Seismic Analysis of Symmetric and Asymmetric Structures with and without Shear wall using Etabs software

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Abstract: Behavior of multistory structures during solid seismic tremor relies on the underlying configurations. Irregularities are not avoidable in development of structures in light of the fact that the space accessible for building the structures are restricted consequently the structure with irregularity is built up more, because of these abnormalities in the structure damages are more during earthquake. The effect of lateral load as wind/Earthquakes influences the performance of these constructions significantly. For the stability against seismic forces of multi-celebrated structure, there is need to investigation of seismic examination to plan earthquake opposition structures. It was tracked down that principle reason for failure of RC building is due to irregular circulations of load, plan of the structures, strength, stiffness. In this paper the correlation of seismic behavior of G+15 story structures having plan irregularities was finished utilizing ETAB programming. For this reason different multi-storey structure plans are viewed as that are regular plan without shear wall, regular plan with shear wall, L shape without shear wall, L shape with shear wall, irregular plan of C shape without shear wall, irregular plan of C shape with shear wall structures. For the correlation, boundaries taken are displacement, story float and storey shear. Every one of the six structures was dissected for zone V. The fundamental objective is to contemplate the behavior of both symmetric and Asymmetric structures during seismic tremor having abnormalities in plan but the plan area is same. The another aim of the study is to examine the taken boundaries like storey shear, storey displacements, Maximum storey float of all structures that are build in this paper during seismic tremor and also to study the impact of shear wall on the behavior of different structures.

Keywords: Irregularities, Shear wall, Storey shear, Storey drift, Storey displacement, ETAB.
1. Introduction:
Tremors are generally erratic and annihilating of every single catastrophic event. Quakes have the potential for causing the greatest harm among all the common hazards. During an earthquake, disappointment of design begins at the weaker points. These weaknesses emerge because of irregularity in mass, stiffness and due to irregularities in plan. The constructions having these abnormalities are named as Irregular structures. Hence so as to conquer those troubles we want to become aware of the seismic overall performance of the built environment via the improvement of various analytical procedures, which make sure the systems to face up to for the duration of common minor earthquakes and produce sufficient warning each time subjected to foremost earthquake events. So that may keep whatever number lives as could reasonably be expected [1]–[4]. The conduct of a structure during a tremor relies upon a few variables, stiffness, satisfactory lateral strength, flexibility, and geometry of structures. If buildings have regular geometry and mass is uniformly distributed on the building than there is less damage as compared to the buildings having irregular geometry. But now a day’s developing populace has made the architects or engineers to be anticipated towards planning of abnormal configurations for the good esthetic view and fulfillment of all the needs, hence earthquake engineering has advanced the key issues in understanding the position of structures configurations. For this reason, giant studies is needed for accomplishing remaining performance in spite of a negative configuration. To opposing the horizontal loads that might be incited by the impact of wind and earthquake loads shear walls are normally utilized as an upward underlying component. To lessen the impact of earthquake built up RC shear walls for improving seismic reaction of structures. Shear walls are typically utilized in tall structure to stay away from breakdown of structures. At the point when shear walls are arranged in profitable situations in the structure, they can shape a proficient parallel power opposing framework. The fundamental objective of the present study is to contemplate the behavior of structure having shear wall in their configuration and to study the variations in the storey float, storey shear and storey displacement of the structures. There are lot of building that are already exist having shear wall as to overcome the overturning movement of the building. Structure that are newly built up are utilize many types of shear wall like reinforced concrete shear wall, Plywood shear wall, masonry shear wall etc. Location of shear wall is different for different building because it also effect the response of structure against lateral forces. Generally the lift of building is used as shear wall [5], [6].

2. SIMILAR WORK
P. S. Kumbhare, A. C. Saoji. They worked on the impact of earthquake on buildings that are of middle height like neither a tall structure nor a short structure. The location of the shear wall is not fixed in all model considered. They built up few models having different location of shear wall. They considered dual frame system and normal frame system. Analysis is done by utilizing Etab software. For the correlation different values of all parameters are taken and make final results. They investigate that the building with dual system have more strength and stability [7]–[9].

Shahzad JamiSardar1, Umesh2, N. Karadi3 studied on topic effect of position of shear wall. They considered mainly changes in storey drift values when the position of shear wall is changes. To get results they build up five models and analyzed that models in ETAB software. Seismic load is applied over the structure and equivalent static load method and response spectrum method is applied to analyze the building [10]–[12]. In all the built up models have different position of shear wall in their plan in some
models shear wall is placed over the outer periphery, on the corners or in the middle part of the storey. As a result, they got that model 5 quite suitable because it has least values as contrasted to rest of four models [10]–[14].

Himalee Rahangdale1, S.R. Satone2 they work on multistory building having shear wall to find out the effect of shear wall on the structure response when lateral load like wind or seismic load is applied over these structures. They built up various structure some of them have shear wall and rest of all are designed without shear wall. Shear walls are perhaps the best structure components in opposing parallel forces during earthquake. They got results that position of shear wall in the structure plays specific role like it effect the load distribution pattern on whole components of buildings. By developing shear wall harms because of impact of lateral loads because of tremor and high forces of wind is minimized. Shear wall development will give larger stiffness to the structures thereby diminishing the harm to design and its segments.

Suruchi Mishra, Rizwanullah work on comparison of regular and irregular buildings with and without shear wall in this paper the correlation of all parameters of G+10 Storey structures having plan irregularities with the regular structures is done by utilizing the Etab software.

K Venkatesh1, T. Venkatdas2 work on earthquake impact on tall structures with and without shear wall. In this they display the designs in zone II, zone III structure are made up of with and without shear wall. In model 1 there is no shear wall provided, In model 2 shear wall is provided upon the corners, In model 3 shear wall is located over the outer periphery. For the analysis equivalent lateral load method is applied by utilizing STAAD Pro. Software [15].

Pradeep Pujar, Amaresh work on seismic behavior of multistoried structure having no shear wall or with shear wall in structures plan. They were made plan irregular structures like L Shape, C shape and regular structures in zone V. To find the impact of shear wall on storey displacement, storey float and base shear the analysis done by equivalent lateral load method by utilizing ETAB software.

3. PROBLEM FORMULATION AND ANALYSIS:

3.1 SPECIFICATIONS TAKEN FOR MODELLING: This investigation depends on Earthquake Analysis of multistory regular and irregular structures. For this investigation the particulars utilized are taken from IS 1893-2002 section 1. The loading conditions are taken from IS 1893-2002 section 1, IS 456-2000, IS 875. The material properties determination depends on the materials utilized for multi-storey structures and the details gave in Indian Standard codes. In present investigation six models of constructions are planned. The choice of seismic elements depends on the spot of site like, zone, Response factor, significance factor, sort of design and the soil kind whose particulars are given in IS 1893-2002 section 1.

3.2 RESPONSE SPECTRUM ANALYSIS: For seismic analysis Response spectrum method was performed on all the models which are made in present study using ETAB software. The results are obtain from performing response spectrum analysis are storey drift, storey shear and storey displacement of designed structures [16]–[18].

4. MODELLING DETAILS

Here are few models of buildings are prepared according to Indian standard codes. Details of all the models as following:
Model 1: Regular structure (Square shape) have no shear wall in its configuration.

Model 2: Regular structure (Square shape) having shear wall in its configuration.

Model 3: Irregular structure of L shape with no shear wall is provided in its configuration.

Model 4: Irregular building of L shape having shear wall in their configuration.

Model 5: Irregular building of C shape without shear wall.

Model 6: Irregular building of C shape with shear wall.

5. Building details

| Type of building  | Residential building |
|-------------------|----------------------|
| Number of stories | 16(G+15)             |
| Column size       | 600*600 ,750*750,500*500 |
| Beam size         | 650*200,550*350,600*400 |
| Slab thickness    | 150mm                |
| Plan area         | 49mm*49mm            |
| Concrete grade    | M30                  |
| Grade of steel    | Fe415                |
| Storey height     | 3m                   |
| Ground storey height | 3.5m               |

**Loading details:**

- **Frame load** = External wall load (13.719) + Internal wall load (7.62)
- **Shell load** = Dead load 1.25kn/m2 (floor finishing +mortar thickness) +Live load (3kn/m2)

**Mass participation ratio:** Dead load =1, Live load =0.5, Wind load =1, EQ-X =1, EQ-Y =1

5.1 SEISMIC FACTORS THAT ARE USED:

1. Seismic zone is taken zone V

2. According to zone V zone factor is taken as 0.36 [IS TABLE 3]
3. Importance factor \((i)\) is taken as 1.5 [IS TABLE 8]

4. Response reduction factor is taken as 5 [IS TABLE 9]

5. Type of soil considered as Class B. [IS TABLE 1]

5.2 PLAN VIEW OF MODELS:

**MODEL 1**

**MODEL 2**

**MODEL 3**

**MODEL 4**
6. RESULTS AND DISCUSSION

To study the response of structure in terms of storey displacement, storey shear and storey drift at response spectrum function in two directions x and y. Graphs are build up by collecting data from analysis. Below given graphs shows the maximum values of storey drift, storey displacement and storey shear according to analysis results by ETAB software. Applied load combinations are (serviceability load combination), 1.2(dead load +live load + wind load), 1.2(live load + dead load +EQ x), 1.2(dead+ live+ EQ y), 1.5(dead +RS x),1.5 (dead +RS y) , (0.9 dead load + 1.2 RS y )etc. In total 26 combinations are applied. When EQ is applied at that point all the parameters have more values as compared to response spectrum function.

7. Graph DRIFT IN RS – X and RS – Y

shows maximum value of storey drift on all the constructed structures in this study when response spectrum function is applied in X – direction and Y- direction. Higher value of storey drift is obtained mostly on storey 3 in Model 1, Model 3, Model 5 as these models have no shear wall to overcome the effect of seismic forces. In model2, model 4, model 6 the value of storey drift is less when compared with Model 1, Model 3, Model 5. Allowable limit for storey drift is obtained according to IS 1893:2016 is 0.004 multiply with storey height for safety factor 1, in our problem factor of safety is 1.5 and height of storey is 3m and storey drift is 18. Model 2 have least value of maximum storey drift as compared to all models as it has shear wall and regular geometry which provides stability to the model against seismic /wind forces.

8. Graph STOREY SHEAR IN RS – X and RS – Y

shows maximum storey shear of constructed buildings in present problem at Response Spectrum Function in( X and Y ) direction. Maximum storey shear is obtained at the base of buildings in all the models when
we take RS function but at earthquake load cases in X direction and earthquake load cases in Y direction obtained storey shear is zero at the base. Storey shear is increases in model2, model 4, model 6 because these are having shear wall in their configuration.

**DISPLACEMENT IN RS –X**

**DISPLACEMENT IN RS - Y**

**MAXIMUM DRIFT IN RS –X**

**MAXIMUM DRIFT IN RS -Y**

**MAXIMUM SHEAR IN RS – X**

**MAXIMUM SHEAR IN RS -Y**
9. CONCLUSION:

1. In Model 2, Model 4, Model 6 storey shear is increases in RS-x direction 71.1%, 75.3%, 64.6% respectively and in RS-y direction 71.1%, 71.8%, 73.6% respectively.

2. Maximum storey shear is 2054.23 KN/m in Model 6 at RS y and at RS x maximum storey shear is 2026.76 KN/m in Model 4.

3. In Model 2, Model 4, Model 6 displacement is decreases in RS-x 35.4%, 40.06%, 31.1% respectively and in RS-y direction 35.4%, 36.7%, 36.2% respectively.

4. In Model 2, Model 4, Model 6 storey drift in RS-x direction is decreases 47.4%, 50.2%, 43.8% respectively. In RS-y direction 47.4%, 48.01%, 47% respectively.

5. Model 2 is more stable as it has less value of storey drift and storey displacement when contrasted with different models.

6. In this research paper we are doing analysis of structure having shear wall at outer periphery. This study gives the idea about the execution of the structure having regular and irregular geometry along with shear wall in its configuration in zone V. We can analyze plan irregular structures non linear dynamic analysis (push over analysis). We can analyze structures by providing openings in shear wall and by providing steel bracings along the shear wall.

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