International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 07 | July -2017 www.irjet.net p-ISSN: 2395-0072

NON LINEAR ANALYSIS OF RCC BUILDING WITH AND WITHOUT SHEAR WALL

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Abstract - Although different procedures are possible, the non-linear static analysis, also known as the Pushover analysis, also known as collapse analysis is considered to be a convenient method for evaluating the performance. On this study, the method is used to evaluate the performance of RC plane frames. Reinforced concrete (RC) frame buildings are becoming increasingly common in urban India due to increase in population and safety in such situation is much more important.

The static pushover analysis is becoming a popular tool for seismic performance evaluation of existing and new structures. The expectation is that the pushover analysis will provide adequate information on seismic demands imposed by the design ground motion on the structural system and its components. The purpose of the paper is to summarize the basic concepts on which the pushover analysis can be based, assess the accuracy of pushover predictions, identify conditions under which the pushover will provide adequate information and, perhaps more importantly, identify cases in which the pushover predictions will be inadequate or even misleading.

This paper deals with the non-linear analysis of an RCC frame and also the non-linear analysis of an RCC frame with shear walls at different levels. The main aim is to carry out the difference in the push-over curves of the RCC frames and to calculate the displacement in the frames.

The analysis is carried out using ETABS software .Push-over the analysis is carried out using ETABS software .Push-over curves for both the frames are obtained and comparison is carried out.

***Key Words*: Linear Static and Dynamic, Non-Linear static pushover analysis and performance based analysis, ETABS**

1.INTRODUCTION

The major criteria now-a-days in designing RCC structures in seismic zones is control of lateral displacement resulting from lateral forces. In this thesis effort has been made to investigate the effect of Shear Wall position on lateral displacement and Base Shear in RCC Frames. RCC Frames withG+14 are considered with and without shear wall. Non-linear static analysis (pushover analysis) was carried out for the frames and the frames were then compared with the push over curves. Displacement and Base shear is calculated from the curves and compared. The nonlinear analysis of a frame has become an important tool for the study of the concrete behavior including its load-deflection pattern and cracks pattern. It helps in the study of various characteristics of concrete member under different load conditions.

1.1 OBJECTIVE

1. To provide analysis of R.C.C Structural with or without shear wall.
2. To perform Linear Analysis and Non-Linear Analysis.
3. To study the performance of R.C.C structure with or without shear wall w.r.t. different parameters such as story drift, story displacement, base shear, shear force etc.
4. To study the hinge formation during the performance of concrete frame to verify strong column weak beam.
5. To determine the effect of earthquake on various parameters like fundamental, time period, storey drifts, lateral joint displacements, bending moments and shear force in beam and columns.
6. To study the hinge formation during the performance of concrete frame to verify strong column weak beam behaviour of the members.
7. To determine the performance point of R.C.C with shear wall and without shear wall concrete frame by capacity spectrum.

1.2 Description of pushover analysis

The non-linear static pushover procedure was originally formulated and suggested by two agencies namely, federal emergency management agency (FEMA) and applied technical council (ATC), under their seismic rehabilitation programs and guidelines. This is included in the documents FEMA-273 [4], FEMA-356 [2] and ATC-40 [32].

1.3 Introduction to FEMA-273

The primary purpose of FEMA-273 [4] document is to provide technically sound and nationally acceptable guidelines for the seismic rehabilitation of buildings. The Guidelines for the Seismic Rehabilitation of Buildings are intended to serve as a ready tool for design professionals for carrying out the design and analysis of buildings, a reference document for building regulatory officials, and a foundation for the future development and implementation of building code provisions and standards.

1.4Introduction to ATC-40

Seismic Evaluation and Retrofit of Concrete Buildings commonly referred to as ATC-40 [32] was developed by the Applied Technology Council (ATC) with funding from the California Safety Commission. Although the procedures recommended in this document are for concrete buildings, they are applicable to most building types.

1.5Pushover guideline as per ATC-40

In Nonlinear Static Procedure, the basic demand and capacity parameter for the analysis is the lateral displacement of the building. The generation of a capacity curve (base shear v/s roof displacement) defines the capacity of the building uniquely for an assumed force distribution and displacement pattern. It is independent of any specific seismic shaking demand and replaces the base shear capacity of conventional design procedures. If the building displaces laterally, its response must lie on this capacity curve. A point on the curve defines a specific damage state for the structure, since the deformation for all components can be related to the global displacement of the structure. By correlating this capacity curve to the seismic demand generated by a specific earthquake or ground shaking intensity, a point can be found on the capacity curve that estimates the maximum displacement of the building the earthquake will cause. This defines the performance point or target displacement. The location of this performance point relative to the performance levels defined by the capacity curve indicates whether or not the performance objective is met. Thus, for the Nonlinear Static Procedure, a static pushover analysis is performed using a nonlinear analysis program for an increasing monotonic lateral load pattern. An alternative is to perform a step by step analysis using a linear program. The base shear at each step is plotted again roof displacement. The performance point is found using the Capacity Spectrum Procedure. The individual structural components are checked against acceptability limits that depend on the global performance goals. The nature of the acceptability limits depends on specific components. Inelastic rotation is typically one of acceptability parameters for beam and column hinges. The limits on inelastic rotation are based on observation from tests and the collective judgment of the development team. Irjet Template sample paragraph .Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

2. METHODOLOGY

2.1 LINEAR STATIC ANALYSIS

This method is based on the assumption that whole of the seismic mass of the structure vibrates with a single time period. The structure is assumed to be in its fundamental mode of vibration. But this method provides satisfactory results only when the structure is low rise and there is no significant twisting on ground movement. As per the IS 1893: 2002, Total design seismic base shear is found by the multiplication of seismic weight of the building and the design horizontal acceleration spectrum value. This force is distributed horizontally in the proportion of mass and it should act at the vertical center of mass of the structure.

2.2 DYNAMIC ANALYSIS

Dynamic analysis is perform after the static analysis is completed. Therefore the response-spectrum scale factor is $I g / R$, where g is acceleration due to gravity (386.4 in/sec^2 for kip-in and 9.81 m/sec^2 for KN-m). After analysis, users should review the base shear due to all modes, reported in the Response Spectrum Base Reaction Table. If the dynamic base shear reported is more than 80% of the static base shear, no further action is required. However, if dynamic base shear is less than 80% of the static base shear, then the scale factor should be adjusted such that the response-spectrum base shear matches 80% of the static base shear. In this case, the new scale factor would be ($I g / R$) * (0.80 * static base shear / response-spectrum base shear). Analysis should then be rerun with this scale factor specified in the response-spectrum.

2.3 NON-LINEAR STATIC ANALYSIS

Non-linear static analysis is improvement over linear static or dynamic analysis in the sense that it allows inelastic behavior of structure. The method is simple to implemented and provide information on strength, deformation and ductility of the structure as well as distribution of demands. This permits the identification of critical member that are like to reach limits states during the earthquake, to which attention should be paid during the design and detailing process. But this method is based on many assumptions which neglected the vibration of the loading patterns, the influence of higher modes of vibration and the effect of resonance. In spite of deficiencies this method known as pushover analysis. It is the method of analysis by applying specified pattern of direct lateral loads on the structure, starting from zero to a value corresponding to a specific displacement level, and identifying the possible weak points and failure patterns of a structure. The performance of the structure is evaluated and using the status of hinges at target displacement or performance point corresponding to specified earthquake level (the given response spectrum). The performance is satisfactory if the demand is less than capacity at all hinges

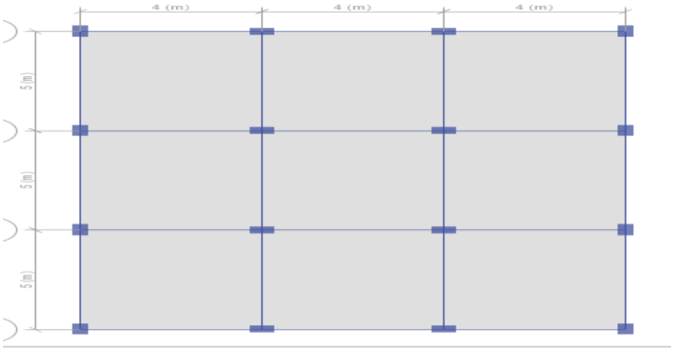


Fig.no.1 plane of without shear wall

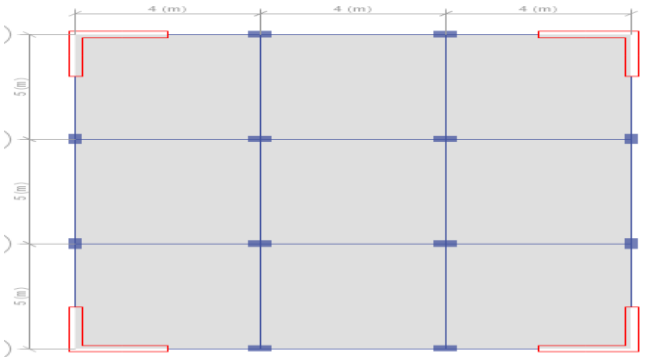


Fig.no.2 plan of with shear wall

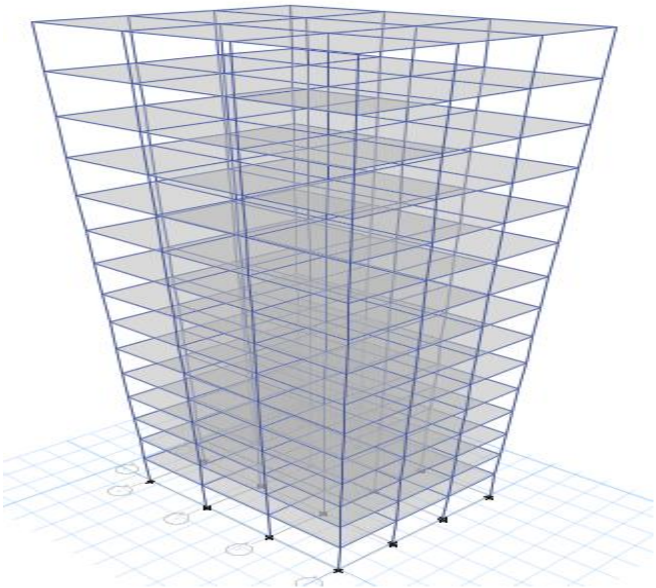


Fig.no.3 3D VEIW

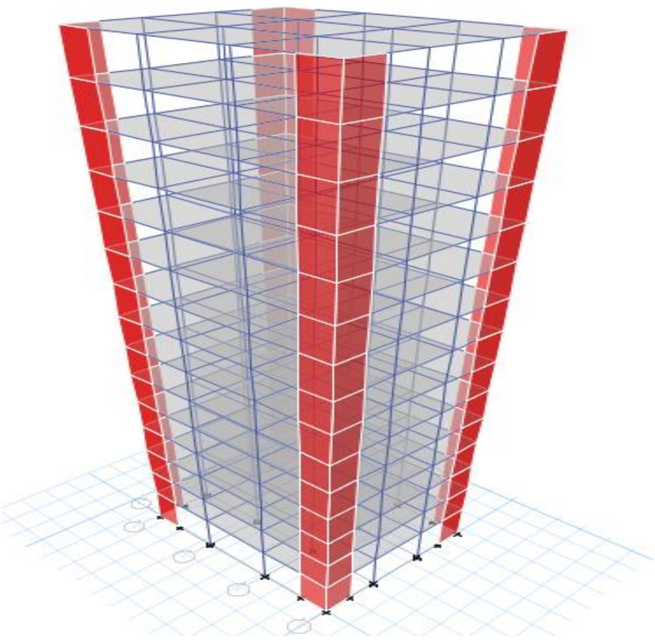


Fig.no4

2 MODEL CONFIGURATION

Table.no.1

	R.C.C BUILDING WITH SHEAR WALL	R.C.C BUILDING WITHOUT SHEAR WALL
HEIGHT	45.5 m	45.5 m
AREA	180 sqm.	180sqm.
Each Story height	3m	3m
COLUMN	0.35m*0.55m (1st to 15th floor)	0..35m*0.55m (1st to 15th floor)
BEAM	250mm*450mm	250*450mm
SLAB	125mm	125mm
GRADE OF CONCRETE	25M (SLAB)	25M(SLAB)
GRADE OF CONCRETE	25M (BEAM)	25M (BEAM)
GRADE OF CONCRETE	30M(COLUMN)	30M(COLUMN)
ZONE	IV	IV
REGION	NOIDA	NOIDA
LIVE LOAD	3KN/sqm	3KN/sqm

3 RESULTS

3.1 BASE SHEAR

Table.no.2

	WITHOUT SHEAR WALL	WITH SHEAR WALL
DEAD LOAD	22852.125	18184.75
EQX	1005.5067	1066.6376
EQY	1005.5067	1066.6378
RSX	1011.4049	1180.4846
RSY	1016.6182	1186.2659

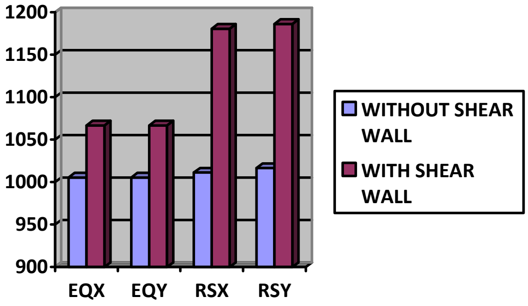


Chart.no.1 BASE SHEAR

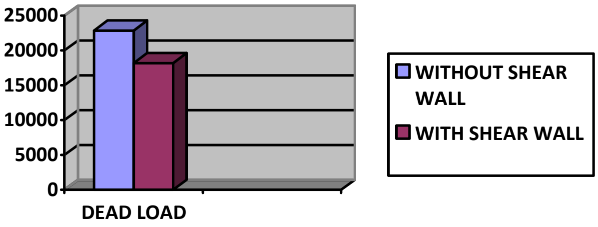


Chart.no.2 BASE SHEAR OF DEAD LOAD

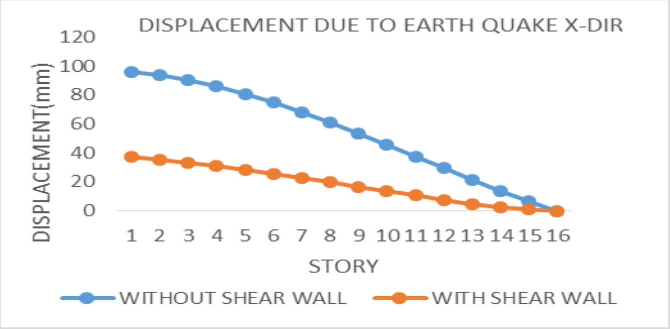


Chart.no.3

3.2. DISPLACEMENT DUE TO EARTH QUAKE

Table.no.3

DISPLACEMENT		DUE TO EARTH QUAKE	
WITHOUT SHEAR WALL		WITH SHEAR WALL	
X-DIR	Y-DIR	X-DIR	Y-DIR
95.78	111.50	37.43	44.74
93.52	109.30	35.48	42.42
90.23	105.90	33.37	39.92
85.90	101.21	31.06	37.18
80.64	95.38	28.53	34.17
74.62	88.58	25.79	30.91
67.96	80.98	22.89	27.43
60.82	72.75	19.85	23.79
53.30	64.02	16.74	20.04
45.54	54.93	13.62	16.27
37.62	45.59	10.55	12.57
29.64	36.12	7.63	9.05
21.68	26.61	4.95	5.83
13.85	17.19	2.66	3.19
6.39	8.185	0.93	1.07
0	0	0	0

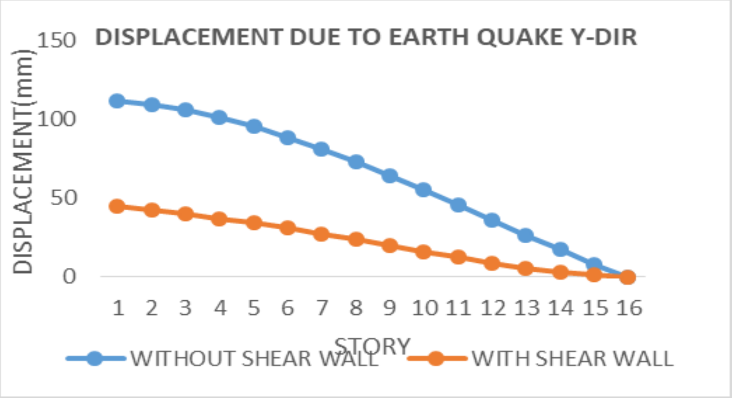


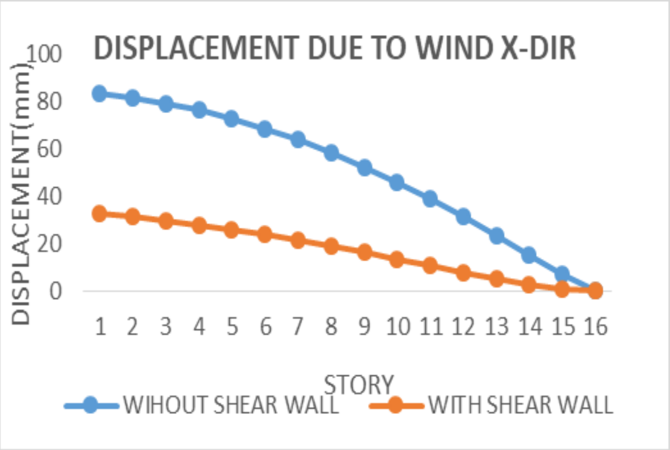
Chart no.4

3.3. DISPLACEMENT DUE TO WIND

WITHOUT SHEAR WALL		WITH SHEAR WALL	
x-dir	y-dir	x-dir	y-dir
82.90	77.68	32.83	31.38
81.28	76.46	31.34	29.97
79.05	74.66	29.74	28.46

76.16	72.22	27.98	26.79
72.63	69.13	26.03	24.94
68.45	65.40	23.89	22.89
63.66	61.05	21.55	20.64
58.28	56.10	19.03	18.22
52.34	50.58	16.36	15.64
45.86	44.50	13.58	12.95
38.90	37.9	10.75	10.21
31.48	30.82	7.94	7.51
23.64	23.29	5.28	4.95
15.47	15.38	2.90	2.69
7.26	7.44	1.04	0.95
0	0	0	0

Table.no.4



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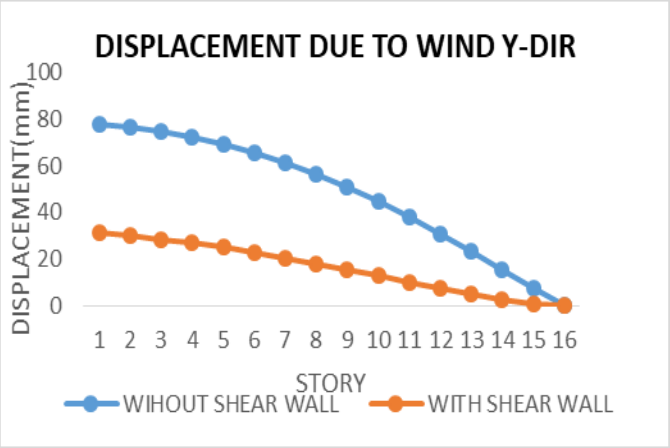
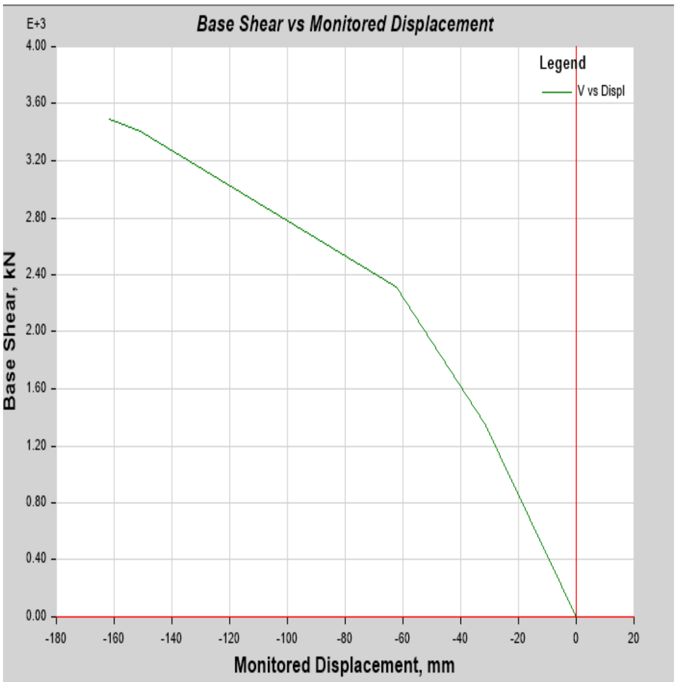


Chart.no.6

3.4. PUSHOVER CURVE

Table.no5

WITH SHEAR WALL		WITHOUT SHEAR WALL	
DISP(mm)	SHEAR(KN)	DISP(mm)	SHEAR(KN)
0	0	0	0
-31.66	1358.3	-9.187	153.11
-62.47	2316.7	-35.03	465.44
-150.92	3406.2	-44.51	511.38
-155.61	3443.2	-90.51	602.3
-155.62	3442.5	-173.92	683.76
-161.67	3489.	-180.76	688.19
		-181.48	688.42
		-181.51	688.42
		-181.53	688.43
		-183.3	688.99
		-183.32	688.99
		-183.45	689.03
		-183.47	689.04
		-183.49	689.05
		-183.5	689.05
		-183.89	689.17



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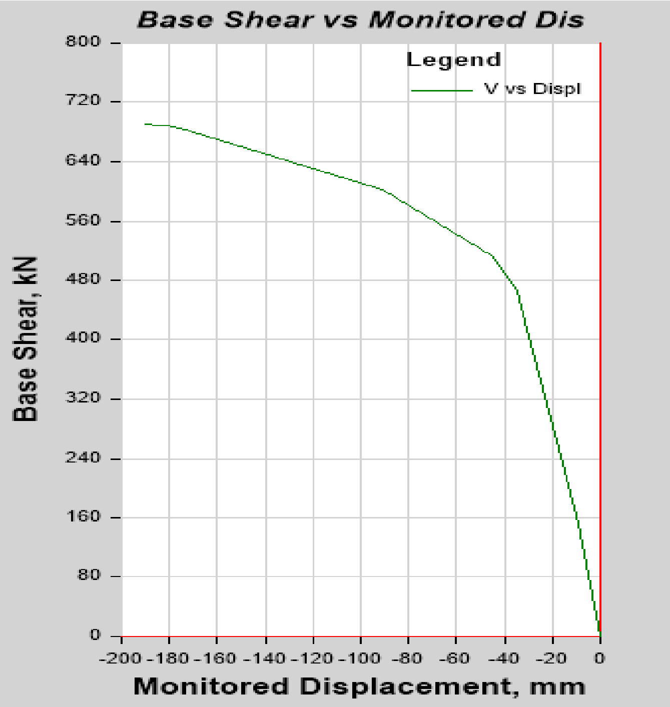

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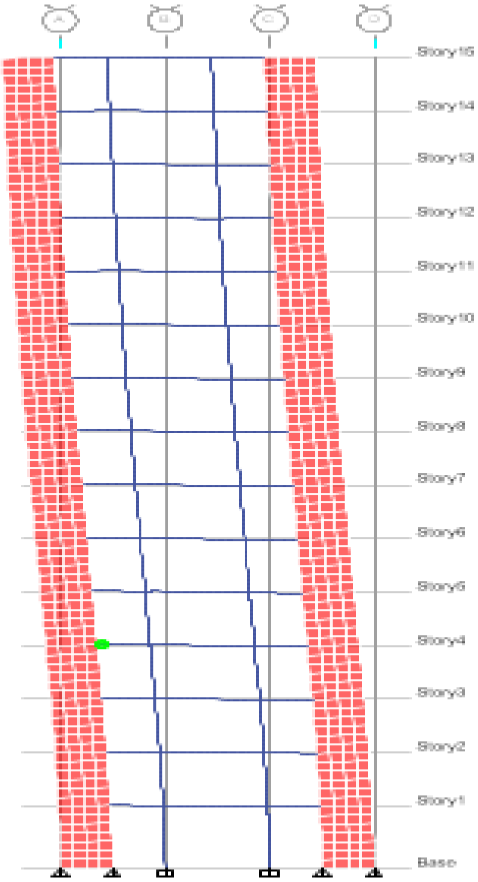

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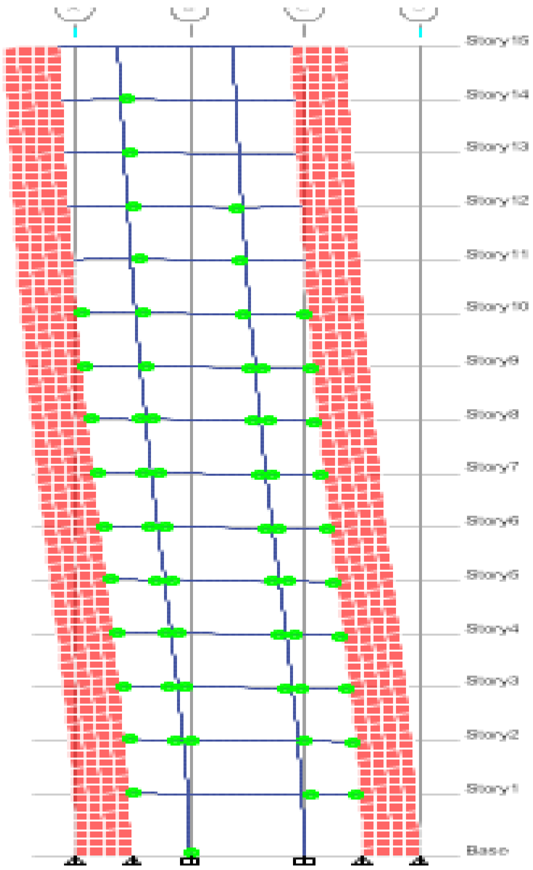

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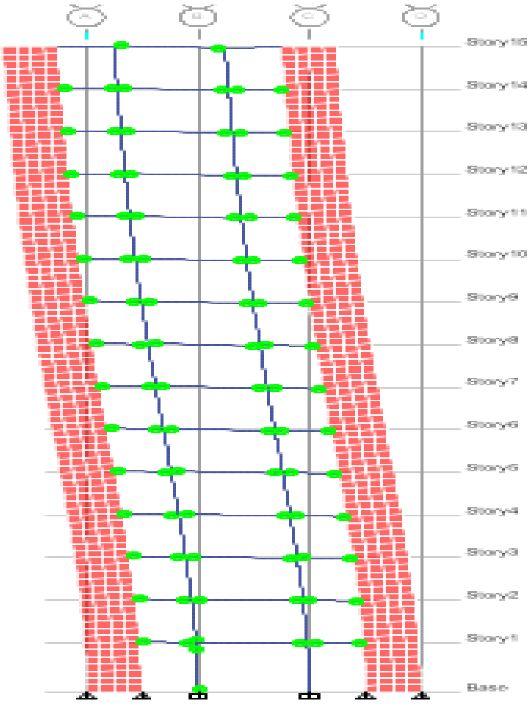

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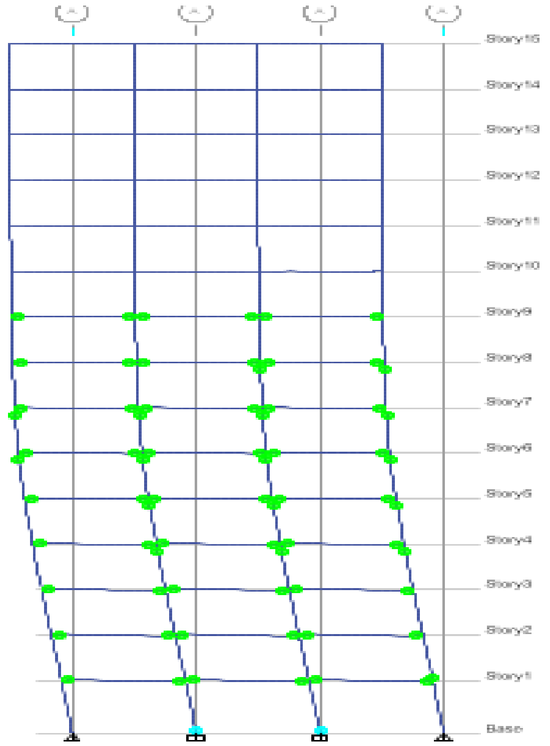

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3. CONCLUSIONS

1) Provision of shear wall results in a huge decrease in base shear and roof displacement both with shear wall building and without shear wall building.
3) The performance based seismic design obtained by above procedure satisfies the acceptance criteria for immediate occupancy and life safety limit states for various intensities of earthquakes.
4) Performance based seismic design obtained leads to a small reduction in steel reinforcement when compared to code based seismic design (IS 1893:2002) obtained by etab .
5).With shear wall RCC building frame having more lateral load capacity compare to without shear wall building frame.
6) The lateral displacement of With shear wall RCC building frame is reduced as compared without shear wall RCC frame.
7) With shear wall RCC building frame is give good result in pushover curve base shear v/s displacement is less as compared to R.C.C.

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ACKNOWLEDGEMENT

First of all I thank the Almighty God, I would like to express my sincerely gratefulness to **Mr. NAZISH** my thesis Co-guide without whom this project could possibly never have been accomplished. He gives me not only large number of significant advice, guidance and comments, but also motivates supervision and encouragement.

There are people without whom this dissertation might not have been possible and to whom I am greatly thankful. Therefore, I would like to acknowledge:

My supervisor **MISBAH DANISH SABRI,** Assistant Professor and Project Guide, Department of Civil Engineering, Al-FALAH University who was not simply supervisors, but also friends and mentors. Without him and his wealth of knowledge, patience and reliability; I could not reach this far.

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