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# Comparison of Seismic Behavior of Multi Storey Reinforced Concrete Structure with Dual System by Using Etab.

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**ABSTRACT:** Generally, the structure can be prone to serious harm in elevated seismic regions. Along with the structure of the gravity load, the lateral load must be able to create elevated stresses. Now a days the shear wall in R.C structure with the steel structure and steel bracing system is most common for resisting lateral loads due to earthquake, wind, blast, etc. One of the finest lateral load resisting system is the shear wall. which is widely used in construction world. This study includes linear-static and non-linear static analysis of an E-shaped and diaphragm discontinuity G+14 multi-story RC building with different shear wall arrangements on dual system such as flat slab and shear wall, moment-resistant frames and shear wall using ETABS software for various irregular designs. Parameters like base shear, storey shear, storey drift, displacement..

**KEYWORDS:** Dual System, Shear Wall, Flat Slab, Point Displacement, Storey Shear, Storey Drift, Diaphragm Discontinuity

## I. INTRODUCTION

### 1.1 GENERAL

Their primary focus is on the existence of structure, which should be tall and thin, and there has been a massive increase in the measurement of tall structures in contemporary locations. This means that these buildings must resist not only vertical but also horizontal stresses. The building is vulnerable to wind and seismic forces because of its height and slim profile. Structure should thus be addressed in relation to performance. Since it is composed of two load-resisting systems, the realistic expectation is that a dual system will be able to withstand parallel loads. You can employ both flat slabs and moment resisting frames (MRFs) with shear walls as a dual system. In order to readily withstand lateral loads and achieve acceptable performance, shear walls are often utilized. These walls operate like cantilevers in the vertical planes.

Earthquake is an unpredictable calamity known to mankind for many years and many researchers have been working to protect the structures from the disasters of earthquakes. Many existing structures must need retrofitting to avoid the damage which may occur due to vibrations. Also at the time of an seismic activity, the building base suffers a lot of lateral displacement which affects the structure and its elements. Considering all the mutilations in this type of calamity, a building should be designed against these lateral force effects by using dual systems such as Shear walls, Bracings, Infill walls as shown in Fig.1.1.Other dual systems are used as well, such as dampers and sometimes a mix system which consists of multiple lateral load dual systems together.

In earthquake defiant design, structures often undergo significant non-linear movement and are typically intended for reduced seismic movements. When studying a structure that is breaking down, it is essential to take its behavior and ductile characteristics into account. Nowadays, a method known as push over analysis is used, which takes into account a number of characteristics including base shear, displacement, loading drifts, etc., as true dynamic analysis is usually not feasible. A G+14 story RC framed structure is examined in this research via the lens of a dual system. The dual

system in question is a special moment resistant frame (SMRF) with shear wall and flat slab.

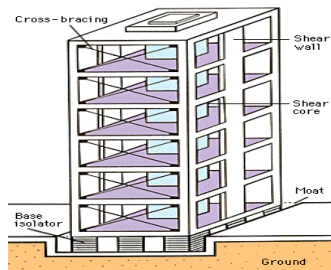


Fig. 1.1 Building Comprising of Multiple Lateral Load Dual System

As said before, the dual system combines the two lateral load resisting systems to provide resistance to lateral load. A change in the geometry of the shear force and bending moment diagrams as a result of interlocked forces causes these systems to deform differently than walls and frames. With this setup, the walls can control the displacement of the frames from above, and the frames can control the displacement of the walls from below, thanks to the combination of the two. It provides heightened protection to buildings located in areas prone to earthquakes. One example of a dual system is the special moment resisting frame (SMRF) with shear wall. Another is the SMRF with bracing or infill wall. Still another is the flat slab with shear wall, bracing, or infill wall.

• **Dual System** : A dual system is a system comprising of multiple lateral load stiffeners imparting the structure an enhanced capacity to prevent the tremor forces acting on it. Structures located in areas prone to earthquakes get increased protection from this. There are other dual systems that are often utilized, such as SMRF with shear wall, SMRF with bracing, SMRF with infill wall, flat slabs with shear wall, infill wall, and bracing independently, and many more.

• **Shear wall**

These are the walls which are straight up constituents of the horizontal force defying element. Distinctively they are wood frame sealed walls enfolded with plywood which is a structural scabbard material. With the sealing of this scabbard matter, the Shear wall can defy forces couriered down the length of the separator. When assembled fittingly they have the strength and tautness to defy the plane forces.

These walls defy plane forces which are in correlation to the plane of the wall by

- Cantilever exploit.
- Truss exploit

The former for slender walls where in the bending deformation is more or dominant and the latter for squat Shear walls (short) where in the shear distortion is more i.e. dominant.

Shear walls should impart ample lateral strength to defy horizontal forces. If these Shear walls are fittingly assembled and are strong enough; they transfer these plane forces to other tranche's in the track beneath them which may be floors, or other Shear walls. Tautness is imparted in terms of relationship of their 'h' to 'b' ratio on the preponderance part.

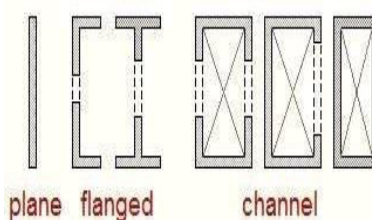


Fig.1.2 Different Sections of a Shear wall

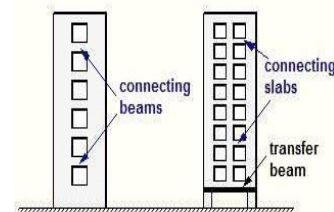


Fig.1.3 Coupled Shear wall

Flat slab : A structure with flat slabs is the one that does not use beams i.e. the beams are lacking and it differs from

prevailing RC frame in a way that, in a traditional frame the loads are relocated from the slabs to the beams then the columns and then the footings. Whereas in a structure with Flat slabs the loads from the beams are directly relocated to the columns via the column drops used instead of beams where the column may some times lead to punching shear. It results in quick construction and imparts a supple arrangement.



Fig.1.4 Flat slabs with Column Drop

**Presnt Study :** The proposed study is on the assessment of seismic behavior of a 15 storey RC structure situated in seismic zone V by considering the effect of dual system. Shear wall with and without Flats lab are considered as a dual system for E-Shaped and diaphragm discontinuity models. Both linear static and nonlinear static analysis have been performed for all ten models and results are tabulated. Parameters such as bases hear, storey shear, storey drift, displacement, pushover curves and performance levels have been obtained for all ten models.

## II. LITERATURE REVIEW

2.1 General : The literature review for this research is the focus of this section. It provides specifics on the study's chosen parameters. A comparative seismic study of multi-story RC buildings taking the effects of dual systems into account is part of the current literature review. The dual system at separate sites is SMRF with Shear wall and Flat slab in this investigation. The following are the list of papers considered for the present study.

**Peiqi Ren et. al. (2015)** did the work to research the dynamic breakdown obstruction of skyscraper RC edges hear divider structures. Twocommon 15-story RC edges hear divider building models, with proportional generally sidelong protection from seismic activities, are set up in this investigation to assess their dynamic breakdown protections. Be that as it may, the basic formats in opposing the side long powers are very extraordinary for the two structures: One is a frail divider solid edge structure and the other is a solid divider feeble casing framework. Three-dimensional limited component models are developed Dependent 0on general limited component program. The demonstrating procedures are depicted in some detail with approvals. The dynamic breakdown protections of the two structure models are assessed by means of the nonlinear unique interchange way (AP) strategy under different section (shear divider) evacuation situations. The investigation results exhibit that if the RC casing shear divider building is intended to oppose the flat seismic activities mostly through the shear dividers, the breakdown obstruction of the edges willing general bed efficient and consequently, an extraordinary breakdown counteractive action configuration is required. Conversely, on the off chance that the casings fill in as the fundamental parallel safe parts, at that point the general breakdown opposition can be improved by the seismic plan and thus, a dynamic breakdown can be satisfactorily anticipated. Further, this investigation recommends that the shear dividers ought to be interconnected in the floor plane, for instance, in a C or a cylinder shape, gave that the practical prerequisites can be met. This is on the grounds that interconnected shear dividers cangivesatisfactoryelectiveburdenwayandinthiswayhaveunrivalledbreakdown obstruction. Additionally, point by point dynamic breakdown aversion plan methodology is given for edges with insufficient breakdown obstruction.

**Ozgun Avsar et. al. (2014)** completed the work on Reinforced cement (RC) structures having the satisfactory measure of auxiliary divider region with a symmetrical course of action. The constructive outcome of basic dividers was seen by contrasting the presentation of two RC structures, which were influenced by the May 19, 2011 Simav seismic tremor in Turkey. Explanatory models of the two structures were created to look at the impact of auxiliary dividers on the seismic presentation of RC structures by leading reaction history and sucker investigation. The consequences of this investigation demonstrates that the structures with symmetrically or chest rated auxiliary dividers indicated generally excellent seismic execution and endure the tremor with just restricted non-basic harm. Though the nearness of two basic dividers with a symmetrical game plan killed the negative impact of existing auxiliary inadequacies and endure the tremor with no basic harm. What's more, in conclusion it presumes that auxiliary dividers can be amiable answer

for creating nations in seismic locales where the development and structure reviews can't be connected appropriately

**Rajesh Jakka (2013)** completed the work to play out the nonlinear investigation of a RCC outline and furthermore the non-direct examination of a RCC outline with shear dividers at various levels. The investigation is done utilizing ETABS programming. Push-over bends for both the edges are acquired and examination is completed and inferred that that shear divider putting up to initially floor is progressively noteworthy if there should arise an occurrence of base shear and dislodging or more than that i.e.,(second, third and fourth floors), there is as light increment in base shear, so it is discretionary.

**Nabin Raj et. al. (2012)** Carried out the work on Steel propped casing is one of the auxiliary frameworks used to oppose seismic tremor stacks in multi-storied structures. Many existing strengthened concrete (RC) structures can be retrofitted to beat lacks, to oppose seismic loads in the meantime steel bracings can be consolidated with RC outlines which in join can be called as double framework to oppose horizontal power in the new structures. Conservative, easy to erect, space-efficient, and adaptable to plan for collecting the necessary quality and solidness—that is what steel propping is all about. Seismic performance of reinforced concrete buildings with concentric steel props is the focus of this investigation. At the peripheral parts, bracings are provided. Using SAP 2000 programming, six-, twelve-, and eighteen-story buildings are analyzed for seismic zone V in accordance with IS 1893: 2002. For the buildings, reaction range testing is carried out. The MathCAD Prime software is used to obtain Eigen values and Eigen vectors. Also recorded are story shear and base shear as a result. The building's seismic performance is evaluated up to the story floats.

**Jose A. Pincheira et. al.(1995)** Carried out the work on the seismic exhibition of different retrofit plans for non malleable fortified cement (RC) outlines initializing in elastic static and dynamic reaction investigations of three model structures. These structures considered for study contain run of the mill strengthening subtleties of more seasoned edges and speak to low and medium ascent development in districts of high seismicity in the United States. Retrofit plans incorporated the establishment of post tensioned propping, auxiliary steel supporting, or infill dividers of fortified cement. Dynamic investigations were led for five ground movements illustrative of serious seismic tremors on firm and delicate soil conditions. Reaction of the first and retrofitted structures is assessed as far as most extreme removals, entombs story floats, and anticipated part conduct. The outcomes demonstrate that there is no special arrangement and that few diverse retrofit plans can be intended to give satisfactory execution. The presentation of post tensioned propping, basic steel supporting, and infill dividers as a retrofit plot for non flexible fortified solid edges was examined for three model structures. Inelastic powerful reaction of the first and retrofitted structures was thought about for five ground movements estimated on firm and delicate soils.

**Summary of Literature :** From above literature review presents the study of RC multi storey building by using dual system. Shear wall and Flat slab is used as a dual system to resist lateral forces coming on the structure during earth quake. The flat slab building type is popular because it satisfies both economic and architectural needs with its lower floor heights. There is a lot of precedent for the analysis and construction of flat slab structures to withstand gravity loads. The building's performance in severe seismic zone V is determined by non-linear static analysis. From the review it is seen that RC building with Special Moment Resisting System and Shear wall is the dual system which can be implemented in sever seismic zone V.

**Scope for Present Study :**An examination of RC multi-story buildings with a dual system in mind is the primary focus of the research. Both the dual system and the shear wall with flat slab take into account various lateral load resisting devices. The primary objective of this research is to evaluate RC building seismic analyses in seismic zone V with a focus on the impact of dual systems subjected to heavy seismic loading.

### III. OBJECTIVES AND METHODOLOGY

- **General :** This chapter discusses about the objective sand methodology of current research.
- **Objectives of current research**

The purpose of this research is to examine the effects of a dual system on multi-story RC buildings. The following are the primary aims of the current investigation.

- Base shear, storey shear, point displacement, and storey drift are some of the outcomes that have been produced from analytical studies of comparable static analysis.
- The purpose of doing linear and nonlinear static analyses is to learn how dual systems react to seismic stresses.



- In order to research and evaluate the efficiency of structural RC building models with geometrically uneven shapes.
- Using linear and nonlinear static analysis, we will study the RC-framed building's seismic behavior in severe seismic zone V.
- To investigate the impact of two systems on the resistance to lateral and gravitational loads of a G+14-story RC-framed structure to the combined requirements of IS 1893 Part-I 2002.
- The purpose of this study is to determine the total capacity of the RC-framed building under consideration by obtaining the capacity or pushover curves using nonlinear static pushover analysis.
- In order to determine how well a structure holds up in very hazardous seismic zone V.

**• Methodology**

The model represents a 14-story structure with an E-shape and a diaphragm discontinuity, with dimensions of 30 m x 25 m in plan. This research examines ten models that use SMRF with Shear wall and Flat slab as a dual system. Different sites employ shear wall for E-shaped and diaphragm discontinuity models. This research makes use of both linear and nonlinear static analyses.

**• About Software (ETABS) • General :**

It is finite elements of software which is used for exclusive purposes such as structural designs and analysis of structural systems. The essential notion of ETABS is that it works off an assimilated catalogue. The basic notion is to create model consisting of straight up and horizontal frame systems and proposing then tire building. It encompasses various dynamic and static analysis options. It allows performing assessments of straight up floor tremor problems in addition to customary techniques that are built in the software. It has more advanced potentials which have superior options for modeling non-linear pushover analysis, base isolation, etc. It has features which enable us to export the models from ETABS to other software packages and also enables us to import from other software packages such as AUTOCAD which is the most frequent software used to export models to ETABS.

**• Advantages of E-TABS**

- Several floors of the buildings are same and this relationship can be used to trim down the computational attempt.
- The models are premeditated logically i.e. not as non-descript nodes stream as in broad programs. Hence making it simplified.
- In several buildings the dimensions of the tranches are more than the bay widths and storey heights influencing the tautness of the frame. ETABS can correct for such upshots of tautness different from other programs.
- The results can be interpreted with ease.

**• Description of Building Structure**

A series of load-defying components is used to simulate the structures. The constructions are subjected to lateral loads according to Indian specifications. In accordance with IS 1893:2002, the study is carried out for seismic zone V. Table 3.1 provides a full explanation of the structure that was taken into account for this investigation.

STRUCTURE	DESCRIPTION
Plan Dimension	30m x 25m
No of Storey	15
Height of one storey	3m
Height of Beam Storey	3.5m
Soil Type	Medium Soil
Seismic Zone	V
Importance Factor	1
Grade of Concrete $f_c$	M30
Grade of Steel $f_y$	Fe 415
Size of the Beam	300mm x 450mm
Size of the Column	300mm x 300mm
Slab Thickness	150mm
Live Load	1 kN/m <sup>2</sup>
Live Load on Roof	0.5 kN/m <sup>2</sup>
Floor Finish	1 kN/m <sup>2</sup>
Column Drop	300mm
Shearwall Thickness	200mm

Table3.1Descriptionof the Structure

**IV. STRUCTURAL MODELING AND ANALYSIS**

For the current research, there are five models considered that include Shear Wall at various places. Models are conducted with equivalent static analysis and push over analysis. Different parameters like base shear, storey shear, storey drift, push over curves are acquired based on the assessment. It reflects various kinds of models considered for the current research below from Fig1 to Fig5.

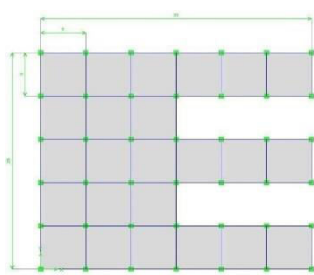


Fig.4.1 Plan of RCE-shaped structure

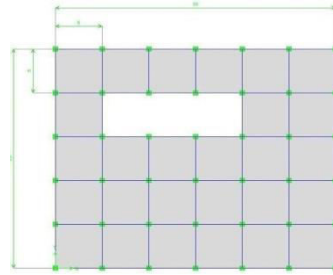


Fig.4.2 Plan of RC Diaphragm discontinuity

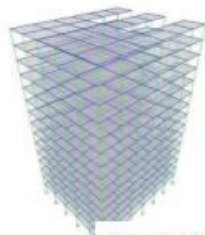


Fig. 4.5 E- Shaped Bare Frame model

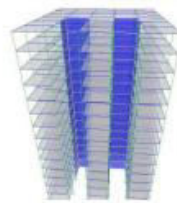


Fig. 4.6 E-shaped model SMRF and Shear at re-entrant corners.

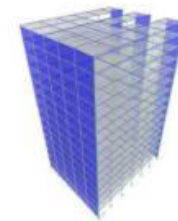


Fig.4.7 E-shaped model with SMRF and Shear wall at Alternate Periphery.

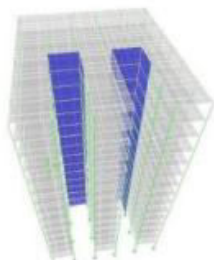


Fig. 4.8 E-Shaped Model with Flat slab

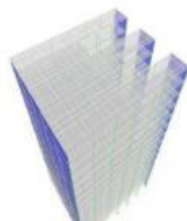


Fig. 4.9 E-Shaped Model with Flat slab and Shear wall at Alternate Periphery

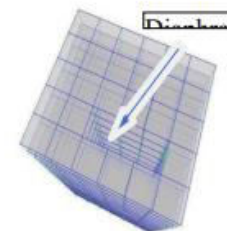


Fig. 4.10 Diaphragm Discontinuity Bare

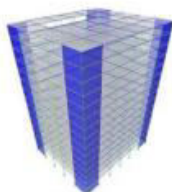


Fig. 4.11 Diaphragm Discontinuity Model With SMRF And Shear Wall At

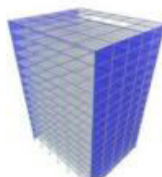


Fig. 4.12 Diaphragm discontinuity model with SMRF and Shear wall at



Fig.4.13 Diaphragm discontinuity model with Flat slab and Shear wall at

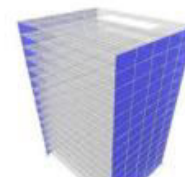


Fig. 4.14 Diaphragm discontinuity model with Flat slab and Shear



V. RESULTS AND DISCUSSIONS

RESULTS The following results for linear static or equivalent static and non-linear static or pushover analysis are tabulated for both the considered models under various load combination as per IS 1893 Part-I 2002. Here M1= E-Shaped Bare Frame Model M2= E- Shaped model with SMRF and Shear Wall at re-entrant corners M3= E- Shaped model with Flat slab and Shear Wall at re-entrant corners M4= E-Shaped model with Flat Slab and Shear Wall at re-entrant corners M5= E-Shaped model with Flat Slab and Shear Wall at alternate periphery

BARE FRAME	SMRF AND SHEAR WALL re-entrant corners M2	FLAT SLAB AND SHEAR WALL at Periphery M3	FLAT SLAB AND SHEAR WALL re-entrant corners M4	FLAT SLAB AND SHEAR WALL at alternate periphery M5
4805.26	5194.11	5323.72	4880.52	5038.8

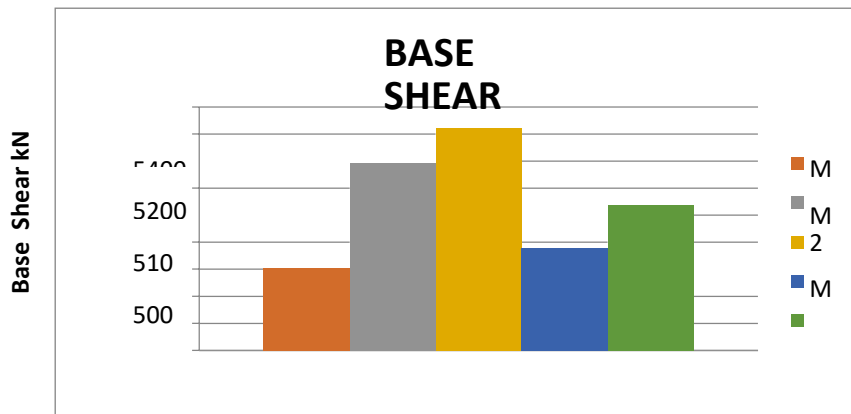


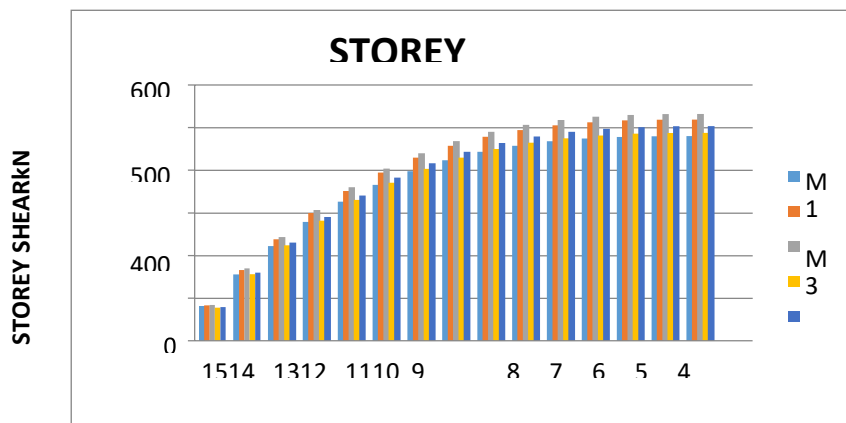
Fig. 5.1 Base Shear for E-

A. BASE SHEAR B. Table2. Base Shear in kN





STOREYNO	BAREFRAME (kN) M1	SMRFANDSHEAR WALL ( kN ) SW at re-entrant corners MM2	FLAT SLAB AND SHEARWALL ( kN ) atSW at re-SW cornersM4	AND SHEARWALL ( kN ) at re-SW PeripheryM5
15	796.87	829.8	840.71	776.16
14	1562.73	1663.65	1697.24	1560.34
13	2224.28	2383.94	2437.11	2237.73
12	2789.16	2998.97	3068.87	2816.12
11	3265	3517.05	3601.05	3303.35
10	3659.43	3946.5	4042.18	3707.22
9	3980.08	4295.63	4400.79	4035.55
8	4234.59	4572.73	4685.44	4296.15
7	4430.58	4786.13	4904.64	4496.83
6	4575.7	4944.13	5066.93	4645.42
5	4677.57	5055.04	5180.86	4749.73
4	4743.82	5127.17	5254.95	4817.56
3	4782.08	5168.83	5297.75	4856.74
2	4800	5188.34	5317.79	4875.09
1	4805.26	5194.11	5323.72	4880.52



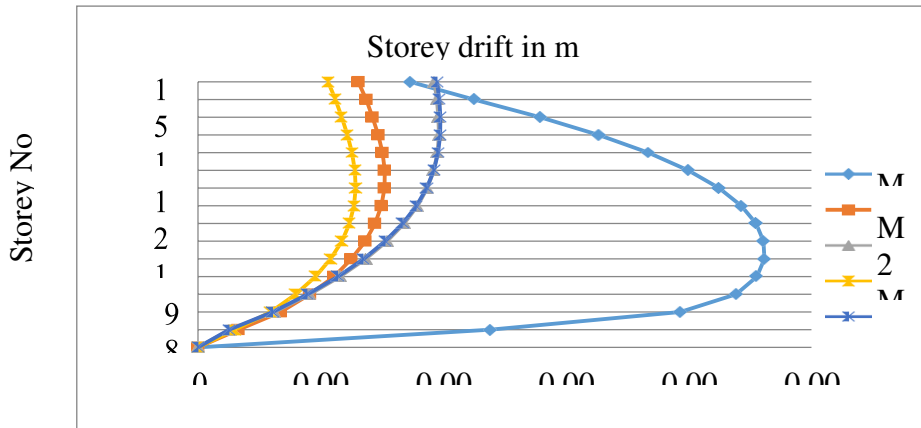


Fig. 5.4 Displacement for Model 1 to Model 5

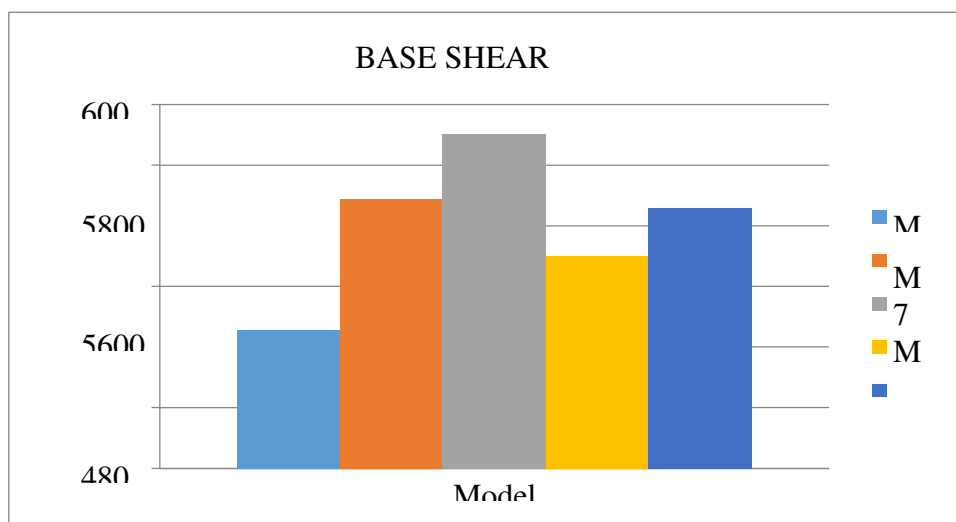
**Results and Discussions for Diaphragm discontinuity models**

Following are the results of the diaphragm discontinuity model

**Base Shear Table 5.5 Base Shears for "Diaphragm Discontinuity " Mode link N**

BAREFRAME	SMRF AND SHEARWALL		FLATSLAB AND SHEARWALL	
	SW at corners M7	SW at Periphery M8	SW at corners M9	SW at periphery M10
M6	5256.46	5688.92	5904.54	5499.18
			5499.18	5657.47

Fig.5.5 Base Shear for Model 6 to Model 10





*Story Shear*

Table 5.6 Story Shears for " Diaphragm Discontinuity "Shaped Model in „, kN “

STOREYNO	BAREFRAMEM6	SMRFANDSHEAR WALL		FLAT SLAB AND SHEARWALL	
		SW at Corners M7	SW at Periphery M8	SW at Corners M9	SW Periphery at M10
15	876.61	905.05	931.43	874.05	890.11
14	1713.44	1819.06	1881.6	1757.74	1800.97
13	2436.3	2608.59	2702.36	2521.07	2587.77
12	3053.53	3282.75	3403.19	3172.85	3259.6
11	3573.46	3850.64	3993.54	3721.9	3825.53
10	4004.45	4321.38	4482.9	4177.01	4294.63
9	4354.82	4704.06	4880.72	4547	4676
8	4632.91	5007.81	5196.48	4840.67	4978.69
7	4847.07	5241.72	5439.64	5066.82	5211.79
6	5005.63	5414.91	5619.68	5234.26	5384.38
5	5116.94	5536.48	5746.06	5351.8	5505.54
4	5189.33	5615.55	5828.26	5428.24	5584.33
3	5231.14	5661.22	5875.73	5472.39	5629.84
2	5250.72	5682.6	5897.96	5493.06	5651.15
1	5256.46	5688.92	5904.54	5499.18	5657.47

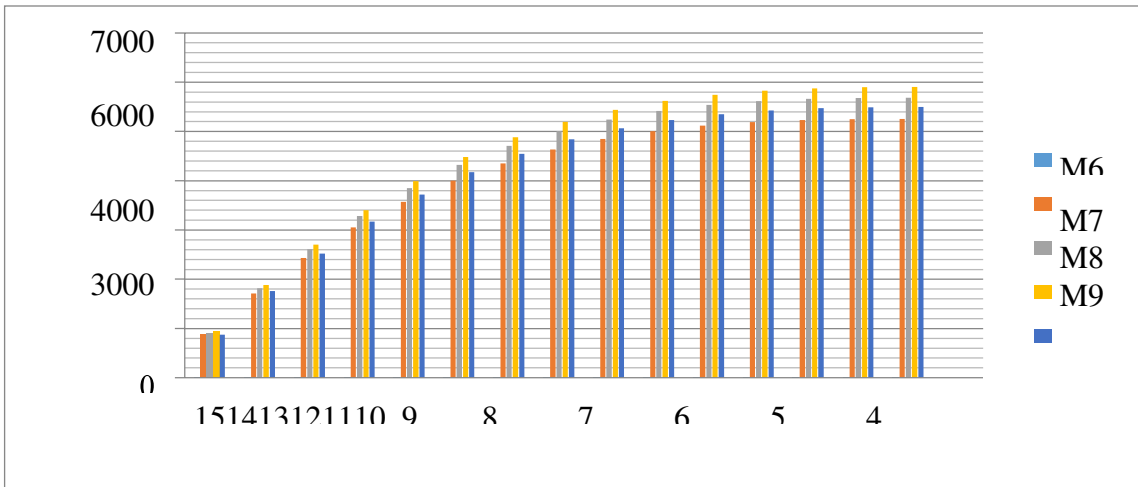


Fig. 5.6 Variation of Story Shear for Model 6 to Model 10

For models 6–10 of the diaphragm discontinuity series, the point displacement is shown in Table 5.6. As the height of a storey rises, the storey shear continues to decrease. When compared to previous models, model 9 shows less storey shear on the top floor. The fluctuation of storey shear for models 6 to 10 is shown in Fig. 5.6.

**Story Drifts**

Table 5.7 Story Drifts for " Diaphragm Discontinuity " Model in „m“

STOREYNO	BAREFRAME M6	SMRFANDSHEAR WALL		FLAT SLAB AND SHEARWALL	
		SW at CornersM7	SW at PeripheryM8	SW at CornersM9	SW at PeripheryM10
15	0.001083	0.001819	0.000162	0.001471	0.000156
14	0.001611	0.001855	0.000169	0.001509	0.000163
13	0.002138	0.001876	0.000175	0.001535	0.000168
12	0.002604	0.001889	0.000179	0.001555	0.000172
11	0.003002	0.001887	0.000181	0.001563	0.000174
10	0.00333	0.001866	0.000181	0.001555	0.000173
9	0.003593	0.001822	0.000178	0.001528	0.000171
8	0.003797	0.001752	0.000173	0.001478	0.000166
7	0.003947	0.001654	0.000165	0.001404	0.000158
6	0.00405	0.001525	0.000154	0.001302	0.000148
5	0.00411	0.001363	0.000141	0.001172	0.000136



4	0.004124	0.001166	0.000126	0.001009	0.000121
3	0.004064	0.000932	0.000108	0.000813	0.000103
2	0.00379	0.000658	0.000087	0.00058	0.000083
1	0.002389	0.000301	0.000058	0.000271	0.000055

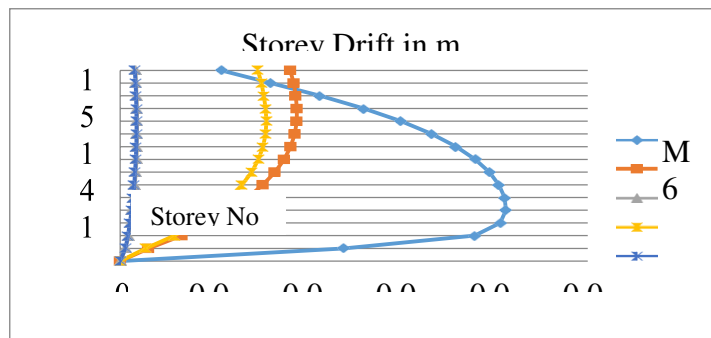


Fig. 5.7 Variation of Storey drift for Model 6 to Model 10

Storey drift for diaphragm discontinuity models 6–10 is shown in Table 5.7 above. The amount of storey drift diminishes as the storey height rises. Compared to previous models, model 10's storey drift is lower on the top floor. The fluctuation of storey drift from model 6 to model 10 is seen in Fig. 5.7.

**Displacements**

Table 5.8 Displacements for “Diaphragm Discontinuity ”Model in „m”

STOREY NO	BAREFRAME M6	SMRF SHEAR WALL		AND FLAT SLAB AND SHEAR WALL	
		SW at Corners M7	SW at Periphery M8	SW at Corners M9	SW at Periphery M10
15	0.1435	0.067	0.0066	0.0562	0.00638
14	0.1403	0.0616	0.0061	0.0518	0.00593
13	0.1355	0.056	0.00567	0.0472	0.00544
12	0.1291	0.0504	0.00515	0.0426	0.00494
11	0.1213	0.044	0.00462	0.038	0.00444
10	0.1123	0.0391	0.004	0.0333	0.00392
9	0.1023	0.0335	0.00355	0.02871	0.0034
8	0.0916	0.0281	0.00302	0.0241	0.0029

Storey No

7	0.0802	0.0228	0.0025	0.01972	0.0024
6	0.06844	0.0179	0.00201	0.01552	0.0019
5	0.0563	0.0133	0.0016	0.0116	0.0015
4	0.044	0.0093	0.00114	0.0081	0.0011

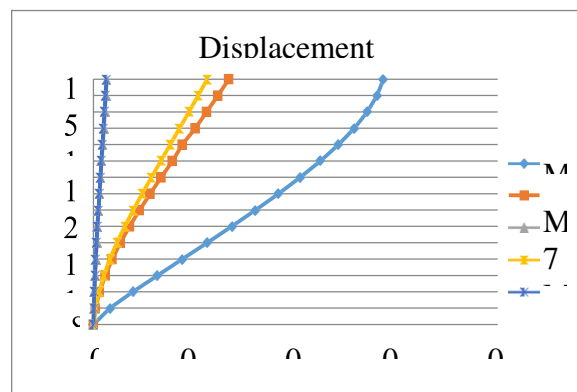


Fig. 5.8 Displacement for Model 6 to Model 10

3	0.0317	0.0058	0.0008	0.0051	0.0007
2	0.0195	0.003	0.0005	0.0027	0.0004
1	0.0082	0.001	0.0002	0.0009	0.0002

Diaphragm discontinuity models 6–10 exhibit increasing displacements with increasing storey height, as seen in Table 5.8. Model 6 has greater displacement on the upper floor than the previous variants. Figure 5.8 displays the storey drift variation from model 6 to model 10.

1) **Push over Curves** Base Force ( kN )  
Push over curves For E-Shaped Model

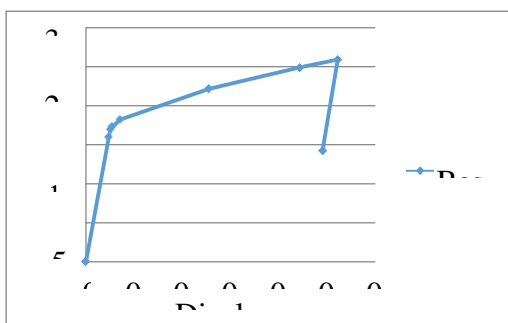


Fig.5.9 Push over Curve for Bare Frame

STEP	DISPLACEMENT (m)	BASEFORCE (kN)
0	0	0
1	0.0475	1603.0659
2	0.0508	1698.2466
3	0.0539	1734.5967
4	0.0696	1818.7019
5	0.2548	2214.5837
6	0.4439	2489.9434
7	0.5222	2589.5581
8	0.4906	1426.4105

Table 5.9 Pushover Table for Bare Frame

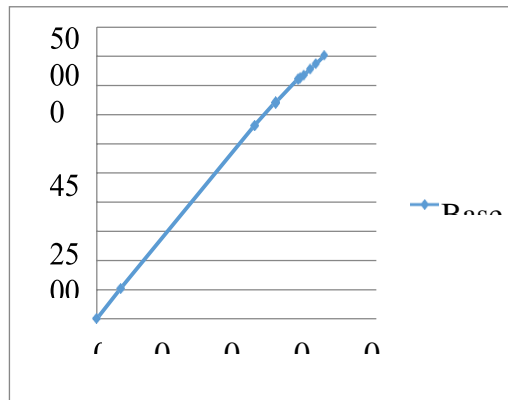


Fig. 5.10 Push over Curve for SMRF with Shear wall at Re-Entrant Corners

STEP	DISPLACEMENT (m)	BASE FORCE (kN)
0	0	0
1	0.0068	5220.751
2	0.0451	33153.543
3	0.0451	33133.6992
4	0.0511	37178.7695
5	0.0511	37029.0117
6	0.0577	41218.2109
7	0.0577	40992.8438
8	0.0583	41403.9688
9	0.0583	41254.3359
10	0.0593	41827.1211
11	0.0593	41739.2734
12	0.0611	42851.4883
13	0.0611	42754.5859
14	0.0627	43741.9297
15	0.0627	43658.9883
16	0.0651	45109.5664

Table 5.10 Pushover Table for SMRF with Shear wall at Re-Entrant Corners

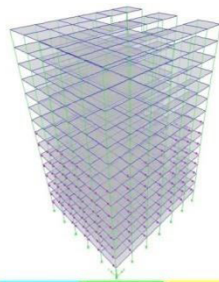


Fig. 5.19 Pictorial Representation of Plastic Hinge Formation for Bare Frame

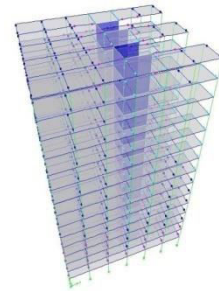


Fig. 5.20 Pictorial Representation of Plastic Hinge Formation for SMRF with Shear walls at Re-Entrant Corners.

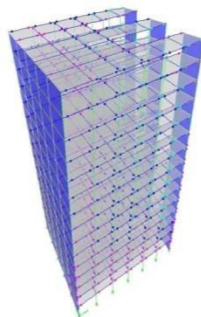


Fig. 5.21 Pictorial Representation of Plastic Hinge Formation for SMRF with Shear wall sat Periphery.

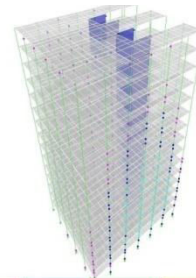


Fig. 5.22 Pictorial Representation of Plastic Hinge Formation for Flat slabs with Shear walls at Re-Entrant Corners

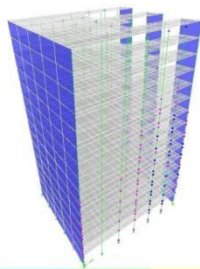


Fig. 5.23 Pictorial representation of plastic hinge formation for Flat slabs with Shear walls at periphery.

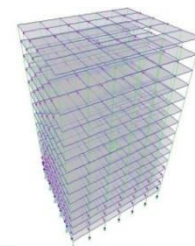


Fig. 5.24 Pictorial Representation of Plastic Hinge Formation for Bare Frame

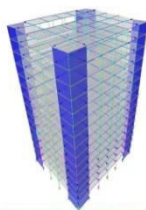


Fig. 5.25 Pictorial Representation of Plastic Hinge Formation for SMRF with Shear walls at Corners

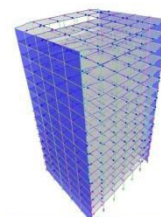


Fig. 5.26 Pictorial Representation of Plastic Hinge Formation for SMRF with Shear walls at Periphery.



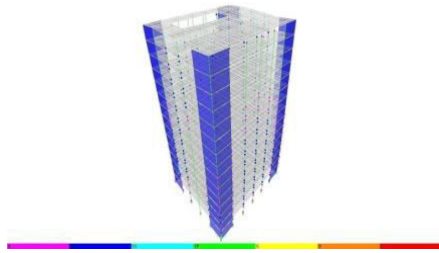


Fig. 5.27 Pictorial Representation of Plastic Hinge Formation for Flat slabs with Shear walls at Corners.

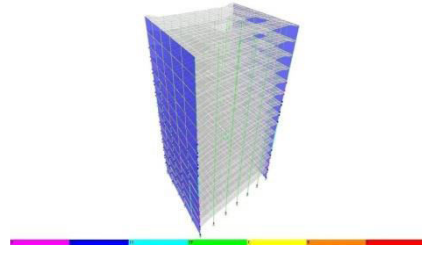


Fig. 5.28 Pictorial Representation of Plastic Hinge Formation for Flat slabs with Shear walls at Periphery.

## VI. CONCLUSIONS AND SCOPE FOR FURTHER WORK

### Conclusions :

The results of the current investigation are detailed below.

In contrast to all previous E-shaped models, SMRF with a shear wall at the perimeter dual system exhibits much higher base shears and storey shears.

Results from the E model for SMRF with a shear wall at the perimeter and a dual system are superior than those from other models—and the bare frame model in particular—by a margin of 58.5%.

A dual system including SMRF with shear walls at the perimeter produced displacements that were 62.29% better than those of the bare frame model and outperformed all other improvements.

The figures show that without a lateral load resisting mechanism, model E's bare frame is the weakest model in seismic zone V.

One diaphragm discontinuity model, Flat slabs with shear walls at the perimeter, has greater values for base and storey shears than the others.

Comparing the displacements of two models with a diaphragm discontinuity—SMRF with shear wall at the perimeter and Flat slab with shear wall at the periphery—we find that the former model performs somewhat better than the latter, and that the bare frame model performs 90% better.

It is evident from the figures that the bare frame for the Diaphragm discontinuity model is the weakest model in seismic zone V since it does not have a lateral load resisting mechanism.

The graphs revealed that the diaphragm discontinuity model with shear walls at the perimeter and Flat slabs with shear walls at the periphery performed better for storey drift and displacements than all other versions when compared to the E-Shape model. Consequently, it is the best dual system among all the systems that were studied in this research. Results for the G+14 story RC framed structure with all of the systems taken into account fall within the life safety range (i.e., LS - CP) for post-yield behavior at the overall performance level.

### Scope for Further Work

Detailed below are the potential areas of future study.

Linear static and non-linear static analyses have both been the subject of dissertation research; time history analysis is another viable option for dynamic analyses.

Other dual systems, such as SMRF with bracings, flat slabs with bracings, tubular shear walls, bundled shear walls, and outrigger systems, may also undergo further study.

In accordance with IS 1893 Part-I 2016 seismic zones and load combinations other than gravity are acceptable for the investigation.

## REFERENCES

- [1] Balaji and Selvarasan (2016), "Design and Analysis of multi-storeyed building under static and dynamic loading conditions using ETABS", International Journal of Technical Research and Applications e-ISSN: 2320-8163, www.ijtra.com Volume 4, Issue 4, PP. 1-5
- [2] Geethu S N, Depthi M, Abdul Nasir N A and Izzudeen K M(2016) "Comparative study on design and analysis of multi storied building by STAAD.Pro and ETABS softwares".
- [3] IS: 456:2000, "Indian Standard Code for Plain and Reinforced Concrete", Bureau of Indian Standards, New Delhi



- [4] IS: 875:1987 (part-1 and part2) “Indian Standard Code of practicefor design loads”, Bureau of Indian Standards,New Delhi
- [5] Design aid for reinforce concrete to IS-456-1978.SP: 16 Indian Standards institution,1980.
- [6] IS 13920 (1993): Ductile detailing of reinforced structures subjected to seismic forces - Code of practice[CED 39: Earthquake Engineering]
- [7] SP 34 (1987): Handbook on Concrete Reinforcement and Detailing [CED 2: Cement and Concrete]
- [8] Agarwal. P. and Shirkhande.M, “Earthquake resistant Design of Structures” Printice- Hall of India Private Ltd. New Delhi, India.
- [9] Bhavikatti S.S, “Advance R.C.C. Design” , New Age International (p) Limited, Publishers, New Delhi, I ndia.



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