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Seismic Performance Study of Multistoried Buildings with Oblique Columns by using ETABS

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ABSTRACT

Facing a large number of new-type complex structural system and progressively consummate earthquake-resistant theories, the conventional software can no longer meet the needs of calculation and analysis. Meanwhile, some international finite element programs, such as ETABS, were updating themselves but remained respective limitations. China has Circum-Pacific seismic belt and Europe-Asia seismic zone. These two are the largest seismic belts in the world. Densely populated and low seismic capacity buildings, in which the earthquake can be simply summarized as high frequency, wide distribution, high intensity and shallow focal depth was described as the world's most earthquake disaster area. The seismic performance analysis and research of building structures look more indispensable. The Oblique Columns are neither parallel nor at right angles to a specified line means they are slanted or Rotated at an angle. In this present work, concerns with the elastic flexural buckling of doubly symmetric columns with oblique restraints under concentric loading. Oblique restraints cause coupling between the principal axis deflections and rotations, and the flexural buckling mode involves simultaneous bending about both principal axes. The present work deals with a study on the Oblique columns of different angles in high rise building. In this work, a high rise building with Normal Columns & at different locations of Oblique columns is considered for analysis. In this paper, response spectrum analysis was executed, which were also compared following the analysis results. The results of the analysis on the Story shear, Story stiffness, Storey drift and Displacements are compared. The results are presented in the tabular and graphical form.

Key Words: *ETABS, Displacements, Story shear, Story stiffness, Storey drift.*

1. INTRODUCTION

High-rise structures are an important indicator of a country's economic and technological strength. In recent years, countries going for tall buildings, because of material, technology, progress of economy and continued development. Large populations and small per capita area are the main reasons for the need of ultra high-rise buildings. Due to various architectural features and style, more and more complex high-rise buildings are appearing.

The Oblique Columns are neither parallel nor at right angles to a specified line means they are slanted or Rotated at an angle. Oblique columns are stiffer as RC frames, and therefore, the initial stiffness of the RC frames largely depends upon the stiffness of oblique column. For oblique column of below 90^0, there will be a decrease in plan dimensions and for above 90^0, there will be increase in plan dimensions as we reach upper floors. It affects the lateral stiffness of the buildings. Compared to conventional columns, oblique columns of below 90^0 have lesser storey shear values. Oblique columns of above 90^0 have higher storey shear values. Stiffness of RC frames significantly depends on the distribution of oblique column in the frame. The lateral loads are resisted by structure with Oblique columns, the top storey displacement is very much less in Oblique structure as compared to the simple RC Frame building.

2. PROJECT DESCRIPTION

2.1 Overview.

Analyzing the behavior of oblique columns is the main purpose of this study. Analysis has been carried out by considering columns of 80, 84, 88, 90, 92, 96 and 100 degrees. Static and Dynamics analysis has to be done for these Columns. Ground motion performance of oblique columns are analyzed by Response spectrum method.

2.2 OBJECTIVES

- To compare the results of the analysis on the Maximum story displacement, Story shear, Story stiffness and story drift of a multistorey structural building with normal and oblique columns.
- To investigate the seismic performance of a multistorey structural building with normal and oblique column by Response Spectrum analysis.

3 MODELING

3.1 General

ETABS is a complex structural analysis package. It can be used for the analysis and design of buildings and its components. No need of text commands, because it has powerful GUI- graphical user interface system. Buildings can easily modelled by using available components. It is capable of handling the most complex structures which includes the effect of wide range of non-linear behavior. The updated version of ETABS provides 3D object based modeling and visualization tools, fast linear and non-linear analytical power, sophisticated and comprehensive design capabilities for a wide range of materials and insightful graphic displays, reports and schematic drawings that allow users to quickly and easily decipher and understand analysis and design results.

3.2 Modelling using ETAB

This chapter includes the modeling of the G+15 storey buildings. This building is modelled with concrete structural elements. Different types of models are mentioned below.

PROJECTS MODELS

MODEL 1- Multistoried building with oblique column of 80^0.

MODEL 2- Multistoried building with oblique column of 84^0.

MODEL 3- Multistoried building with oblique column of 88^0.

MODEL 4- Multistoried building with normal column. (90^0).

MODEL 5- Multistoried building with oblique column of 92^0.

MODEL 6- Multistoried building with oblique column of 96^0.

MODEL 7- Multistoried building with oblique column of 100^0.

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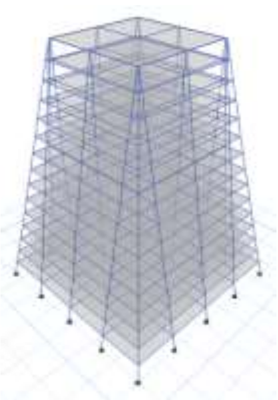
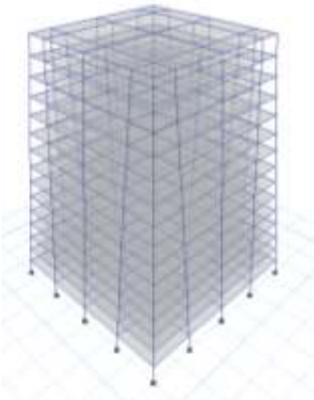
3.3 BUILDING INFORMATION

3.3.1 Models description

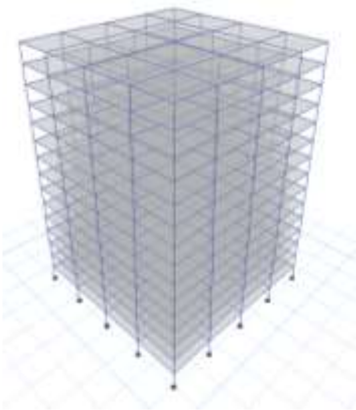
TYPE OF FRAME	ORDINARY MOMENT RESISTING RC FRAME (OMRF) FIXED AT THE BASE
Seismic zones	III
Number of storey	G+15
Floor height	3m
Depth of slab	125 mm
Size of beam	(350× 650) mm
Size of normal column (90 degree)	(750 × 750) mm
Spacing between frames in X- direction	8m
Spacing between frames in Z- direction	8m
Materials	M 30 Concrete, Fe 500 steel
Size of oblique column for 80, 84 and 88 degrees	(750 x 750) mm
Size of oblique columns for 92, 96 and 100 degrees	(900 x 900) mm
Thickness of walls	230 mm



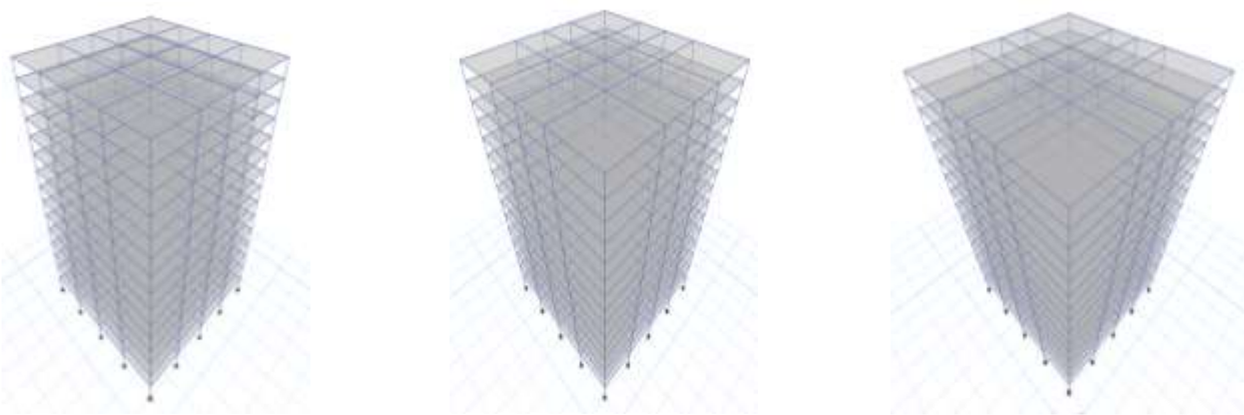
(a)



(b)

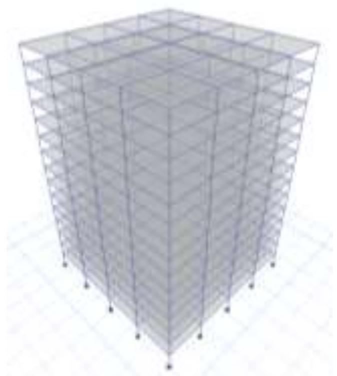


(c)



(d) (e) (f)

Figure 3.1 (a, b, c, d, e and f) Multistoried building with oblique column of 80, 84, 88, 92, 96 and 100 degrees respectively



(g)

Figure3.2 Multistoried building with normal column (90 degree)

4 RESULTS AND DISCUSSIONS

4.1 Response spectrum analysis

(a) Maximum story displacement of all models

Table 4.1 Maximum story displacement of all models

Column inclination (in degrees)	Maximum story displacement (mm)
80	13.109
84	15.642
88	33.355
90	35.219
92	17.294
96	22.924
100	33.609

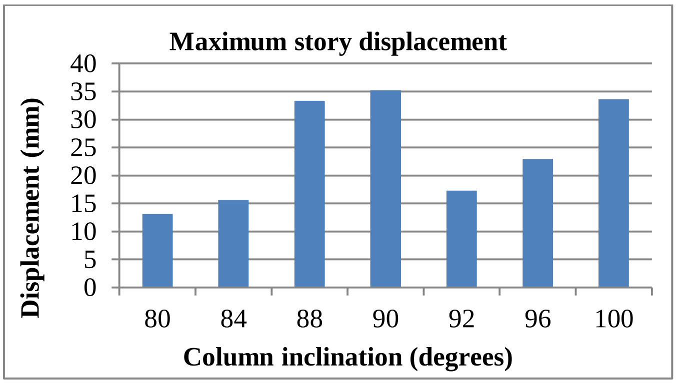


Figure 4.1 Maximum story displacement of all models

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(b) Maximum Story shear of all models

Table 4.2 Story shear of all models

Column inclination (in degrees)	Story shear (kN)
80	1852.521
84	2160.25
88	3042.91
90	3275.129
92	6118.08
96	6980.878
100	7925.133

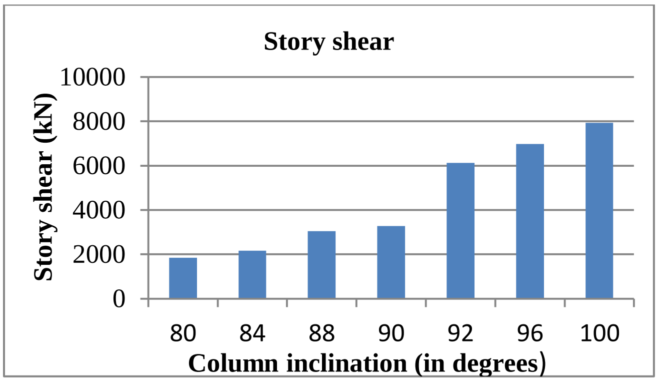

Figure 4.2 Story shear of all models

(c) Maximum Story stiffness of all models

Table 4.3 Story stiffness of all models

Column inclination (in degrees)	Story stiffness (kN/m)
80	3032053
84	2306821
88	1930842
90	1432435
92	7264488
96	6709650
100	4556184

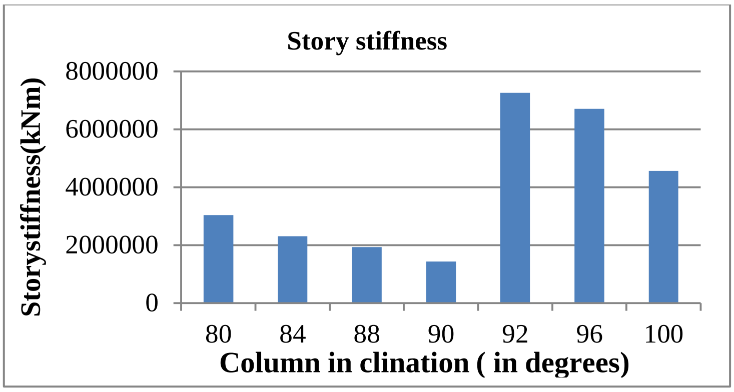

Figure 4.3 Story stiffness of all models

(d) Maximum story drift of all models

Table 4.4 Maximum story drift of all models

Column inclination (in degrees)	Maximum Story drift (unitless)
80	0.000688
84	0.00067
88	0.001117
90	0.001253
92	0.000539
96	0.000682
100	0.000968

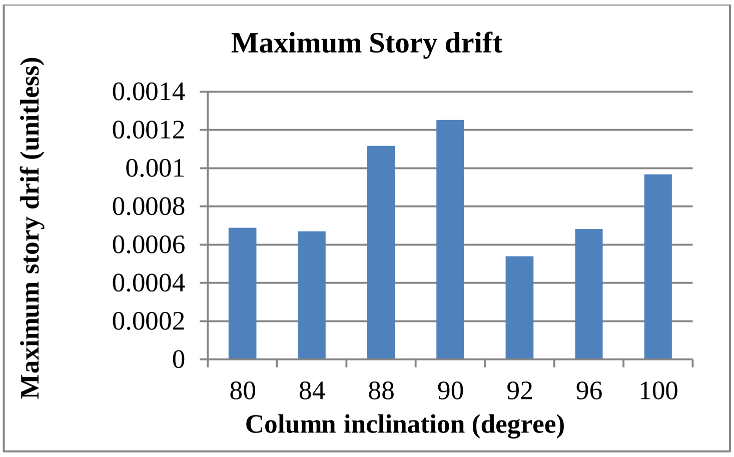

Figure 4.4 Maximum story drift of all models

5. CONCLUSIONS

- Comparing to multistoried buildings with normal columns, the multistoried buildings with oblique columns of 80, 84 and 88 degrees show 41% lesser top story displacement and 28% lesser story shear.
- Oblique columns of 92, 96 and 100 degrees have 30% lesser top story displacement than conventional column.
- Multistoried building with oblique column of greater than 90 degree have story shear and story stiffness greater than conventional columns.
- Oblique columns show 38% lesser story drift than normal columns
- Hence the oblique columns is more seismic resistant than conventional columns

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