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COMPARATIVE ANALYSIS AND DESIGN OF MULTISTORY REINFORCED CONCRETE SMRF AND OMRF BUILDINGS IN SEISMIC ZONE II

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ABSTRACT

The present work has been performed on G+ 15 story OMRF & SMRF Symmetrical Building for seismic zone II as per IS 1893:2002 (Part I). Building has been Modelled Analysed in ETABS & design Calculations & optimizations are done in RCDC. Structure Modelled is having 6 Bays of 4m & 1 bay of 5m along 29m side & 4 Bays of 4m & 2 Bays of 3m along 22m side. Amount of steel required, Story drift, story Displacements, lateral loads, story stiffness, story moments are taken as Parameters of comparison.

KEYWORD

SMRF, OMRF, Story drift, Earthquakes.

I. INTRUDOCTION

Some of the largest earthquakes of the world have occurred in India & the earthquake engineering development in the country started rather early. After, 1987 earthquakes in Assam, A new Earthquake Resistant type of housing was developed which is still prevalent in north east India. After the Baluchistan earthquakes of 1935 the evolution of first seismic zone map started

Seismic analysis will ascertain the conduct of RCC structures during seism. The seismic evaluation greatly hinge on materials, Ductility of structural members, strength, stiffness & Reinforcement detailing. Criteria for Earthquake resistant design of structures (IS1893:2002) Have provision to follow different framing system.

The code has provision over SMRF & OMRF framing systems. The best framing system whirl economical, dependable, safe & better seismic performance. Indian seismic codes divides the country into five zones (I, II, III, IV, V) Depending upon seismic risks. OMRF is commonly adopted type of framing in mild seismic zones. As the seismic peril increases OMRF becomes deficient to defy the gain of lateral force and is supersede by SMRF. OMRF is comprised of less stringently proportioned and detailed members and joints, while SMRF consist of additional requisite to ameliorate inelastic response characteristics.

The study focuses on seismic performance of various moment resisting frames in high rise buildings. The two buildings are provided with SMRF & OMRF Framing system and analysed in seismic zone II. The analysis is carried out in ETABS software. The analysis and results are then compared to find out the best framing system.

II. METHODOLOGY

The Methodology follows in this study is;

1. Study of ETABS & RCDC software's and literature Reviews.
2. Preparation of the Architectural plan of the building in AutoCAD software.
3. Framing of the above mentioned building in ETABS-19 software.
4. Analysing the Building with SMRF & OMRF Configuration in Seismic Zone II Using ETABS-19. Designing the structure on the basis of above mentioned Analysis in RCDC-V9.software.
5. Comparative study of all the results in terms of Max. Shear force, Maximum Bending Moment, Max. Story drift, Economical & serviceability.

III. BUILDING DESCRIPTION & MODELLING DETAILS

Building Description.

Sr.No.	Description	Dimensions
1.	Plan dimensions	31m x 22m
2.	No of stories	G+15
3.	Total height of building	49.5M
4.	Height of each story	GF=4.5M, Rest all floors=3m each
5.	Size of beams	300 x 500 mm
6.	Size of columns	300 x 600 mm
7.	Thickness of slab	150 mm
8.	Thickness of walls	230 mm
9.	Seismic zone	II
10.	Soil Condition	Medium Soil
11.	Importance Factor	1.2
12.	Response Reduction Factor (R)	SMRF=5 OMRF=3
13.	Damping of structure	0.05
14.	Live loads	a) On Roof = 1.5KN/m2 b) On floor = 3 KN/m2
15.	Floor finishing	0.5 KN/m2
16.	Material	M45 Concrete Grade &FE500 Steel

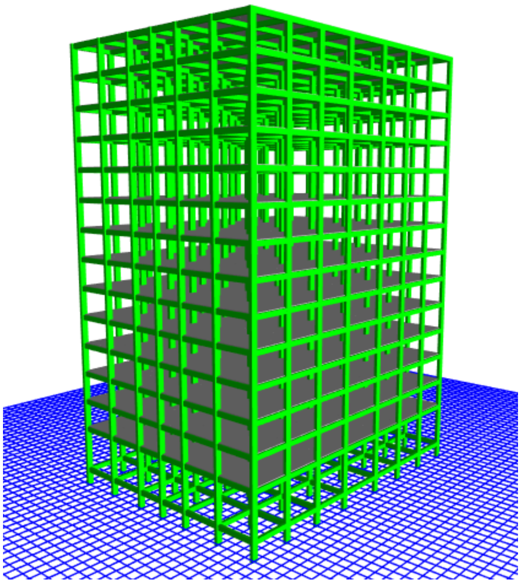

Fig1. 3D Rendered view of model in ETABS

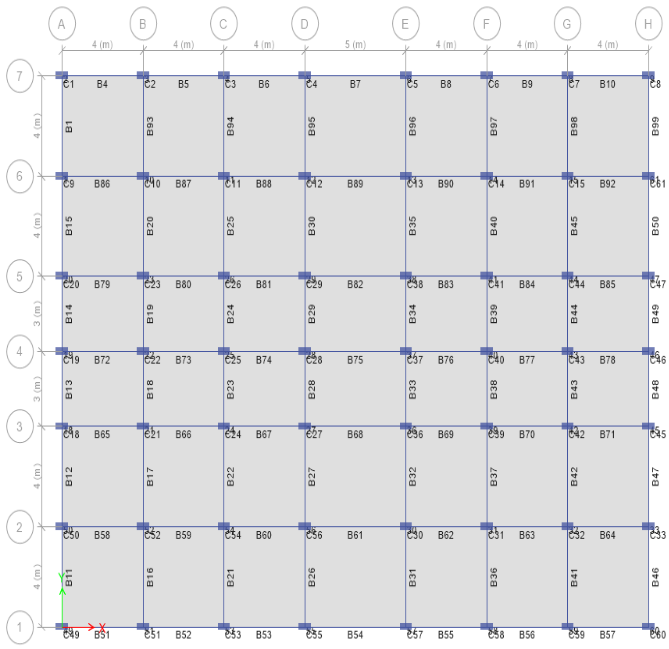

Fig2. Plan of Typical floor of model in ETABS

IV. LOAD CASES & LOAD APPLICATION ON THE MODEL

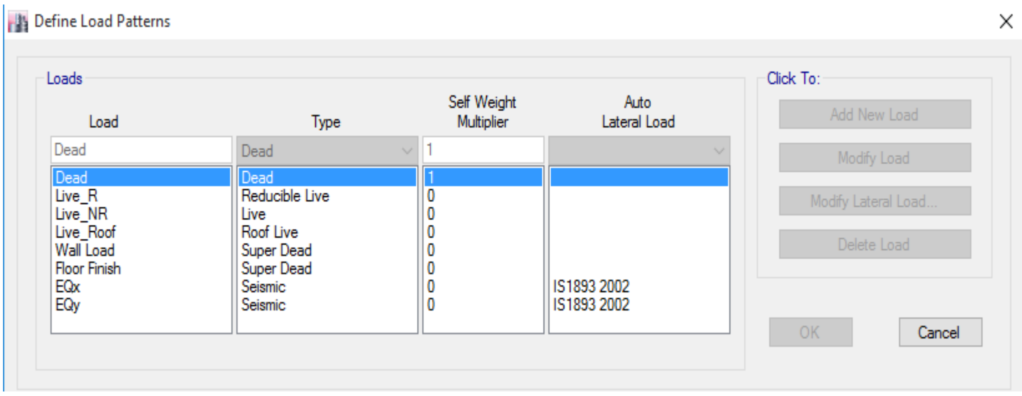

Fig 3: Load Patterns applied

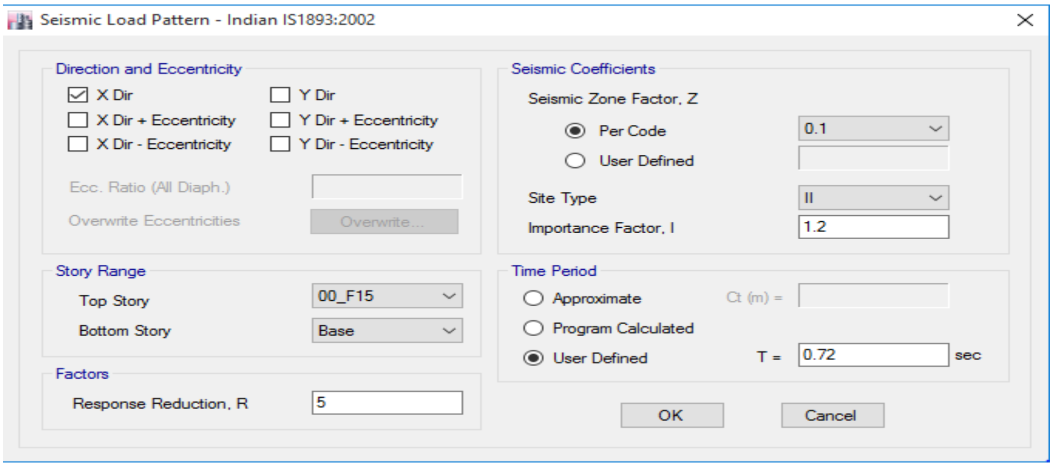

Fig 4. .Seismic Load Input Pattern for SMRF

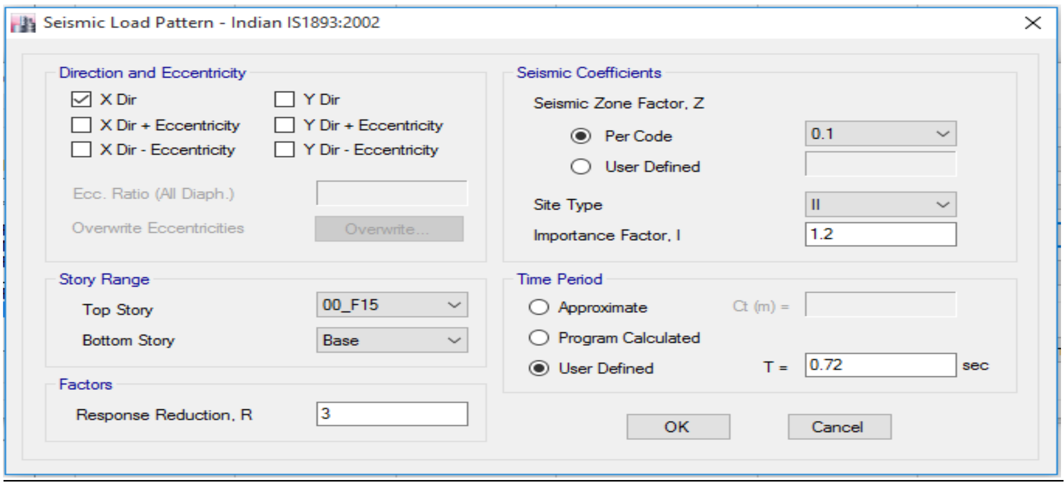

Fig.5 : Seismic Load Input Pattern For OMRF

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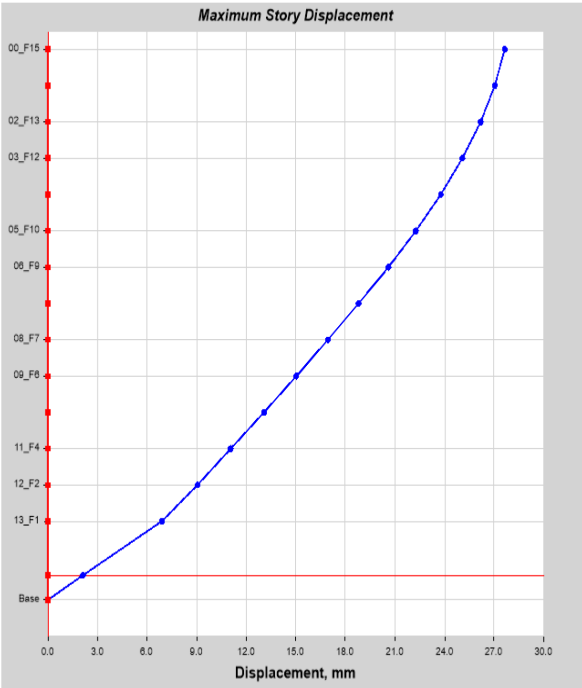
V. GRAPHICAL RESULTS

A) For Ordinary moment Resisting Frame (R=3)& IS 456:2000



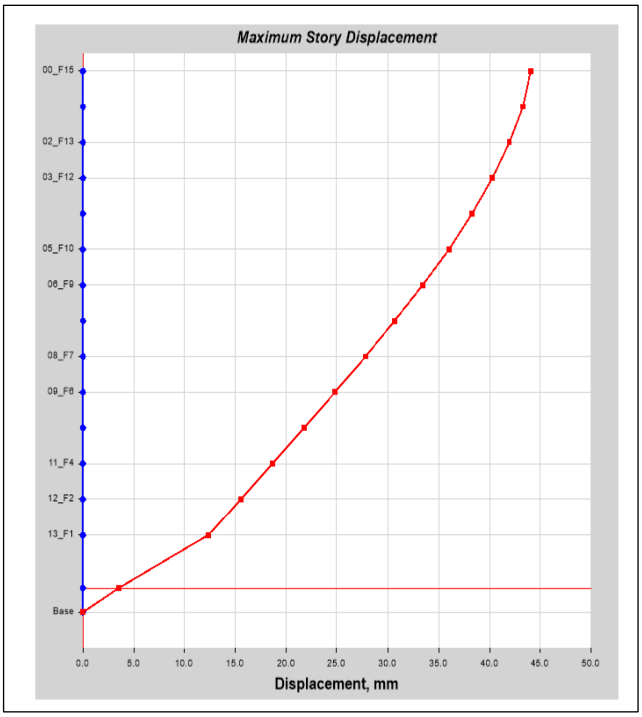
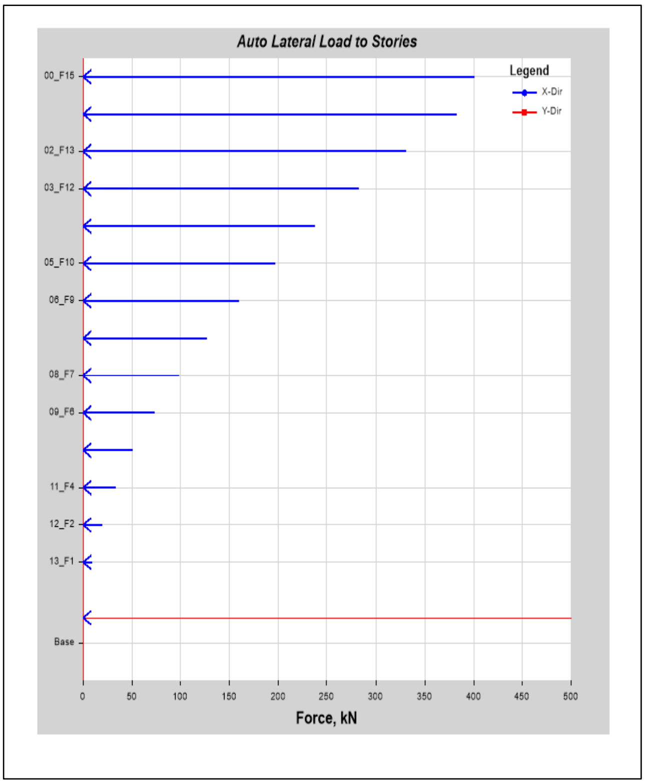


Fig 6. Maximum story Displacement at X and Y direction Due to load EQx and EQy



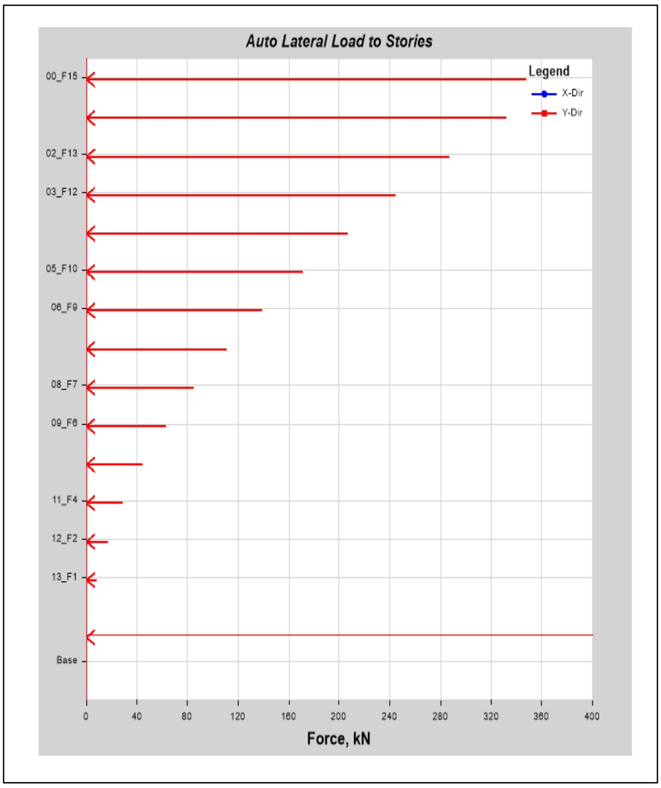
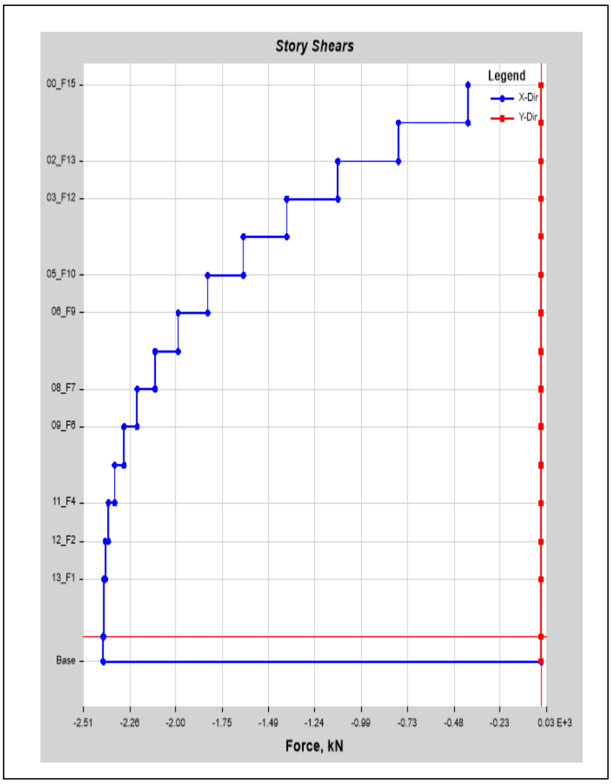


Fig 7. : Lateral Loads at X and Y direction Due to load EQx and EQy



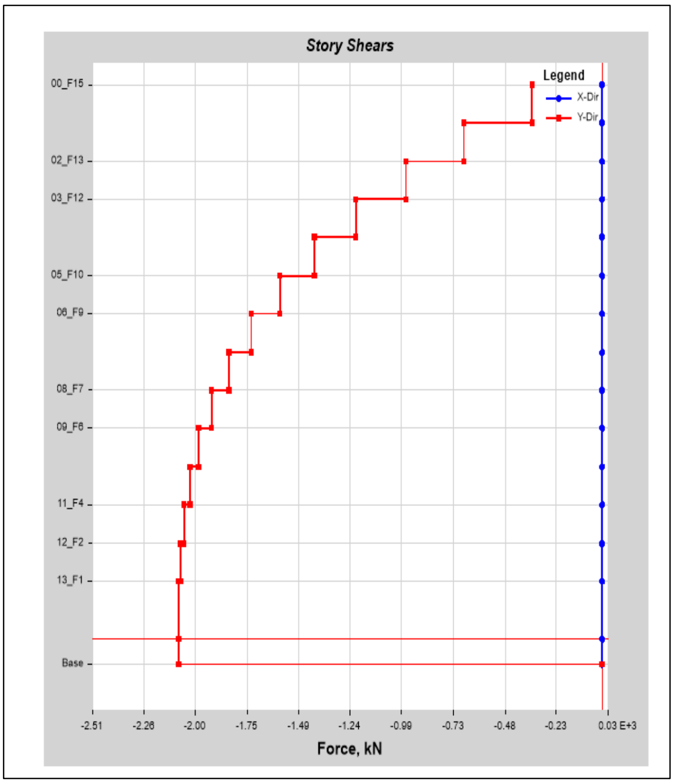
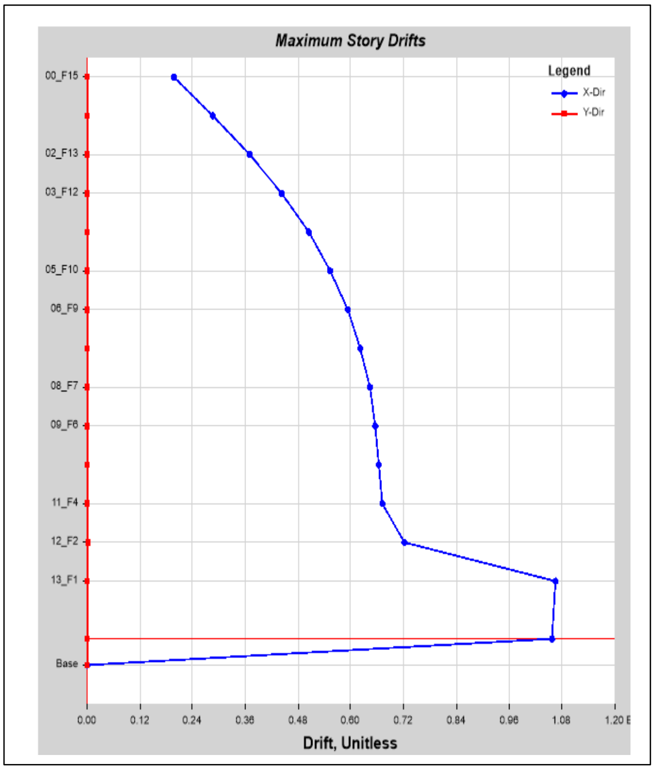


Fig 8. Story Shear at X and Y direction Due to load EQx and EQy



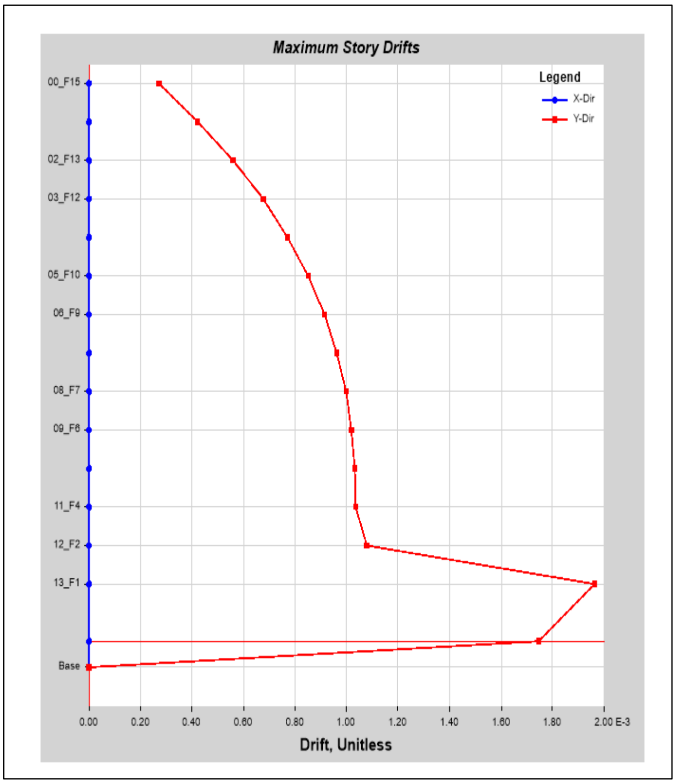
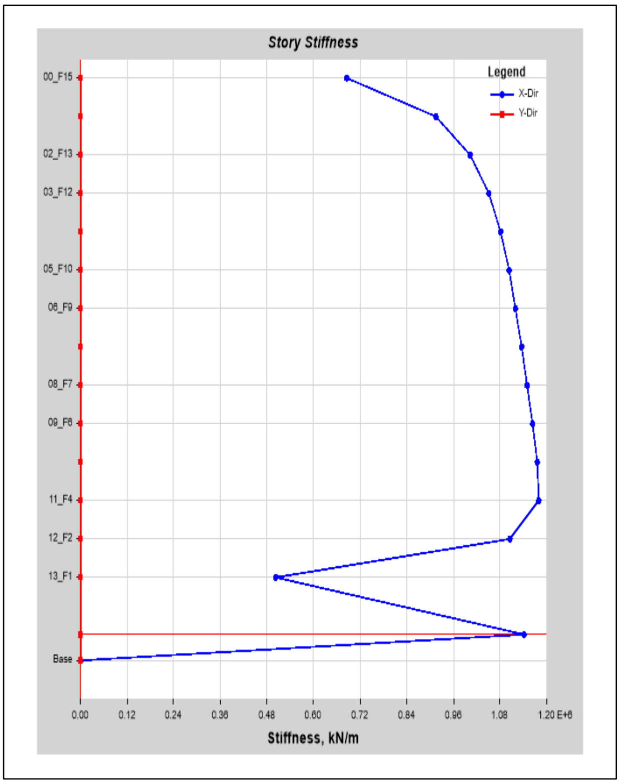


Fig 9. : Story Drifts at X and Y direction Due to load EQx and EQy



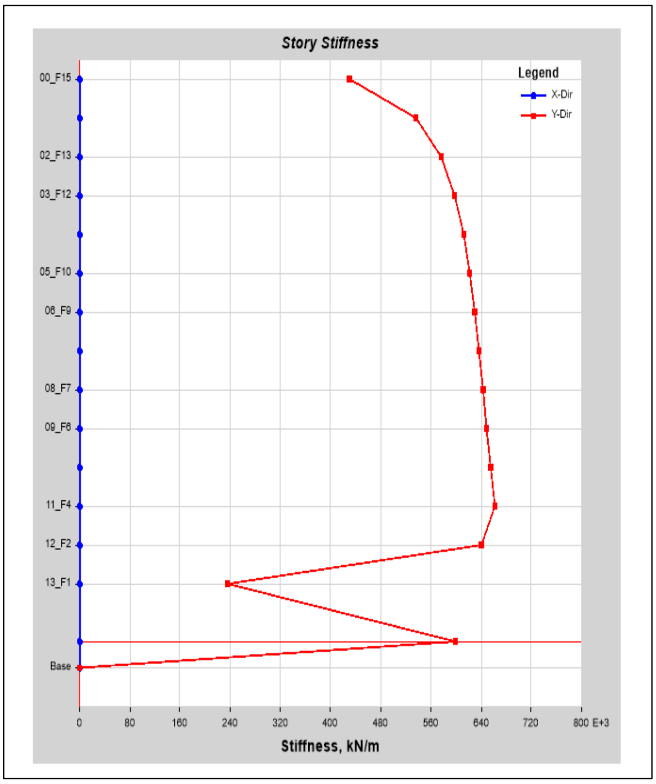
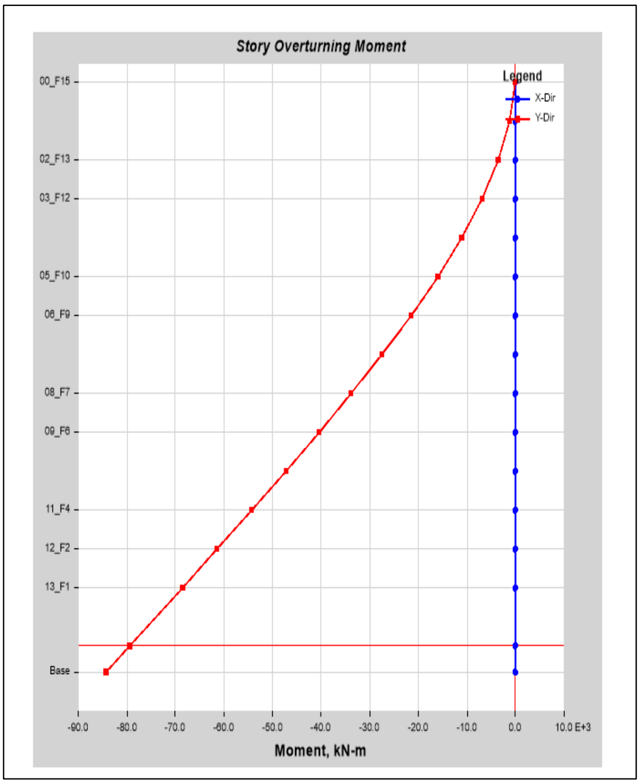


Fig 10. Story Stiffness at X and Y direction Due to load EQx and EQy



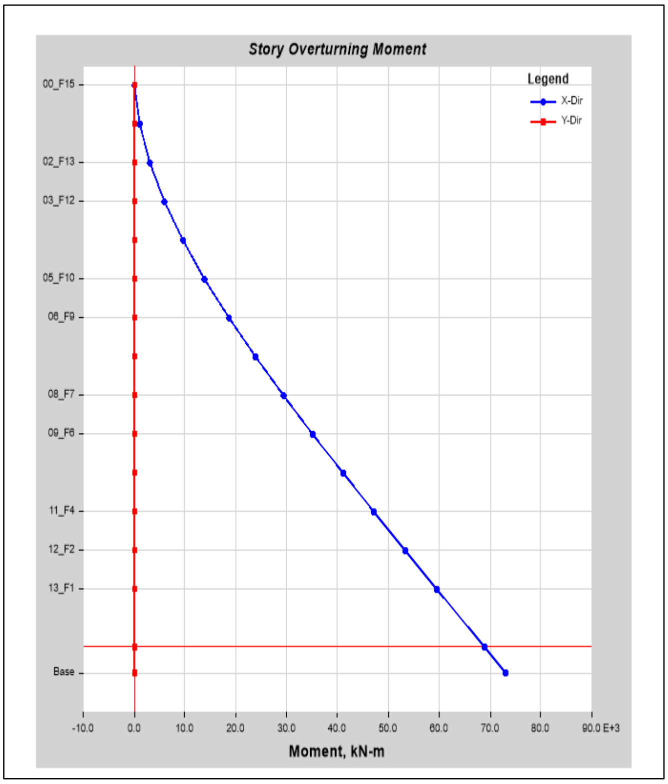


Fig 11.: Story Moments at X and Y direction Due to load EQx and EQy

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B) For Special Moment Resisting Frame (R=5) & IS 13920 :2016

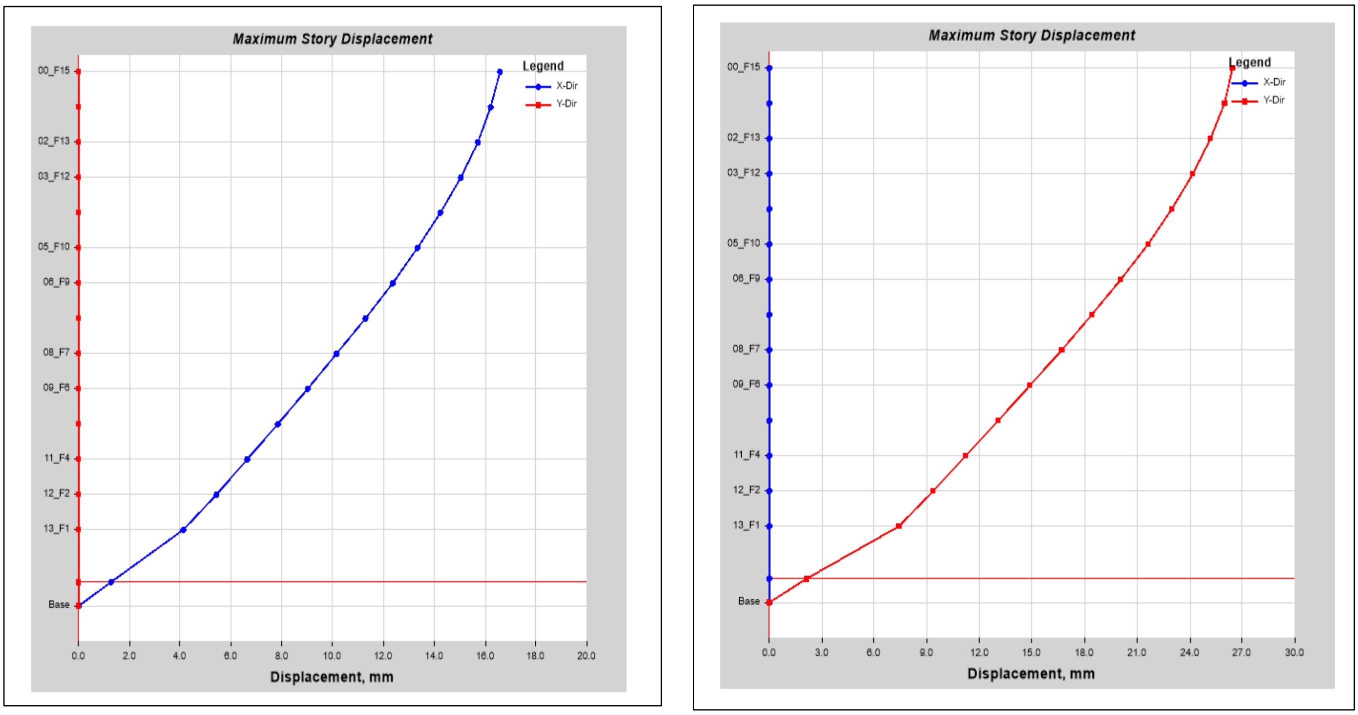

Fig 12. : Maximum story Displacement at X and Y direction Due to load EQx and EQy

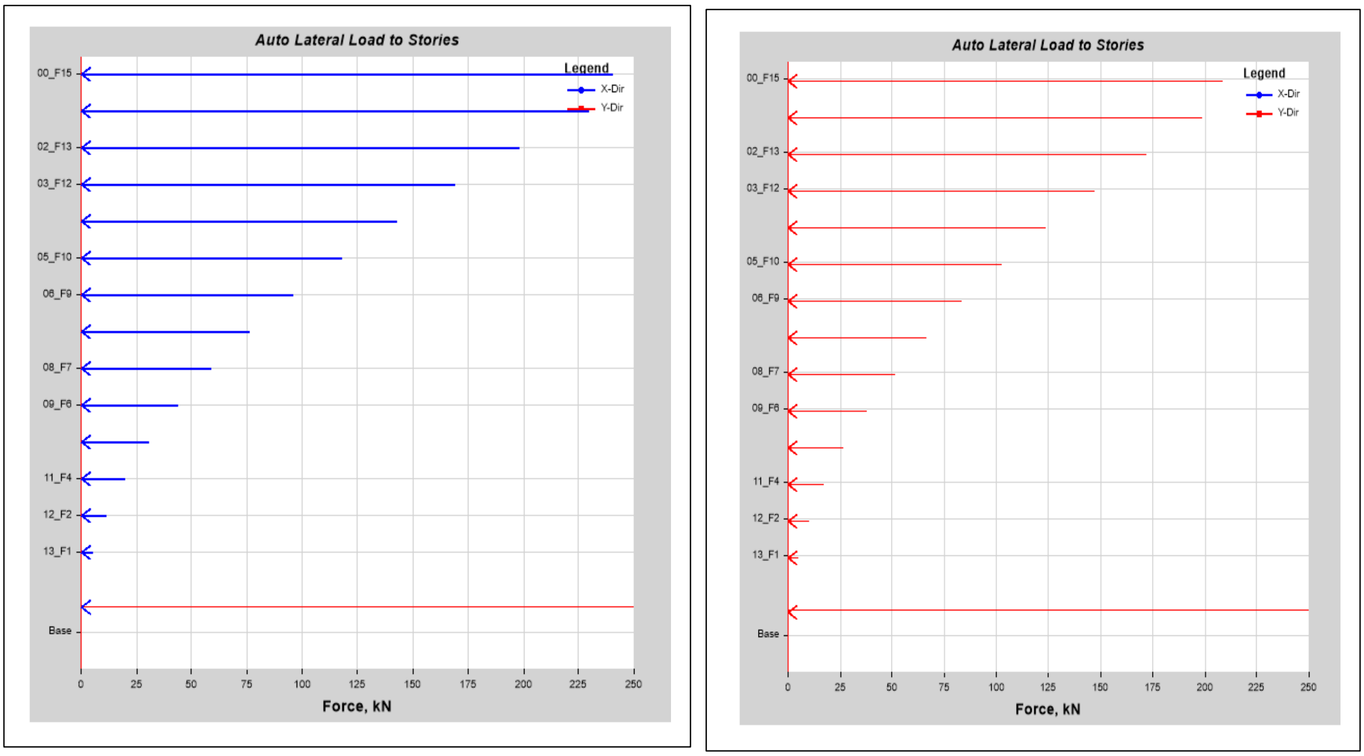

Fig 13. Lateral Loads at X and Y direction Due to load EQx and EQy

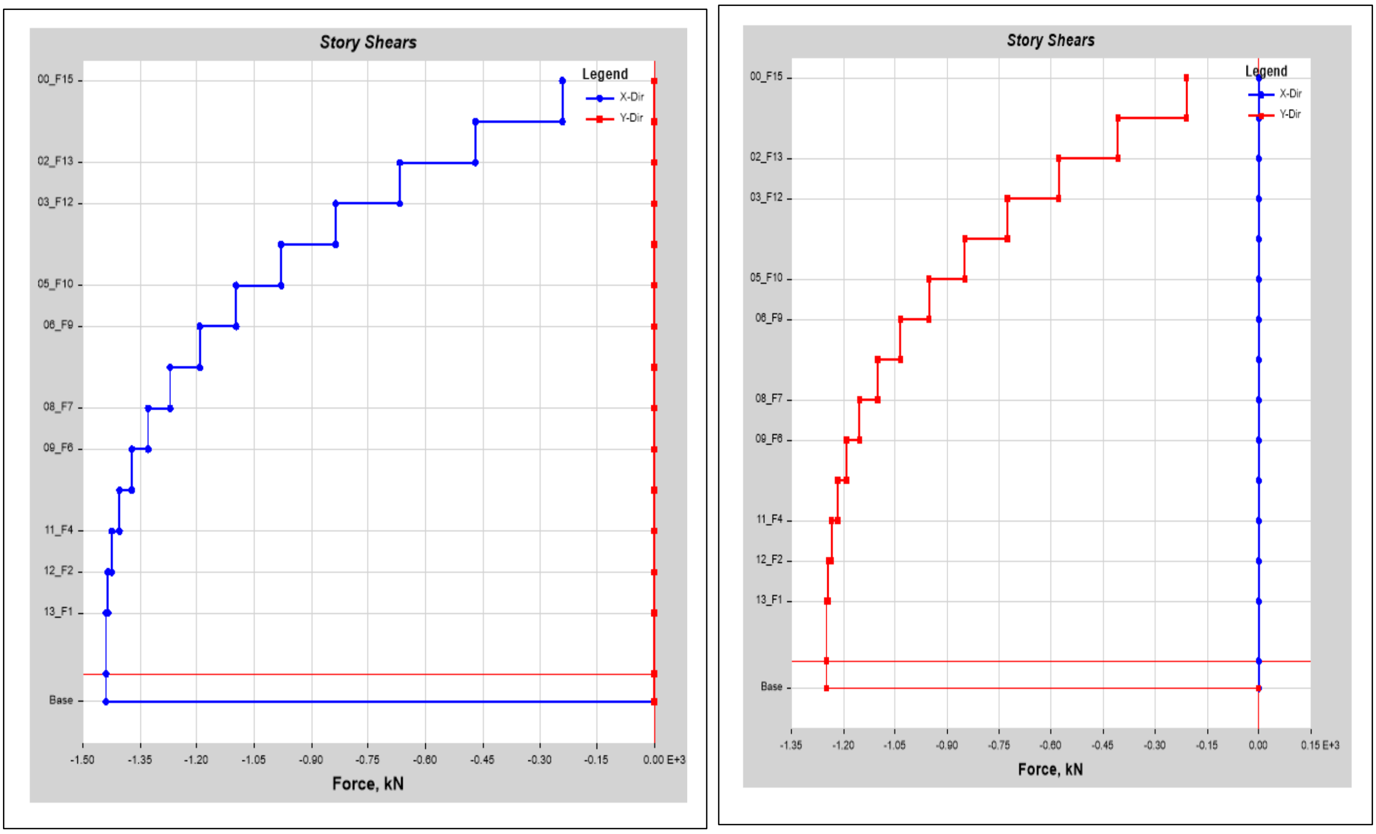

Fig 14. Story Shear at X and Y direction Due to load EQx and EQy

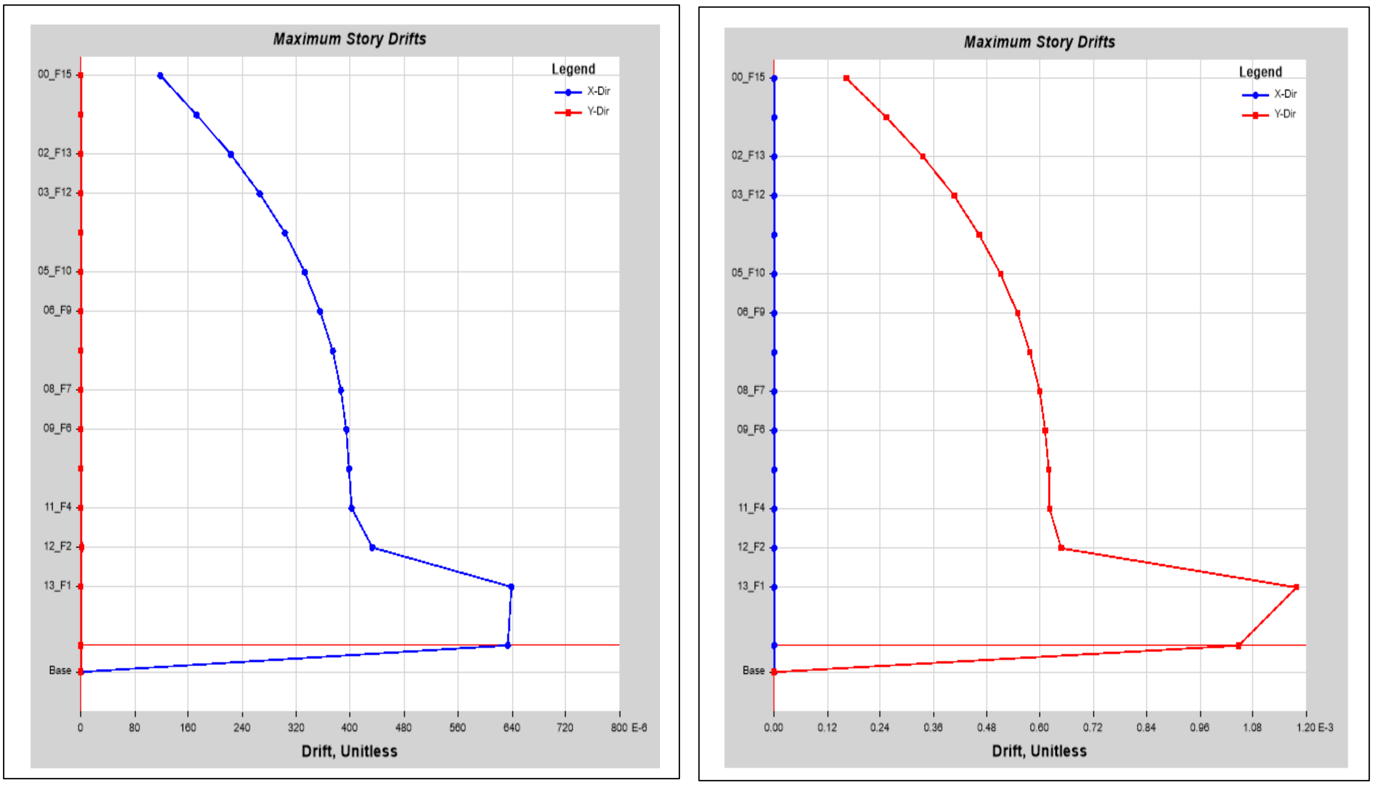

Fig 15.: Story Drifts at X and Y direction Due to load EQx and EQy

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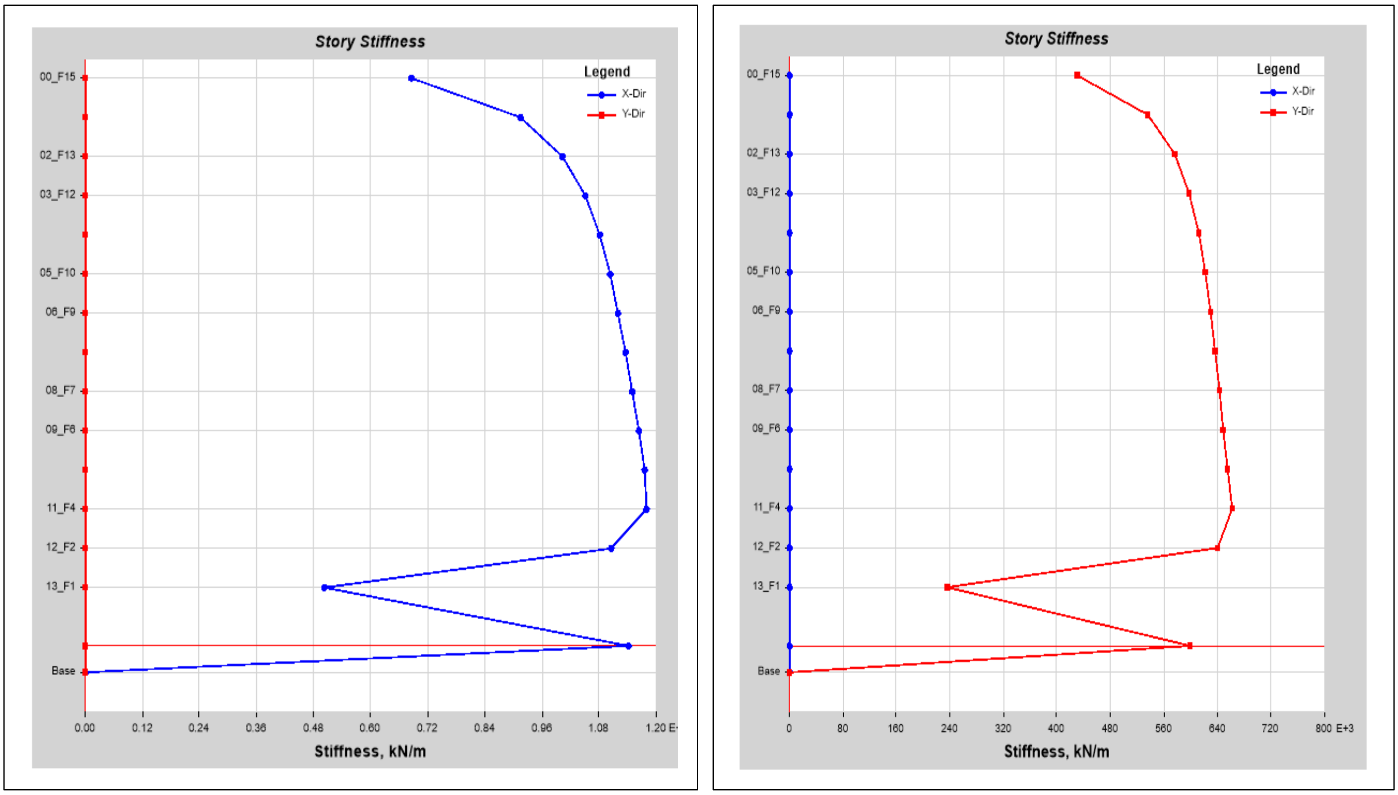

Fig16. : Story Stiffness at X and Y direction Due to load EQx and EQy

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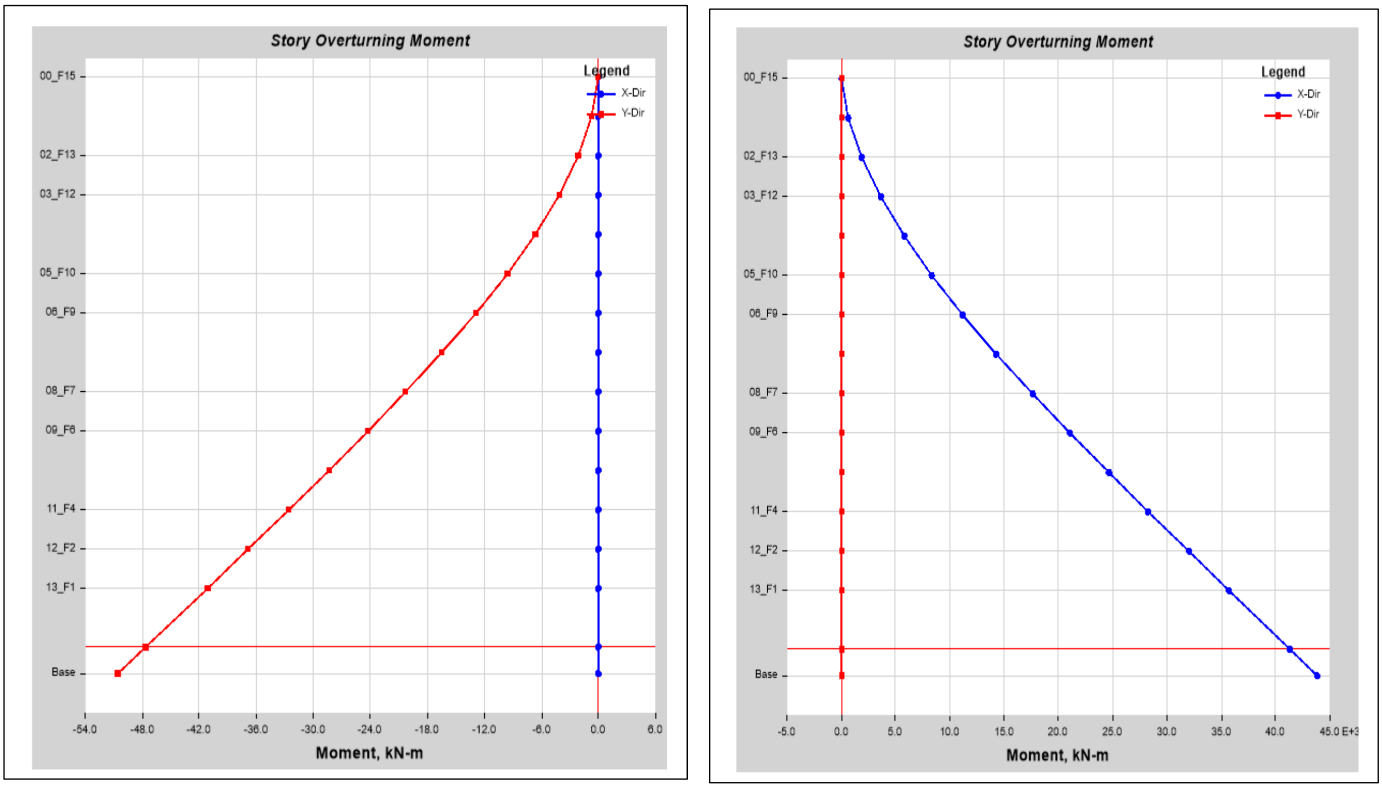

Fig 17. : Story Moments at X and Y direction Due to load EQx and EQy

CONCLUSIONS

From the graphical observations it is observed that In case of SMRF buildings when subjected to Seismic forces the Storey displacement is found to be 44% less in X direction & 33.33% less in Y direction than OMRF Buildings

Similarly from the analysis we also Observed that Effect of Lateral loads Acting on SMRF buildings are 37.5% (x direction) & 40.78 % (y direction) Less than OMRF Buildings.

The Storey drifts and Storey shear values For SMRF buildings are observed to be less than OMRF buildings. SMRF is more efficient than OMRF in resisting Shear.

The SMRF Framing System offers better than OMRF in terms of Bending Moment. Increase in bending moment increases the area of steel, hence OMRF is uneconomical.

The story Stiffness Value for SMRF are also found less than that OMRF especially in X direction.

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