COMPARATIVE STUDY OF DIFFERENT SHEAR WALL ON IRREGULAR STRUCTURE

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Abstract- *A shear wall is a rigid vertical member. the lateral forces acting in a structure. These walls are mostly used in an earthquake zone. RCC structures are transferring lateral forces slab to beam, beam to column, column to the foundation, and foundation to soil. These walls are especially used high rise buildings subject to earthquake and wind forces. These walls have more vigor, and rigidity, and resist in-plane loads that are applied along with their height. The special region for this wall used devastation is the destruct During the earthquake, the reduction of lateral stability and strength in the man-made structure for the special reason for the extermination. The present investigation is to study about effects of the shear wall materials in a typical high-rise building to repair earthquake resistance. This report determines bonzer materials of shear walls. G+12 residential building modeling, analysis and determine the results. In the present study, seven models were prepared. Case 1. Original building plan. Case 2. uses 300mm thickness of RCC walls. Case 3 thickness of shear walls 500mm. Case 4. 22mm thickness of steel plate shear wall. Case 5. 24 mm thickness of steel plate shear wall. Case 6. The thickness of the steel plate is 26mm. Case 7 without shear walls in the original plan. The behaviors of the structure by using the response spectrum method for dynamic analysis. The present study has been done by E-TAB 2018. The determine the resultant shear force and bending moments diagram, shear stress, and displacement, base sear, time period, etc. property of the structure. This present research paper completes the assessment of the earthquake performance of the shear walls.*

Keywords: Shear Wall, Irregular Building Plan, Story Drift, Displacement, Time period, Base Shear, Materials, Response Spectrum Method.

1. INTRODUCTION:

In high-rise buildings, a shear wall is a primary element. it resists the later forces. Past research indicated that loss in lateral capacity in the case of reinforced concrete shear walls exhibits a sudden loading case. In this condition the wall corner and web crushing in the plastic zone. Shear walls may give rise to low energy extravagance capacity due to these reasons. Ductile failure mechanism and high energy absorption to displacement control steel plate shear wall system and given substantial stiffness and control ductile failure mechanism, the higher energy of steel plate shear wall. The Constitutes of two

boundary columns and a horizontal floor connected to a steel plate. The steel plate reduces energy, dissipation capacity, and decreases shear strength, and drops the stiffness of the system.

1.2 FUNCTION OF SHEAR WALL:

- The behavior of the shear wall depends upon the different categories like the thickness of the wall, the position of the wall, using materials property, shape, and size of the wall.
- Shear wall transfers the loads into the foundation of the rigid vertical diaphragm.
- The shear wall is resisted wind and gravity load.
- The building structure shear wall provides general strength and inertia for the construction.
- These walls reduce the lateral loading of the building.

1.3 OBJECTIVES:

The objectives of this study are as follows-

- In the case of an irregular building plan the main objective is the find the optimal position for the shear wall.
- In the case of an irregular building plan the most important objective is the determine which hunky-dory material of the shear wall.
- In the condition of different thicknesses and different materials evaluate the story force diagram, story drift, story shear, period, and displacement using the response spectrum method.

2. ANALYTICAL STUDY:

The present study has been carried out on G+12 residential buildings with the shear walls.

GEOMETRICAL PROPERTIES:

- Height of the building = 44.94m
- X direction distance = 47.53m
- Y direction distance = 36.08m
- Concrete grade = M30, M35, M40, M45.
- Rebar grade = 500 HYSD
- Steel grade = Fe 250, 345.
- ISMB= 350,400,450.

- Column size -

  C1 = 400mmx600mm

  C2 = 600mmx400mm

  C3 = 600mmx600mm

- Beam size-

  B1 = 900mmx500mm

  B2 = 230mmx300mm

  B3 = 300x500mm

- Slab thickness = 200mm

LOADS-

Dead load:

All specifications are given as I.S 875 (part 1):1987.

- Unit weight of RCC = 25KN/m
- Unit weight of plaster = 20KN/m
- Unit weight of brick masonry = 19.2 KN/M
- Unit weight of soil = 17 KN/m
- 200 thickness of RCC slab and 400mm floor finishing.

Live load:

All specifications are given as I.S 875 (part 2):1987.

- All room and kitchen =2.0
- Toilet and bath =2.0
- Balconies = 3.0
- Corridors, passages =3.0
- Stair-case including time escapes and storeroom = 3.0

Wind load:

All the parameters given as I.S 875(part-3):1987.

- Wind speed = 47m/s
- Terrain category = 3
- Risk coefficient (k1) = 1
- Topography (K3) = 1

Seismic loading:

All the parameters given as I.S 1893(part-3) :1987.

- Seismic zone = IV
- Seismic zone factor = 0.24
- Soil types = medium soft soil
- Story range = base to 12
- Importance factor (I) = 1
- Time period x direction = 0.6733
- Time period y direction = 0.5866

3. METHODOLOGY:

In this work, seven models of different materials and thicknesses are considered to be under gravity and lateral loading. Case 1 original building plan modeling. case 2 in this case 300 mm thickness of RCC shear wall. Case 3 500mm thickness of RCC shear wall. Case 4 thickness of steel plate shear wall 22mm. case 5 24 mm thickness. Case 6 thickness of steel plate 26mm. case 7 without a shear wall in the original plan. Using these steps for modeling and analysis of structure.

Step 1. Setup the standard country codes.

We selected the new model template open and mention country codes and display units.

Step 2. Create grid line according to plan:

The crate grid dimension and story dimension define the master story according to plan.

Step 3. Define Materials property:

We define the material property and go to the define menu, Material properties template. we add a new material defined as concrete, rebar, and steel.

Step 4. Define Section Property:

Go to define menu and go section property templated. Crate beam, column, slab, and shear wall size according to the building plan.

Step 5. Create structure elements:

After defining section properties next step is to start the modeling process. Place beam, column, slab, and shear wall.

Step 6. Assign supports:

Go to the assign menu and apply joint/ frame /fixed reaction. Select the base area and apply fixed supports.

Step 7. Assign dead load:

Gravity load is frame loads available in the structure. Calculated dead load value and assign outer walls and internal walls. We have gone to assign menu, frame loads, distributed and absolute distance, apply load then ok.

Step 8. Assign live load:

As per I.S code for given the all specification value. apply live load. Go to shell load, uniform, apply then ok.

Step 9. Assign earthquake load:

It defines I.S 1893:2016. All parameters are given like time period, seismic zone factor, soil profile, etc. properties.

Step 10. Assign wind load:

Using I.S 875(part3): 1987, this code is given wind speed, risk coefficient, terrain roughness, topography factor, importance factor, etc. properties.

Step 11. Crate load combination:

The Combination is defined as it applies to the result for every object in the structure. Go to define menu, load cases template, and add n new combination.

Step 12. Define p-delta, mass source, and response spectrum method:

Apply response spectrum method and define p-delta value sand, mass sources value.

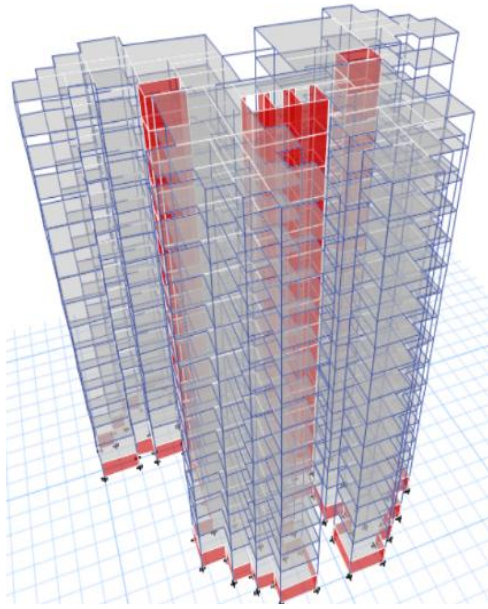

Figure: 1. 3D Modelling original plan**, Case1**

Step 13. Analysis of the model:

After the completion of all the modeling steps. We have performed the analysis process and checked errors. Go to the analysis menu and the first step is to apply the check model. The next step is the active degree of freedom, set load case run, auto mesh setting for floor and wall, and then run analysis. These are analysis steps are completed and read the last analysis. In this list check the stability of the model, linear static case using for p-delta readings, RITZ model analysis, response spectrum x, y, and z-direction. Several joints with restraints and moss sources.

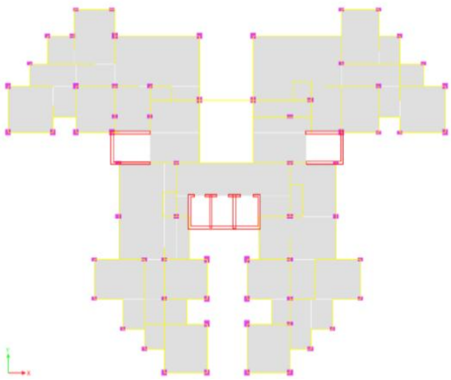

Figure: 2. plan, Case 6

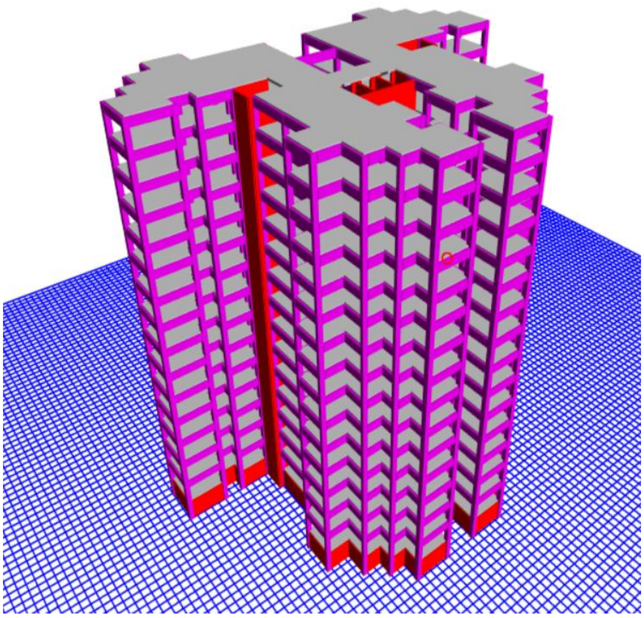

Figure: 3. 3D Modelling, **Case 6**

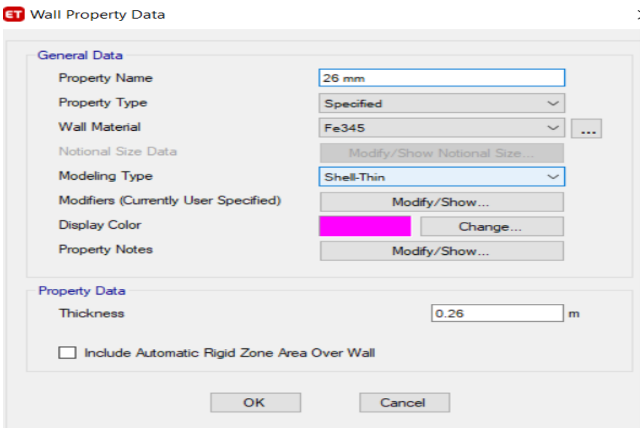

Figure: 4 case 6. 26mm thickness wall material

- When the thickness of the steel plate is decried, the steel plate wall case and the composite story drift is be increasing.
- Figure 8. Depicts that the time periods shear slightly reduces. when the thickness of the RCC shear wall decreases.
- Table 2. Depicts that the bae shear is slightly when thickness of steel plate.
- When the thickness of the steel plate is decried, the steel plate wall and the composite story drift is be increasing.
- The graph 4,5,6,7,8, and 10 given below depict the displacement along the x and y direction minimum steel plate shear wall.
- The base shear for steel plate wall and RCC shear wall is depicted in table 2.

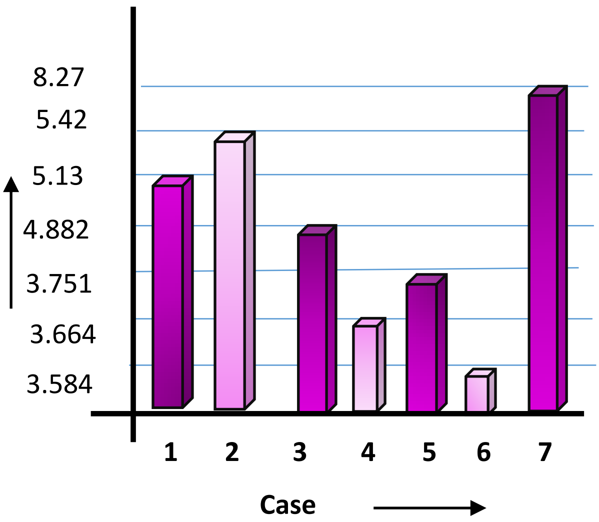

Figure 5. X Direction Time Period

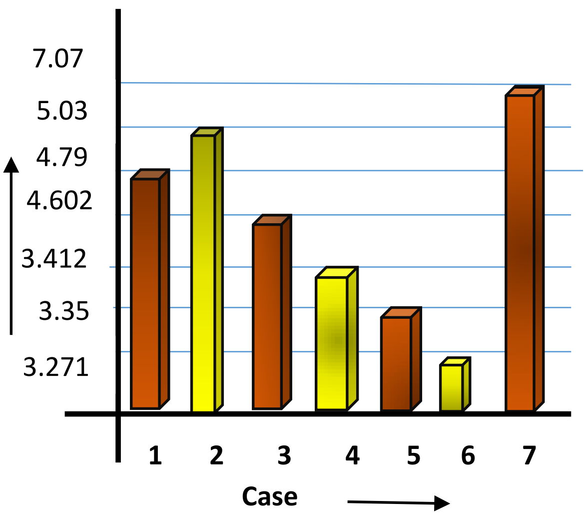

Figure 6. Y Direction Time Period

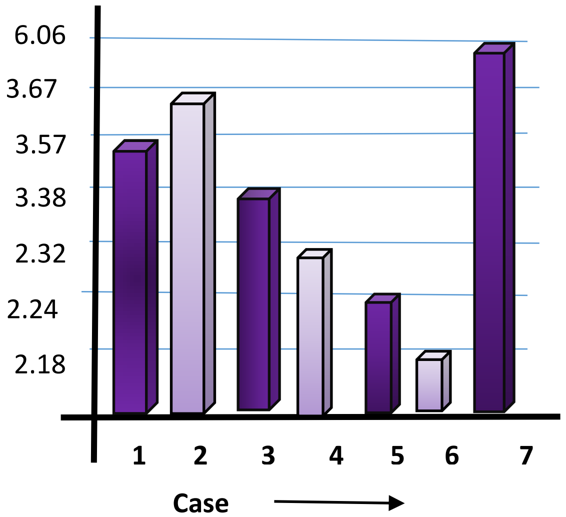

Figure 7. Z Direction Time Period

DISPLACEMENT OF STRUCTURE(MM)							
Condition	Case-1	Case - 2	Case -3	Case-4	Case-5	Case-6	Case-7
E Q (X)	0.619937	0.676917	0.576396	0.354436	0.338359	0.323872	1.276244
E Q (Y)	0.967683	1.071975	0.890181	0.491641	0.465721	0.442602	1.995065
E.Q X(+EC)	0.803141	0.873275	0.749098	0.474506	0.453696	0.434869	1.49697
E.Q X(-EC)	0.445971	0.504101	0.403693	0.234367	0.223022	0.212874	1.550734
E.Q Y(+EC)	1.213968	1.337798	1.20798	0.643559	0.611245	0.582293	2.339465
E.Q Y(-EC)	1.008931	1.111316	0.931937	0.543331	0.516175	0.491906	2.267242
Wind X	0.000006	0.000007	0.000006	0.000004	0.000003	0.000003	0.000022
Wind Y	0.000038	0.000043	0.000035	0.000019	0.000018	0.000017	0.000099
Wind -X	0.000027	0.00003	0.000025	0.000014	0.000014	0.000013	0.0001
Wind -Y	0.00038	0.000043	0.0003	0.000019	0.000018	0.000017	0.000099

Table 1. Maximum Displacement

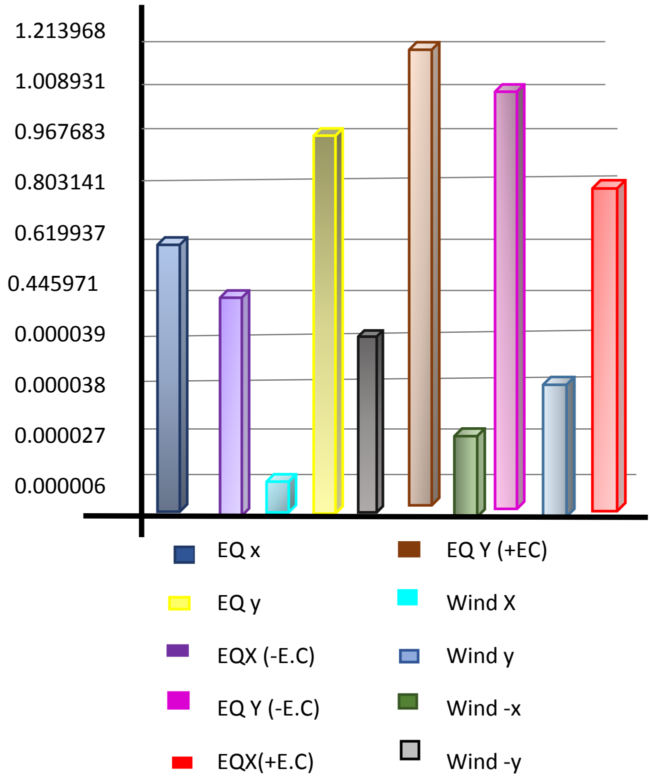

Figure 8. Displacement, mm in case 1

Where,

EQX= Earthquake x-direction.

EQX (+,- EC)= Earthquake x direction eccentric case (+,-)

EQY(+,-EC)= Earthquake y direction eccentric case (+,-)

EQY= Earthquake y direction.

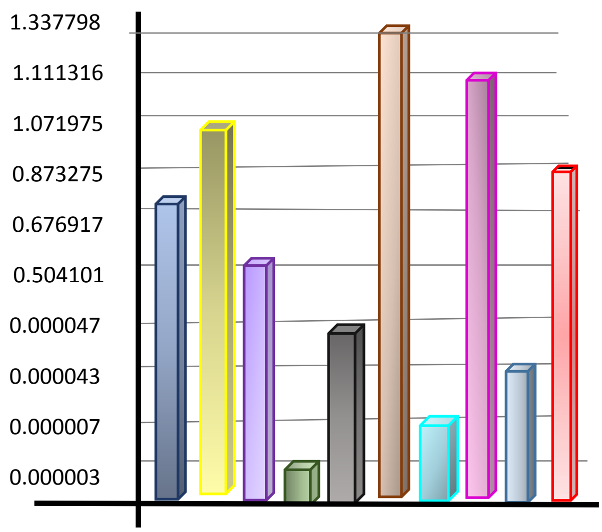

Figure 9. Displacement, mm in case 2

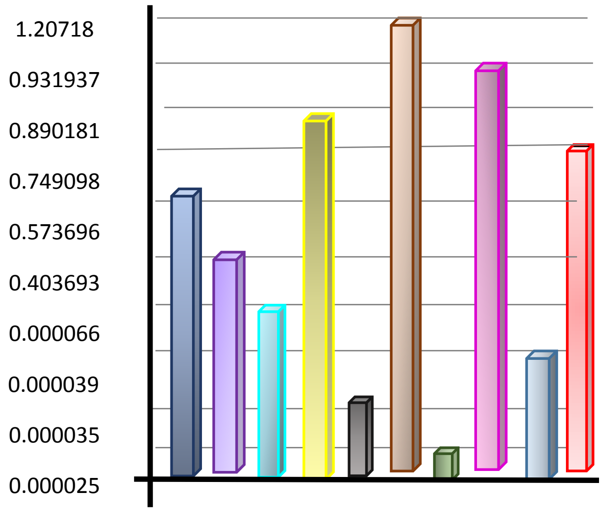

Figure 10. Displacement, mm in case 3

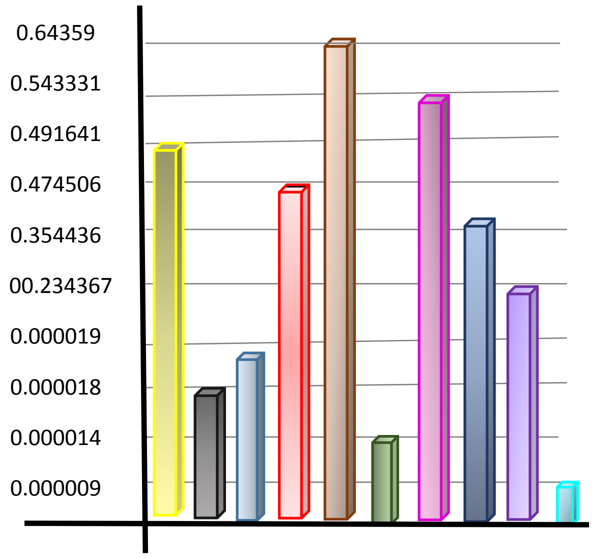

Figure 12. Displacement, mm in case 4

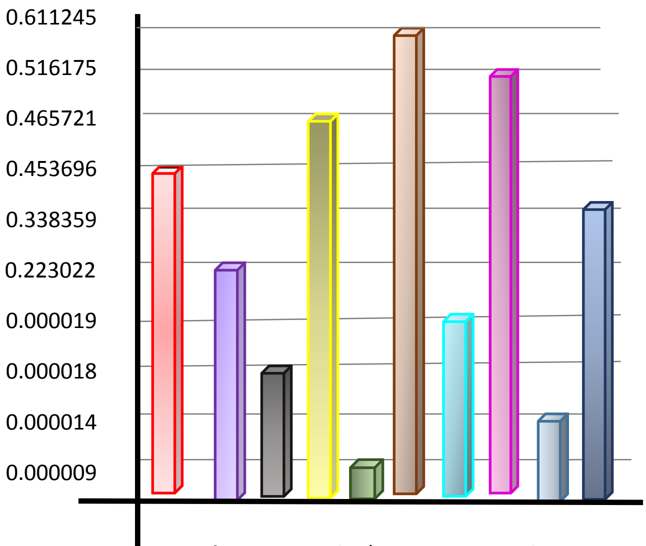

Figure 12. Displacement, mm in case 5

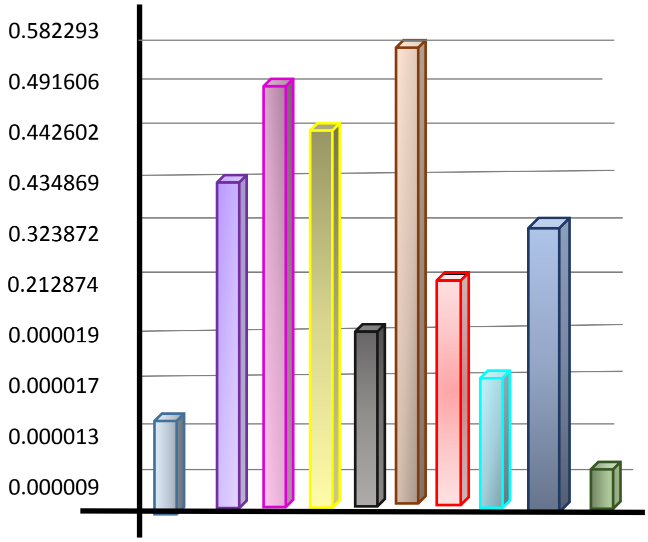

Figure 13. Displacement, mm in case 6

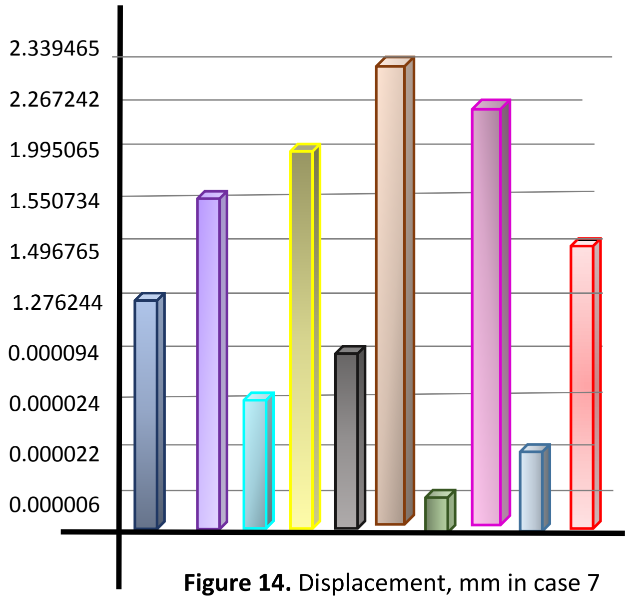

Figure 14. Displacement, mm in case 7

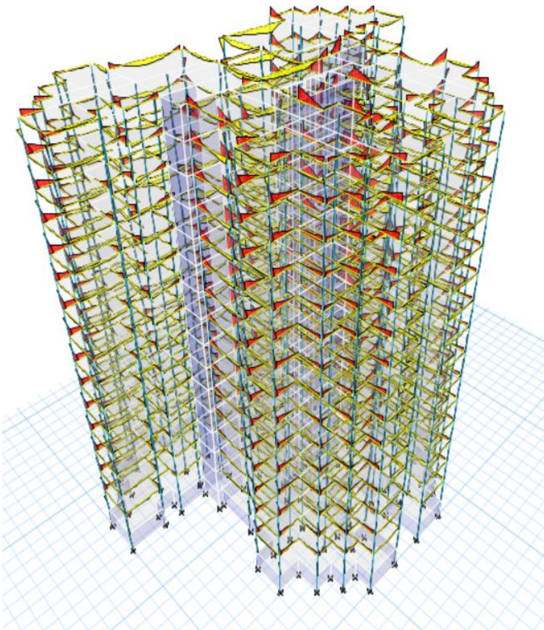

Figure :15. Force/Stress Diagram Case **1**

Base Shear (maximum)						
S.NO	EQ X	EQY	RSZ	Shear X dir	Shear Y	Shear Z
Case 1	0.05092	0.024001	0.7971006	580.0522	273.4041	386.7015
Case 2	0.08803	23931576	6370355	0.0001255	34110.93	0.666667
Case 3	0.00585	0.240707	0.9630144	55.167482	2269.565	0.666667
Case 4	0.10907	2419299	2501971	0.0003958	8779.972	0.666667
Case 5	0.00283	0.242372	2.5740292	9.968838	854.9764	0.666667
Case 6	0.02483	0.000099	0.2976071	757.47249	3.020493	0.666667
Case 7	7.5E-05	0.207288	0.3431188	1.9847353	5485.5	0.666667

Table 2. Maximum Base Share

CONCLUSIONS:

- The maximum time period is without the shear wall in original plan and the minimum time period is thickness of steel plate in 26mm.
- The time period slightly reduces when the thickness of the RCC wall and steel plate is decreased.
- The story drift decreases in the case of RCC shear wall and increases in the case of steel plate shear wall.
- The RCC wall and steel wall is traditional in seismic behavior.
- The minimum displacement in 26mm thickness of steel plate shear wall.
- In the original plan without a shear wall was given more displacement, time period, and story drift as to compared to the plan with the original plan.
- Calculation of the values manual and software almost same results.

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