International Journal of Research in Advent Technology (IJRAT)
(E-ISSN: 2321-9637)
Special Issue National Conference "CONVERGENCE 2018", 09th April 2018

Comparative Earthquake Analysis of G+10 Rcc Building With and Without Shear Wall

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Abstract- Shear wall is the basic important structural component. These walls can be utilized for giving more strength & safety to the structure, when the structures are subjected to external loads, such as earthquake loads, wind loads etc. Structural walls provide an efficient bracing system and offer great potential for lateral load resistance. These type of walls , basically play a main role for the construction of tall structure. The properties of these seismic shear walls dominate the response of the buildings, and therefore, it is important to evaluate the seismic response of the walls appropriately. In this present study, main focus is to compare various seismic properties of the Building with and without shear wall. Also the building is analysed by changing the position of the shear wall symmetrically. Effectiveness of the shear wall has been studied with the help of four different models. Model 1 is bare frame structural system and other three models are dual type structural system. An Earthquake load is applied to a building ofG+ Ten Story located in Zone III. Parameters like Lateral displacement, Storey drift, Base shear, Time Period are compared.

Index Terms- Shear wall, Sismic analysis, E-Tab software.

1. INTRODUCTION

SHEAR WALL:- Shear wall is a structural member used to resist lateral forces i.e. parallel to the plane of the wall. For slender walls where the bending deformation is more, shear wall resist the load due to cantilever action. In other words shear walls are the vertical elements of the horizontal force resisting system. In building construction, a rigid vertical diaphragm capable of transferring lateral forces from exterior walls, floors, and roofs to the ground foundation in a direction parallel to their planes. Examples are the reinforced – concrete wall. Lateral forces caused by wind, earthquake, and uneven settlement loads, in addition to the weight of structure and occupants create powerful twisting (torsional) forces. This leads to the failure of the structure by shear.

EARTHQUAKE HAZARDS:- Earthquakes really pose little direct danger to a person. People can't be shaken to death by an earthquake. Some movies show scenes with the ground suddenly opening up and people falling into fiery pits, but this just doesn't happen in real life. Buildings can even sink into the ground if soil liquefaction occurs. Liquefaction is the mixing of sand or soil and groundwater (water underground) during the shaking of a moderate or strong earthquake. When the water and soil are mixed, the ground becomes very soft and acts similar to quicksand. If liquefaction occurs under a building, it may start to lean, tip over, or sink several feet. The ground firms up again after the earthquake has past and the water has settled back down to its usual place deeper in the ground. Liquefaction is a hazard in areas that have groundwater near the surface and sandy soil. Buildings can also be damaged by strong surface waves making the ground heave and lurch. Any buildings in the path of these surface waves can lean or tip over from all the movement. The ground shaking may also cause landslides, mudslides, and avalanches on steeper hills or mountains, all of which can damage buildings and hurt people.

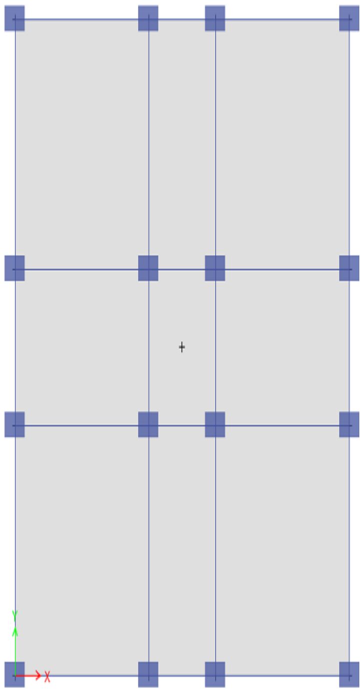
ETABS SOFWARE:- As our country is the fastest growing country across the globe so the need of shelter for highly populated cities where the cost of land is high and further horizontal expansion is not possible due to unavailability of space, so the only solution is vertical expansion. Structural design is the primary aspect of civil engineering. The foremost basics in structure is the design of simple basic components and members of a building like slabs, beams, columns, and footings. In order to design them it is important to first obtain the plan of the particular building. Thereby depending on the suitability plan layout of beams and the position of columns are fixed. Thereafter, the vertical loads are calculated namely the dead load and live load. Once the loads are obtained, the component takes the load first i.e. the slabs can be designed. Designing of slabs depends upon whether it is a one-way or a two-way slab, the end condition and the loading. From the slabs, the loads are transferred to the beam. The loads coming from the slabs onto the beam may be trapezoidal or triangular. Depending on this, the beam may be designed. There after, the loads (mainly shear) from the beams are taken by the columns. For designing columns, it is necessary to know the moments they are subjected to for this purpose, frame analysis is done by Kanis method.

2. BUILDING MODELING

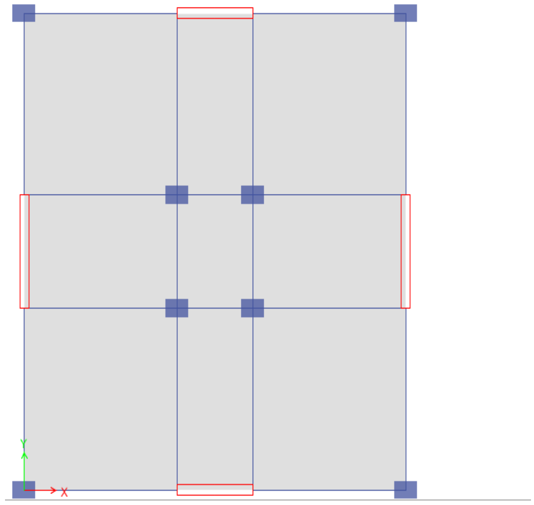
For this study, a 10-story building with a 3-meters height for each story, regular in plan is modeled. These buildings were designed in compliance to the Indian Code of Practice for Seismic Resistant Design of Buildings .The buildings are assumed to be fixed at the base and the floors acts as rigid diaphragms. The sections of structural elements are square and rectangular and their dimensions are changed for different building. Storey heights of buildings are assumed to be constant including the ground storey. The buildings are modeled using software ETAB Nonlinear v 9.5.0.Four different models were studied with different positioning of shear wall in building. Models are studied in all four zones comparing lateral displacement, story drift, % Ast in column, concrete quantity required, steel and total cost required in all zones for all models.

The plan of the building model are given below

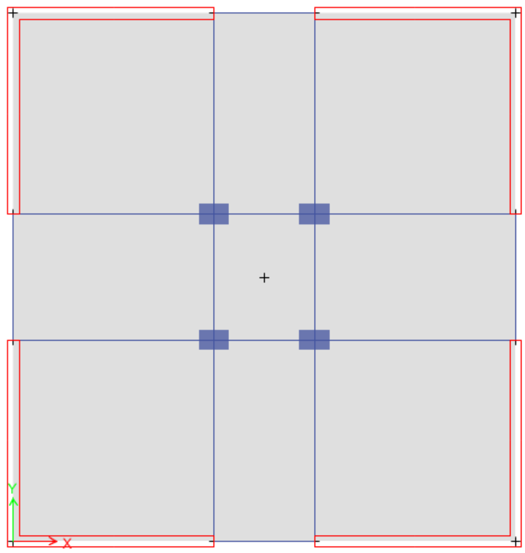
Model 1 – Floor plan of the bare framed structure.



Model 2 – Floor plan of the dual system with shear wall one on each side.



Model 3 - Floor plan of the dual system with shear wall on corner with L = 4m



Building Configuration Data:

NO OF STORIES	Eleven (G+10)
EACH STOREY HEIGHT	3m
THICKNESS OF SLAB	150mm
FLOOR FINISH	1 kN/sq.m
LIVE LOAD	3 kN/sq.m
GRADE OF CONCRETE	M25
GRADE OF STEEL	Fe500
SIZE OF BEAM	0.3m X 0.4m

SIZE OF COLUMN	0.4m X 0.6m
THICKNESS OF SHEAR WALL	0.23m

Time Period calculation as per IS 1893-2002
Tx = 0.09H / SQRT(Dx)
Ty = 0.09H / SQRT(Dy)

MODEL 1 : BARE FRAME MODEL

TABLE 1: Diaphragm Center of Mass Displacements

Story	Diaphragm	Load Case/Combo	UX
Story10	D1	SPECX Max	8.01
Story9	D1	SPECX Max	7.641
Story8	D1	SPECX Max	7.126
Story7	D1	SPECX Max	6.46
Story6	D1	SPECX Max	5.658
Story5	D1	SPECX Max	4.74
Story4	D1	SPECX Max	3.729
Story3	D1	SPECX Max	2.653
Story2	D1	SPECX Max	1.559
Story1	D1	SPECX Max	0.556

Model 2 One shear wall on each side

TABLE 3: Diaphragm Center of Mass Displacements

Story	Diaphragm	Load Case/Combo	UX
Story10	D1	SPECX Max	8.231
Story9	D1	SPECX Max	7.724
Story8	D1	SPECX Max	7.103
Story7	D1	SPECX Max	6.348
Story6	D1	SPECX Max	5.463
Story5	D1	SPECX Max	4.468
Story4	D1	SPECX Max	3.396
Story3	D1	SPECX Max	2.298
Story2	D1	SPECX Max	1.255
Story1	D1	SPECX Max	0.405

Model 3 Shear wall at Corner location

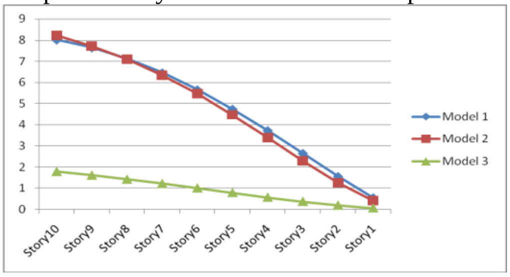
TABLE 6: Diaphragm Centre of Mass Displacements

Story	Diaphragm	Load Case/Combo	UY
Story10	D1	SPECY Max	2.158
Story9	D1	SPECY Max	1.934
Story8	D1	SPECY Max	1.695
Story7	D1	SPECY Max	1.443
Story6	D1	SPECY Max	1.181
Story5	D1	SPECY Max	0.917
Story4	D1	SPECY Max	0.66
Story3	D1	SPECY Max	0.422
Story2	D1	SPECY Max	0.219
Story1	D1	SPECY Max	0.07

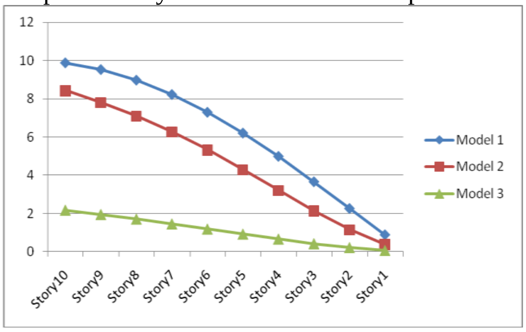
3. RESULT AND DISCUSSION

LATERAL DISPLACEMENT Lateral displacement for all model in all four zones are as shown in fig.

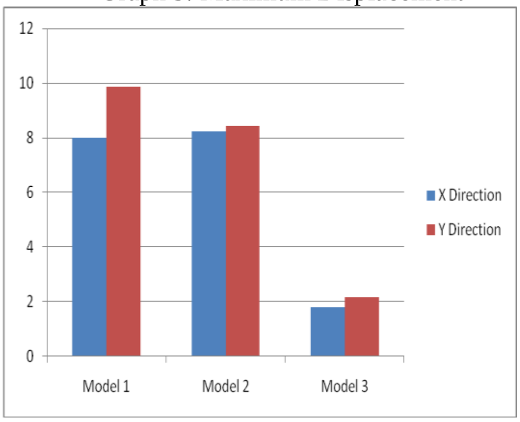
Graph 1 : Story wise X directional displacement



Graph 2 : Story wise Y directional displacement



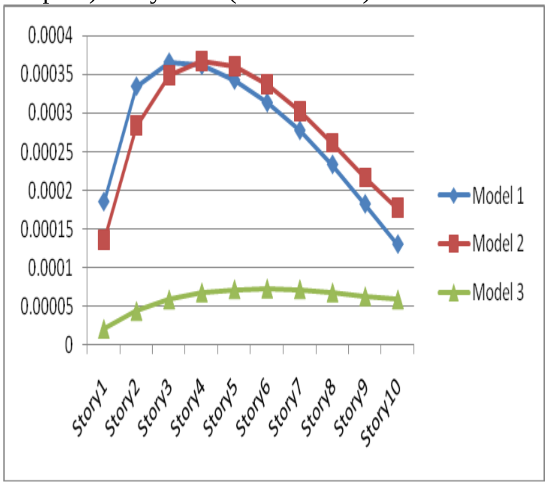
Graph 3: Maximum Displacement



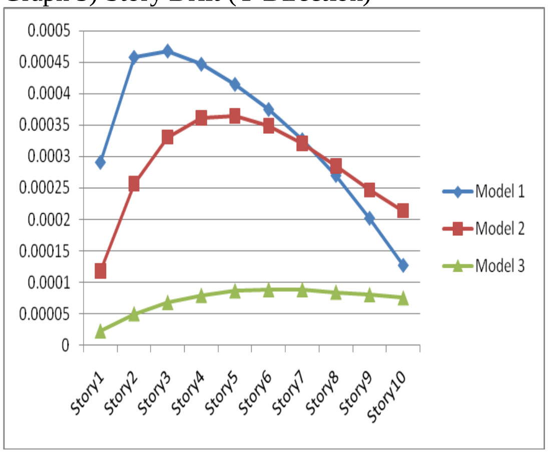
1) Story Drift

Story Drift is the Displacement of one level relative to other level above or below.
Story Drift ratio = (Difference Between displacement of two stories / Height of story)

Graph 4) Story Drift (X Direction)



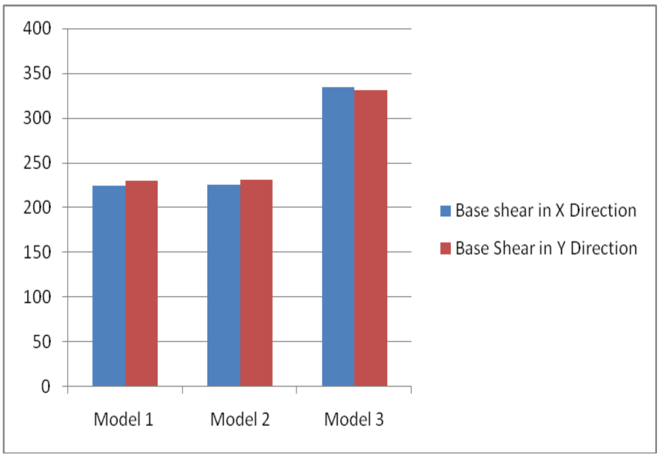
Graph 5) Story Drift (Y Direction)



2) BASE SHEAR

The base shear of a building with and without shear wall is calculated by time history analysis method. In the time history analysis of a building with and without shear wall Imperical valley (El Centro 1979) earthquake record is used. The numerical value of the building with and without shear wall is shown in table II.

Base Shear	**Model 1**	**Model 2**	**Model 3**
Base shear in X Direction	224.1953	226.025	334.52
Base Shear in Y Direction	229.682	231.323	331.297



CONCLUSION:-

From above tables and Graph it can be concluded that with the incorporation of Shear walls the displacement reduces.

The shear walls added at the corner location as shown in model 3 reduces the displacement by 78.11%

So introduction of the Shear walls helps in reducing the displacement by a considerable amount, for the horizontal forces.

From above tables and graph it is clear that both X and Y Directional Story Drift is having lesser values for the buildings with shear wall compared to Bare Frame models

The story drift increases from Story 1 to story 5 and then it starts decreasing till story 10.

The Base Shear observed to be increasing with the incorporation of the shear walls.

The Model with the shear wall at corner location shows highest values of base shear.

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