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A Study on Multi-Storeyed Building 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.
The Oblique Column 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 shapes in high rise building. In this work a high rise building with Normal Columns & with different locations of Oblique columns is considered for analysis.
In this paper, response spectrum & Linear Static analysis were executed combined with a Numerical Building Model by this program, which were also compared following the analysis results. The results of the analysis on the Axial forces, Base shear, Time period, Storey drift and Displacements are compared. The results are presented in tabular and graphical form. The results on the displacement are checked with serviceability conditions and are compared and presented in tabular form.

KEYWORDS: ETABS, Axial forces, Base shear, Time period, Storey drift, Displacements

I. INTRODUCTION

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. The level of high-rise buildings is an important indicator technological strength. With the continued development and progress of economy, technology and material in recent years, pretty a few countries are conceived to design and built more and higher buildings. Due to the large population and small per capita area, the needs of ultra high-rise buildings become much more urgent. By the various architectural features and style, more and more complex high-rise buildings are appearing. Meanwhile, China has two largest seismic belt in the world, circum-Pacific seismic belt and Europe-Asia seismic zone. China, a developing country with densely populated and low seismic capacity building, 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. And the earthquake has just occurred in Wenchuan is so that we still remember now. Therefore, the seismic performance analysis and research of building structures look more indispensable.
However, facing a large number of new, complex structure system and increasingly sophisticated seismic performance requirements, many conventional design and analysis software cannot ever meet all the needs. Meanwhile, a number of international design and analysis software, such as ETABS, SAP2000, MIDAS/Gen and SATWE are constantly improving themselves, but remained respective limitations. In this paper, response spectrum & Linear Static analysis

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were executed combined with a Numerical Building Model by this program, which were also compared following the analysis results.
Oblique columns are stiffer as RC frames, and therefore, the initial stiffness of the RC frames largely depends upon the stiffness of oblique column. Stiffness of RC frames significantly depends on the distribution of oblique column in the frame. Generally, the RC frames with regular distribution of masonry oblique columns in plan as well as along height are stiffer than the RC frames. The factor of 2.5 is specified for all the buildings with soft stories irrespective of the extent of irregularities and the method is quite empirical. The other option is to provide symmetric RC Columns, designed for 1.5 times the design storey shear force in both directions of the building as far away from the centre of the building as feasible. In this case, the columns can be designed for the calculated storey shears and moments with considering the effects of oblique columns.

II. LITERATURE REVIEW

Nishith B.Panchal, Dr. V.R.Patel, Dr. I.I.Pandya studied by considering the different angles of diagrid and also different storey of the building. The plan of 36m x 36m is considered with four different types of angles of diagrid that is 50.2°, 67.4°, 74.5° and 82.1° and also by considering 24-storey, 36-storey, 48-storey and 60-storey building, a comparative study is carried out and found 67.4°, 74.5° gives the better results.
RohitKumar Singh, Dr. Vivek Garg, Dr. Abhay Sharma presented a study on analysis of concrete diagrid structure and compared with conventional concrete building.In this study STAAD.Pro software is used for modelling and analysis and said that, Indiagrid structure, the major portion of lateral load is taken by external diagonal members who in turn release the lateral load in inner columns. This cause's economical design of diagrid structure compared to conventional structure and also Drift in diagrid building is approx. half to that obtained in conventional building.
ShahanaE, Aswathy S Kumar worked on comparative Study of Diagrid Structures with and without Corner Columns. Concrete diagrid structures with and without corner columns were modelled and analysed using STAAD Pro and the results are compared. Due to inclined columns, lateral loads are resisted by axial action of the diagonal in diagrid structure compared to buckling of vertical columns. By comparing the analysis results they concluded that the behaviour of structure without corner column is more effective than with corner columns.
Nishith B. Panchal, Vinubhai, R.Patel In this paper, the comparison study of 20 storey simple frame building and diagrid structural system building is presented here. Analysis of results in terms of top storey displacement, storey drift, steel and concrete consumption is presented here.

III. MATERIAL DESCRIPTION

Type of frame	**Ordinary moment resisting RC frame OMRF) fixed at the base**	**Type of frame**	**Ordinary moment resisting RC frame OMRF) fixed at the base**
Seismic zones	IV	Density of concrete	24KN/m^3
Number of storey	G+7 storey	Density of infill	20 KN/m^3
Floor height	3 m	Type of soil	Medium soil
Depth of Slab	150 mm	Seismic zone	As per IS (1893-2002)
Size of beam	(300× 500) mm	Seismic zone factor, Z	For zone IV: 0.24
Size of column	(230 × 450) mm	Importance Factor, I	1
Spacing between frames in x-direction	8 m	Response spectrum analysis	Linear dynamic analysis
Spacing between frames in y-direction	8 m	Damping of structure	5%
Materials	M 25 concrete, Fe 415 steel	Plinth height above ground level	1.8 m

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Size of oblique column	(230 x 300) mm	Type of the building	OMRF(Ordinary moment resisting RC frame)
Thickness of external walls	300 mm	Wall load for the outer side for (3 m height wall)	12.42 KN/m
Thickness of internal walls	230 mm	Wall load for the inner side for (3 m height wall)	6.21 KN/m

IV. MODELS

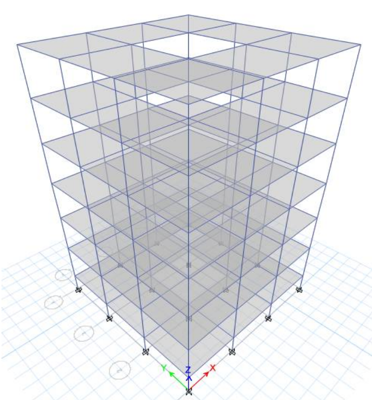

Figure: Isometric view of Model-1

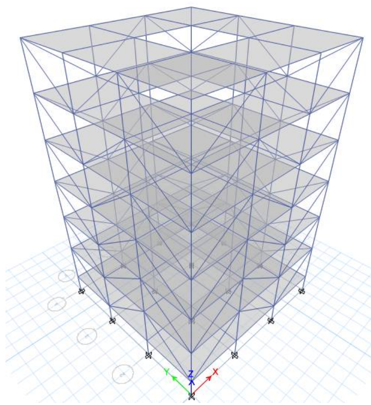

Figure: Isometric view of Model-2

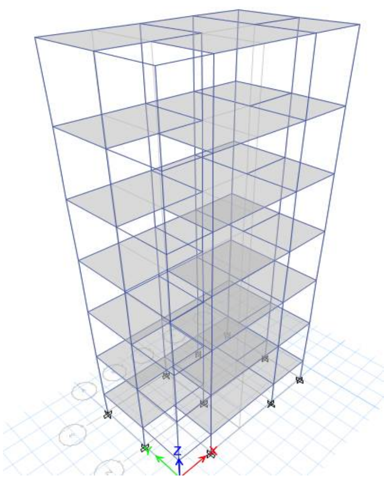

Figure: Isometric view of Model-3

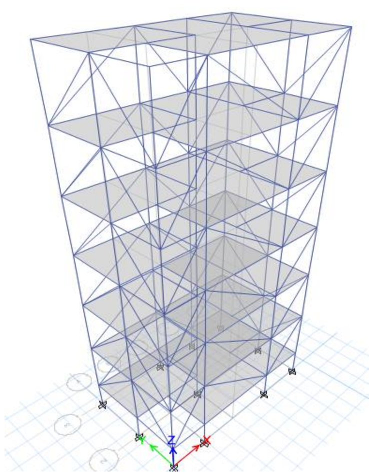

Figure: Isometric view of Model-4

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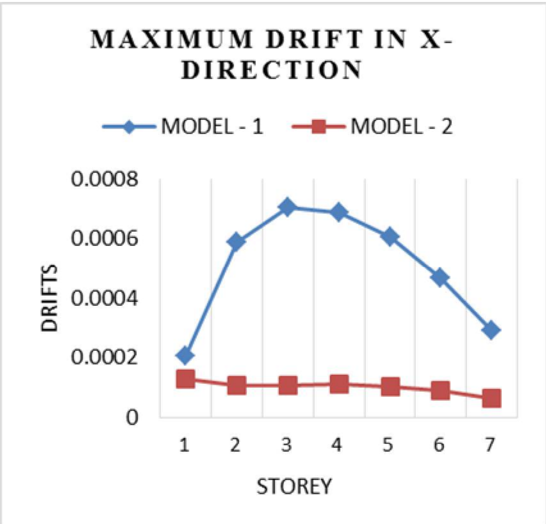
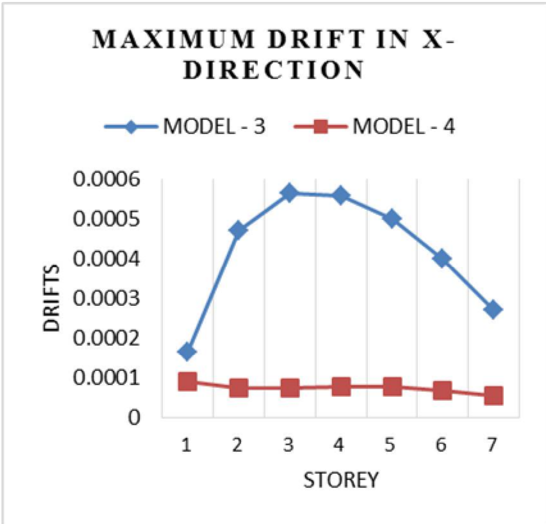
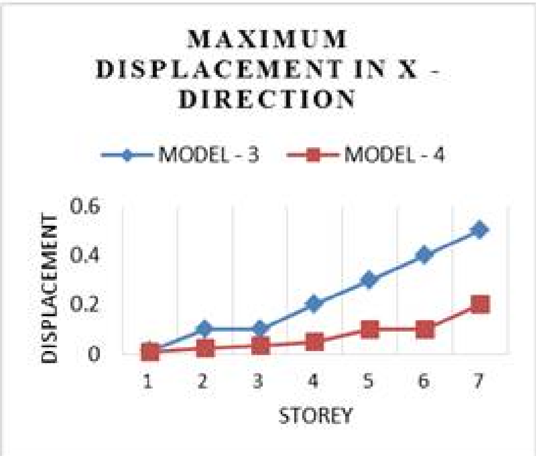
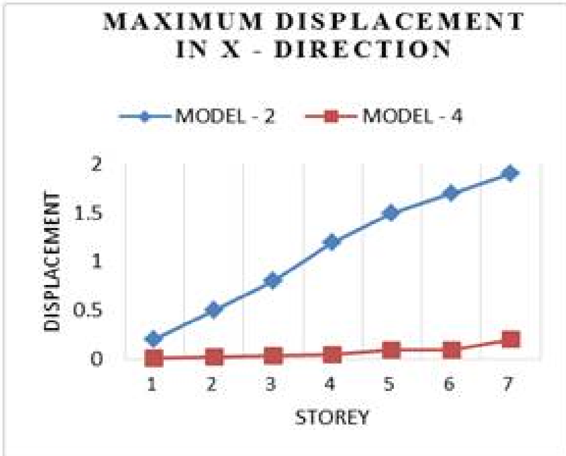
V. RESULTS

Linear static analysis is performed for all models for seven storey buildings as listed. Loads are calculated and distributed as per code IS 1893(Part-I):2002 using ETABS. The results obtained from analysis are compared with respect to the following parameters. The parameters which were studied are Story drifts, Storey displacements, Axial forces, Response spectrum drifts, Time period for all models in zone IV.
All the models are listed below:
Model 1: RCC Framed Model (Symmetric)
Model 2: RCC Framed Model with Oblique Columns (Symmetric)
Model 3: RCC Framed Model (Asymmetric)
Model 4: RCC Framed Model with Oblique Columns (Asymmetric)









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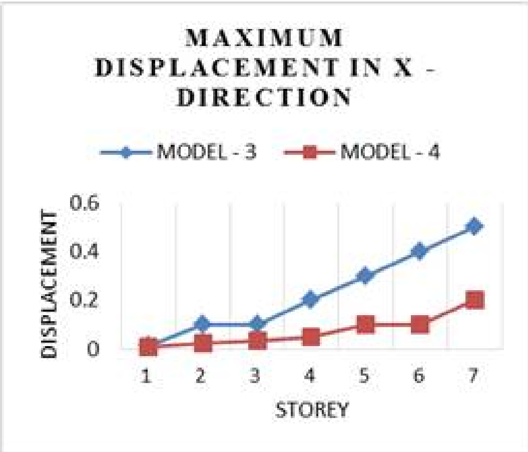

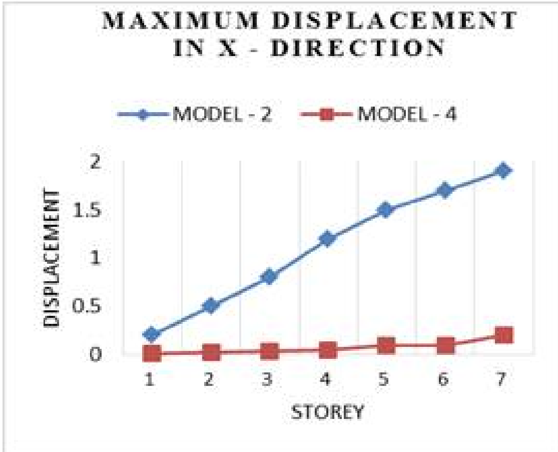

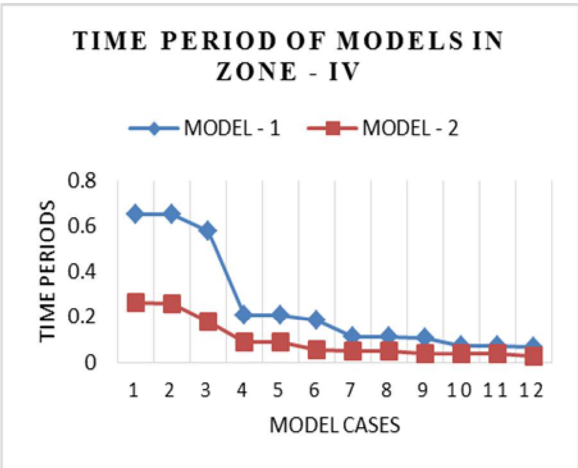

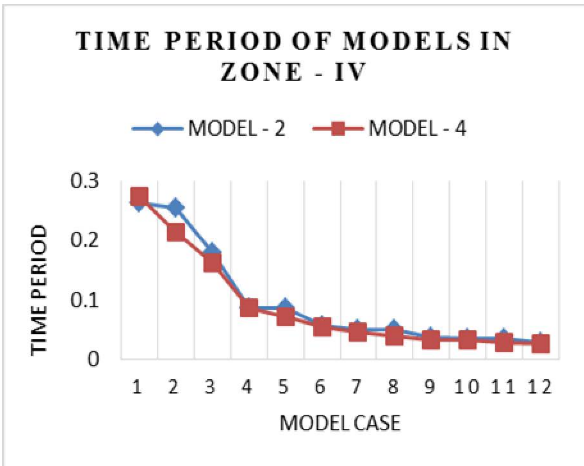

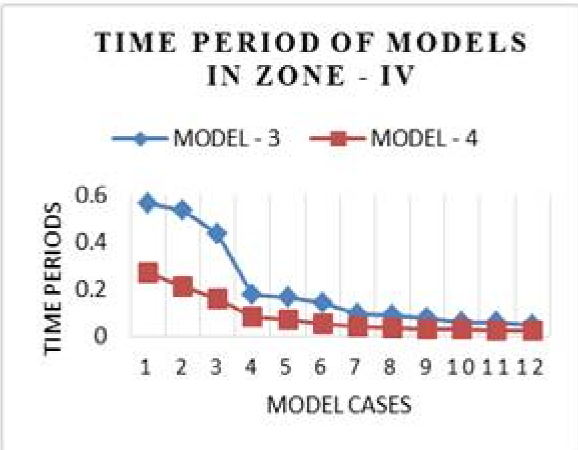

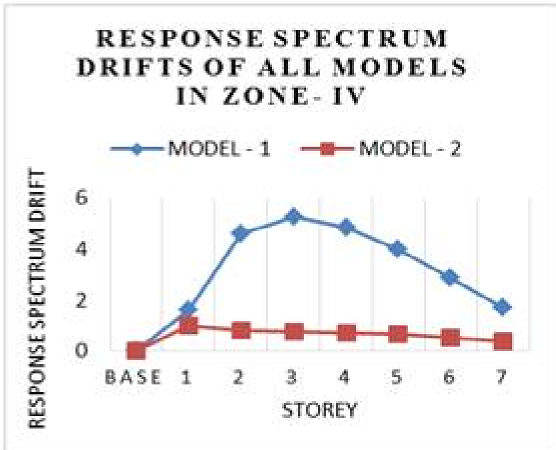

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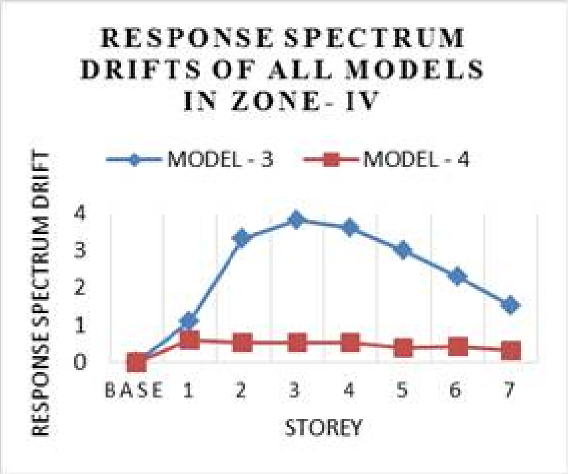

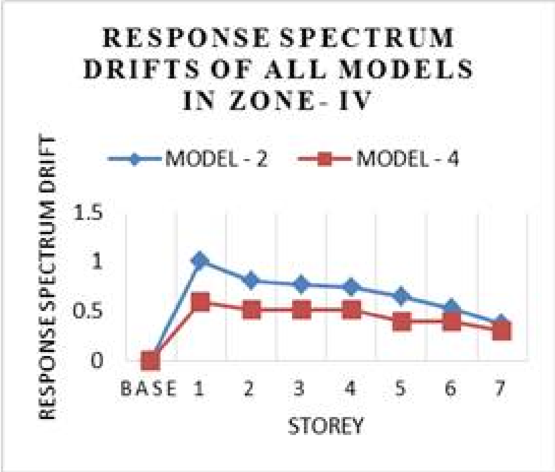

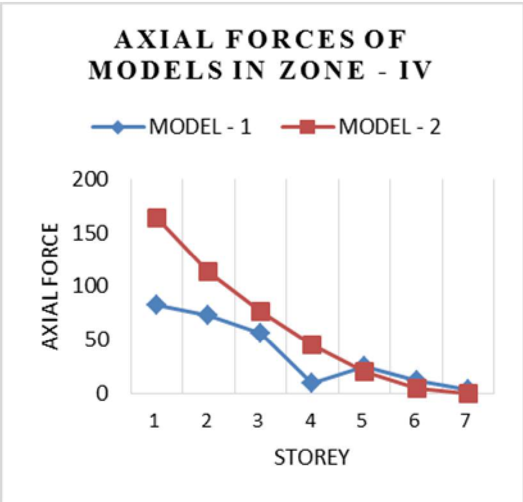

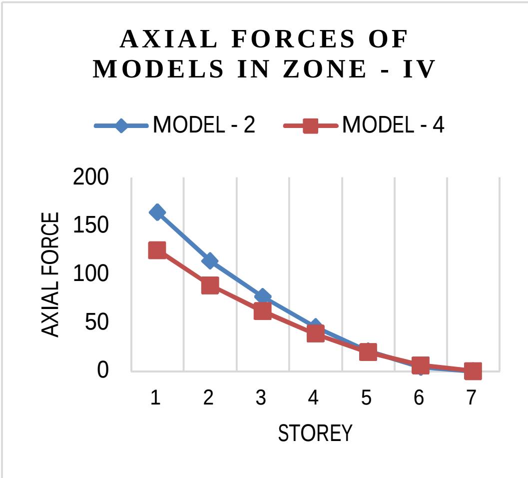

VI. CONCLUSION

- As 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.
- As time period is less, lesser is mass of structure and more is the stiffness. The time period is observed less in Structure with Oblique columns. This reflects more stiffness of the structure and lesser mass of structure.
- Structure provides more resistance in the oblique column building which makes the structural system more effective.
- From the above all models we will prefer symmetrical building because it gives better results than asymmetric building.
- The overall results suggested that Oblique column is excellent seismic control for high-rise symmetric Buildings.

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