Corelative Study of Regular and Mass-Irregular Multistorey Building

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Abstract - Many modifications have been made to enhance the performance of high-rise buildings in seismic activity prone areas based on previous studies and technology developments. This paper examines the performance of RCC mass irregular buildings in zone IV with medium soil using code 1893-2016 (part 1), because irregularity has been shown to reduce the seismic performance of structures. Practically all multistory buildings must be assessed as three-dimensional systems according to the current edition of the IS: 1893-2016. This is because buildings typically contain irregularity in their plans, elevations, or both. In efficient design and construction methods for multistory buildings, particularly in Peninsular India, result in irregularity in the buildings' elevation and layout. The performance assessment of an irregular work is covered in this Mass irregularity in the RC Building. The current study attempts to assess the impact of heavy mass at floor levels 2, 5, and higher to investigate the many factors, including Base Shear, Stiffness, Story Displacement, and Story Drifts, of the G+8 building.

Key words: Irregular building, mass irregularity, E-Tabs 2017.

1. INTRODUCTION

The distribution of stiffness, mass, plan, strength, and several other abnormalities in the structure's vertical and horizontal directions all affect how the structure behaves during earthquakes. The damage to buildings in the past showed that irregularity was a primary cause of those structures' downfall [1]. A period of intense earth trembling. When a structure experiences an earthquake, horizontal forces are produced. Throughout the structure, which caused inertia forces to act via the building's Centre of mass. various forces vertical walls and columns resist these forces, and as a result, these forces impact through such a location known as the Centre of the stiffness [2].

For a structure to function well against seismic stresses, it needs to have enough lateral strength, a straightforward, regular shape, and enough stiffness and ductility. In comparison to structures with irregular shape, buildings with basic geometry and evenly distributed mass or stiffness in elevation and plan are less vulnerable [3]. There are many irregular architectural structures. Some were originally intended to be this way, while others happened to be by accident. For instance, during the construction process, structures may be inconsistent or even mistaken, but many others may become inconsistent during the course of their lifetime owing to damage, restoration, or change in usage [4]. City ordinances force vertical inconsistencies in structures, and structural designers must account for earthquake response. The key vertical irregularities that the researchers have focused on are discontinuities in stiffness, mass, vertical geometry, in-plane discontinuity, and capacity. The asymmetrical plan forms, re-entrants' corners, diaphragm discontinuity, and torsional abnormalities are primarily responsible for the horizontal irregularities [5].

In the present period, irregular constructions are regularly constructed in nearly every nation, including Nepal. Because of its usage in both functional and aesthetically pleasing design, irregular structure is becoming more and more common in multi-story buildings. Additionally, in an urban region having closely spaced tall buildings, this land restriction is the primary reason for providing appropriate sunshine and ventilation for the lower story. Fundamental period, base shear, and most crucially stress concentration or ductility demand are located in the structure from the perspective of seismic safety [6]. Therefore, compared with vertically irregular structures, geometrical regular shape structures with homogeneous mass and stiffness function well during an earthquake [7]. In order to do this, the bay was removed at various floor levels and the columns were removed at various portions, creating anomalies in geometry, mass, and stiffness, respectively. For this paper seismic behavior of Regular and mass irregular g+8 multi-story building is taken and analyses the Story displacement, base shear, Stiffness and story drift. With the help of ETABS to analyses the dynamically linear response spectrum of a G+8 multi-story structure's seismic performance under lateral and gravity load [8].

2. METHODOLOGY

In accordance with design requirements, a G+8 structure is created in ETABS v16 with such a story height of 3 meters, a building length of 25.6 m for one side and 14.3 m in another, and element sizes that vary. Follow these steps to complete the model and analysis:

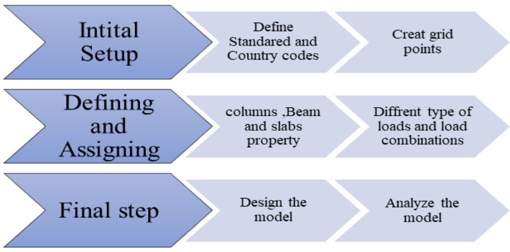


Fig 3.1: Methodology steps

3. BUILDING DESCRIPTION-

For the analysis, a (G+8) Floor Residential Building in Zone IV is taken into consideration, and its geometric specifications are provided in the table.

3.1. MATERIAL PROPERTIES-

S. No	Material	Grade
1.	Concrete (beam, slab)	M30
2.	Concrete (Column)	M30
3.	Rebar	FE 415

3.2. SEISMIC DATA (IS-1893:2016 PART-1)-

1.	Earthquake Zone	IV
2.	Zone factor (Z)	0.24 (Table 3, clause 6.4.2)
3.	Damping Ratio	5% (clause 7.2.4)
4.	Important Factor	1.2 (Table 8, clause 7.2.3)
5.	Type of soil	Medium soil (clause 6.4.2.1)
6.	Response Reduction Factor	5 (SMRF) (Table-9, clause 7.2.6)

3.3 LOADING DATA

For dead loads, we get IS 875 Part 1, for live loads, IS 875 part 2, and seismic analysis is carried out in accordance with the 2016 edition of IS 1893 part

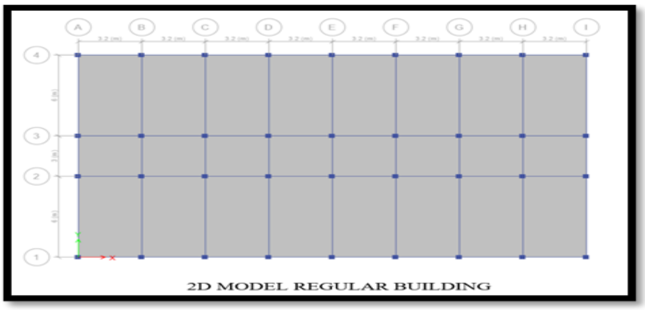
Table 3.1 Load data

1.	Live load	3.5 KN/m^2 as per IS 875 Part II
2.	Earthquake load	as per IS 1893:2016Part-I
3.	Dead load	4.75 kN/m

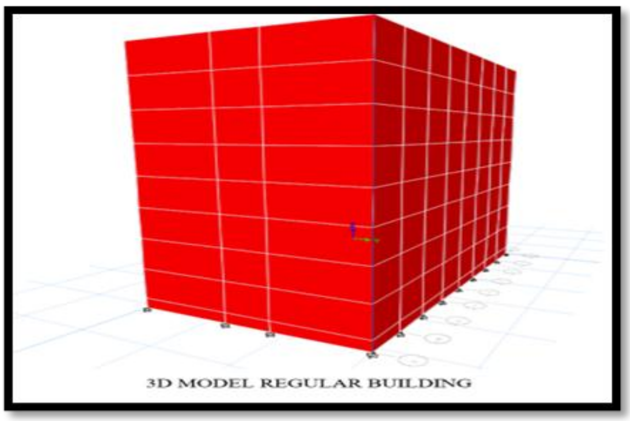
3.4 BUILDING PARAMETERS-

S.No	Parameters	Dimension
1	Model type	3D
2	Plan Dimension	25.6*14.3 m (X*Y)
3	No of stories	G+8
4	Floor to Floor height	3m
5	Total Height of building	24m
6	Slab Thickness	150mm
7	Column size	350*350 mm
8	Beam size	300*400 mm
9	Grade of concrete (slab)	M30
10	Grade of concrete (Column, Beam)	M30
11	Rebar	Fe 415
12	Earthquake Zone	1V

MODEL 1



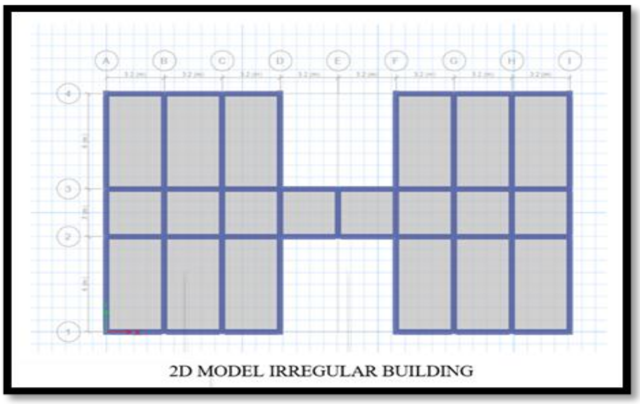
(a)



(b)

Fig -1 : Plan and Elevation View of Regular Building

MODEL 2



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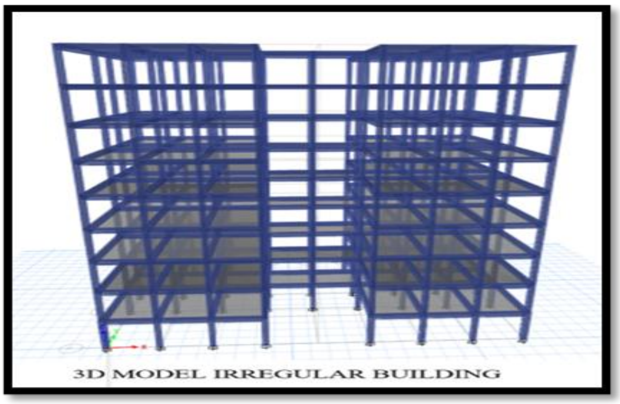


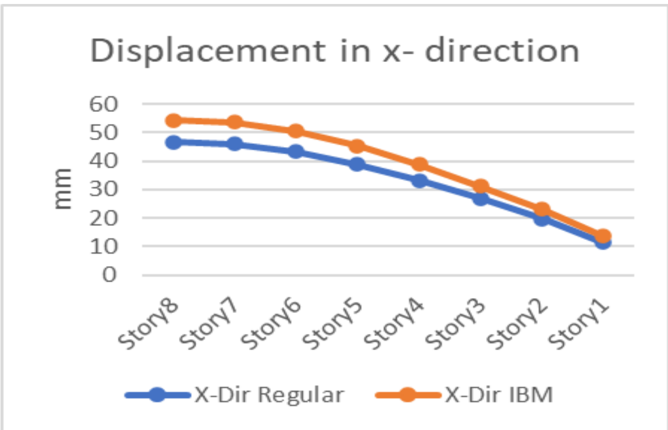
(b)

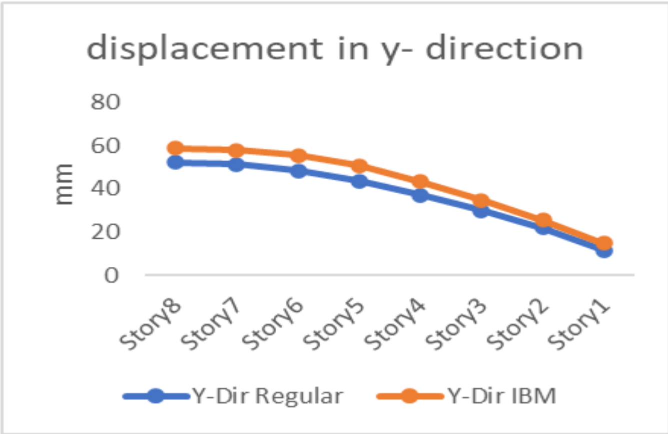
Fig -2 : Plan and Elevation View of Regular Building

4.RESULTS AND DISCUSSION-

In this result section we will use the abbreviation IBM for "building with mass irregularity" and RB for "Regular building" for convenience.

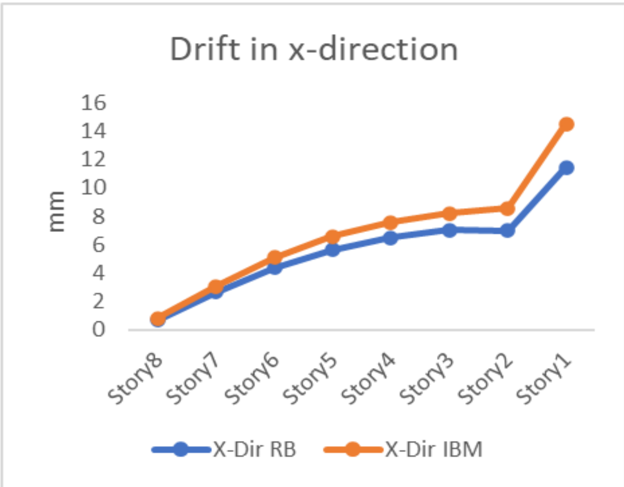
4.1 STORY DISPLACEMENT

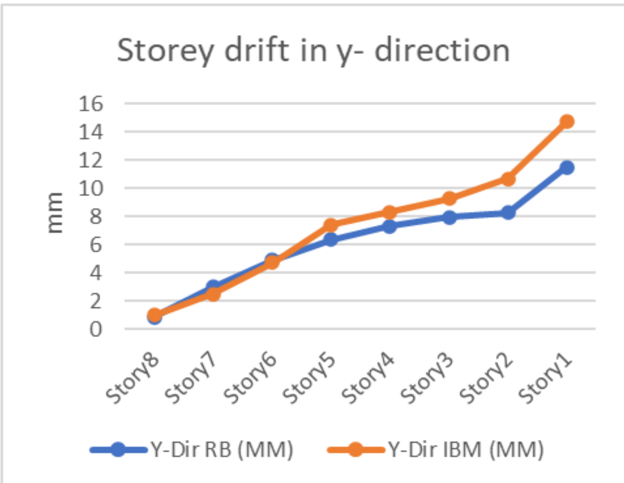




The graph shows, the displacement of building with mass irregularity has lesser displacement in both X and Y Direction which is approximately 33.34% less than the regular RCC building

4.2 STORY DRIFT

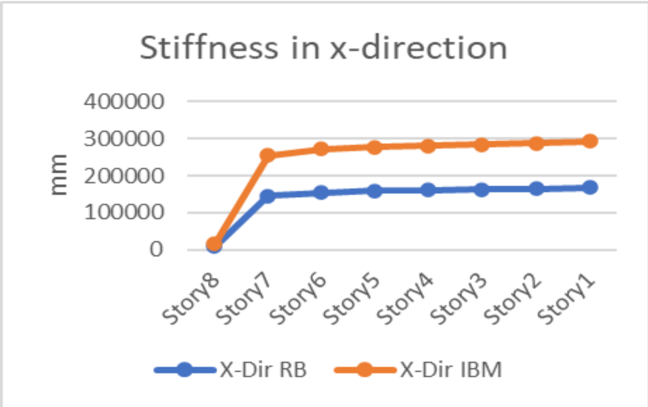


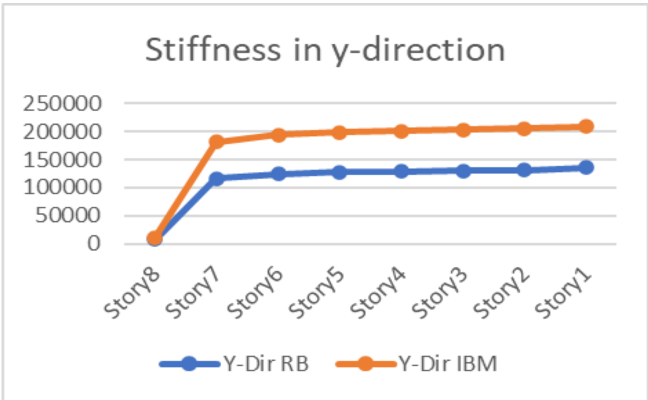


International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 07 | July 2022 www.irjet.net p-ISSN: 2395-0072

The graph shows the drift in regular RCC building is less than the story drift in building with mass irregularity in all story in x- direction and the max story drift in regular Building is 24.04% less than the max drift in IBM building where as in y-direction the story drift in building with mass irregularity is observe less than the regular building in 7th story due to mass irregularity which is approximately 16.75% less than the regular building but both are within permissible limits and the max story drift in y-direction in regular building is approximately 22% less than the Mass irregular building.

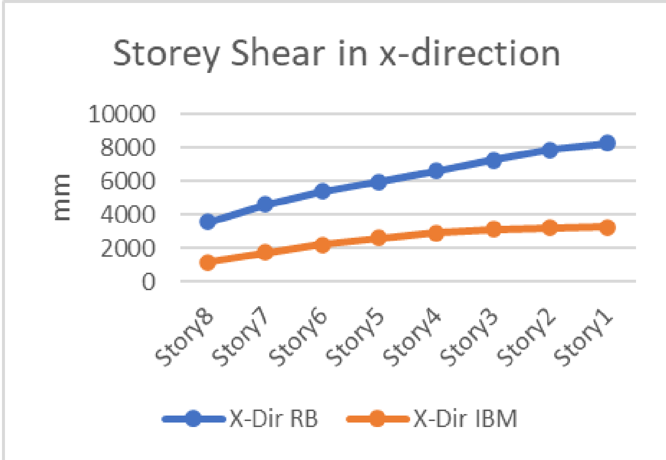
4.3 STIFFNESS

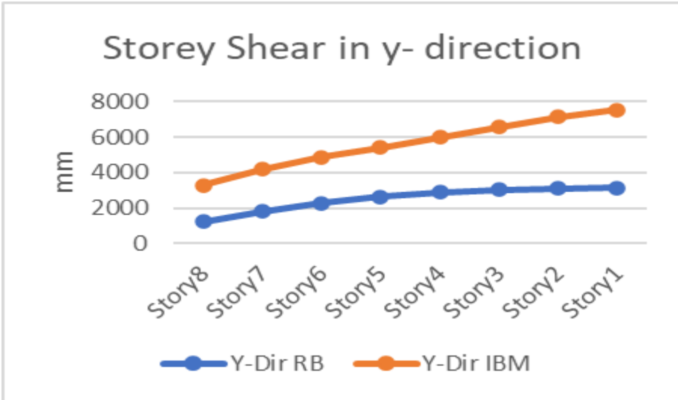




The graph shows, the stiffness of building with mass irregularity has more stiffness in both X and Y direction and maximum story stiffness of Mass irregular building is approximately 42.85% in x-direction and 35% in y-direction more than the regular RCC buildings.

4.4 STORY SHEAR





The graph shows, the storey shear of building with mass irregularity has less in X- direction and more in Y-direction and maximum storey shear of Mass irregular building is approximately 60.7% less in x-direction and 58.35% more in y- direction less than the regular RCC buildings.

5. CONCLUSION

The purpose of this study was to analyze and compare the seismic performance of the G+8 Story H Shape irregular buildings for different models at varying location. THE RESPONSE SPECTRUM method was used, and results were found in terms of base shear, story displacement, story drift, story stiffness and maximum story drift. The results of analysis for the models following conclusions can be drawn. The maximum values of STOREY DRIFT of Model 2 observed in x and y-direction are approximately 24% & 22% more than the values observed in Model 1 in the respective direction. Similarly the maximum values of STIFFNESS of Model 2 observed in both directions are approximately 13 percent more than the values observed in Model 1 in the respective direction. In this study maximum value of base shear is observed in Model 1(REGULAR) building and minimum value is seen in Model 2 (IRREGGULAR). The value of base shear in Model 1 building is more than Model 2. The story displacement remains constant but with increase mass irregularity in story height of building there is an exponential rise in top most storey which is approximately 33% more than the regular building. The maximum value of story displacement observed at top most story of building for both the models increases gradually and exponentially. Hence it is concluded that regular building perform best when it is subjected to seismic loading.

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