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Comparative study of conventional and outrigger structure for p-delta analysis

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Abstract
The The development in tall buildings has evolved rapidly in recent years. Population from rural areas is migrating in large numbers to metro cities. Due to this, metro cities are getting densely populated day by day. As population is getting denser the availability of land is diminishing and cost is also increasing. Hence to overcome these problems multi-storey buildings is most prominent and efficient solution. thus outrigger structure is commonly used structure for high rise building.in this paper how a outrigger structure resist p-delta effect is studied as compare to conventional structure

Keywords-– *Earthquake,Outrigger Structure,P-delta,Storey drift,storey displacement.*

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I. INTRODUCTION

Linear In order to study the behaviour and performance outrigger structural system in High rise Building, Equivelent static analysis and Dynamic analysis were carried out. For this purpose, three different heights of Building having same outrigger configuration were analysed. In this analysis Base shear, Base moment, Storey displacement, Storey drift are the main parameter considered for the analytical study.

The analysis results are summarised with six different parameters to interpret the behaviour and performance of outrigger structural system and conventional building for P-Delta analysis.

1. Storey Displacement
2. Storey Drift
3 .Base Shear
4. Base Moment
5 Time period

Model Configuration

The selection of model configuration is most important in the context of seismic and wind assessment of outrigger structural systems because the configuration greatly alters the performance of the structure. Three dimensional models are to be prepared using very reputed Finite Element based software, such as ETABS (version 2018). ETABS is selected because the software specially designed for design and analysis of three-dimensional building frames. ETABS is widely used in Construction industry worldwide. In addition, the software is able to run analysis and obtain results according to Indian Standard Code of practice.

Finite Element Analysis (FEA) is a numerical system for solving complex problems. In this method, structural elements are divided into finite elements and analysed for strain, stress, moments and shear etc. FEA has been embedded in engineering and other sciences and it is now essential in the solution of mathematical problems.

This research is conducted by analysing building prototypes through Finite Element Modelling (FEM). "ETABS" is chosen for research because of its popularity within the structural design industry.

SUMMARY FOR MODELS
For the present study,
- G+60,g+70 and G+80 storey building is modelled. The models are based on an C-SHAPE.
- Storey height is kept constant at 3 meters for all storeys
- The plan of the structure is C in shape with size 40 m x 40 m
- The structure is in region Mumbai as per IS:1893 (Part1):2016

- The structure is analysed for three Basic Wind Speed i.e. 44 m/s, for Mumbai regions
- Soil type selected is Type-II (Medium soil) as per IS:1893 (Part-1):

Layout selection for models

C-shaped model

This model is selected to study an extended layout in plan with core walls and shearwall at corners. It is symmetrical in plan. The effects of lateral loads on this model will be studied.Comparative study of P-delta for conventional and outrigger will be studied.

Optimum Position of Outrigger System

From the study of literature reviews paper of Raj Kiran Nanduri and others it has been concluded that the optimum position of outrigger is at mid height of the building.This optimum position is for wind and earthquake loadings.Thus, we have concluded that providing outrigger at mid height is optimum and thus the model of ETABS has been provided with outrigger at mid height of the building.Bracing of size 230x600 is provided as an outrigger at mid height of building connecting to the core.

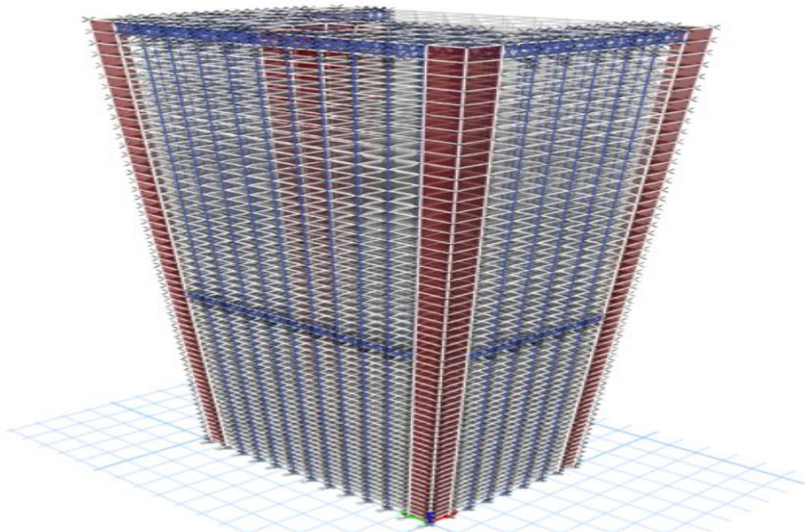
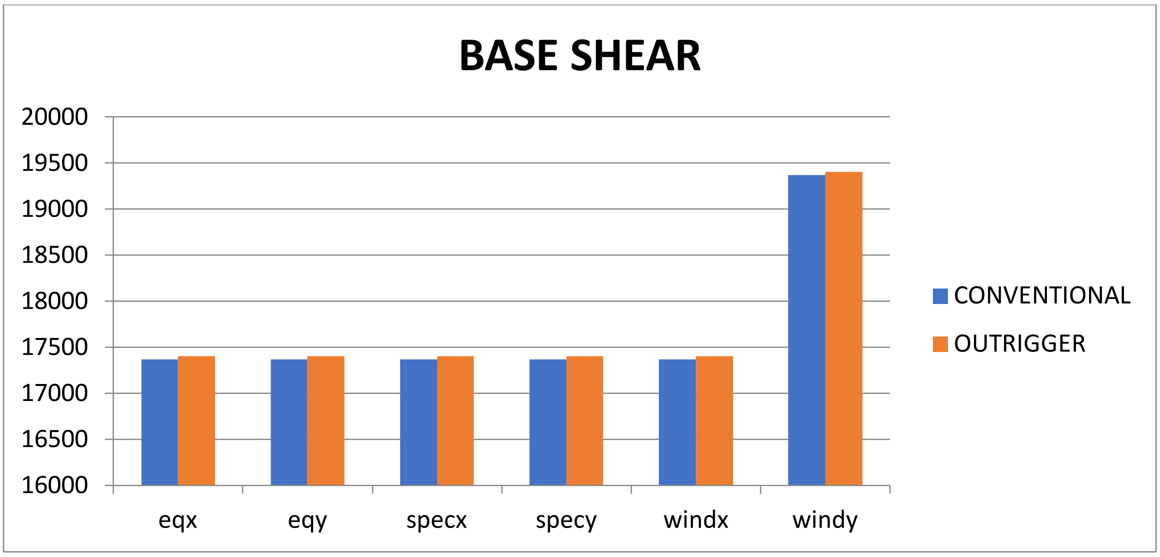


Fig 3D model in ETABS-(Outrigger at Top and Mid Height)

BASE SHEAR

base shear of building in equivalent static,response spectrum and wind analysis for G+60 storey

BASE SHEAR		
LOAD CASE	G+60	
	CONVENTIONAL KNm	OUTRIGGER KNm
EQX	17364.57	17402.57
EQY	17364.57	17402.57
SPEC X	17364.57	17402.57
SPEC Y	17364.57	17402.57
WIND X	17364.57	17402.57
WIND Y	20127.36	19400.82

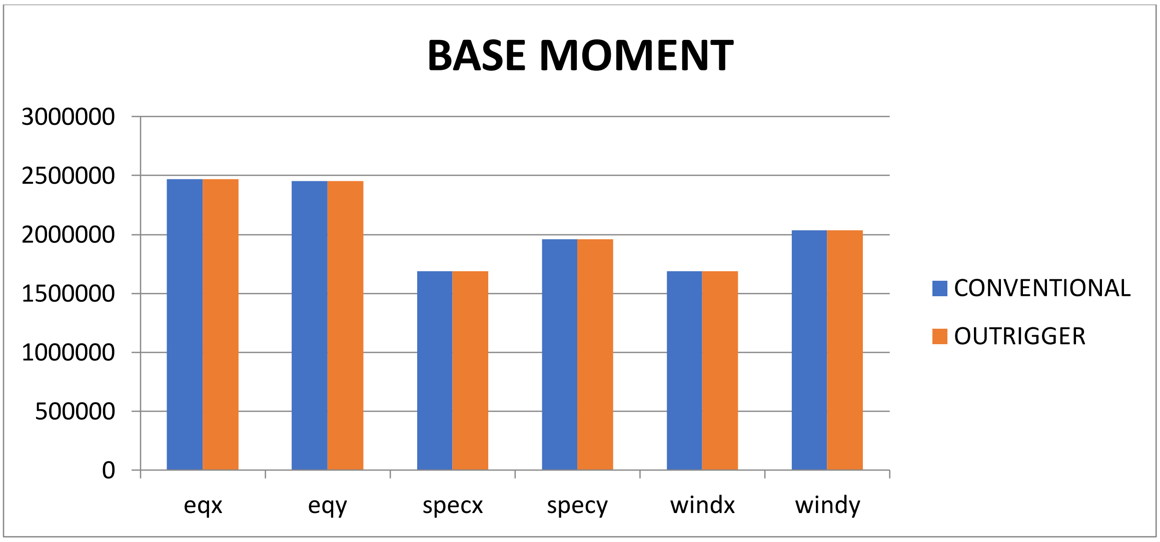


BASE SHEAR GRAPH FOR G+60 STOREY

BASE MOMENT

base moment for different storeys of building in equivalent static,response spectrum and wind analysis for G+60 storey.

BASE MOMENT		
LOAD CASE	G+60	
	CONVENTIONAL KNm	OUTRIGGER KNm
EQX	2468718	2468518
EQY	2451076	2450989
SPEC X	1689202	1689102
SPEC Y	1962174	1962074
WIND X	1689202	1689102
WIND Y	2036227	2036127



BASE MOMENT GRAPH FOR G+60 STOREY

TIME PERIOD

Time period for different storeys of building in equivalent static,response spectrum and wind analysis

G+60 STOREY	CONVENTIONAL	OUTRIGGER	% Reduction in Time period
MODE 1	3.85	3.704	3.79 %
MODE 2	3.733	3.572	4.31 %
MODE 3	2.896	2.816	2.76 %

II. CONCLUSION

Based on the analysis results obtained following conclusion are drawn:-

1. The use of outrigger systems in tall structure increases the stiffness and makes the structure more efficient under seismic and wind loading.
2. Top storey displacement is reduced in outrigger as compared to conventional structure.displacement comparatively is less in outrigger structure than conventional structure
3. Storey drift is comparatively less in outrigger structure than conventional structure.
4. In parametric study of base shear and base moment not so much of changes observed in reading in both type of structure
5. Modal time period decrease for different storey as increased in storey is observed

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