

Behaviour of Diaphragm Irregular Steel Building with Concentric Bracing

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ABSTRACT: When a structure is subjected to lateral or torsional deflection under the action of earth shaking, the resulting rotational movement can cause wide reactions from the minor inconvenience to the people living in the building due to acute nausea. As a result, lateral stiffness in the design of tall buildings is a big idea. Bracing is a highly efficient and economical way to oppose the lateral forces in one frame structure because the diagonals work in axial stress and therefore demand minimum member size to provide hardness and strength with horizontal shear. In this research study, four different types of concentric bracings are used to analyze a structure with diaphragm irregularity and the obtained results were compared. Dynamic analysis method response spectrum analysis is being performed to know the best type of bracing using structural software ETABs.

KEYWORDS: Diaphragm Irregularity, Response Spectrum Analysis, Steel Structure, Vertical Irregularity, Asymmetrical Plan, Bracing System, ETABs.

I. INTRODUCTION

A Jinkoo Kim [2] evaluated the over strength, ductility, and the response modification factors of special concentric braced frames (SCBFs) and ordinary concentric braced frames (OCBFs) by performing pushover analysis of model structures with various stories and span lengths and the results were compared with those from nonlinear incremental dynamic analyses. At the end of the results, the conclusion was (a) the overstrength factors increased as the structure height decreased and the span length increased, (b) the ductility factors increased as the structure height decreased and the bay length increased, (c) The response modification factors obtained from the two different procedures turned out to be similar.

M.A. Youssef [3] was made an experimental investigation and conducted to assess the behavior of braced RC frames. Two specimens, a conventional moment frame with moderate ductility and a braced frame, were designed using the same seismic force reduction factor and after the analysis, it has been concluded that (a) the brace members and their connections can be designed using a similar procedure to that for braces in steel structures. (b) The use of braced RC frames as the main lateral load resisting system is a promising design alternative.

II. OBJECTIVE OF THIS PAPER

The main objective of this paper is to find which bracing system is appropriate for the diaphragm irregular structure among taken parameters like story displacement, story drifts and axial forces in column.

III. MODELLING AND ANALYSIS OF BUILDING

The analysis of G+ 14 T-shape structure is carried out using ETABs professional software for special moment resisting frame (SMRF) situated in zone III. The G+14 steel structure is analyzed under seismic loading. Story displacement, story drifts and axial forces are compared using different types of bracing systems in structure which is taken. In this

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study, the floor area is same up to 8th floor and the diaphragm irregularity has been taken in 9th floor to 15th floor. The geometry of the structure is shown in table 1.

SIZE OF COLUMN	
UPTO 8TH FLOOR	BUILTUP ISHB350*
9TH TO 15 FLOOR	BUILTUP ISHB250*
SIZE OF BEAM	
UPTO 8TH FLOOR	ISWB450
9TH TO 15 FLOOR	ISMB500
HEIGHT OF EACH FLOOR	3m
FLOOR AREA	1600 m ²
TYPE OF STRUCTURE	STEEL FRAME

TABLE. 1. MODELLIN DATA FOR BUILDING

The bracings are located on the center of all the four sides of periphery. Four types of bracings are assigned in the structure and the data were compared. Story displacement, story drift and the axial forces on the columns are recorded and compared. The data were compared to see which type of bracing system is appropriate for structure if it is provided at the center bay of the structure. Models providing different types of bracing are shown in figure 1, figure 2, figure 3 and figure 4.

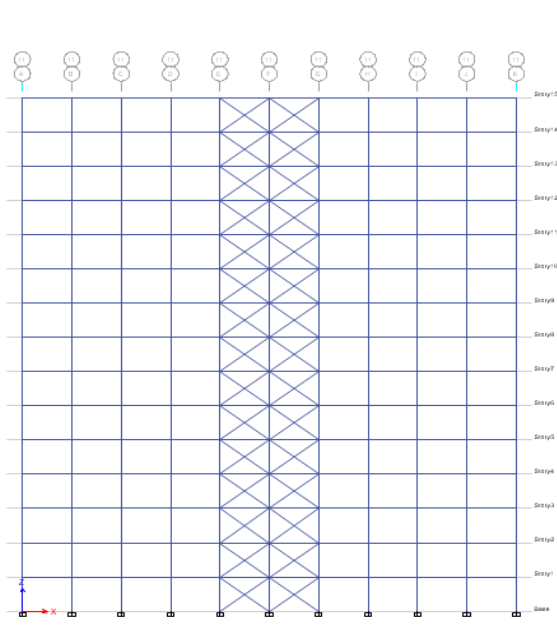


FIG. 1. STRUCTURE WITH X-BRACING AT CANTER

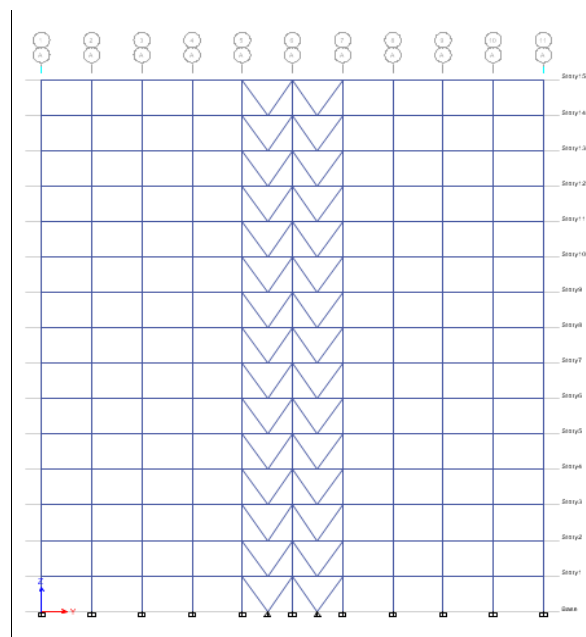


FIG. 2. STRUCTURE WITH V-BRACING AT CANTER

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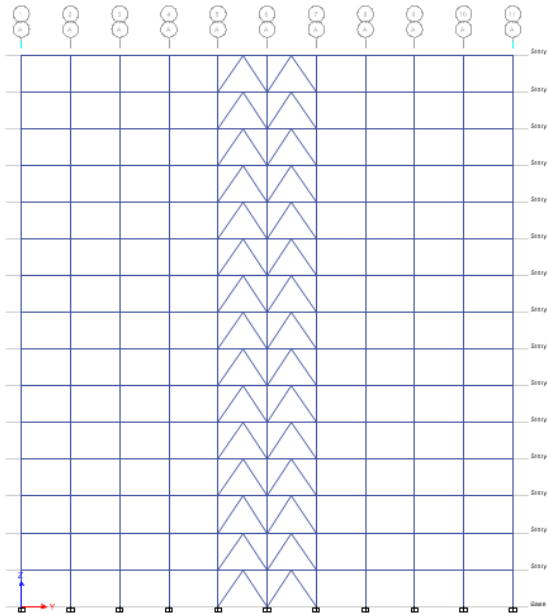


FIG. 3. STRUCTURE WITH INVERTED V-BRACING AT CENTER

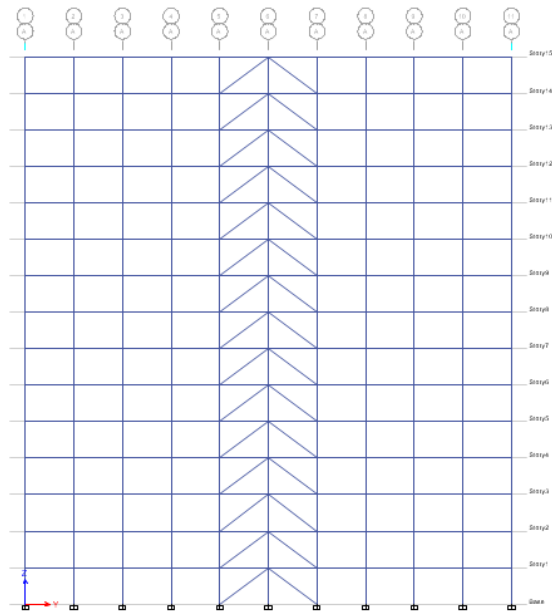


FIG. 4. STRUCTURE WITH DIAGONAL BRACING AT CENTER

IV. RESULTS AND DISCUSSION

Story Displacement RSX

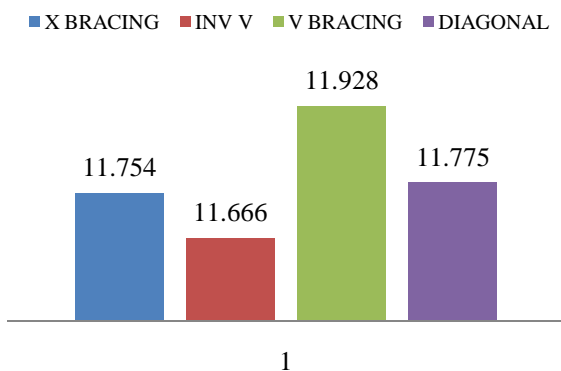


FIG 5. MAXIMUM STORY DISPLACEMENT (mm) IN

Story Displacement RSY

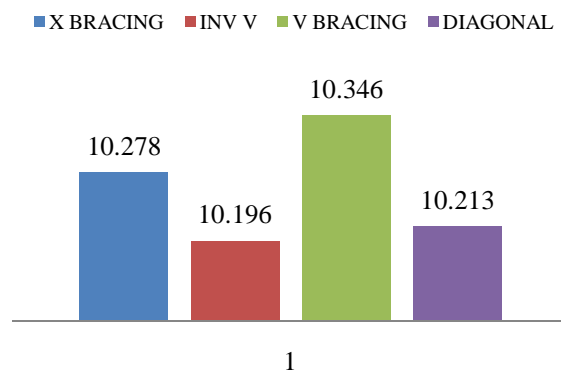


FIG 6. MAXIMUM STORY DISPLACEMENT (mm) IN

Fig 5 & Fig 6 show the maximum lateral displacement for seismic load in RSX & RSY direction respectively at 15th story level. The lateral displacements of the structure with different bracing systems are compared. The above graph shows that the minimum displacement obtained bracing system in X direction & Y direction is Inverted V shape bracing.

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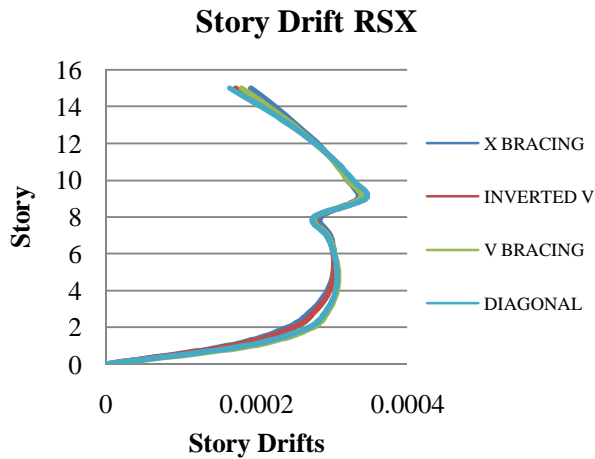


FIG 7. MAXIMUM STORY DRIFT (mm) IN RSX

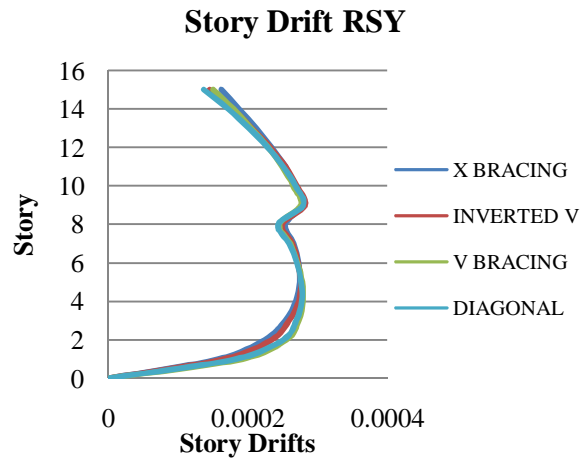


FIG 8. MAXIMUM STORY DRIFT (mm) IN RSY

Fig 7 & fig 8 show the maximum story drifts for seismic load in RSX & RSY direction. The Story Drifts of the structure with different bracing systems are compared. The above graph shows that the minimum story drifts obtained bracing system in X direction & Y direction is single diagonal bracing.

AXIAL FORCE IN COLUMN

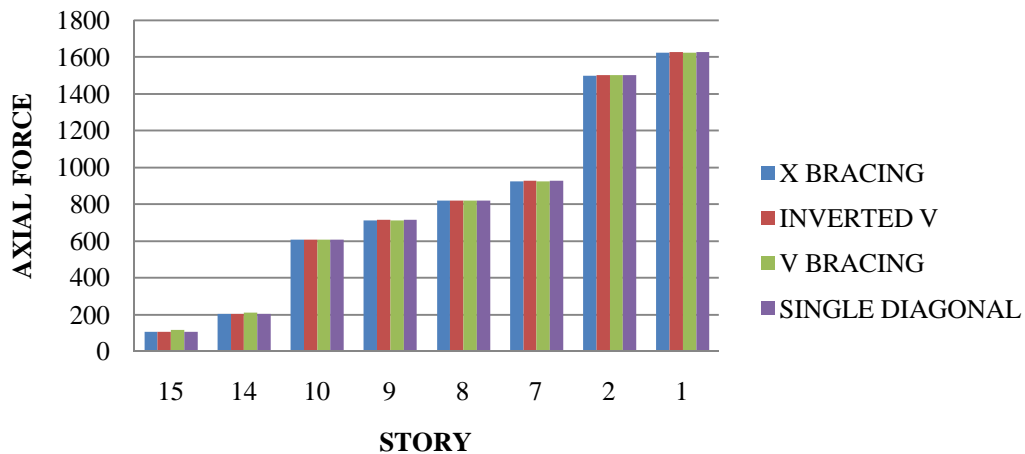


FIG 9. AXIAL FORCES IN COLUMN (kN)

Fig 9 shows the axial force in column under seismic load in both RSX & RSY direction. The axial forces obtain by comparing all the axial forces for all the types of bracing system which are taken. The above graph shows that minimum axial force on column is in Inverted V shape bracing.

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V. CONCLUSION

The comparative study of diaphragm irregular steel structure has been studied using software ETAB. The analysis has been done by dynamic method Response Spectrum. Different parameters like story displacement, story drift and axial forces in column are compared with all the types of bracing system and the results are obtained. The analysis has been performed for obtained the most appropriate bracing system with diaphragm irregularity. After the analysis of the structure, it has been concluded that Inverted V shape bracing system is most appropriate bracing system in structure with diaphragm irregularity.

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