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Precast Concrete Construction Technology

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Abstract
Multi-storey building would be the greater part influenced by quake constrains to seismic prone areas. The major concern in the design of the multi-Storey building is the structure to have enough lateral stability to resist lateral forces buckling to control lateral drift and displacement of the building. The application of the shear wall system in Reinforcement concrete (RC) building has been widely used to minimize seismic consequences. Besides, the building with concentrated steel bracing system is used for the building. Both of the system has significance of the structural performance. Although both systems are used for same reason, their effect shows unequal variation and behaviours against seismic load. In the Project, G+10 storey building, along with shear wall and bracing are being considered for the analysis. The performance of building will be evaluated on the basis of following parameters Story displacement, Storey drift. In this work, the shear wall and bracing are provided at different locations with the overall analysis to be carried out using STAAD PRO Reinforced concrete structures are in greater demands in construction because the construction becomes quite convenient and economical in nature. RCC construction is best suited for low rise building but in High rise building construction are composite is a better option among the RCC and steel Structure.

1. Introduction

The earthquake is a phenomenon of ground movement, or it can be said that the vibrations that disturb the earth's surface due to the waves inside the earth's surface are called earthquakes. Earthquakes can damage structures that were not built for earthquakes. Many buildings in India are designed with static and permanent loads, but earthquakes are occasional loads. Reinforced concrete structures (RC) have special properties that are of interest to designers. Globally, there is a great demand for high-rise structures due to increasing urbanization and population growth, and earthquakes are likely to cause most of the damage to high-rise structures. In the event of an earthquake, a building experiences dynamic movements. In fact, the building is exposed to inertial forces that counteract the acceleration of the seismic stimuli. The shear divider is a construction frame for 1oad-bearing pane1s, otherwise it would be called shear panels to counteract the effects of the parallel load on the structure. The population explosion and the advent of the Industrial Revolution led to the migration of the population from the villages to the urban areas, which made the construction of multi-story buildings for residential and office purposes inevitable Because of the exorbitant land prices, tall buildings are currently under construction. These tall, multi-story buildings require small, expensive lots and provide the necessary floor space. Earthquakes are defined as an oscillation of the earth's surface that occurs after an energy release in the earth's crust. Since the earth's crust is made up of many plates that are constantly moving slowly, vibrations can occur and cause small earthquakes.

1.1 Literature Review

Papers published on different types of seismic analysis of building with shear wall and bracing from the year 2010 to 2020 have been reviewed and relevant papers are discussed in this chapter.

(Runbahadura Singh 2019;) This work is presented to investigate the behavior of the soil during an earthquake and the influence of the shear wall on the structure. The effect of the earthquake is highly dependent on the soil present in the foundation of the building, as the earthquake changes the movement of the soil. This work comes to the conclusion that the natural duration of the building increases when the interaction of soil structures in isolated ground structures is considered. Changing the position of the bracing wall affects the attraction of forces, so the wall must be in the correct position.

(Sumananth G 2016;) This article shows the influence of the position of the wall slab on various parameters to be compared. The static and response spectrum method is used to obtain the overall performance level of a structure. In this article, they are presented in order to compare various parameters such as the shear drift of the ceiling and the displacement of buildings under shear loads depending on the strategic placement of the wall slab. This paper concludes that the location of the triangular shear wall is effective to withstand the seismic impact and that the base shear is maximal when analysing the response spectrum.

(Kalsliwal N. A 2016;)

In this contribution the method of the dynamic linear response spectrum in the construction of multi-storey reinforcement walls with different numbers and positions of the reinforcement walls is discussed. Different strength frames at the time of the structural system, there are two main structural systems used in the construction of reinforced concrete to withstand the forces of wind and earthquake. This article concludes that a model with a shear wall on the first floor is also better because of the little bend and bend in the floor. A model with a corner cut wall is also a good budget type. Based on the analysis, the best sequential model is the fully cut wall model from the cut wall to the floor in the corner position and the shell.

1.2 Objective & Methodology

1.2.1 Objectives

The objectives of the present study are as follows:

- To study complete multistore building frame.
- To study complete multistore building with shear wall.
- To study complete multistore building with bracing.
- To compare the results of shear, wall and bracing with available literature results.
- To study comparisons of displacement of structural systems.
- Making Focus on economical displacement and story drift of frame by taking the comparisons to the consideration.
- To study about the above three different structural systems by modelling and analysis to be done using the static analysis using STAAD Pro.
- Comparison of the story displacement and story drift for three structural systems.

1.2.2 Methodology

The methodology is the research strategy in general that traces the manner by which research is to be attempted and, in addition to other things, recognizes the strategies to be utilized in it. In the present study, the methodology followed is as per objectives listed and everything is carried out in a systematic way, that is first the manual designs required followed by the software analysis and output results are represented in graphical format for better interpretation. In the present study, Multistorey Building Frame with shear wall and bracing Engineering are studied for the analysis using Staad Pro V8i. All the necessary information such as Building plans, Length, Height and Span of Multistory building is decided based upon the most common building construction practices in India. A detailed study and investigation of the behavior of Multistory type building frame and structure frame by keeping the Span and Height constant for all types of alternatives along with wind forces as critical load condition, are main parameters of the study. The Dead load and Live load and Wind load will be calculated using Indian standards 875. The Designing of different type of frames considered is performed using Indian Standard code 800-2007 (Limit State Design). The serviceability checks for the vertical displacements and horizontal displacements are considered from a range of values according to Indian standards. The Main frames are analyzed and designed by using F.E.M based software STAAD PRO. The RC frame is subjected to different load combination and frame sections are optimized. The present study mainly will be concentrated on the comparison between seismic analysis of multi-storey building with shear wall and bracing.

2. Numerical Example

2.1 G+10 Story Multi-Storey Building

2.1.1 Bare Frame Analysis

Dimension of Multi-storey Building

3-D plan view of multistore building with a span of 20 m, length of 20m and height 33m (Figure 1 & 2).

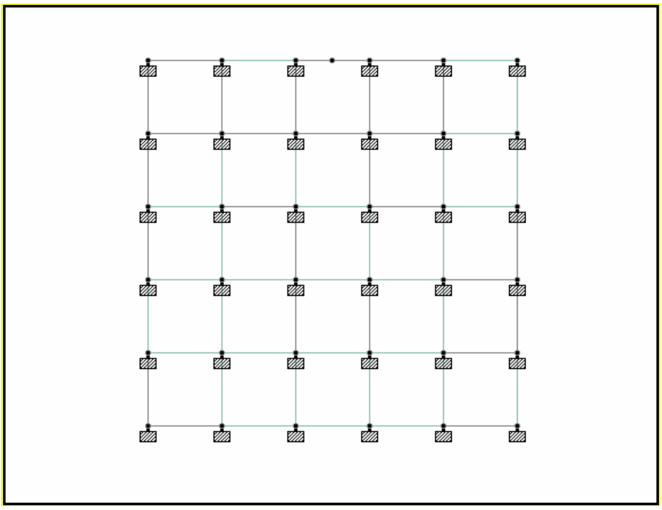

Figure 1 3D Plan View of Multistore Building

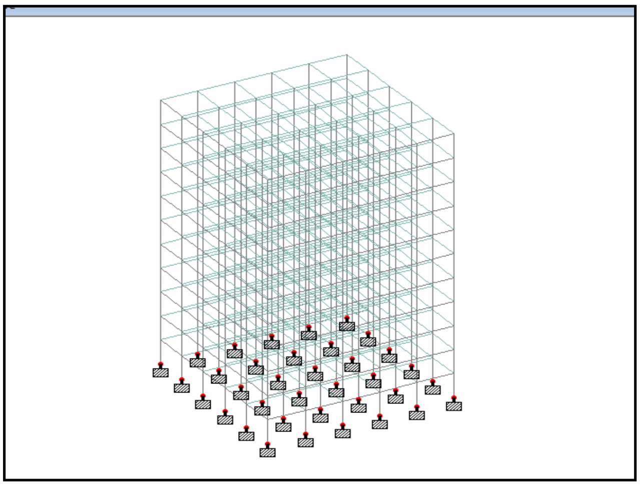

Figure 2 3D View of Multi-Storey Building

Given Data:

1. Plan Dimensions:
    - Width: 20 m
    - Length:20 m
    - Height: 33m
2. Height of each story: 3m
3. Grade of concrete: M20
4. Soil type: Medium type
5. Unite weight of concrete: 25kN/m3
6. Damping ratio: 0.05
7. No's of story: G+10
8. Total height of building: 33m
9. Grade of steel: Fe 415
10. Beam size: 300mm×400mm
11. Column size: 500mm×500mm
12. Seismic zone: V
13. Soil type: Medium type (II)
14. Slab thickness: 150mm
15. Earthquake directions: X and Y

Frame Modelling Details:

One individual frame is considered for analysis with span of 20m length, 20m width and 33m height.

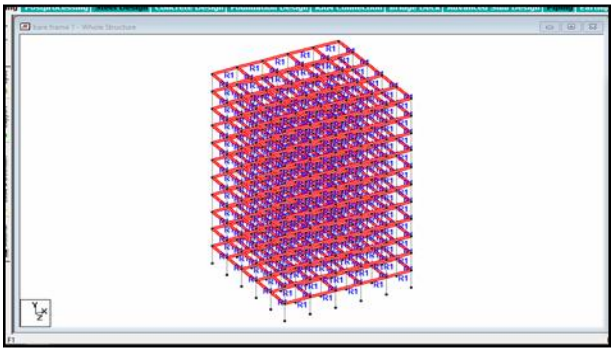

Figure 3 Assigning of Beam

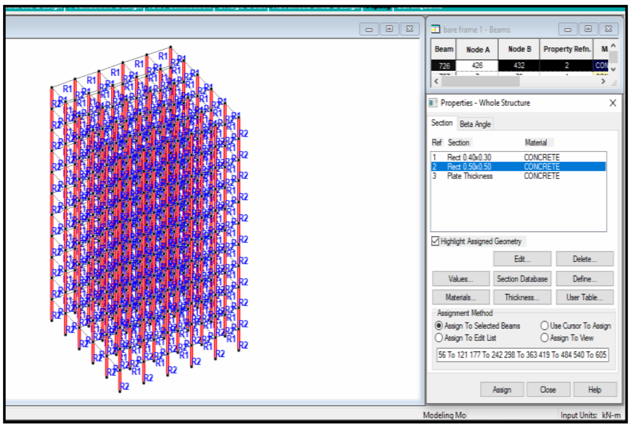

Figure 4 Assigning of Column

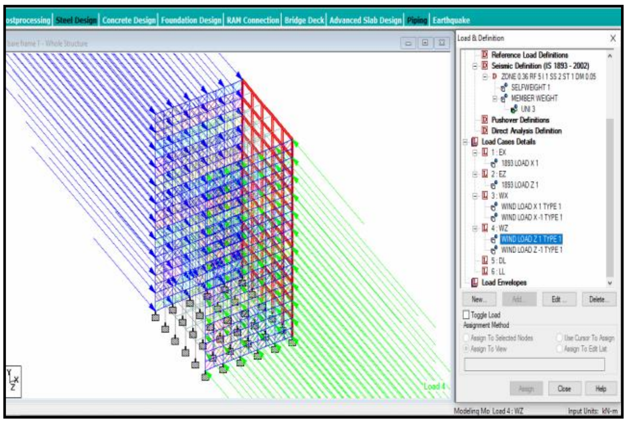

Figure 5 Assigning of Wind Load

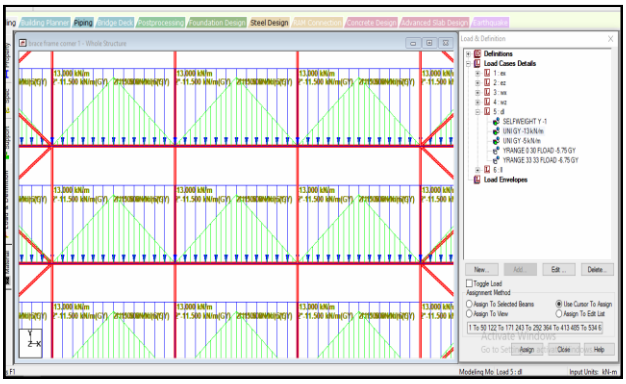

Figure 6 Assigning Member Load Application

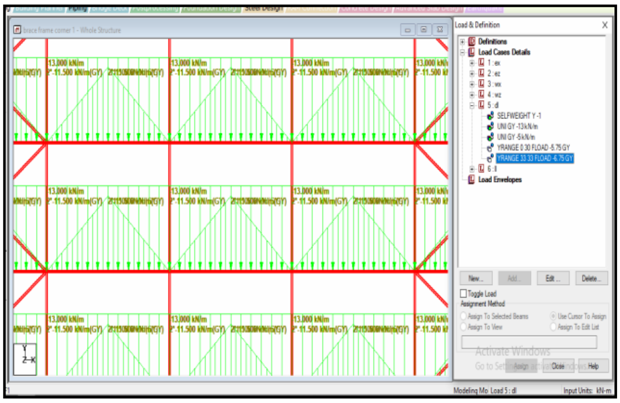

Figure 7 Floor Load Application

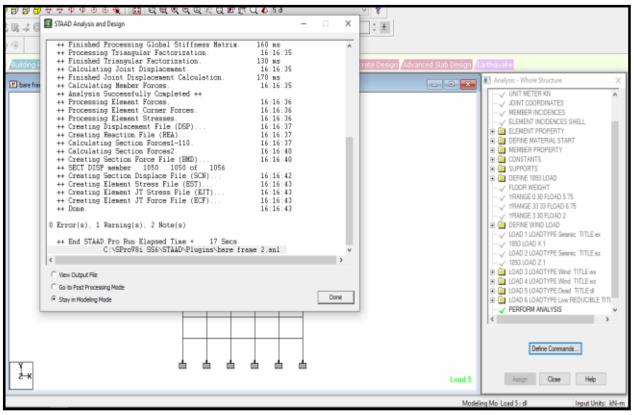

Figure 8 Analysis Using Stead Pro

Table 1 Story Displacements & Story Drift

Story no	Story displacements (mm)	Story drift (mm)
11	64.416	2.3
10	62.116	3.636
9	58.480	4.854
8	53.626	5.823
7	47.803	6.561
6	41.242	7.084
5	34.158	7.429
4	26.729	7.611
3	19.118	7.607
2	11.511	7.155
1	4.356	4.356

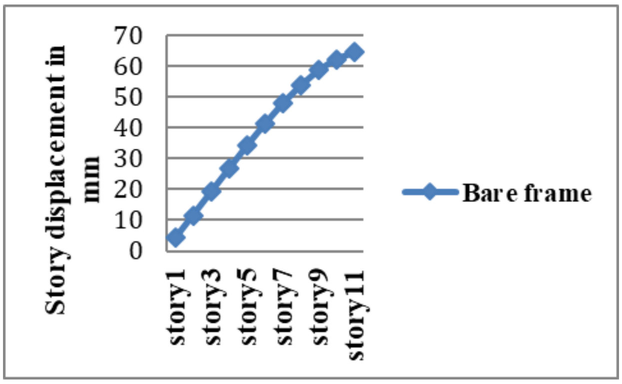

Figure 9 Story Displacement

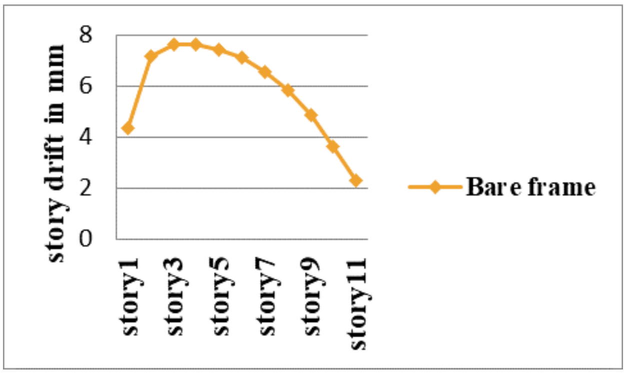

Figure 10 Story Drift

2.2 Brace Frame Building

Given Data:

1. Plan Dimensions:
    - Width: 20 m
    - Length :20 m
    - Height: 33m
2. Height of each story: 3m
3. Grade of concrete: M20
4. Soil type: Medium type
5. Unite weight of concrete: 25kN/m3
6. Damping ratio: 0.05
7. No's of story: G+10
8. Total height of building: 33m
9. Grade of steel: Fe 415
10. Beam size: 300mm*400mm
11. Column size: 500mm*500mm
12. Seismic zone: V
13. Soil type: Medium type (II)
14. Slab thickness: 150mm
15. Earthquake directions: X and Y

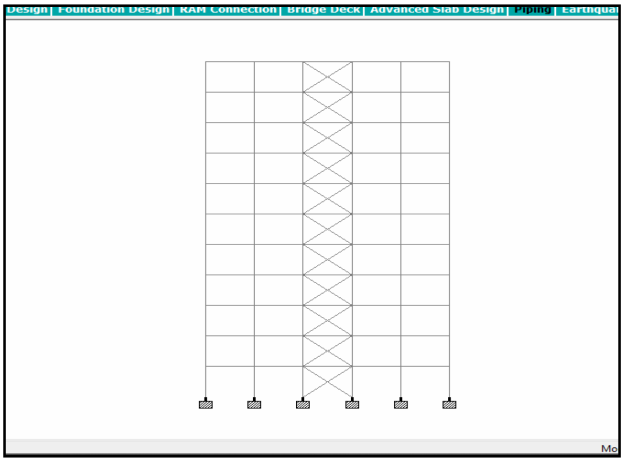

Figure 11 Bracing Provided at Sidewall

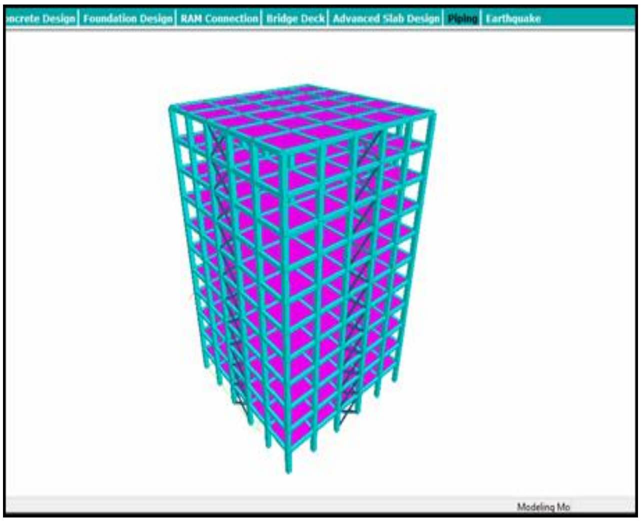

Figure 12 3D Rendering View of Braced Frame

2.3 Application of Load

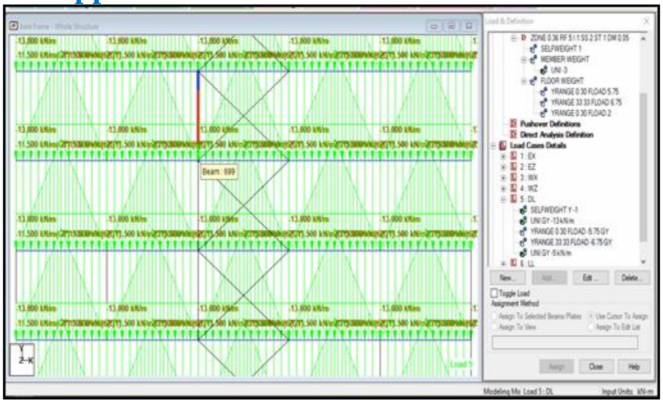

Figure 13 Assigning of Floor Load

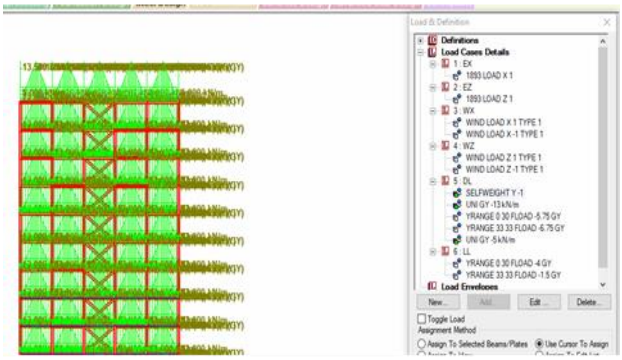

Figure 14 Assigning of Load

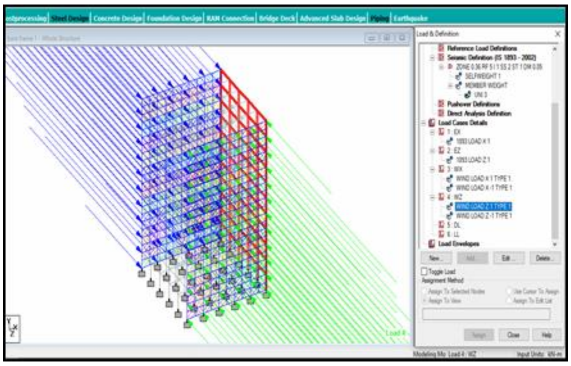

Figure 15 Wind Load Application

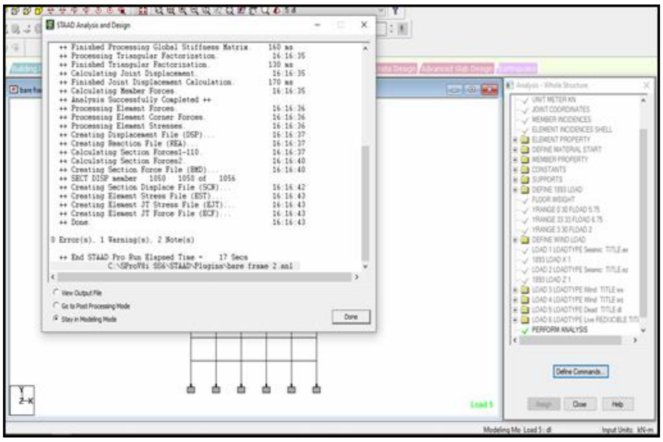

Figure 16 Analysis Using Staad Pro

Table 2 Story Displacement & Story Shear

Story no	Story displacements (mm)	Story drift (mm)
11	53.155	2.31
10	50.845	3.37
9	47.475	4.264
8	43.211	4.959
7	38.252	5.476
6	32.776	5.818
5	26.958	6.003
4	20.955	6.035
3	14.920	5.917
2	9.003	5.526
1	3.477	3.477

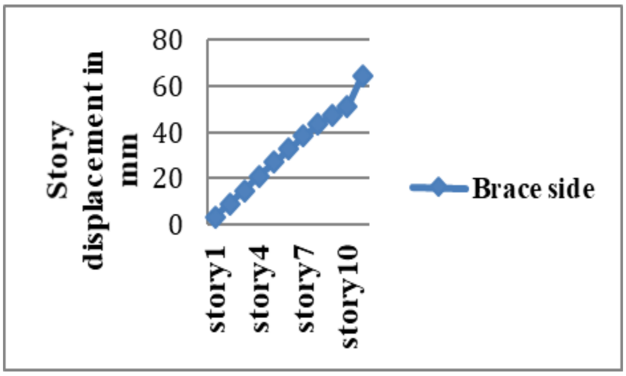

Figure 17 Story Displacement

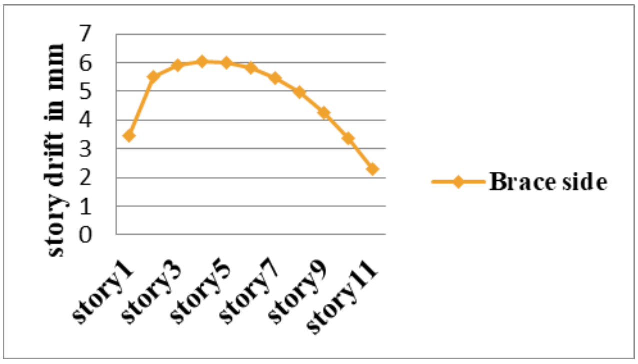

Figure 18 Story Drift

2.4 Bracing Provided at Corner of Sidewall

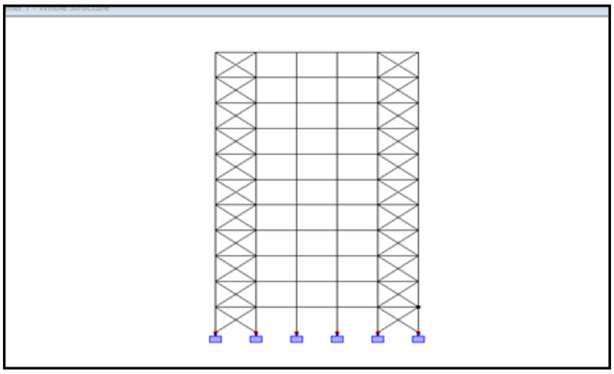
Figure 19 Assigning of Bracing at Corner

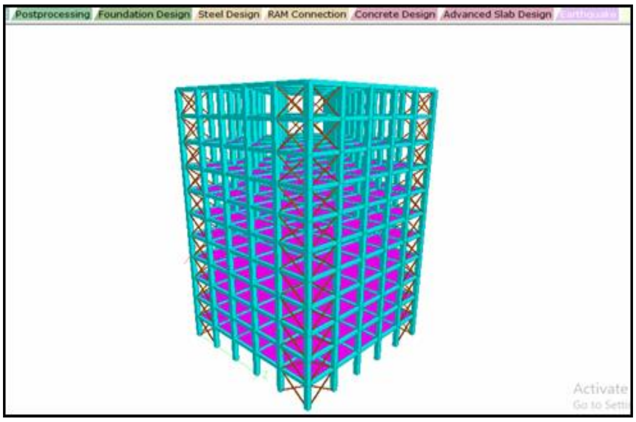

Figure 20 Rendring View Of Braced Frame

Table 3 Story Drift & Story Drift

Story no	Story displacements (mm)	Story drift (mm)
11	48.157	2.6
10	45.557	3.403
9	42.154	4.101
8	38.053	4.633
7	33.420	4.98
6	28.411	5.262
5	23.178	5.308
4	17.87	5.241
3	12.629	5.026
2	7.603	4.595
1	3.008	3.008

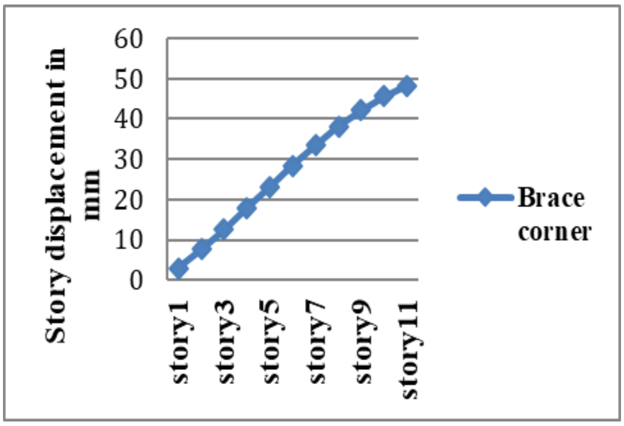

Figure 21 Story Displacement

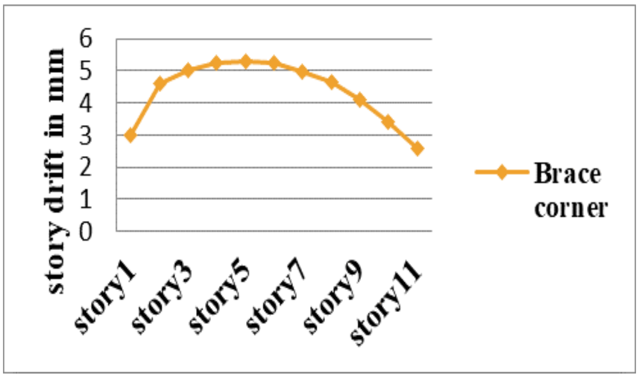

Figure 22 Story Drift

2.5 Shear Frame Building

Given data

1. Plan Dimensions:
   - Width: 20 m
   - Length :20 m
   - Height: 33m
2. Height of each story: 3m
3. Grade of concrete: M20
4. Soil type: Medium type
5. Unite weight of concrete: 25kN/m3
6. Damping ratio: 0.05
7. No's of story: G+10
8. Total height of building: 33m
9. Grade of steel: Fe 415
10. Beam size: 300mm*400mm
11. Column size: 500mm*500mm
12. Seismic zone: V
13. Soil type: Medium type (II)
14. Slab thickness: 150mm
15. Earthquake directions: X and Y

2.6 3D Rendering View of Structure

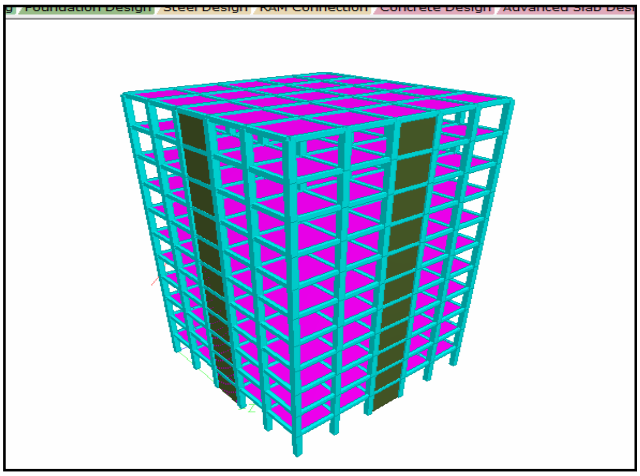

Figure 23 3D Rendering View of Structure

2.7 Analysis using staad pro

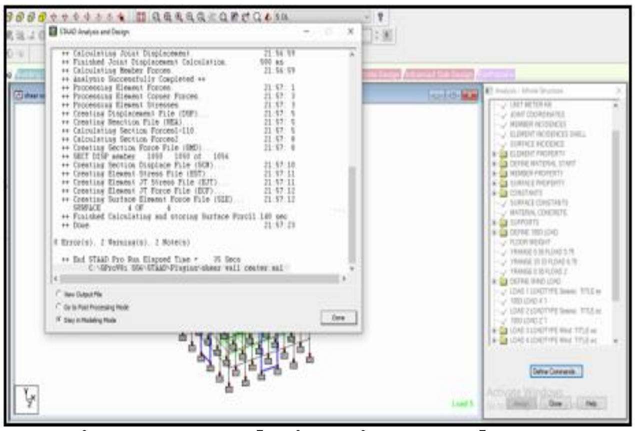

Figure 24 Analysis Using Staad Pro

Table 4 Story Displacement & Story Drift

Story no	Story displacements (mm)	Story drift (mm)
11	30.859	0.763
10	30.096	1.459
9	28.637	2.158
8	26.479	2.725
7	23.754	3.164
6	20.591	3.08
5	17.155	3.686
4	13.429	3.805
3	9.624	3.821
2	5.803	3.605
1	2.198	2.198

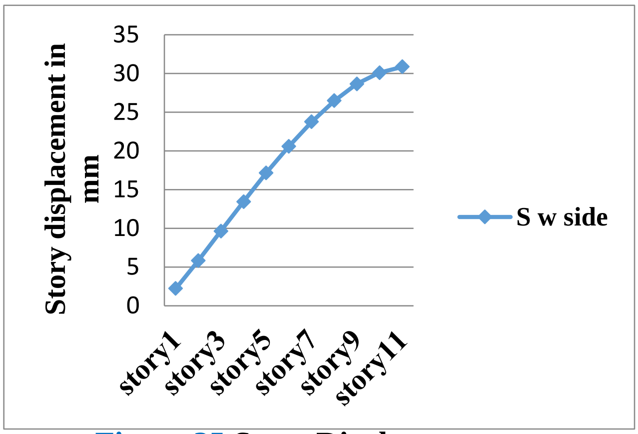

Figure 25 Story Displacement

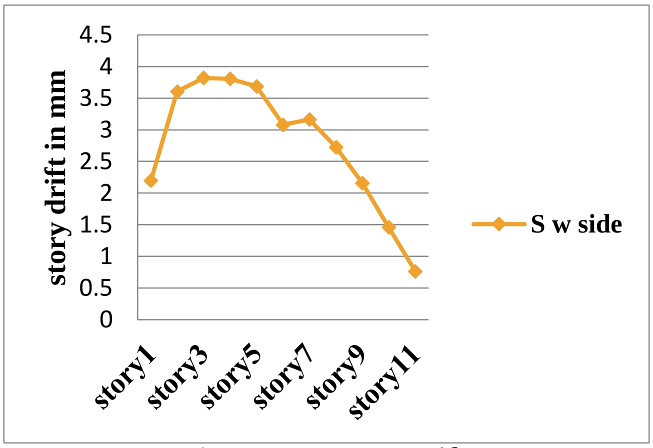

Figure 26 Story Drift

3. Results and Discussion

3.1. Results

The structure is Analyses of three different structural systems that are Bare frame, brace frame and shear wall frame building as per recommended standard codebook. The results of these structural systems are compared and story displacement and story drift are tabulated below.

Table 5 Story Displacement Comparison

Story no	Bare frame	Brace side	Brace corner	Brace core	Shear Wall side	Shear Wall corner	Shear wall core
11	64.416	53.155	48.157	52.698	30.859	22.326	21.726
10	62.116	50.845	45.557	50.541	30.096	22.163	21.397
9	58.480	47.475	42.154	47.143	28.637	21.496	20.591
8	53.626	43.211	38.053	42.940	26.479	20.148	19.210
7	47.803	38.252	33.420	38.038	23.754	18.248	17.343
6	41.242	32.776	28.411	32.620	20.591	15.925	15.103
5	34.158	26.958	23.178	26.854	17.155	13.294	12.591
4	26.729	20.955	17.87	20.901	13.429	10.457	9.899
3	19.118	14.920	12.629	14.906	9.624	7.503	7.103
2	11.511	9.003	7.603	9.015	5.803	4.525	4.285
1	4.356	3.477	3.008	3.484	2.198	1.713	1.623

Table 6 Story Drift Comparison

Story no	Bare frame	Brace side	Brace corner	Brace core	Shear Wall side	Shear Wall corner	Shear wall Core
11	2.3	2.31	2.6	2.157	0.763	0.163	0.329
10	3.636	3.37	3.403	3.398	1.459	0.667	0.806
9	4.854	4.264	4.101	4.203	2.158	1.348	1.831
8	5.823	4.959	4.633	4.902	2.725	1.9	1.867
7	6.561	5.476	4.98	5.418	3.164	2.323	2.24
6	7.084	5.818	5.262	5.766	3.08	2.634	2.512
5	7.429	6.003	5.308	5.953	3.686	2.837	2.692
4	7.611	6.035	5.241	5.995	3.805	2.954	2.796
3	7.607	5.917	5.026	5.891	3.821	2.978	2.818
2	7.155	5.526	4.595	5.531	3.605	2.812	2.662
1	4.356	3.477	3.008	3.484	2.198	1.713	1.623

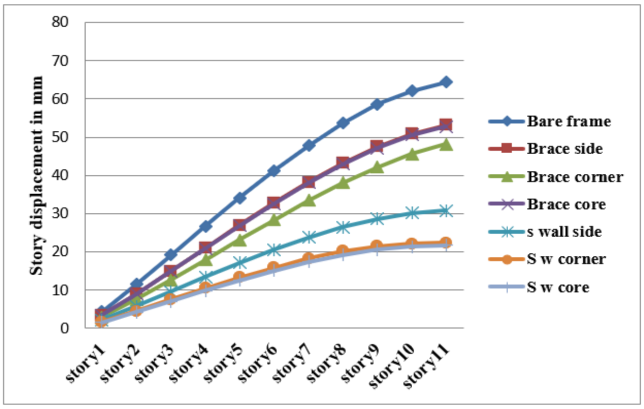

Figure 27 Story Displacement Comparisons

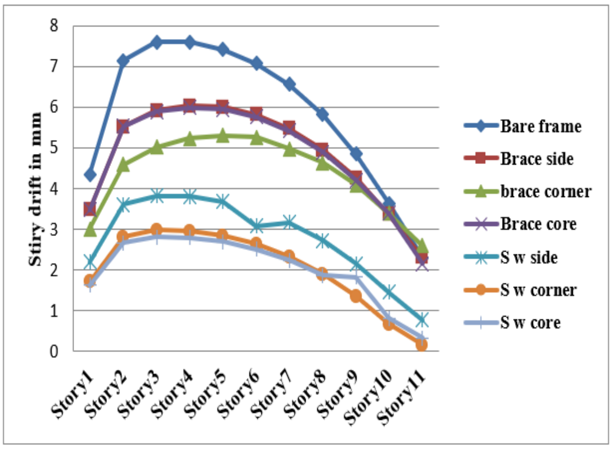

Figure 28 Story Drifts Comparisons

Conclusion

In this study, the analysis of the shell of a conventional building, the frame with bracing and the frame with bracing wall according to the method used by the S.I. In terms of soil displacement and drift in mm. the following conclusions can be drawn

Displacement

At 1st floor the displacement produced about 4.356 which is greater than 1.348mm of displacement produced by bracing at corner and 2.733 greater the displacement produced by the shear wall provided at core (1.623). At 6th floor the displacement produced about 41.242mm which is >12.83mm of displacement produced by bracing at corner and 26.139mm >the displacement produced by the shear wall provided at core (15.103). At 11th floor the displacement produced about 64.416mm which is > 16.259mm of displacement produced by bracing at corner and 42.69mm> the displacement produced by the shear wall provided at core (21.726). By comparing all the modeling, the displacement of a structure produced by shear wall provided at core is very less as compared to bare frame and is about 42.69mm.

Story Drift

At 6th floor the story drift produced by bare frame is about7.084mm which is >. 1.822mm of the story drift produced by bracing at corner and 4.572mm > the story drift produced by the shear wall provided at core(2.512mm). At 11th floor the story drift produced by bare frame is about 2.3mm which is < 0.3mm of story drift produced by bracing at corner and 1.971mm > the story drift produced by shear wall provided at core (0.329). By comparing all the modeling, the story drift produced by the shear wall at corner and core is very less as compared to bare frame and is about 2.137 and 1.971 mm respectively.

References

[1]. Runbahadur Singh et.al (2019) "Seismic analysis of building on different types of soil with and without shear wall" (smsc12019).

[2]. Amith B Anwade "Seismic analysis, Design and Comparative study of RC Structure using different codes" volume 05, ISSUE 04, Apr 2018.

[3]. Krishna G Nair et.al "Seismic analysis of reinforced concrete building" (IRJET), volume 04, Issue 02, Feb-2017.

[4]. Krunal P Suthar et.al "Comparative Study on seismic analysis of multistoried building with shear wall and bracings" (IJRET) ISSN 2321-7308.

[5]. Girum Mindaye et.al (2016) "Seismic analysis of a multistory RC frame building in different seismic zone" volume 5, Issue 9, September 2016.