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Comparative Study of Flat Slab Building with Shear Wall and Bracing

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ABSTRACT
The objective is to study, the performance of lateral load resisting system in high-rise building subjected to seismic load. Study of the literature is reviewed in this paper on various aspects of lateral load resisting system as; Behavior of lateral load resisting system in High-Rise RC building, Effect of seismic load on high rise structure. So, to cater all the lateral forces, we have to design the structure very uniquely so that the structure can withstand for the maximum time period without causing any harm to the society. The Engineers and professional in the structural designing fields have found out many ways to tackle this problem. Traditional simple framed structures have now been replaced by complex yet more effective structural systems that perform better in case of lateral load.

I. INTRODUCTION

1.1 General

Different lateral loads resisting systems are used in high-rise building as the lateral loads due to earthquakes are a matter of concern. The major criteria now-a-days in designing RCC structures in seismic zones is control of lateral displacement resulting from lateral forces. In this thesis effort has been made to investigate the effect of Shear Wall position on lateral displacement in RCC frames. Three models of flat slab with shear wall, flat slab with bracing and bare frame of G+24 storied buildings are designed and performed linear static analysis.

1.2 Shear wall

Shear walls are constructed to counter the effects of lateral load acting on a structure. In residential construction, shear walls are straight external walls that typically form a box which provides all of the lateral support for the building. When shear walls are designed andconstructed properly, and they will have the strength and stiffness to resist the horizontal forces. In building construction, a rigid vertical diaphragm capable of transferring lateral forces from exterior walls, floors, and roofs to the ground foundation in a direction parallel to their planes. Examples are the reinforced-concrete wall or vertical truss. Lateral forces caused by wind, earthquake, and uneven settlement loads, in addition to the weight of structure and occupants; create powerful twisting (torsion) forces. These forces can literally tear (shear) a building apart.

1.3 Flat Slab

Flat slabs system of construction is one in which the beams used in the conventional methods of constructions are done away with. The slab directly rests on the column and load from the slab is directly transferred to the columns and then to the foundation. To support heavy loads the thickness of slab near the support with the column is increased and these are called drops, or columns are generally provided with enlarged heads called column heads or capitals. Absence of beam gives a plain ceiling, thus giving better architectural appearance and also less vulnerability in case of fire than in usual cases where beams are used. In general, normal frame construction utilizes columns, slabs & Beams.

1.4 Bracing

Bracing is a highly efficient and economical method to laterally stiffen the frame structures against wind loads. A braced bent consists of usual columns and girders whose primary purpose is to support the gravity loading, and diagonal bracing members that are connected so that total set of members forms a vertical cantilever truss to resist the horizontal forces. Bracing is efficient because the diagonals work in axial stress.

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II. OBJECTIVE

1. To study the behavior of G+ 24 storey's building with two different models.
2. To carry out response spectrum analysis.

III. METHODOLOGY

In designing and analyzing the performance of flat slab buildings and conventional building, it is especially important that an effective modeling technique be involved because of the complexity of the real structural behavior and the difficulties of full-scale measurement. In both the cases, foundations slightly vary. During the whole process of analysis and design structural member dimensions will seems to vary being of difference in load transfer mechanism. The analysis has been done both for gravity load and lateral load.

3.1 Applied Loads

The loads that are applied on the model so as for the model verification are determined according to the IS875-2016 code.

3.2 Dead Load

The dead load applied on the modal is determined by the ETABS program itself based on the material properties the model also includes floor loads. The floor loads are taken as 1 KN/m^{2}. Those loads are considered as 'super dead' loads in the ETABSsoftware since the program separates them with structural dead loads (column, beam, slab etc.)

3.3 Live Load

Live load is the load that accounts for the intended use or occupancy. The value of live load shall be taken as 3kn/m^{2}in conventional slab and 5kn/m2 in flat slab including wall load in flat slab will be the same for floor from top to bottom.

3.4 Earthquake Load

As earthquake load case is also considered in the ETABS analysis. The earthquake load case is defined using ETABS program's joint weight and response spectrum in accordance to IS 1893:2005codes.

IV. GEOMETRICAL PROPERTIES

Description of Building-

S. No.	Parameter	Values
1	Building Type & Dimension	Commercial & (35m x 35m)
2	Length in X direction	35 m
3	Length in Y direction	35 m
4	No. of bays in X direction @ 3.5m each	10
5	No. of bays in Y direction @ 3.5m each	10
6	Depth of Slab	125 mm
7	Size of Column	900x600
8	Size of Beam	500x300
9	Height of Floor	3 m
10	Shear Wall thickness	200
11	Partition Wall thickness	115 mm
12	No. of Storey	G+16
Loads types		**As per IS 875 Part-1 & 2**

13	Dead Load	Self-weight
14	Roof Live Load	1.5KN/m² (Clause 4.1, Table 2)
16	Floor Live Load	4KN/m²
	Material Property	
17	Grade of Concrete	M30
18	Grade of Rebar	Fe550 and Fe250
19	Concrete Density	25KN/m³
20	Brick density	19KN/m³
	Seismic Data	**As per IS 1893 (Part-1):2016**
21	Zone	V (Table No. 2)
22	Zone factor	0.36 (Clause 6.4.2, Table 3)
23	Importance Factor (I)	1.2 (Clause 7.2.3, Table 8)
24	Soil type	Type II (Medium stiff)
25	Response Reduction Factor (R)	5 (SMRF) (Clause 7.2.6, Table 9)
26	Damping Ratio	5% (Clause 7.2.4)
27	Earthquake Load	As per IS 1893 (part-1):2016

V. STRUCTURE MODELING

1. Columns and slabs will be designed by M25 grade of concrete and Fe550 and Fe250 grade of steel.
2. The optimum position of shear wall is at core and corner of the building because the displacement of the structure is minimum so we provide shear wall at core and corner in our model.
3. Three models were designed one is bare frame structure, second one is flat slab building with shear wall, and third one is flat slab with bracing.
4. The building to be modeled is having G+24stories.

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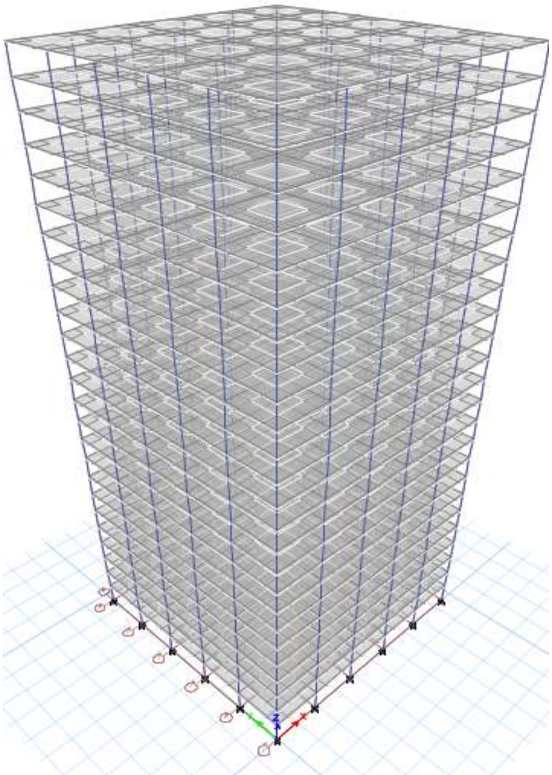

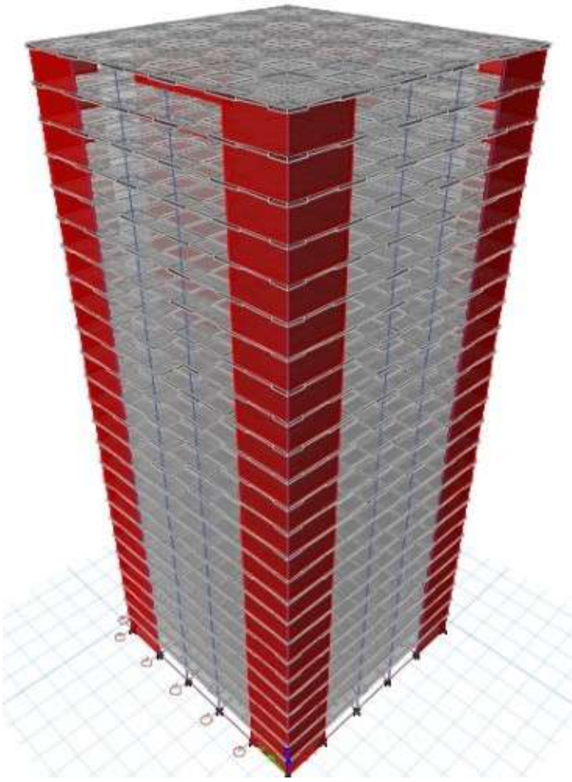

Fig.5.1-3D view of Bare Frame structure. Fig.5.2- 3D view of flat slab building with shear wall.

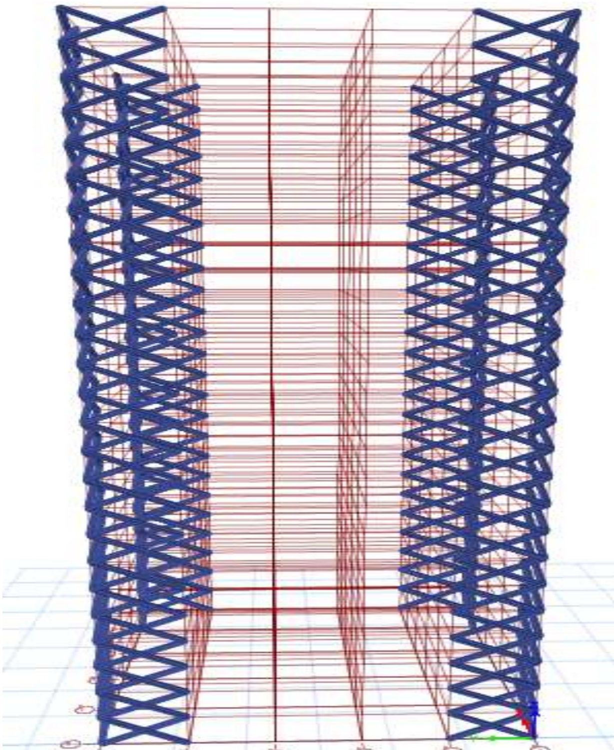

Fig.5.3- 3D view of flat slab building with bracing

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VI. RESULT AND DISCUSSION

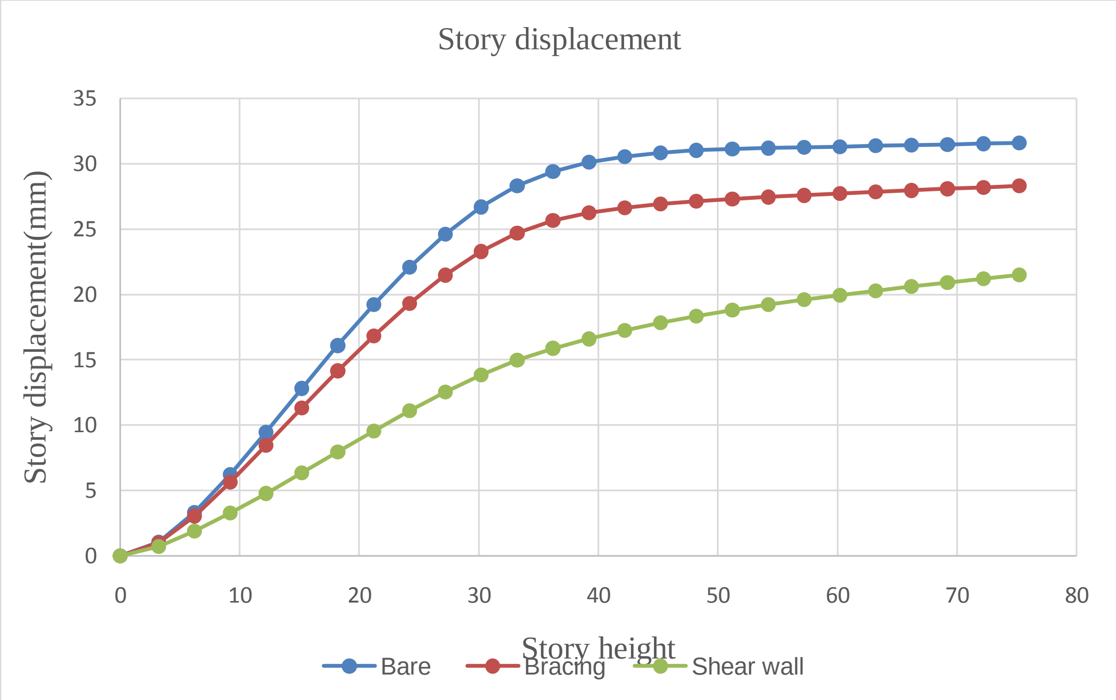

Fig. 6.1- Graph Showing Story Displacement in X Direction

Total displacement of any story with respect to ground is defined as story displacement. Maximum permissible story displacement is limited to H/500, where H is the total height of building. The maximum displacement in bare frame, bracing and shear wall are 31.59 mm, 28.30 mm, and 21.52 mm respectively.

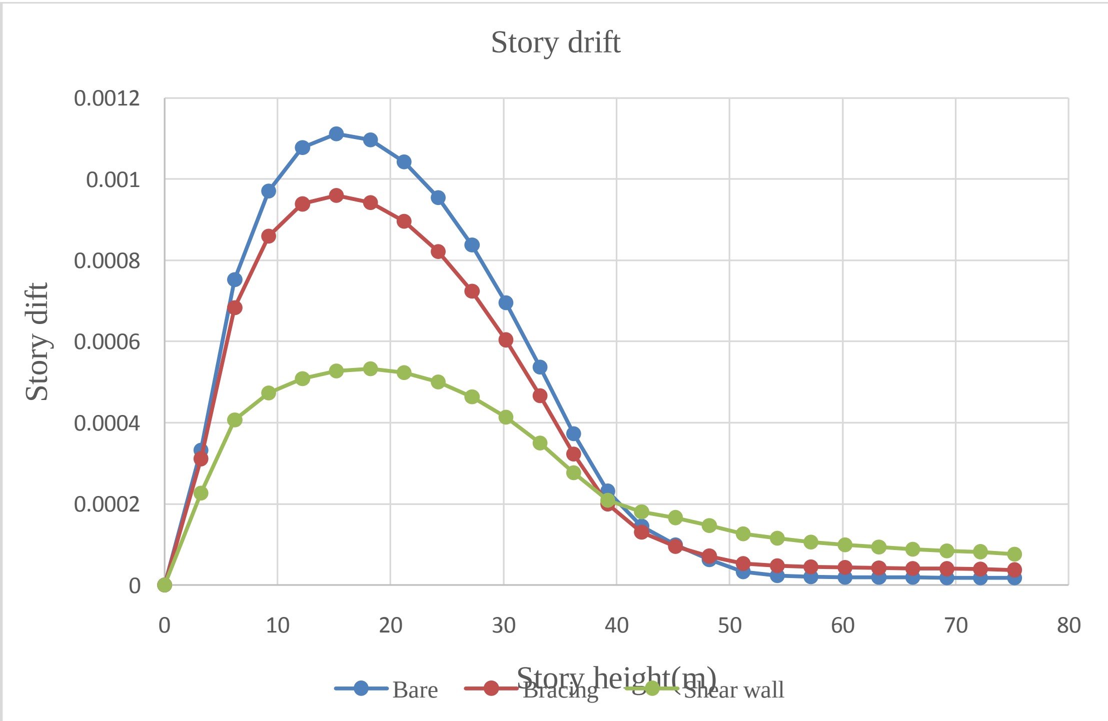

Fig. 6.2- Graph Showing Story Drift in X Direction

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The word "Drift" can be defined as the lateral displacement of the structure, Storey drift is the slower and small movement of one level of a multilevel building relative to the level below. Inner storey drift is the difference between the floor and roof displacements of any given story as the building sways during the earthquake, marked by the story height, more is the storey drift will cause more damages to the structures, its value should not be beyond the limit 0.004h, where (h) is height of the building. The value of story drift increases up to the mid height of building and then decreases to the top of building.

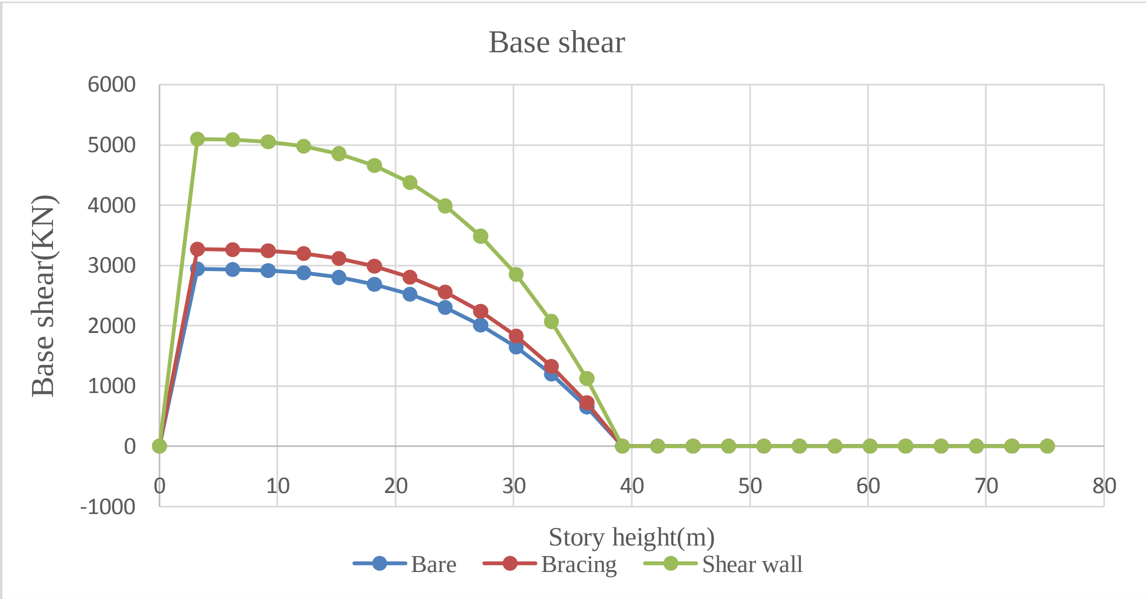

Fig. 6.3- Graph Showing Base Shear in X Direction

The amount of maximum lateral force because of seismic ground motion at the soffit or base of the structure is base shear, its horizontal movement of base of the structures, it depends on following factors: Condition of soil on the site, Closeness to potential sources of seismic activity like geological faults, Probability of significant seismic ground motion due to earthquakes, Total weight of Building, Period of the vibration. Base shear is inversely proportional to story displacement. Maximum shear occurs on bottom of the building.

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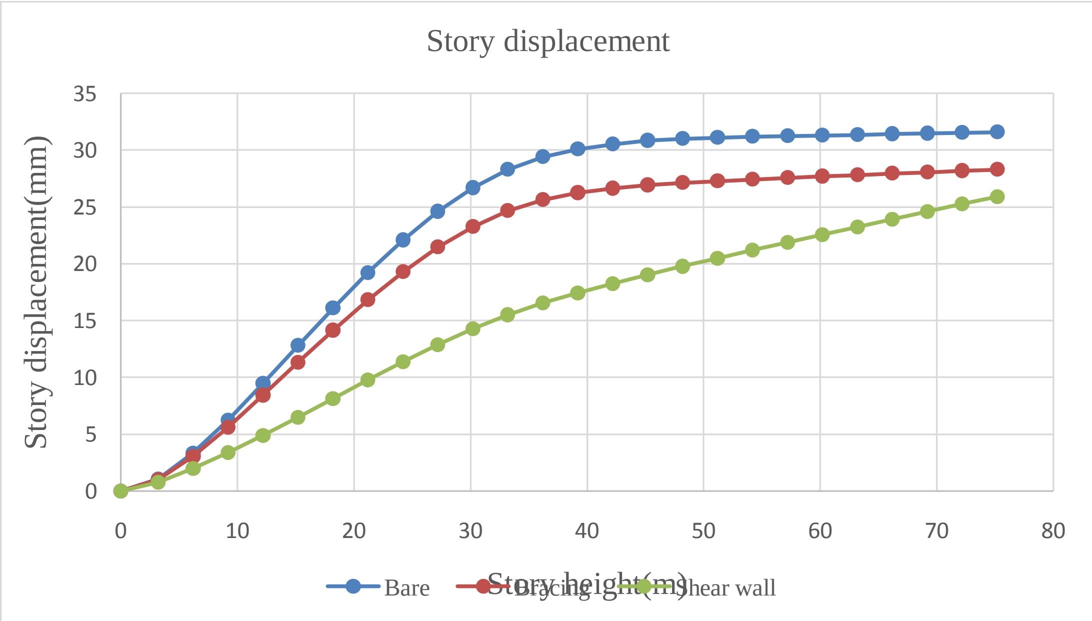

Fig. 6.4- Graph Showing Story Displacement in Y Direction

Total displacement of any story with respect to ground is defined as story displacement. Maximum permissible story displacement is limited to H/500, where H is the total height of building. The maximum displacement in bare frame, bracing and shear wall are 31.59 mm, 28.30 mm, and 25.90 mm respectively.

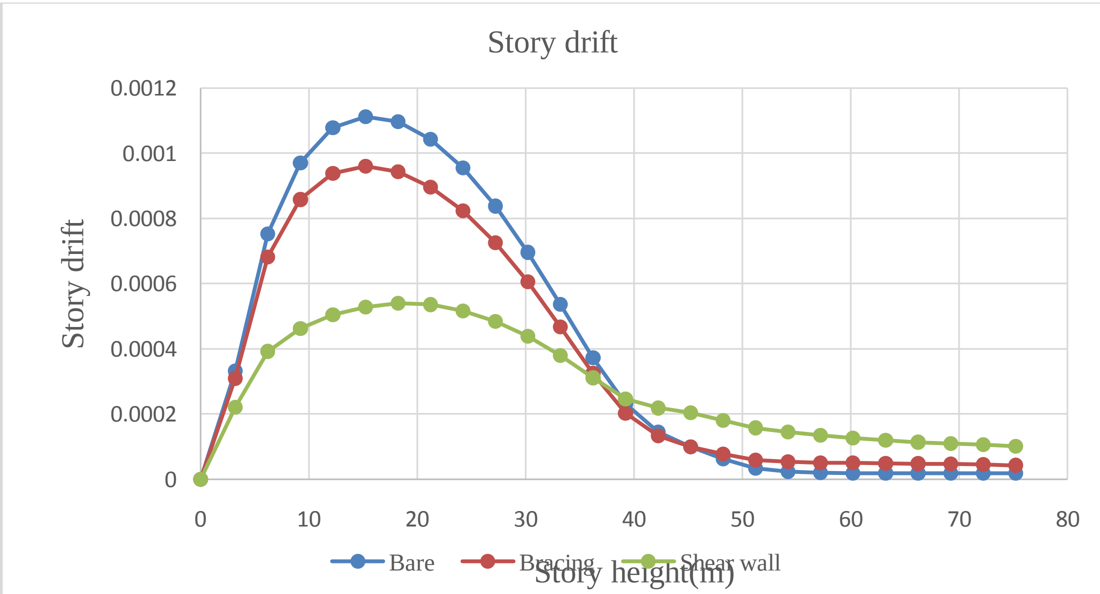

Fig. 6.5- Graph Showing Story Drift in Y Direction

The word "Drift" can be defined as the lateral displacement of the structure, Storey drift is the slower and small movement of one level of a multilevel building relative to the level below. Inner storey drift is the difference between the floor and roof displacements of any given story as the building sways during the earthquake, marked by the story height, more is the storey drift will cause more damages to the structures, its value should not be beyond the limit 0.004h, where (h) is height of the building. The value of story drift increases up to the mid height of building and then decreases to the top of building.

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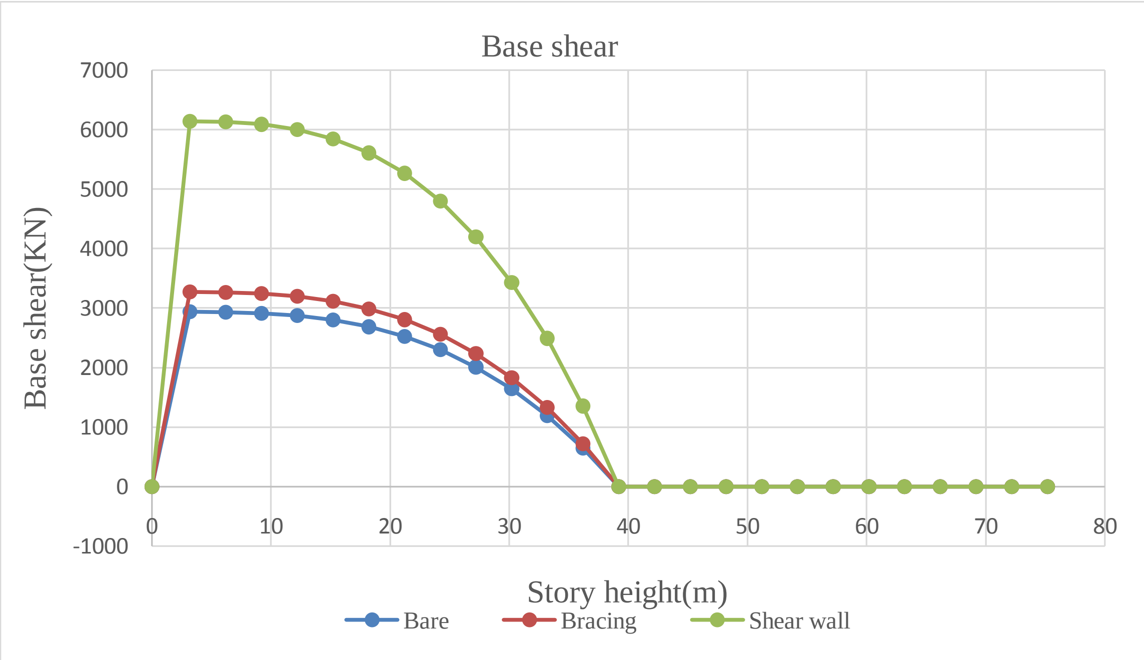

Fig 6.6- Graph Showing Base Shear in Y Direction

The amount of maximum lateral force because of seismic ground motion at the soffit or base of the structure is base shear, its horizontal movement of base of the structures, it depends on following factors: Condition of soil on the site, Closeness to potential sources of seismic activity like geological faults, Probability of significant seismic ground motion due to earthquakes, Total weight of Building, Period of the vibration. Base shear is inversely proportional to story displacement. Maximum shear occurs on bottom of the building.

VII. CONCLUSION

1. The maximum story displacement of flat slab with shear wall, flat slab with bracing and bare frame is 25.90 mm, 28.30mm and 31.59 mm respectively.
2. The values of story drift for all the stories are found to be within the permissible limit i.e., not more than 0.004 times to story height.
3. The story shear values of flat slab with shear wall structure shows maximum value as compared to flat slab bare frame and flat slab with bracing.
4. Shear wall positioned at building core has good seismic response compared to other options due to higher tendency of attraction of lateral loads. As shear wall gets apart from center of the building, its seismic response getting reduced. Base shear is inversely proportional to the story displacement. Hence the model with least story displacement has the maximum base shear value. It means it resists the maximum lateral force.
5. Oncomparison of different parameters like story displacement, story drift and base shear of flat slab with shear wall structure, flatslab with bracingand bare frame we found that flat slab with shear wall structure show better performance against lateral loads.

REFERENCES

[1]. Vivek Kumar, Dr. Kailash (2019) "Seismic Behavior of Flat Slab Building with Steel Bracing System using Pushover Analysis on ETABSv17''.
[2]. Mathew Paul, K. Vasugi, Noel Francis (2019) "Behavior of Multi- Storeyed Building for Flat Slab System with and Without Shear Wall under Seismic Loading".
[3]. Atif Zakaria, M. Shiva Rama Krishna, S.V. Surendhar Comparative study of RCC building with ribbed slab and grid slab international journal of Recent technology Engineering. (IJRTE)) ISSN: 2277-3527, Volume-2, Issue-10 (2019)
[4]. Massimo Lapi, to study the Flat slab strengthening techniques against punching-shear International Research Journal of Engineering and Technology Volume: 01 Issue: 04 (2018)
[5]. Dr. A.K. Jain comparative study of flat slab with perimeter beams and conventional slab structures under seismic conditions. International journal of Recent technology

Engineering. (IJRTE)) ISSN: 4574-4552, Volume-1, Issue-2(2018)

[6]. David Ugaldea& Diego Lopez-Garciaa,b (2017)"Behavior of reinforced concrete shear wall buildings Subjected to large earthquakes".

[7]. Balaji Kumar et.al (2017) **"**To study the performance of flat slab and conventional slab structure subjected to various loads and conditions".

[8]. Thimmayapally Dileep Kumar1, Amownika vardhan2 analysis and design of regular and irregular flat slab for multi storeyed building under two seismic zones using ETABS and safe International Research Journal of Engineering and Technology Volume: 02 Issue: 10 ISSN 2540:1235 (2017)

[9]. Dakshayani S1,Chaithra N (2016) **"**Seismic Performance of RC Flat Slab Structure With Different Types Of Steel Bracing**".**

[10]. Kavish Patwari et.al (2016) **"**studied on Comparative Study of Flat Slab Building with and Without Shear Wall to see earthquake Performance of G+10 building using response spectrum method by ETABS".

[11]. Rajini. A. T, Dr. Manjunath N Hegde "Comparative study of the behaviour of flat slab and conventional slab structures of 20 stories in diverse cases. Conventional RC slab and flat slab structure" International Research Journal of Engineering and Technology Volume: 02 Issue: 05 (2016).

IS 875 (Part 1): Code of Practice for Design Loads for Buildings and Structures, Part 1: Dead Loads.
IS 875 (Part 2): Code of Practice for Design Loads for Buildings and Structures, Part 2: Imposed Loads.
IS 1893-1 (2016): Criteria for Earthquake Resistant Design of Structures, General provisions and Buildings, Bureau of Indian Standards, New Delhi.