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SEISMIC ANALYSIS OF REGULAR AND IRREGULAR BUILDINGS WITH AND WITHOUT SHEAR WALL

Niveditha M P[1], Sunil R[2]

[1]M-tech (Structural Engineering), Dept. of Civil Engineering, B.G.S.I.T, B.G Nagara, Nagamangala, Mandya, Karnataka, India
[2] Assistant Professor, Dept. of Civil Engineering, B.G.S.I.T, B .G Nagara, Nagamangala , Mandya, Karnataka, India.

Abstract - *The behavior of regular and irregular building with and without shear wall under seismic motion. Two varieties of G+8 building geometry of are considered in this; one is regular building with and without shear wall and another one is irregular building with and without shear wall. The buildings are modeled and analyzed in software ETABS-2016. Various parameters are considered such as lateral displacement, stiffness, and storey drift. Seismic analysis is done as per IS: 1893-2002(Part-1) code of practice. Seismic zone V and type of soil II (medium) strata are taken for all of instances. Analysis of buildings is done by equivalent static method and response spectrum method. The results from the analysis are obtained and the results are compared for regular building with and without shear wall and irregular building with and without shear wall using graphical form.*

KEY WORDS: ETABS-2016, Regular, Irregular, Bare frame, Shear wall, Displacement, Storey drift, Stiffness.

1. INTRODUCTION

A quake is the effect from the rapid entry of set away imperativeness in the Earth's casing that makes seismic waves. At the earth surface, quake shows themselves by a pulsation of the structures on the ground. A seismic vibration is brought by tectonic plates reaching fixed and putting a twist on the ground. The strain ends up being inconceivable to the point that the stones give away by breaking and sliding along lack planes. Development of multi-storey frames have emphasized the importance of warning the sideway below the stroke of lateral loads. Provision of reinforced concrete shear wall in the plane of load at selected location of high rise buildings is the modern trend in order to avoid the lateral sway and achieve economy in the designs. Geometry is one of the main parameter that influences the effect earthquake building such it may regular or irregular building type of geometry or plan of configuration. A regular building can be defined as symmetrical in plan and elevation of the building about the axis and providing a continuous path of load for gravity such as dead and live load and lateral loads such as wind and earthquake load. An irregular building can be defined as the lack of symmetry of the building and it has discontinuity in the geometry, mass or load resisting elements. Shear wall is designed in the RC building to resist the lateral force.

1.1 SHEAR WALL

Shear wall is vertical plate like RC wall in building. Shear wall is generally started at the foundation level and are continuous right the way through the stature of the building. The thickness of the shear wall is at minimum thickness as 150 mm or as maximum at 400 mm .shear wall are usually provided along both longitudinal and transverse direction. Shear wall is provided for large stiffness and strength of the building in the way of their point of references which considerably reduce the lateral sway of the building and also reduce the damage of the structure and its contents.

2. METHODOLOGY

The methodology followed to evaluate the seismic behavior of regular and irregular buildings with and without shear wall. A G+8 Storey building geometry are considered such as one is regular building with and without shear wall and another one is irregular building with and without shear wall. The buildings are modeled and analyzed by using software ETABS 2016. Analysis of buildings is done by equivalent static method and response spectrum method. Models are considered for zone factor V and type of soil is II (Medium) as per IS: 1893-2002(Part 1) code of practice. The various parameters are considered for analysis such as maximum displacement, stiffness and storey drift.

MAXIMUM DISPLACEMENT

The maximum displacement caused by the lateral force on the each storey level of the building.

STIFFNESS

Stiffness can be advantageous with respect to earthquake damage because it can limit the deformation demands on a building.

STOREY DRIFT

Storey drift is defined as the displacement of one level relative to the other level above or below.

3. MODELLING

The analysis of both regular and irregular buildings (G+8 Storey) has been analyzed. ETABS-2016 has been used for the modelling and carries out analysis. The analysis results are obtained for seismic zone V.

3.1 MODEL TYPE

The RC regular and irregular buildings are considered for:

Model 1-R-Regular building (Bare frame)

Model 2-RSW-Regular building with shear wall

Model 3-IR-Irregular building (Bare frame)

Model 4-IRSW –Irregular building with shear wall

3.2 MODEL DATA

Table 3.2- Details of building

Plan dimension	25mx25m
Bay width along X direction	5m
Bay width along Y direction	5m
Size of beam	400x500mm
Size of column	400x600mm
Thickness of slab	125mm
Thickness of wall	200mm
Thickness of shear wall	300mm
Height of floor	3m
Concrete grade	M25,M30
Grade of steel	Fe 415
Density of concrete	25kN/m^3
Density of brick	20kN/m^3
Live load	3kN/m^3
Floor finishes	1kN/m^3
Wall load	10kN/m
Seismic zone, Z	0.36[V]
Type of soil	Type II-Medium
Importance factor, I	1
Response reduction factor R	5[SMRF]

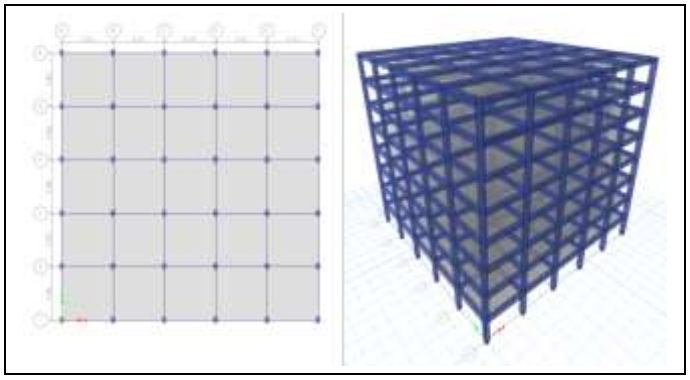

Fig -1: Plan and 3D view of model 1

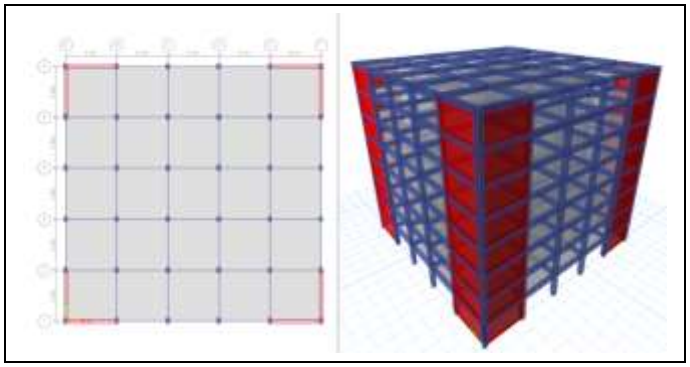

Fig -2: Plan and 3D view of model 2

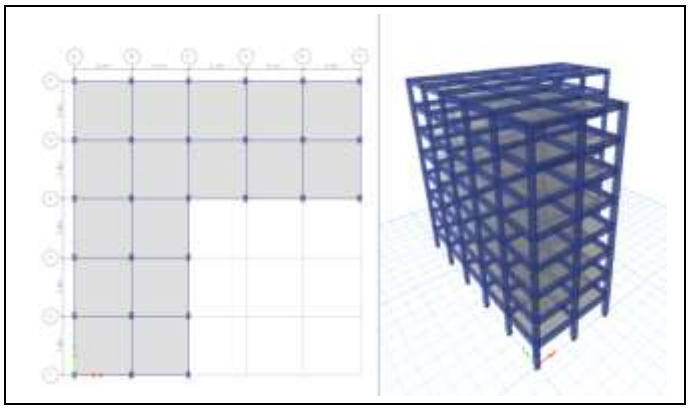

Fig -3: Plan and 3D view of model 3

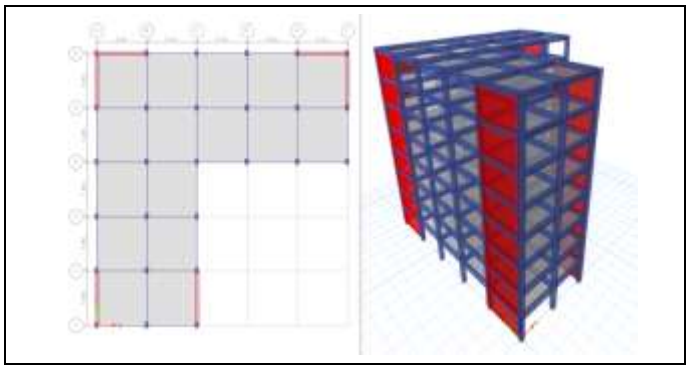

Fig -4: Plan and 3D view of model 4

4. RESULTS AND DISSCUSIONS

Analysis of all models is considered are carried out by both Equivalent static method and Response spectrum method. The analysis and results are obtained for parameters like maximum displacement, stiffness and storey drift.

4.1 EQUIVALENT STATIC METHOD

The results are obtained after analysis are taken and plotted in both X and Y direction as shown below.

4.1.1 MAXIMUM DISPLACEMENT

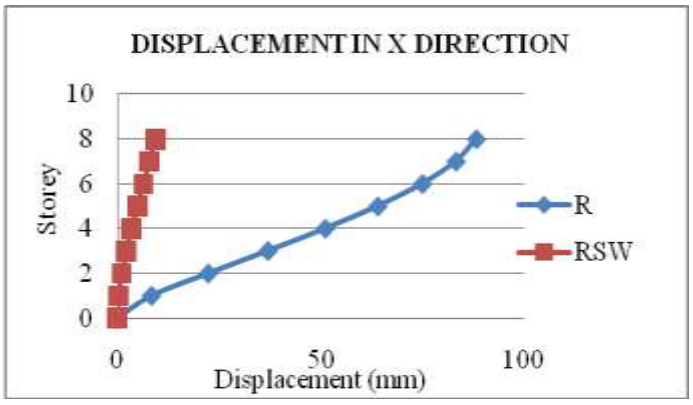

Chart-1: Displacement for R and RSW along X direction

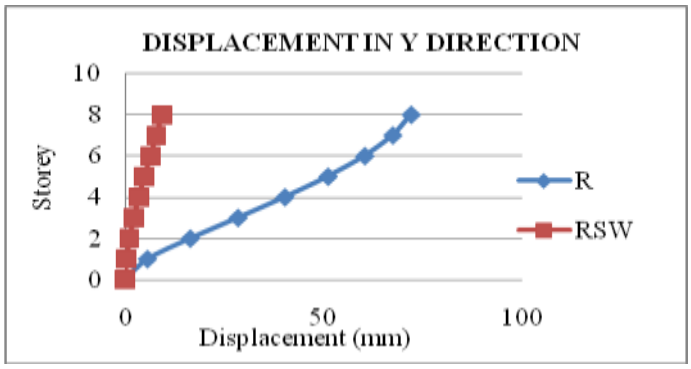

Chart-2: Displacement for R and RSW along Y direction

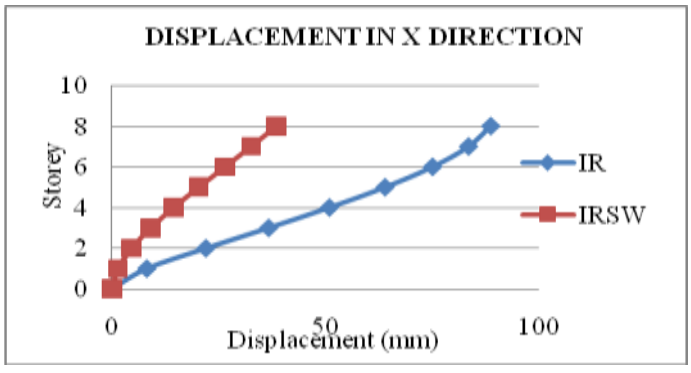

Chart-3: Displacement for IR and IRSW along X direction

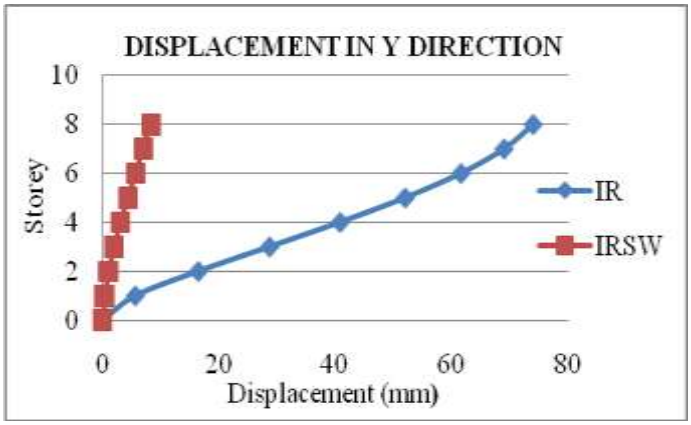

Chart-4: Displacement for IR and IRSW along Y direction

From the graphs, the displacement are taken along X and Y direction. The maximum displacement will be more in regular and irregular building without shear wall. Less displacement will be in regular and irregular buildings with shear wall.

4.1.2 STIFFNESS

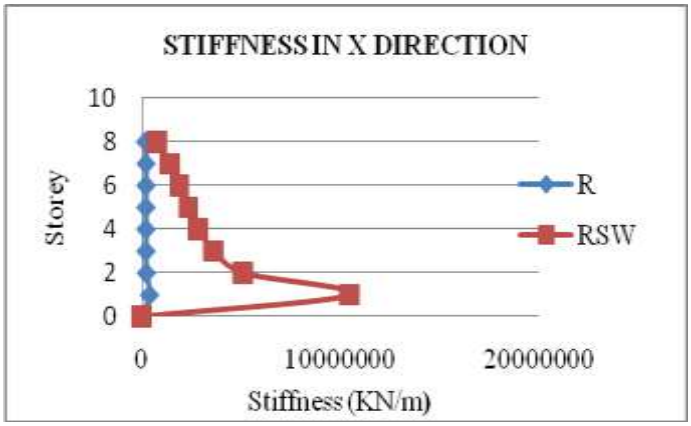

Chart-5: Stiffness for R and RSW along X direction

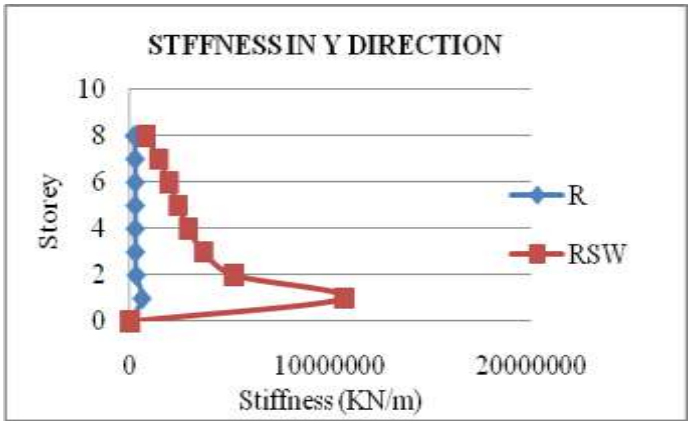

Chart-6: Stiffness for R and RSW along Y direction

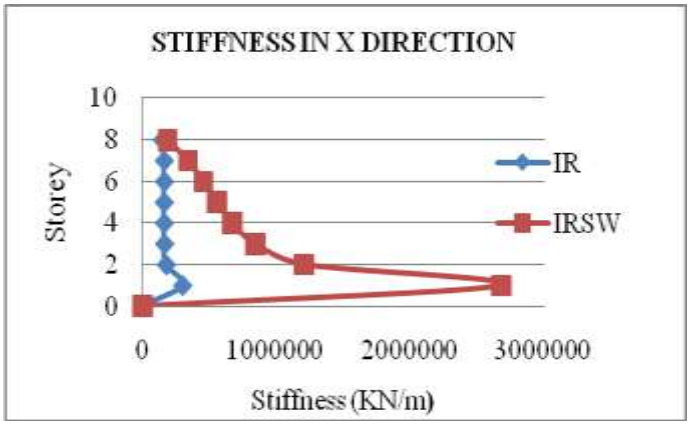

Chart-7: Stiffness for IR and IRSW along X direction

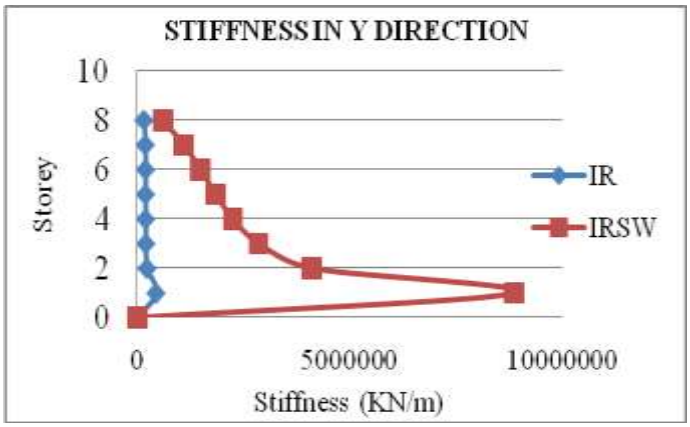

Chart-8: Stiffness for IR and IRSW along Y direction

From the graphs, Stiffness values are plotted in both X and Y direction. The stiffness values are higher in regular and irregular building with shear wall as compared with regular and irregular building without shear wall.

4.1.3 STOREY DRIFT

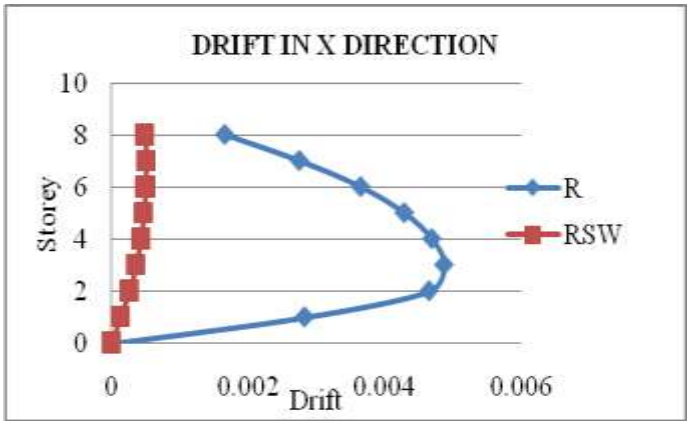

Chart-9: Drift for R and RSW along X direction

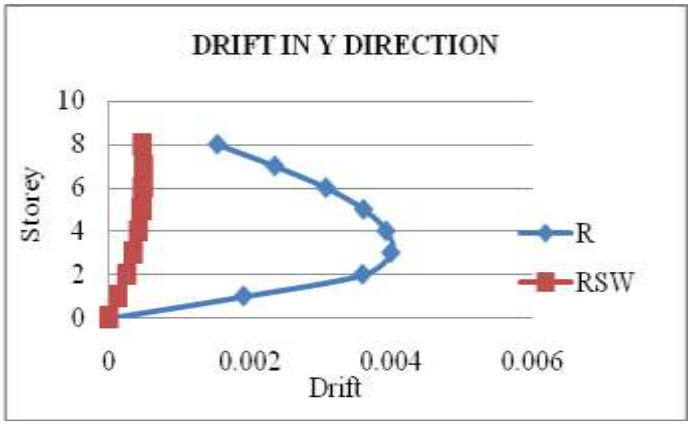

Chart-10: Drift for R and RSW along Y direction

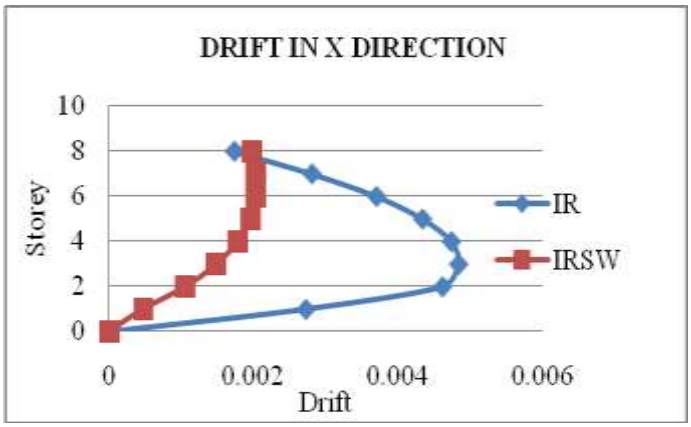

Chart-11: Drift for IR and IRSW along X direction

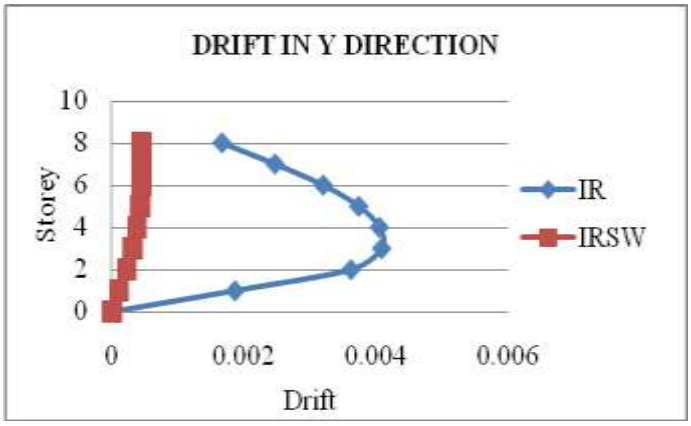

Chart-12: Drift for IR and IRSW along Y direction

From the graphs, Storey drift is less in regular and irregular buildings with and without shear wall as compare with regular and irregular building without shear wall.

4.2 RESPONSE SPECTRUM METHOD

The results are obtained after analysis are taken and plotted along both X and Y direction. The values are plotted with respect to regular and regular with shear wall as well as irregular and irregular shear wall.

4.2.1 MAXIMUM DISPLACEMENT

The displacement values are plotted in both X and Y direction.

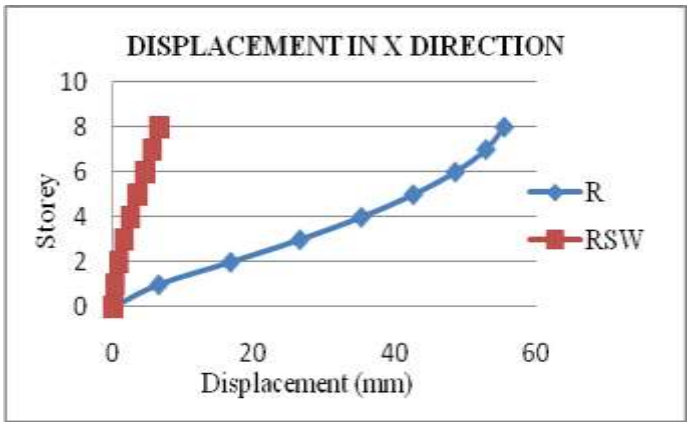

Chart-13: Displacement for R and RSW along X direction

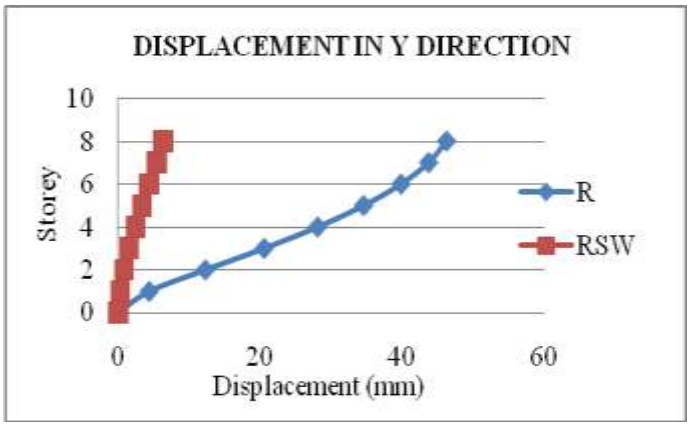

Chart-14: Displacement for R and RSW along Y direction

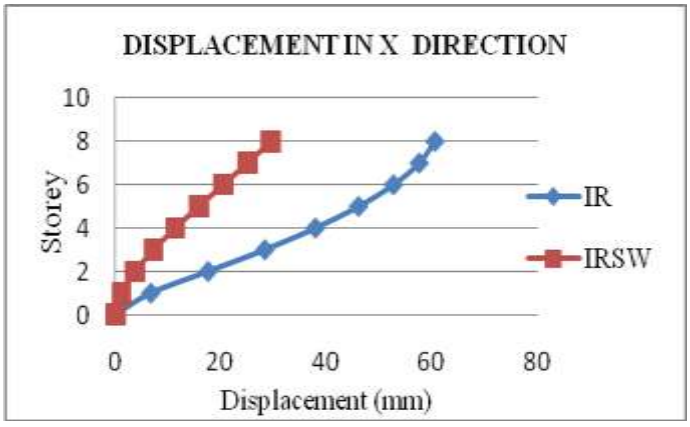

Chart-15: Displacement for IR and IRSW along X direction

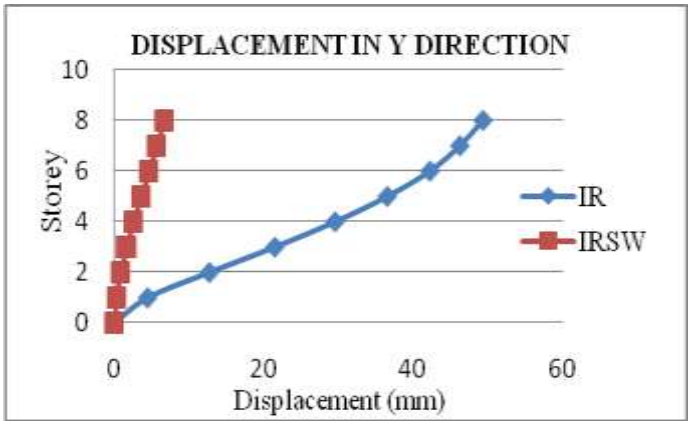

Chart-16: Displacement for IR and IRSW along Y direction

From the graphs, the displacement values are higher in regular and irregular buildings without shear wall as compare with the regular and irregular buildings with shear wall.

4.2.2 STIFFNESS

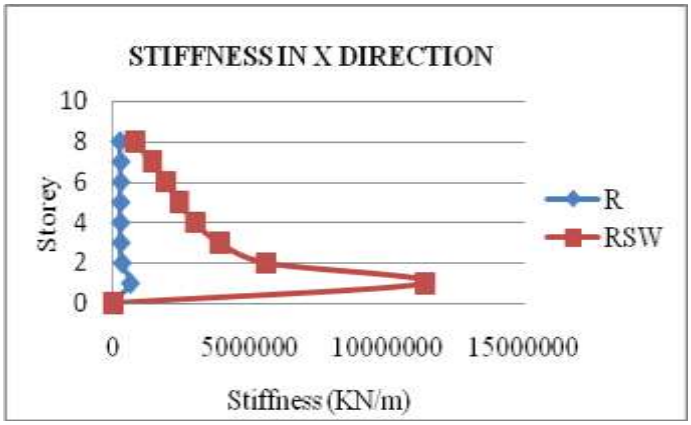

Chart-17: Stiffness for R and RSW along X direction

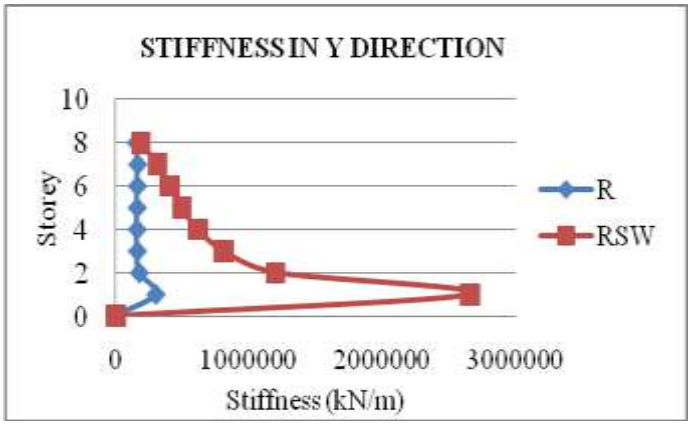

Chart-18: Stiffness for R and RSW along Y direction

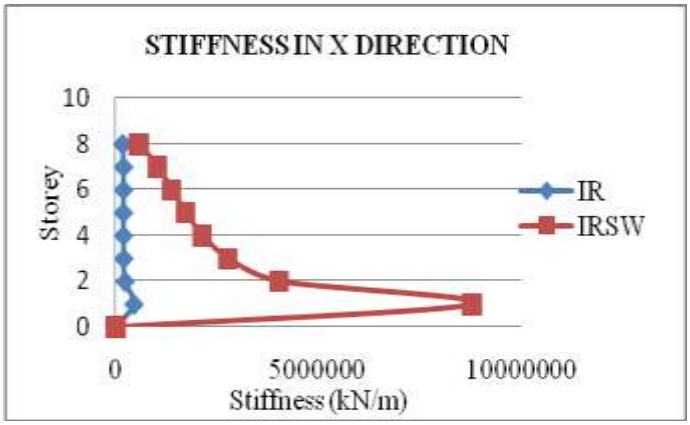

Chart-19: Stiffness for IR and IRSW along X direction

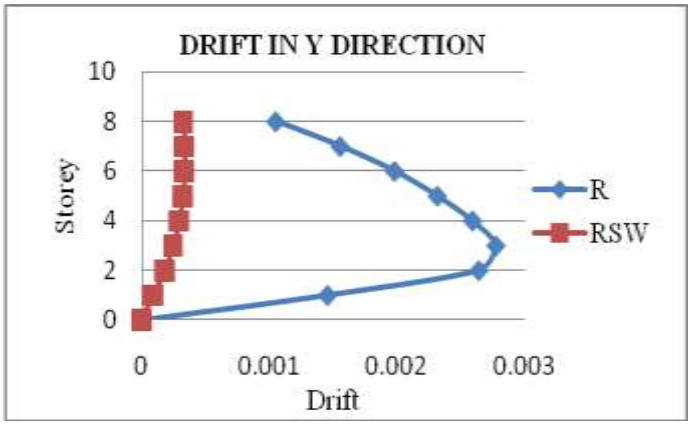

Chart-22: Drift for R and RSW along Y direction

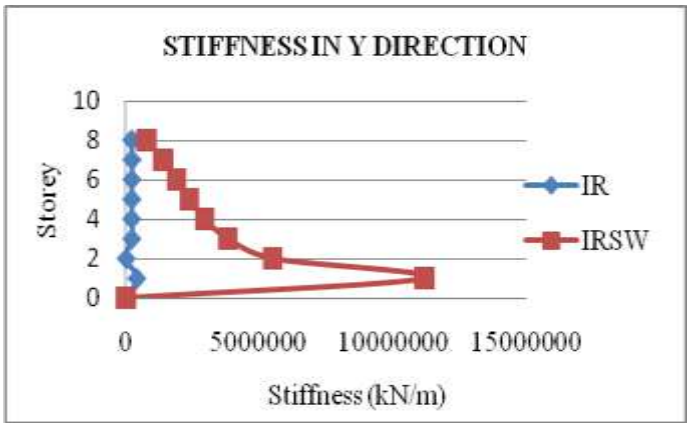

Chart-20: Stiffness for IR and IRSW along Y direction

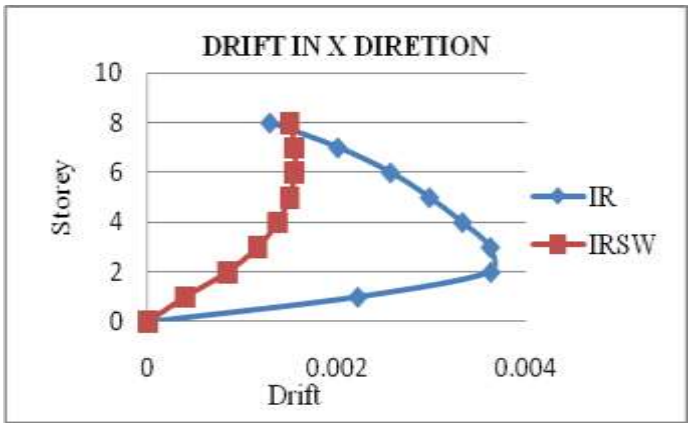

Chart-23: Drift for IR and IRSW along X direction

From the graphs, the stiffness values are higher in regular and irregular buildings with shear wall as compare with the regular and irregular building without shear wall.

4.2.3 STOREY DRIFT

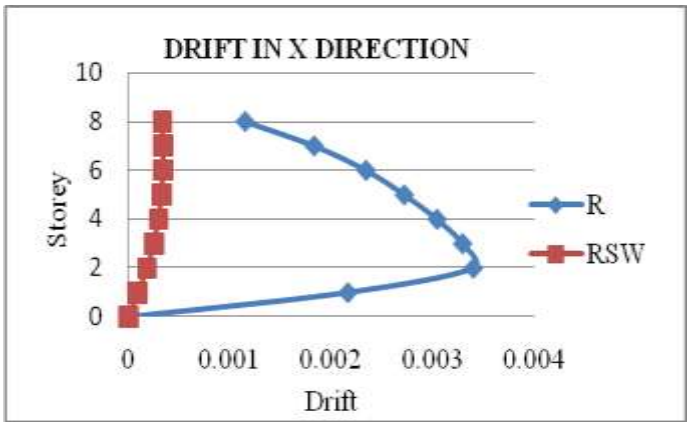

Chart-21: Drift for R and RSW along X direction

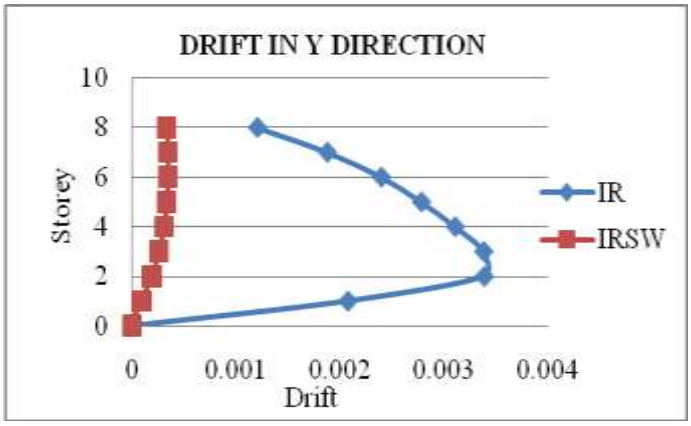

Chart-24: Drift for IR and IRSW along Y direction

From the graphs, the drift values are higher in regular and irregular buildings without shear wall as compare with the regular and irregular buildings with shear wall.

5. CONCLUSIONS

In this, when regular and irregular buildings were analyzed using equivalent static method and response spectrum method method to obtain the following conclusions are:

1. The lateral displacement is less in regular and irregular building without shear wall as compared to regular and irregular shear wall building since shear wall is resist the lateral force hence the displacement is less.
2. Maximum displacement at higher value at top storey and less at bottom storey in all buildings considered for analyzing.
3. Lateral displacement in X direction is more as compare to the displacement in Y direction in both equivalent and response spectrum method.
4. The lateral displacement is less in response spectrum method as compare to the equivalent static method.
5. Stiffness will be higher in regular and irregular building with shear wall when compared with the regular and irregular building without shear wall.
6. Stiffness in each storey is decreases with increasing the storey height. Stiffness is more at bottom storey and less at top storey.
7. Stiffness is more in Y direction when compared to X direction by considering the all models in both the direction.
8. Storey drift is more in regular and irregular buildings without shear wall as compared with the regular and irregular buildings without shear wall.

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