Shear Wall)
Seismic Group	I	Section 1616.2
Site Class	E	Table 1615.1.1 (Soft Clay)
Response Acceleration at Short Period (Ss)	0.45	-
Response Acceleration at 1 Second (S1)	0.18	-

F. Equivalent Static Force Case

Load Case Name	Direction and Eccentricity	% Eccentricity
EQXA	X Dir + Eccen. Y	0.05
EQXB	X Dir - Eccen. Y	0.05
EQYA	Y Dir + Eccen. X	0.05
EQYB	Y Dir - Eccen. X	0.05

CONCLUSION

Conclusion- In this paper some limits of available design standards to evaluate wind actions on high rise buildings (displacements and acceleration responses) are presented, pointing them out in a comparison to a more sophisticated methods like moment frame system and structural wall system to calculate and design in etabs software. Finally the importance of global positioning of the building was examined, considering its rotation with respect to its original layout.

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