iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 **Issue:** V **Month of publication:** May 2024

DOI: https://doi.org/10.22214/ijraset.2024.62968

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue V May 2024- Available at www.ijraset.com

Contrastive Investigation of High-Rise Building with Distinctive Infill Wall by Pushover Analysis

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Abstract: Pushover analysis is a method that uses simple nonlinear techniques to predict seismic structural deformations. Today, we use masonry infill in reinforced concrete (R/C) frames for architectural, aesthetic or economic reasons. In this project, we need to study the effect of backfill on the damage structure of the reinforced concrete frame.
The main purpose of this study is to show that adding walls to the reinforced concrete frame can increase the strength and stiffness of seismic resistant structure loads and increase the feedback for strength and stiffness analysis. . These instructions strictly comply with FEMA-356. In this project, we use three types of bricks: red brick, fly ash brick, deep brick and siporex brick. Taking the output of non-linear analysis, we compare layer V/S i) Base Shear, ii) Storey Displacement, iii) Floor Shift Base Shear V/S Attack and Observe Spectrum Acceleration V/S spectral function . We also use ETABS 2017 software to study the effects of bare shear walls..
Keywords: Pushover Examination, Brick infill, FEMA-356, Displacement, Float, Shear Divider, ETAB-2017

I. INTRODUCTION

Today, understanding the seismic behavior of infill walls has gained importance in earthquake engineering. There are many methods used for frame analysis, seismic analysis, i.e. static method, response spectrum analysis, i.e. seismic analysis. linear dynamic method, pushover analysis e.g. Nonlinear static method analysis, time history method, i.e. nonlinear static method Linear dynamic method. But here we use a non-linear static method.The purpose of pushover analysis is to determine and control the performance of structures in earthquakes. In the old version of IS 1893 specifications we did not consider the strength and stiffness of infill walls but in the new version of IS specifications we have to consider the strength and stiffness of infill walls.
In this project, we used a 17-storey wall type structure as a diagonal column. Brick infill wall Equal diagonal buttress
Model l : Only Framed Structure
Model 2 : Model With AAC blocks with Diagonal members
Model 3: Brick infill wall model using fly ash Equal diagonal buttress model
Model 4: Gray brick infill pattern model wall using fly ash Red brick infill wall pattern parallel diagonally.

A. Pushover Analysis

This is a nonlinear static analysis under sustained vertical loads. Here the change is gradually increased from zero to the limit of movement or until the structure can no longer withstand the load. In thrust analysis, we focus on the design of plastic joints and record the failures of different systems and plot the total force against displacement to define the capacity curve.

II. INTENT OF STUDY

1) The effects of different types of masonry infill walls in reinforced concrete frame buildings were examined using pushover analysis.
2) The effect of providing shear walls in reinforced concrete frame buildings was examined using compression tests.
3) To compare the seismic response of buildings including i) base shear, ii) Storey displacement, iii) base shear with ground shear V/S trace displacement and spectral acceleration V/S spectral displacement, FEMA-356 and tip-cycle.
4) Determination of functional elements for the seismic performance of buildings. Determine the best combination of cost-effective methods.

III. OVERVIEW OF THE ANALYSED STRUCTURE

Our Structure is Multi storey building having Ground floor and having 15 floors with storey height of 3 m following table shows details of corresponding model

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All paragraphs must be indented. All paragraphs must be justified, i.e. both left-justified and right-justified.

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TABLE I
.OVERVIEW OF THE ANALYSED STRUCTURE

Sr. No	Item	Specification
1.	Concrete Grade	M35
2.	Steel Grade	Fe 500
3.	Thickness of Slab	150 mm
4.	Dimensions of Beams	230*500 mm
5.	Dimensions of Columns	400*800 mm
6.	Thickness of Shear Wall	200 mm
7.	Live Load	2 KN/m2
8.	Floor Finishing Load	1.5 KN/m2
9.	Density of Red Bricks	18 N/mm2
10.	Density of Fly Ash Bricks	17 N/mm2
11.	Density of Siporex Bricks	4 N/mm2
12.	Compressive Strength of Red Bricks	5KN/mm2
13.	Brick Strut Dimensions	4KN/mm2
14.	Seismic Zone	3.5KN/mm2
15.	Seismic Zone Factor	230X400 mm
16.	Importance Factor	III
17.	Type of Soil	0.16
18.	Response Reduction Factor	1.2

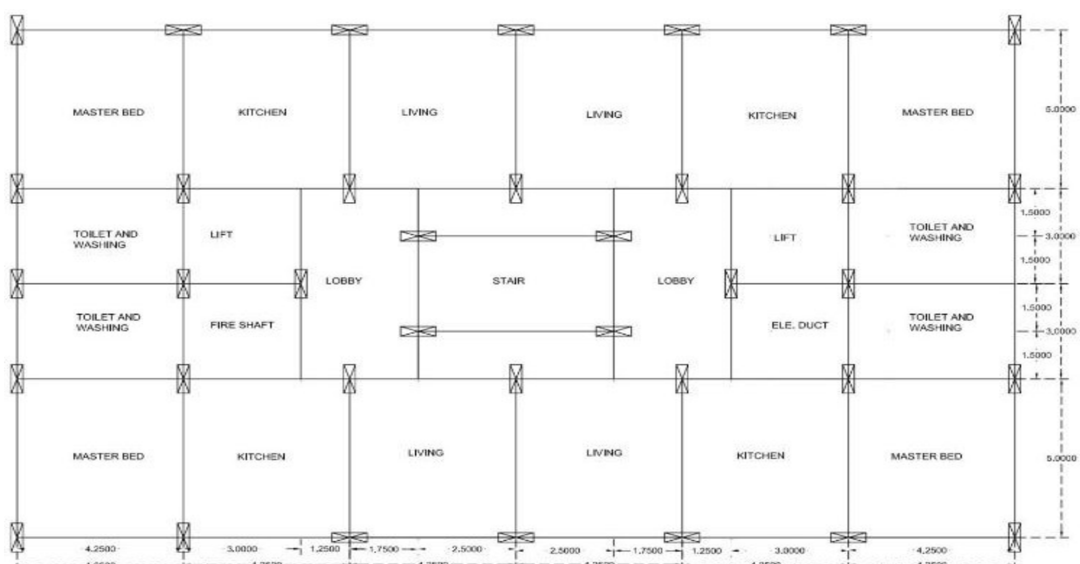

Fig. 1 A sample line graph using colors which contrast well both on screen and on a black-and-white hardcopy

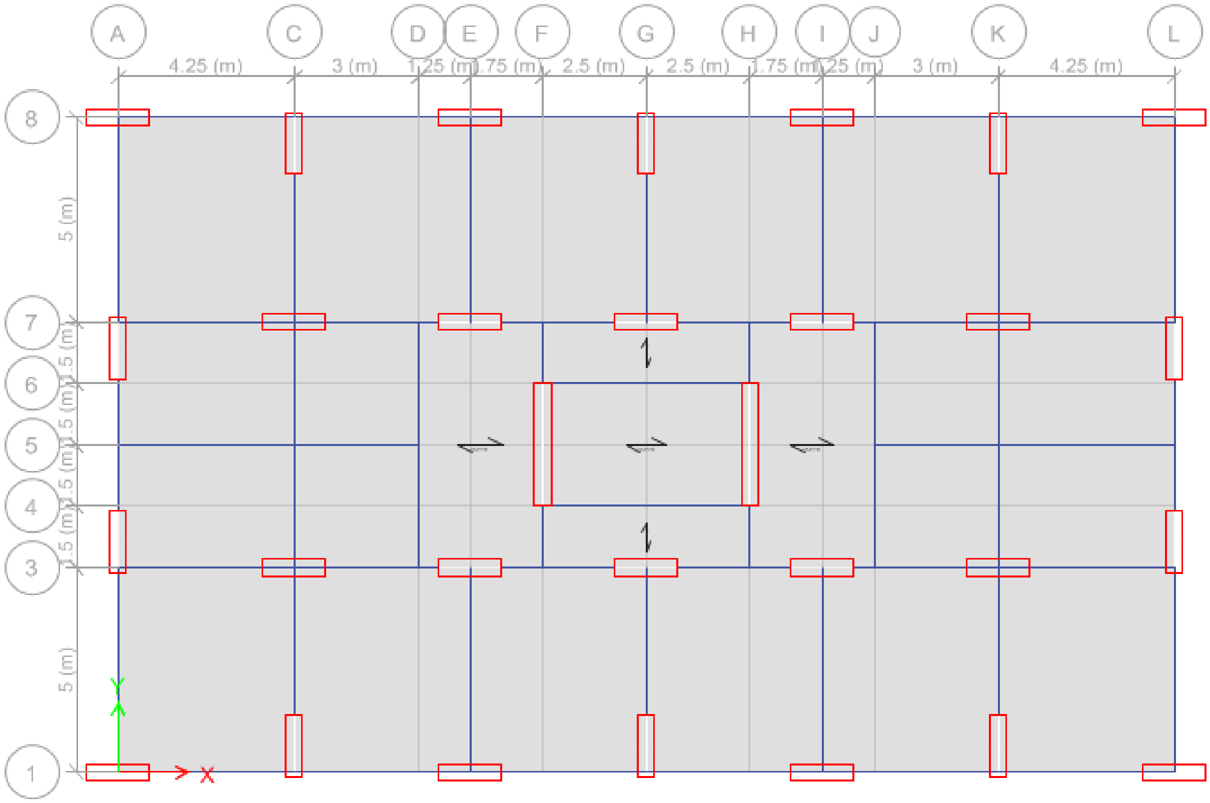

Fig. 2 Example of an unacceptable low-resolution image

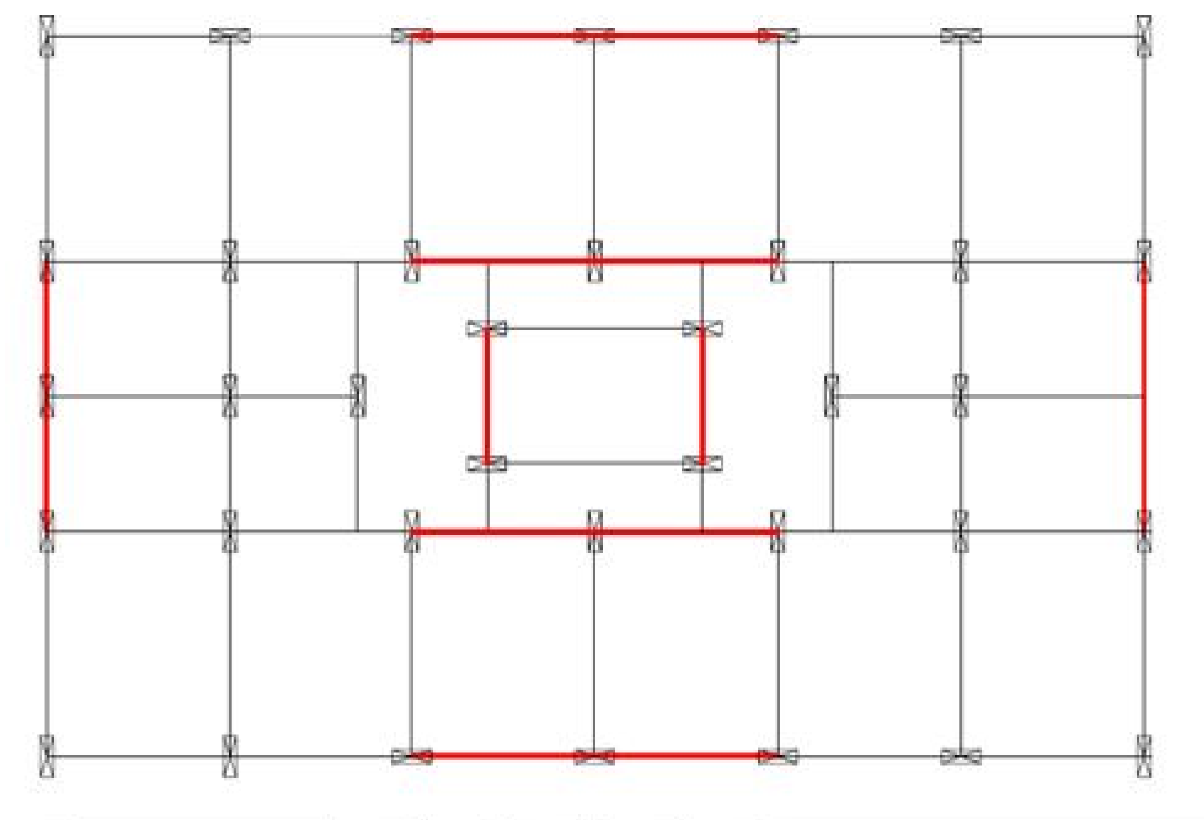

Fig. 3 Example of an image with acceptable resolution

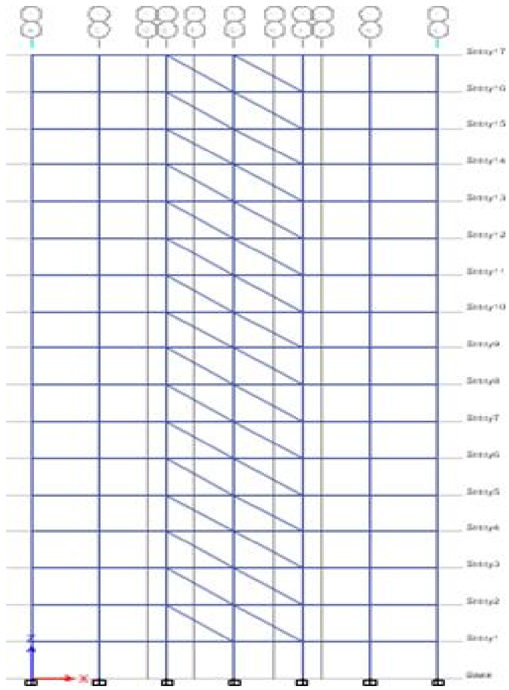

Fig. 4 Example of an image with acceptable resolution

IV. RESULTS AND DISCUSSION

The results are analysed based on storey drifts, displacement, and base shear versus monitored displacement. Tables 2 and 3 present the storey drifts in the X and Y directions, respectively, with their corresponding graphical representations in Graph 1 and Graph 2. Displacement results are shown in Tables 4 and 5, and their graphical representations are provided in Graph 3 and Graph 4. Base shear versus monitored displacement results are displayed in Tables 6 and 7 for the X and Y directions, respectively, with the corresponding graphs in Graph 5 and Graph 6.

TABLE III
X-AXIS STOREY DRIFTS

Storey	Model 1	Model2	Model 3	Model 4	Model 5
Base	0	0	0	0	0
Story1	0.001589	0.0007	0.000498	0.000507	0.0012
Story2	0.003631	0.0015	0.000918	0.000925	0.003
Story3	0.004698	0.0029	0.000991	0.000992	0.004
Story4	0.005171	0.0040	0.000979	0.000978	0.0048
Story5	0.005282	0.0043	0.00093	0.000928	0.005
Story6	0.005173	0.0045	0.000867	0.000865	0.0049
Story7	0.00493	0.0042	0.000799	0.000797	0.0045
Story8	0.004604	0.0038	0.000729	0.000728	0.0042
Story9	0.004229	0.0036	0.000659	0.000657	0.0039
Story10	0.003825	0.0033	0.000587	0.000586	0.0035
Story11	0.003405	0.0029	0.000515	0.000514	0.0032
Story12	0.002981	0.0024	0.000443	0.000442	0.0027
Story13	0.002562	0.0021	0.000371	0.000371	0.0024
Story14	0.002158	0.0019	0.0003	0.000299	0.002058
Story15	0.001787	0.0014	0.000229	0.000229	0.0017
Story16	0.001471	0.0010	0.000164	0.000163	0.001371
Story17	0.001248	0.0007	0.000111	0.000111	0.00118

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TABLE IIIII
Y-AXIS STOREY DRIFTS

Storey	Model 1	Model 2	Model 3	Model 4	Model 5
Base	0	0	0	0	0
Story1	0.001744	0.001588	0.001604	0.001628	0.00143
Story2	0.004086	0.002915	0.002924	0.002937	0.002775
Story3	0.005518	0.003454	0.003456	0.00346	0.003336
Story4	0.006338	0.003577	0.003573	0.003572	0.003481
Story5	0.006726	0.003499	0.003491	0.003488	0.003419
Story6	0.006814	0.003326	0.003315	0.003311	0.003256
Story7	0.00669	0.003107	0.003093	0.00309	0.003043
Story8	0.00642	0.002866	0.002848	0.002847	0.002805
Story9	0.006048	0.002612	0.002592	0.002592	0.002554
Story10	0.00561	0.002352	0.002329	0.00233	0.002296
Story11	0.00513	0.002088	0.002063	0.002065	0.002035
Story12	0.00463	0.001822	0.001794	0.001798	0.001772
Story13	0.004131	0.001557	0.001527	0.001531	0.00151
Story14	0.003652	0.001295	0.001263	0.001268	0.001253
Story15	0.003216	0.001043	0.001009	0.001015	0.001006
Story16	0.002856	0.000814	0.00078	0.000786	0.000782
Story17	0.0026	0.000636	0.000603	0.000609	0.000608

TABLE IVV
X DIRECTION STOREY DISPLACEMENTS

Storey	Model 1	Model 2	Model 3	Model 4	Model 5
Base	0	0	0	0	0
Story1	4.498	3.545	3.502	2.6	2.629
Story2	14.48	9.774	9.751	7.27	8.863
Story3	27.624	17.293	17.305	12.919	17.265
Story4	42.308	25.147	25.21	18.837	26.939
Story5	57.697	33.075	33.196	24.82	37.313
Story6	73.295	40.952	41.132	30.769	48.004
Story7	88.774	48.696	48.934	36.621	58.746
Story8	103.894	56.231	56.524	42.32	69.331
Story9	118.447	63.478	63.825	47.808	79.593
Story10	132.243	70.353	70.748	53.021	89.381
Story11	145.091	76.76	77.201	57.892	98.559
Story12	156.803	82.598	83.079	62.345	107.001
Story13	167.198	87.759	88.275	66.3	114.597
Story14	176.118	92.131	92.677	69.677	121.265
Story15	183.465	95.615	96.187	72.401	126.973
Story16	189.264	98.161	98.754	74.433	131.78
Story17	193.79	99.884	100.495	75.848	135.893

TABLE V
Y DIRECTION STOREY DISPLACEMENTS

Storey	Model 1	Model 2	Model 3	Model 4	Model 5
Base	0	0	0	0	0
Story1	2.843	2.534	2.487	1.841	2.176
Story2	9.105	6.821	6.76	5.027	7.482
Story3	17.975	12.625	12.531	9.326	14.938
Story4	28.306	18.942	18.819	14.014	23.858
Story5	39.477	25.474	25.324	18.866	33.741
Story6	51.057	32.056	31.878	23.758	44.205
Story7	62.733	38.581	38.376	28.611	54.955
Story8	74.264	44.967	44.733	33.363	65.752
Story9	85.451	51.137	50.873	37.958	76.396
Story10	96.12	57.013	56.718	42.34	86.714
Story11	106.117	62.515	62.188	46.45	96.557
Story12	115.301	67.559	67.201	50.228	103.801
Story13	123.556	72.061	71.671	53.612	110.347
Story14	130.795	75.94	75.521	56.546	117.131
Story15	136.991	79.137	78.692	58.984	121.144
Story16	142.207	81.643	81.175	60.919	125.144
Story17	146.658	83.571	83.084	62.426	129.144

TABLE VI
RELATIONSHIP BETWEEN BASE SHEAR AND MONITORED DISPLACEMENT IN THE X AXIS

Model I		Model II		Model III		Model IV		Model V	
Monitor ed Displ	Base Force	Monitor ed Displ	Base Force	Monitor ed Displ	Base Force	Monitor ed Displ	Base Force	Monitor ed Displ	Base Force
mm	kN	mm	kN	mm	kN	mm	kN	mm	kN
0	0	0	0	0	0	0	0	0	0
-30	737.5479	-30	846.4912	-30	868.2535	-30	890.7834	-6.765	3308.853
-60	1475.096	-60	1692.982	-60	1736.507	-60	1781.567	-24.833	13644.61
-90	2212.644	-90	2539.474	-90	2604.761	-90	2672.35	-29.847	13646.05
-103.345	2540.732	-102.57	2894.163	-101.762	2945.172	-101.754	3021.357	-34.877	13647.93
-133.506	3250.086	-133.951	3739.762	-133.004	3807.487	-132.377	3891.789	-45.734	14004.4
-169.09	3627.691	-164.592	4206.049	-163.261	4286.024	-163.993	4421.98		
-202.238	3825.492	-197.076	4531.521	-197.792	4641.236	-197.043	4783.658		
-233.089	3948.934	-227.742	4768.043	-232.678	4914.316	-235.777	5108.413		
-268.863	4063.007	-259.808	4973.008	-267.259	5135.567	-276.615	5377.403		
-299.481	4137.672	-293.267	5145.959	-297.49	5294.54	-300	5516.403		
-300	4138.773	-300	5178.542	-300	5307.617				

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TABLE VII
RELATIONSHIP BETWEEN BASE SHEAR AND MONITORED DISPLACEMENT IN THE Y AXIS

Model I		Model II		Model III		Model IV		Model V	
Monitor ed Displ	Base Force	Monitor ed Displ	Base Force	Monitor ed Displ	Base Force	Monitor ed Displ	Base Force	Monitor ed Displ	Base Force
mm	kN	mm	kN	mm	kN	mm	kN	mm	kN
0	0	0	0	0	0	0	0	0	0
6.97E-05	2829.936	0.032	3151.068	0.015	3194.921	0.019	3245.133	0.003	3596.819
0.00012	4329.902	0.033	3258.06	0.016	3454.495	0.02	3385.381	0.003	3648.186
0.001	4344.864	0.036	3284.039	0.018	3480.625	0.025	3444.308	0.003	3699.07
0.001	4429.091	0.037	3407.272	0.018	3506.571	0.03	4150.137	0.004	4247.949
0.004	4446.465	0.041	3432.313	0.018	3506.827	0.033	4173.413	0.004	4310.106
0.015	4466.039	0.048	3958.143	0.019	3525.743	0.034	4289.015	0.005	4926.7
0.015	4478.479	0.051	3982.898	0.021	3954.401	0.034	4289.349	0.005	4986.446
0.042	4483.276	0.051	4029.963	0.025	3976.256	0.034	4300.891	0.005	5049.451
0.047	4546.554	0.054	4050.613	0.026	4000.155	0.037	4342.717	0.005	5106.795
0.143	4619.714	0.058	4270.861	0.027	4120.443	0.041	4387.235	0.005	5107.431
0.143	4619.723	0.061	4290.368	0.029	4141.575	0.042	4415.285	0.005	5125.165
0.143	4619.75	0.063	4393.787	0.03	4257.435	0.042	4435.356		
0.143	4619.76	0.067	4421.852	0.032	4280.597	0.043	4466.09		
0.143	4619.821	0.068	4442.185	0.034	4299.262	0.043	4462.906		
		0.076	4468.824	0.034	4309.244	0.043	4464.039		
		0.077	4538.088	0.035	4468.539	0.044	4474.552		
		0.077	4538.522	0.035	4465.446	0.046	4496.161		
				0.035	4466.193	0.046	4513.537		
				0.041	4475.853	0.048	4535.115		
				0.041	4478.026	0.048	4535.401		
				0.042	4609.827	0.048	4535.118		
				0.043	4630.494	0.048	4536.549		
				0.043	4632.401	0.048	4535.727		
				0.043	4632.396	0.048	4536.312		
						0.048	4536.617		

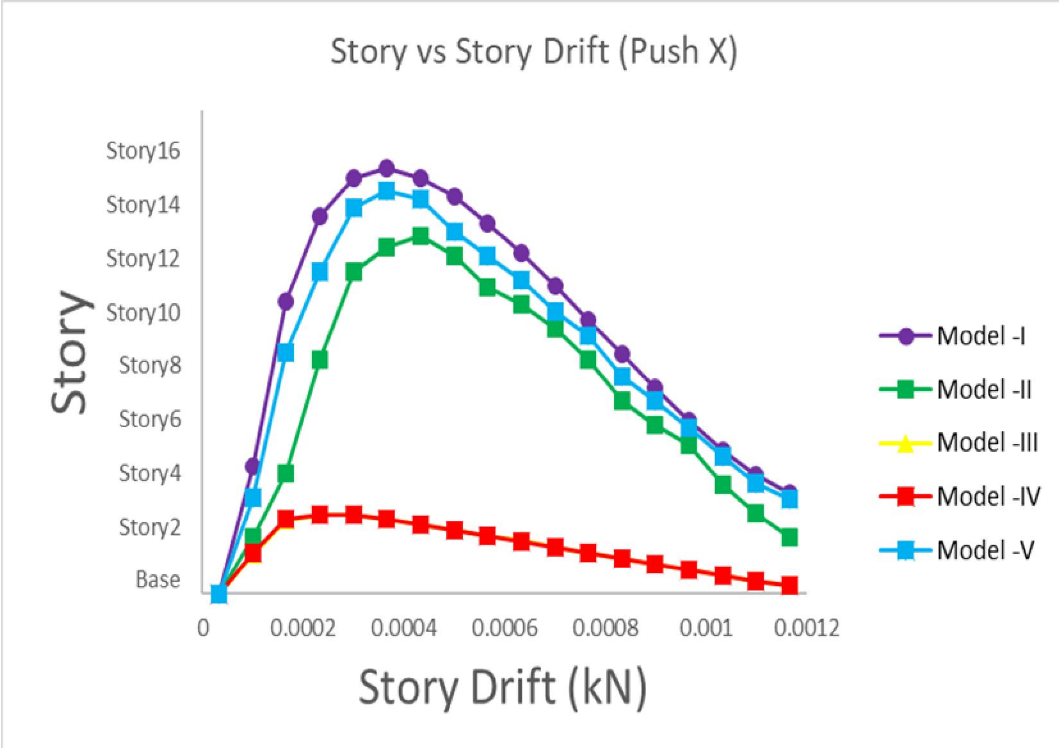

Fig. 4 Example of an image with acceptable resolution

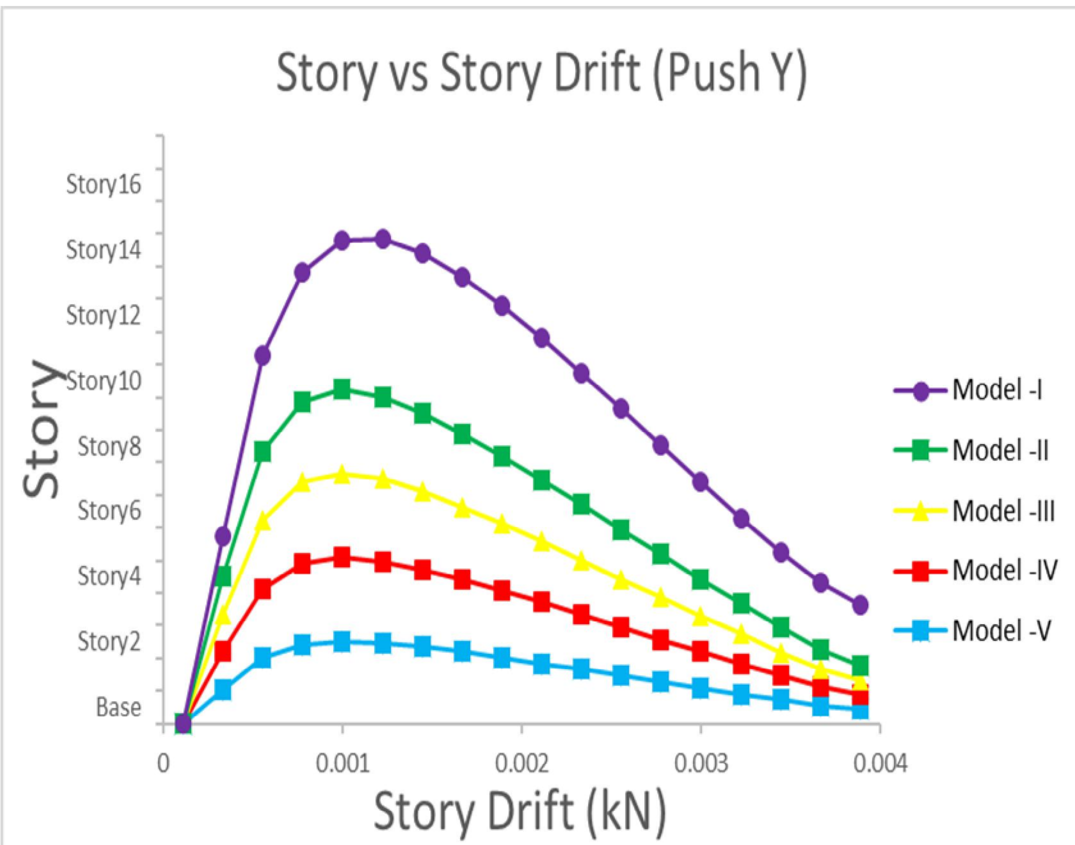

Fig. 5 Example of an image with acceptable resolution

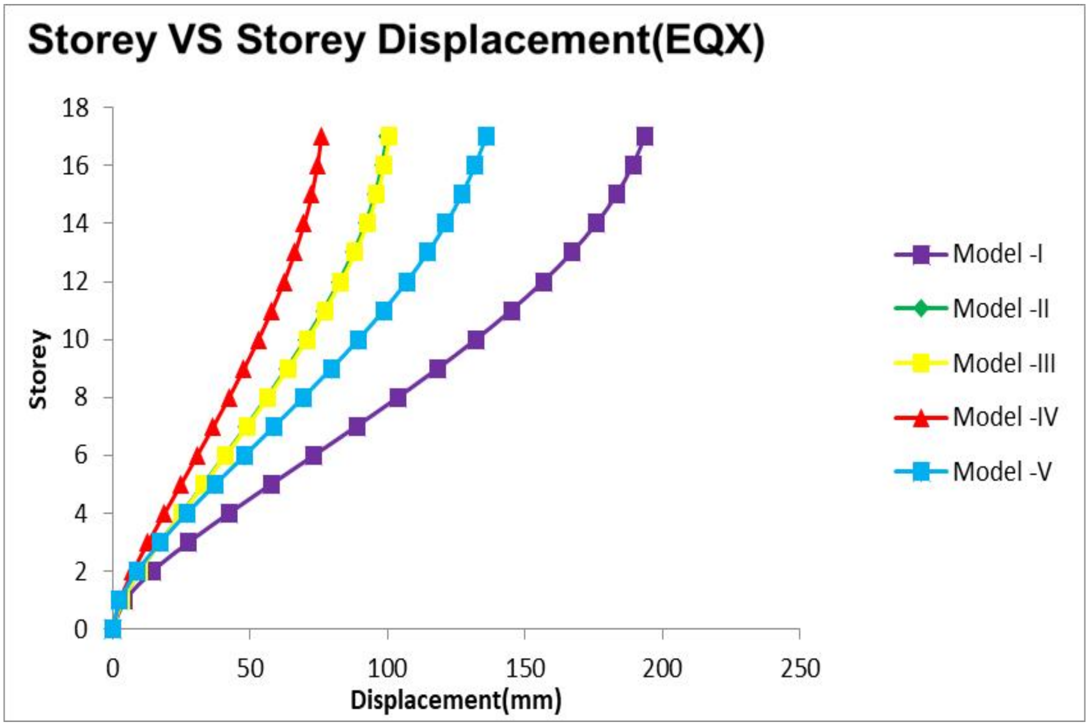

Fig. 6 Example of an image with acceptable resolution

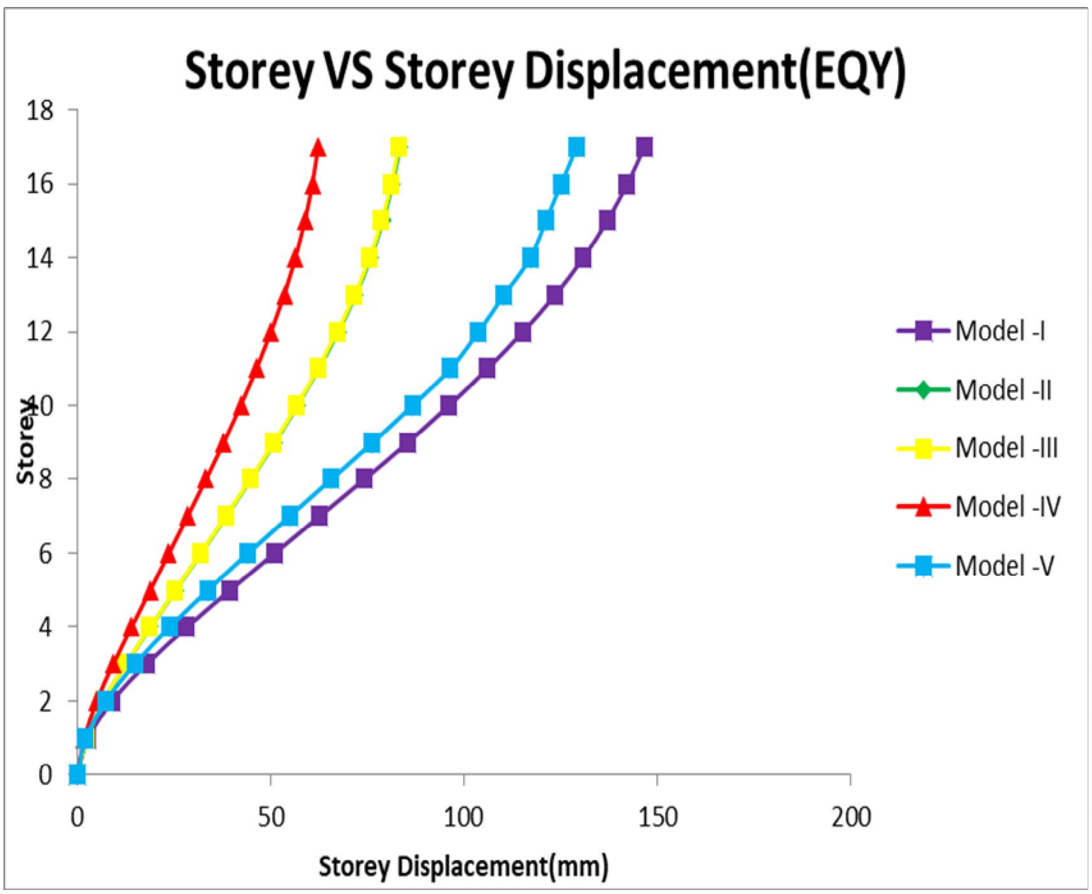

Fig. 7 Example of an image with acceptable resolution

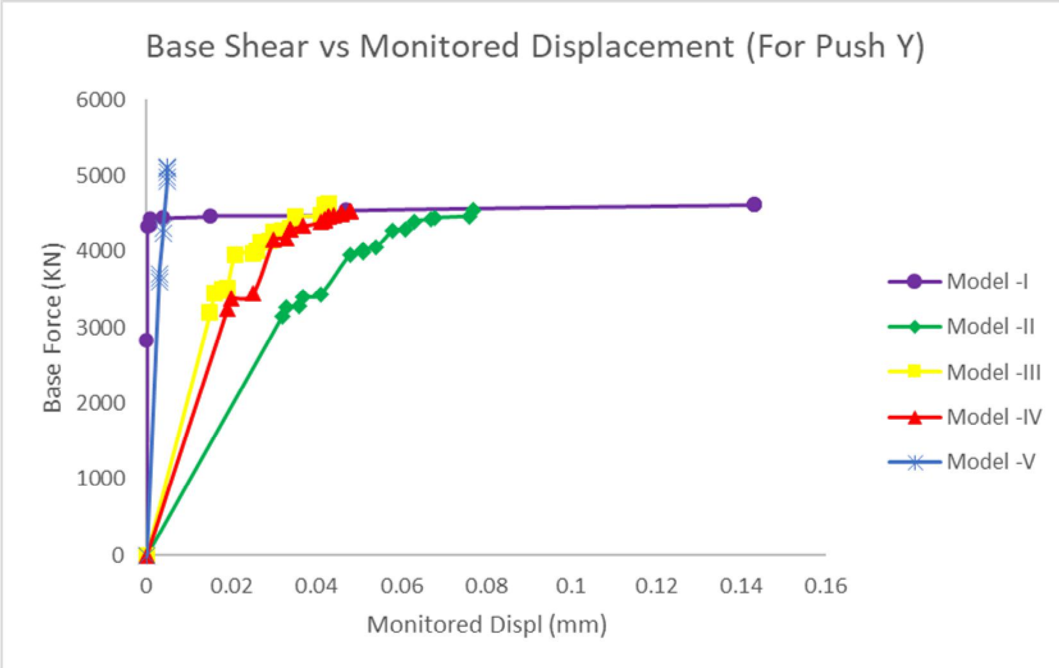

Fig. 8 Example of an image with acceptable resolution

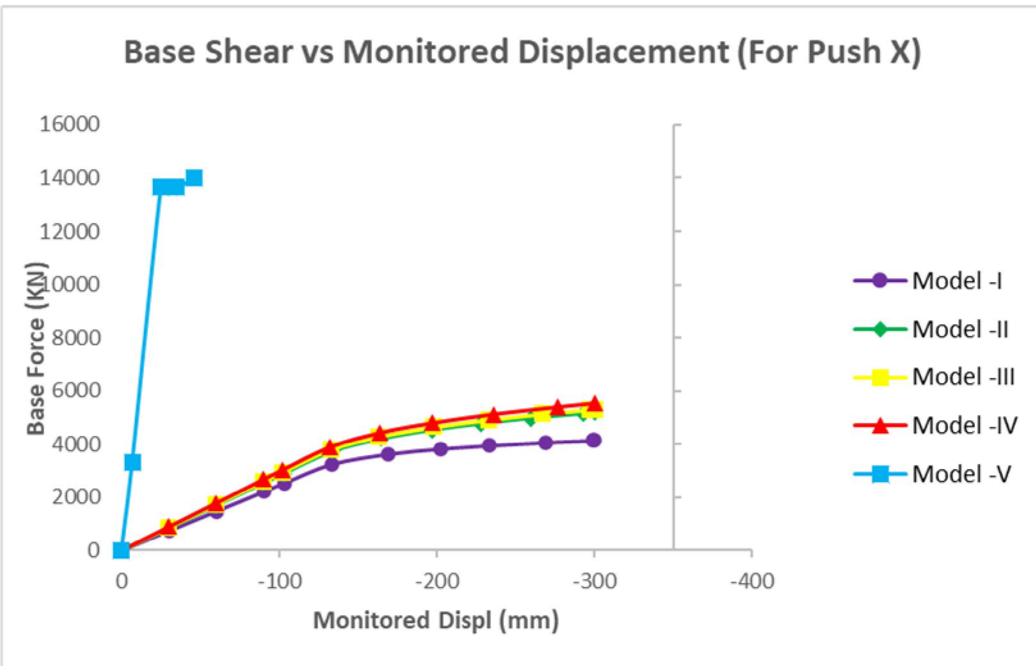

Fig. 9 Example of an image with acceptable resolution

V. CONCLUSIONS

1) In the current study investigating the damage behavior of the structure, five test specimens of a 17-storey reinforced concrete framed building were investigated for various masonry infill walls (including red brick, lightweight and fly ash bricks) along with walls of separate structures. . This study provides input for the nonlinear static analysis of a 17-storey building using Etabs 17.0. Based on the analysis, the following measurements were made: Tables II and III show the relevant results for each model. Based on the study of interlayer slippage, the following conclusions were made:

- The storey drift changes in the x direction are almost the same for models III and IV, which may be due to the rigid beam of the building in the x direction. As can be clearly seen from the inter-storey drift values in the Y direction, the stiffness changes and the response of the structure changes.
- Model IV performs well in the X and Y directions, showing smaller story drift values than all other models, while the bare frame shows higher story drift values, which may be due to the small stiffness and large displacement pressure.
- Model I also shows that the X and Y floors vary more than Models IV and II due to the stiffness of the beam-column structure and the absence of infill and shear walls.
- Model II also shows that the average drift rate can depend on the number of shear walls in the Y direction, with modifiers applied as specified by Kodal, even if shear is present.

2) Tables 4 and 5 show the conversion process for each model. Based on review of the screening process, the following conclusions were reached:
- As can be seen from the table and figure above, Model I performs poorly compared to the other four models, while Model IV performs well with over 60% reduction in variation. This is due to the increased inclusion strength of the red stone in the X and Y directions.
- Model II and Model III performed well, with approximately 50% reduction in displacement compared to Model I.
- Model V demonstrates a 30% reduction in the X direction and a 12% reduction in the Y direction. This is attributed to the stiffness provided by the shear wall, which has a minimum thickness of 200 mm, with modifiers applied according to IS 1893: 2016.
- In all models with infill and curtain walls, reductions occur depending on the installation and material.

3) Tables 6 and 7 show the layer shear force VS analysis results for each model. Based on the cutting force and displacement analysis, the following conclusions were made:
- Structure Shows respectively II,III IV and V has performed well in X heading and stand up to max base shear with nearly same relocation than show I which may due to consideration of infill and shear divider.
- Structure I appears most extreme firmness in Y course due to exceptionally less relocation. It is fundamentally due to 70% columns are accessible in y course
- Model II resists shear in the Y direction less than other models, while Model V resists maximum root shear with negligible hardness.
- The infill walls contribute significantly to the stiffness of the building. This is primarily due to diagonal action of infill increases lateral resistance and initial stiffness of the frames and have a significant effect on the reduction of the global lateral displacement. It is essential to consider the effect of masonry infills for the seismic evaluation of moment resisting RC frames, and new RC frame, especially for the prediction of its ultimate state.
- It is worth making a good decision to prepare infill and curtain walls during the inspection, because it can distribute a lot of money to the outside without causing serious damage.
- Model v shows the maximum stiffness and very small area due to the maximum moment of inertia in the specified direction due to the provision of shear walls.
- According to the new Codal regulations, providing shear walls instead of columns will be a better option, but the cost will be lower than SMRF and the use of spare parts. As can be clearly seen from the Model V results, when analyzed in the X and Y directions, it is seen that there is stiffness and the change is very small.

VI. ACKNOWLEDGMENT

It is with immense pleasure that we express my sincere sense of gratitude and humble appreciation to Prof. Sapate V.M. for his invaluable guidance, whole-hearted co-operation, constructive criticism and continuous encouragement in the preparation of this thesis. Without his support and guidance, the present work would not be a possible.

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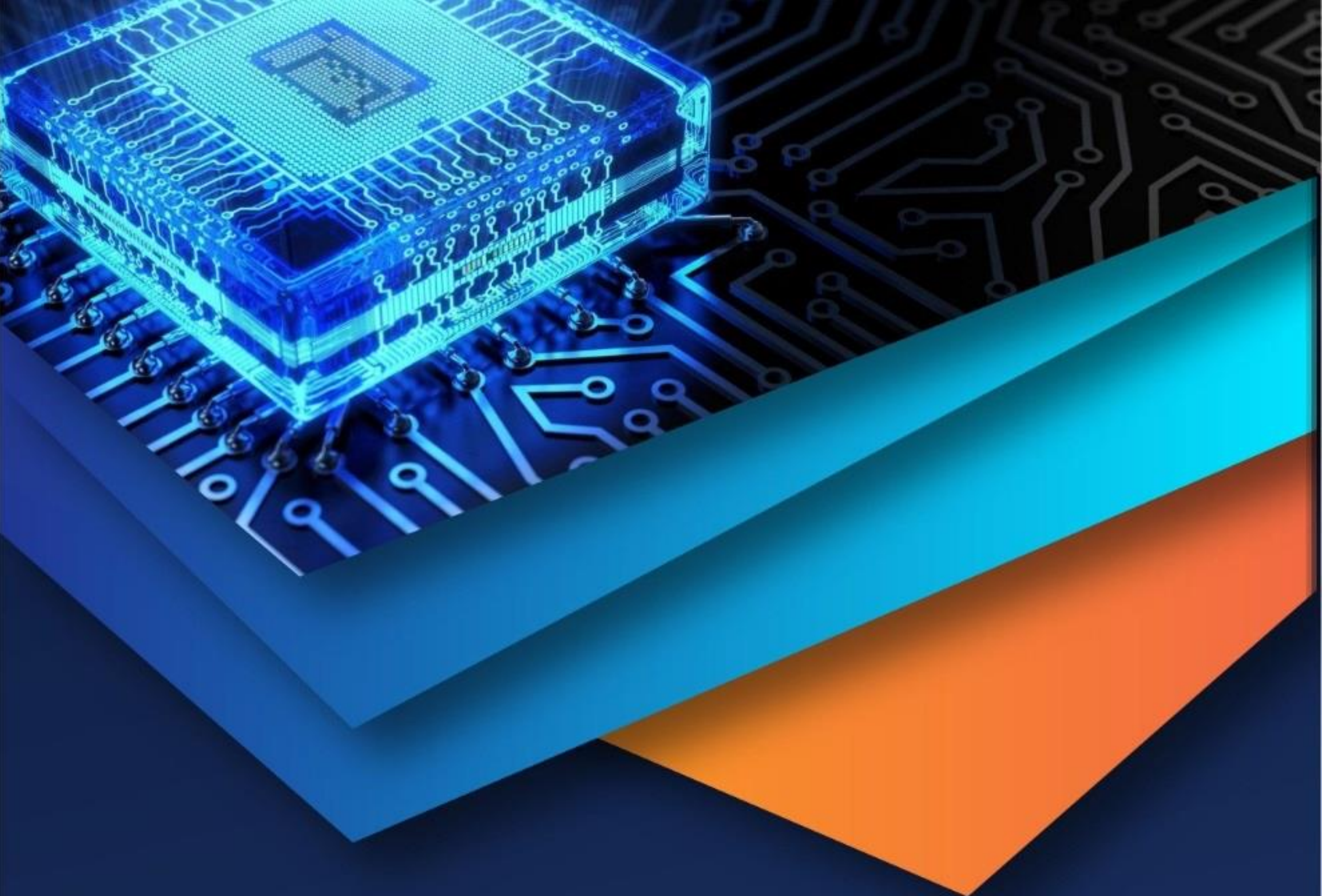

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