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Dynamic Seismic Analysis of Open Soft Storey Building for Different Models

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ABSTRACT: This research paper is about Dynamic seismic analysis of open soft storey building with various models, in current era of development we are facing one major problem which is scarcity of land for the purpose of parking so we construct the multi storey frame and bottom of floors are reserve for the parking but the when we construct those floor as open soft storey those storey which does have a proper resistance against the lateral forces those building will fails under the seismic forces hence for resolving this problem, our research determine that if we provide different models like shear wall frame, infill frame can resist those lateral forces which occurs in earthquake.

KEYWORDS: Response spectrum analysis, Soft storey, Etabs.

I. INTRODUCTION

In this paper the various structural building frame (G+14) having several structural models which is bare frame, braced frame, infill frame ,shear wall frames is analysed by the response spectrum method for the determination of seismic parameters of these different models.

[1].The Indian seismic code are 1893 (Part1): 2016 classifies a soft storey collectively where the lateral stiffness are a lesser than 70 percentage of that within the storey above or lesser than 80 percentage of the common lateral stiffness of the three stories above.

Due to increasing population because the past few years so that vehicle parking space for residential flats in populated cities is an issue of foremost trouble. in order that buildings of multi storied homes with open first storey is a common exercise in all world. Subsequently the trend has been to utilize the floor storey of the constructing itself for parking or reception lobbies within the first storey. these varieties of homes having no infill masonry walls in floor storey, however all higher storeys infill in masonry partitions are called gentle first storey or open floor storey constructing revel in of various international locations with the terrible and devastating overall performance of such buildings for the duration of earthquakes constantly severely discouraged construction of this sort of constructing with a tender ground floor. This storey called vulnerable storey because this storey stiffness is decrease evaluate to above storey so that without problems collapses via earthquake because of incorrect production practices and lack of knowledge for earthquake resistant design of buildings in our maximum of the present homes are susceptible to destiny earthquakes. So, top significance to receive for the earthquake resistant design.

The behaviour of masonry in crammed frame structures has been studied within the closing four decades in tries to develop a rational method for design of such frames gift code of exercise does no longer consist of provision of deliberating the effect of infill it could be understood that if the effect of infill is taken into consideration in the evaluation and layout of frame, the resulting structures may be appreciably special once more when a sudden trade in stiffness takes vicinity along the building top the storey at which this drastic exchange of stiffness occurs is referred to as a tender storey. Many city multi storey buildings in India today have open first storey as an unavoidable characteristic. This leave the open first storey of masonry infill reinforced concrete frame building on the whole to generate parking or reception lobbies in the first testimonies it's been recognized for long time that masonry infill walls have an effect on the energy & stiffness of infill body systems. There are plenty of researches executed to date for infill frames, however partially infill frames are the subject of hobby though it has been understood that the infill play giant function in improving the lateral stiffness of whole systems.

From this thought the floors that don't have any infill factor has less stiffness concerning different flooring bolstered-concrete framed shape in current time has a unique characteristic i.e. the floor storey is left open for the purpose of parking etc. Such constructing are frequently called open ground storey buildings or building on stilts. Open floor storey gadget is being followed in many homes currently due to the gain of open area to fulfil the low-cost and architectural needs. however these stilt ground utilized in most seriously broken or, collapsed R.C. homes, added extreme irregularity of sudden trade of stiffness among the ground storey and top testimonies for the reason that that they had had infill bricks partitions which increase the lateral stiffness of the frame through a issue of 3 to 4 instances. In such buildings the dynamic ductility call for in the course of probable earthquake gets focused in the soft storey and the top storey tends to remain elastic hence the building is completely collapsed because of smooth storey effect.

II. METHODOLOGY

In order to execute the seismic analysis and design of a building structure to be manufacture at a exacting location, the actual time history record is required .However, it is not achievable to have such records at each and every location. Further, the seismic analysis of structures cannot be conceded out simply based on the peak value of the ground acceleration as the response of the structure depend upon the frequency content of ground motion and its own dynamic properties. To overcome the above difficulties,earthquake response spectrum is the most popular tool in the seismic analysis of structures. There is computational reward in using the response spectrum method of seismic analysis for prediction of displacements and member forces in structural systems. The method entail the calculation of barely the maximum values of the displacements and member forces in each mode of vibration using design spectra that are the average of several shaking motions.

This chapter deals with dynamic response spectrum method and its application to various types of the structures. The codal provisions as per IS:1893 (Part 1)-2002 code for response spectrum analysis of multi-story building is also summarized.

RESPONSE SPECTRUM

Response spectra are curves plotted between highest response of SDOF system subjected to particular earthquake ground motion and its time period (or frequency). Response spectrum can be inferred as the locus of maximum response of a SDOF system for given damping ratio. Dynamic Response spectra as a result helps in attain the peak structural responses under linear range, which can be used for attain lateral forces developed in structure due to earthquake thus facilitates in earthquake-resistant design of structures.

Generally response of a SDOF system is resolute by time domain or frequency domain analysis, and for a given time period of system, greatest response is picked. This process is continued for all range of possible time periods of SDOF system. Final plot with system time period on x-axis and response quantity on y-axis is the required response spectra pertaining to specified damping ratio and input ground motion. Same process is carried out with different damping ratios to obtain overall response spectra.

The frequently used methods for obtaining the peak response quantity of interest for a MDOF system are as follows:

1. Absolute Sum (ABSSUM) Method,
2. Square root of sum of squares (SRSS) method, and
3. Complete quadratic combination (CQC) method

Here in this case we use 50 mode for seismic analysis those are combined by CQC method

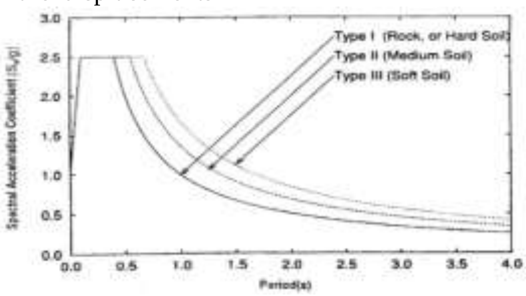

Fig.1 Average Response Acceleration Coefficient for different Soil types

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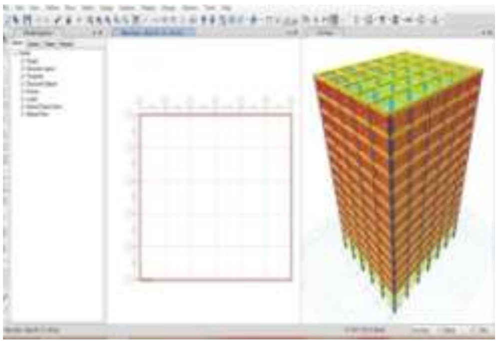

Fig 2- Plan and 3D view of Model 1(Bare Frame)

MODELLING

Different different building models are modelled in the ETABS (bare frame model, braced, infill, shear wall) and analysed in the etabs by the help of dynamic response spectrum analysis method for this first of all the data like number of bays in x direction ,bays in y direction height of the building is given to ETABS and the software will generate a model with these specification .after these commands we will define our material properties such as concrete, steel, masonry. Further we will define the geometry of our structural member like beam column and thickness of slab and apply the vertical as well as the lateral forces i.e. seismic forces in each and every model analysed those model by the response spectrum method.In all the procedure the number of mode should be in such a way that at least 90 percentage of mass should participated in the analysis, check the base shear reaction for both the method static method as well as the dynamic method and apply the response reduction factor as per Indian standard. Again Run the Analysis and check the various structural parameter. Outcomes are achieve in terms of base shear, storey drifts, storey shear, storey stiffness and storey displacements., ultimately comparison of the results of study of different models are done

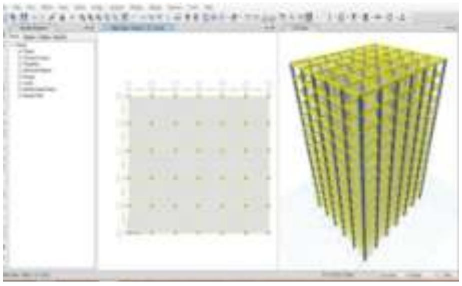

Fig 3- Plan and 3D view of Model 2(infill Frame)

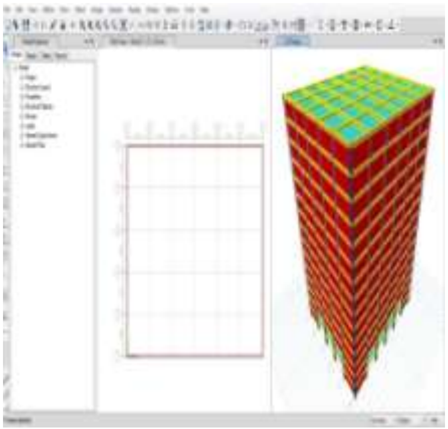

Fig 4- Plan and 3D view of Model 3(shear wall Frame)

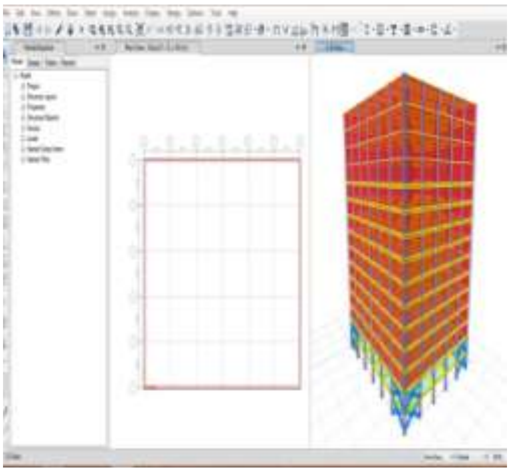

Fig 5- Plan and 3D view of Model 4(Bare Frame)

General properties	bare	infill	Braced	shear wall
Type of structure	3D G+14 RC Framed Structure	3D G+14 RC Framed Structure	3D G+14 RC Framed Structure	3D G+14 RC Framed Structure
Moment resisting frame	OMRF	OMRF	OMRF	OMRF
Plan dimension	30 * 25 m	30 * 25 m	30 * 25 m	30 * 25 m
Type of building use	Commercial Building	Commercial Building	Commercia l Building	Commercial Building
No. of bay in x direction	6	6	6	6
Width of bay in x direction	5m	5m	5m	5m
No. of bay in y direction	5	5	5	5
Width of bay in y direction	5m	5m	5m	5m
Height of each floor	3m	3m	3m	3m
Member properties				
Size of Beam	300*500 mm	300*500 mm	300*500 mm	300*50 mm
Size of Column	500*500 mm	500*500 mm	500*500 mm	500*500 mm
Thickness of Slab	150 mm	150 mm	150 mm	150 mm
Thickness of Shear Wall	-	-	-	230 mm
Thickness of Wall	-	230 mm	230 mm	230 mm
material properties				
Grade of concrete	M-30	M-30	M-30	M-30

Grade of steel	Fe-415	Fe-415	Fe-415	Fe-415
Density of concrete	25 KN /m^3	25 KN /m^3	25 KN /m^3	25 KN /m^3
Bracing Section	-	-	ISLB 600	-
Poisson's ratio of concrete	0.20	0.20	0.20	0.20
Density of Masonry	--	19.20 KN /m^3	19.20 KN /m^3	19.20 KN /m^3
dead load intensity				
Roof finishes	1.0 KN/m^2	1.0 KN/m^2	1.0 KN/m^2	1.0 KN/m^2
Floor finishes	1.0 KN/m^2	1.0 KN/m^2	1.0 KN/m^2	1.0 KN/m^2
live load intensity				
Floor	3.0 KN/m^2	3.0 KN/m^2	3.0 KN/m^2	3.0 KN/m^2

SEISMIC PROPERTIES	
Response Reduction Factor	3
Importance Factor	1.5
Seismic Intensity	Severe
Damping Ratio	5%
Reduction Percentage Live Load	25%
Seismic Zone	IV
Soil Type	Medium
Zone Factor	0.24

III. RESULTS

The behaviour of all different models of structure in seismic zone IV has been analysed using Response spectrum method in ETABS software. As our building frame is unsymmetrical in nature hence it will give the different results in the both direction hence the parameters are compared separately in each direction. in first scenario we assume earthquake forces majorly acting in x direction and in other case we are assuming major latera force direction is in y direction.

The results of different models structure are obtained and finally results of all models of structure are compared. The outcomes are attained and the outcomes of the analysis are demonstrated with the help graphical representation of:

1. Storey Shear
2. Storey stiffness
3. Storey Drift
4. Storey Displacements
5. Base Shear

Followings are the graphical representation of structural parameters when major lateral forces acting on x direction of building model.

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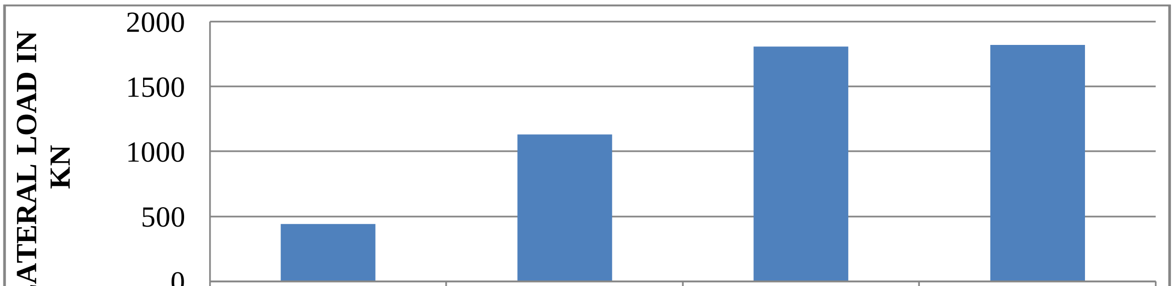
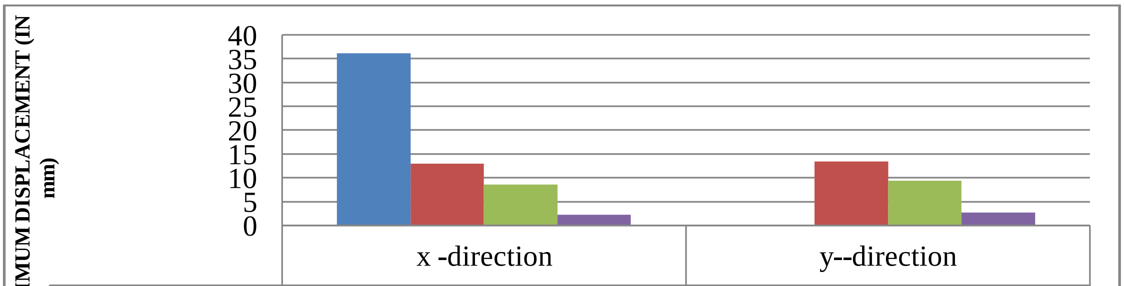


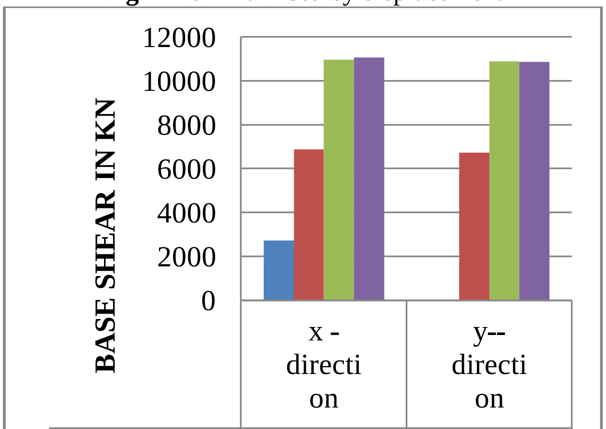
	bare frame	infill frame	braced frame	shear wall frame
x -direction	441.9205	1133.1552	1808.8368	1823.2751

Fig 6- Maximum Storey lateral loads



	x -direction	y--direction
bare frame	36.227	0.005
infill frame	12.912	13.4
braced frame	8.501	9.409
shear wall frame	2.23	2.636

Fig 7-Maximum Storey displacement



	x -direction	y--direction
bare frame	2713.1665	0.0003
infill frame	6875.9537	6736.158
braced frame	10976.3104	10887.7755
shear wall frame	11066.1386	10874.5815

Fig 8- Base shear

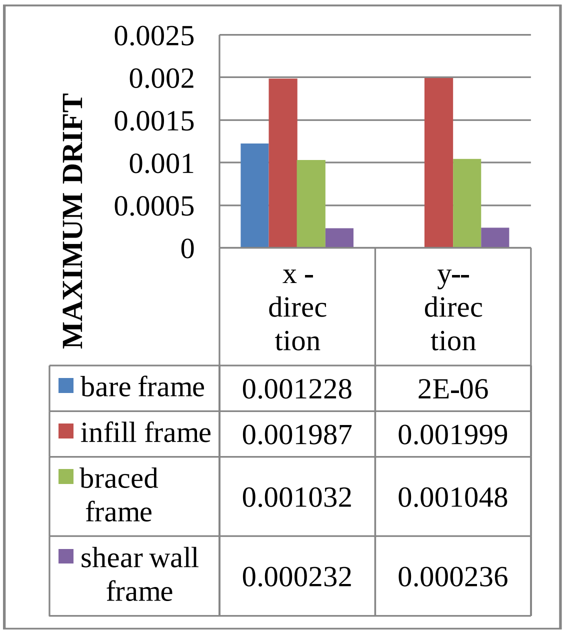


Fig 9-Maimum Storey drift

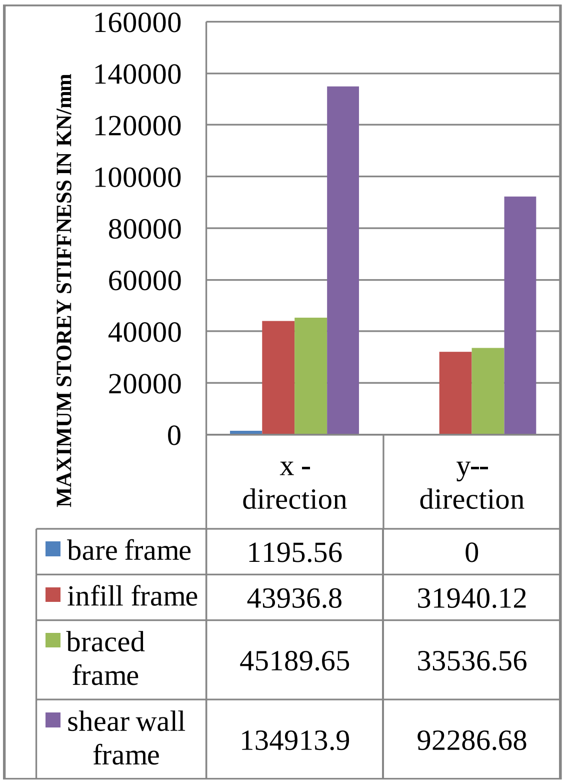


Fig 10-Maximum Storey stiffness

Graphical representation of structural parameters for seismic forces acting majorly in y direction of building models are given below.

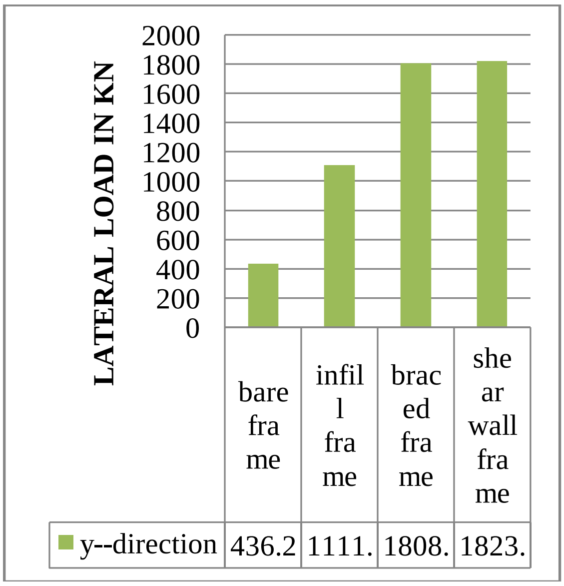


Fig 11- Maximum Storey lateral loads

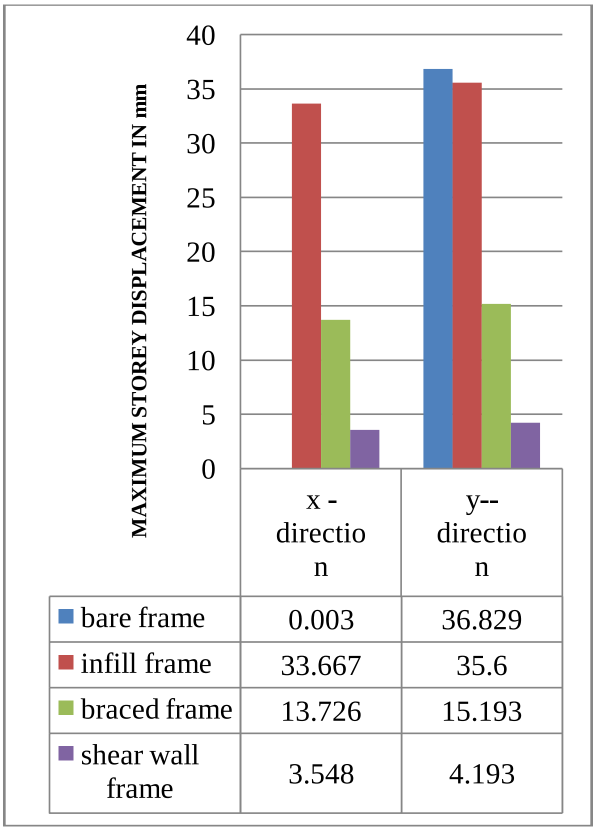


Fig 12-Maximum Storey displacement

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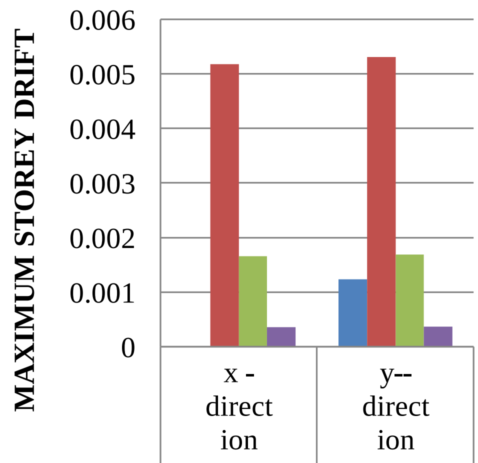
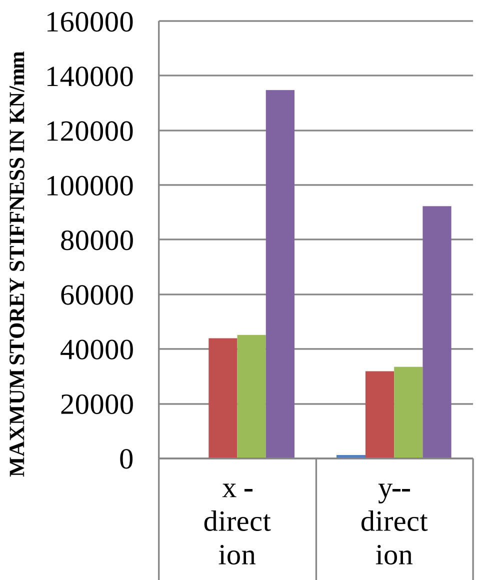


	x - direction	y-- direction
bare frame	2E-06	0.001238
infill frame	0.005182	0.005311
braced frame	0.001666	0.001692
shear wall frame	0.000368	0.000376

Fig 13-Maxximu Storey drift



	x - direction	y-- direction
bare frame	0	1181.15
infill frame	43967.89	31879.25
braced frame	45189.78	33536.88
shear wall frame	134802.69	92219

Fig 14-Maximum Storey stiffness

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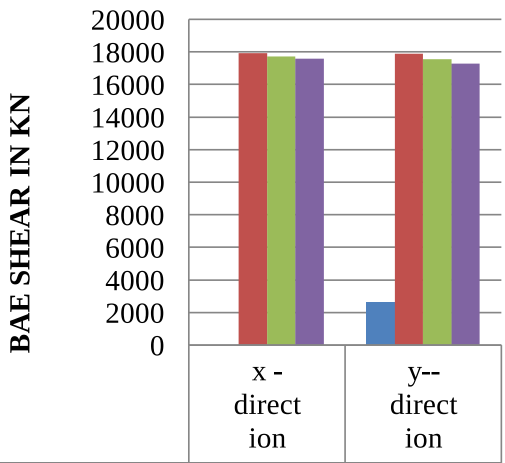

	x - direction	y-- direction
bare frame	0.0006	2681.2815
infill frame	17927.123	17892.961
braced frame	17723.4226	17580.4673
shear wall frame	17607.2533	17304.638

Fig 15-Base shear

IV. CONCLUSION

from the graphical representation of various parameters our research can be concluded in the following recommendations:

1. The maximum lateral load occurs in the model with shear wall in both the condition of seismic loading.
2. The displacement of any multi storey building should be minimum as can as it is possible hence we can say that a structure can be said as a better structure If it shows the lesser displacement, here in our research it is clearly seen the model with bare frame has high value of displacement and model with shear wall is having considerably lesser values than other three models.
3. Base shear if the total lateral force which is acting at the base of building so it should be high as it can in our research the graphs clearly says that base shear is maximum in frame with shear wall
4. Storey drift should be minimum in all frames, it observed that the infill frames have much higher value of storey drift as compared from other models.
5. Storey stiffness can be a known as a most important parameter because from which we can define the structure can stand safely in earthquake, the maximum storey stiffness clearly seen in shear wall model.

Hence we can say that from above the structural parameters that our G+14 building model with shear wall is suitable among all other building models.

REFERENCES

[1]. I.S. 1893 (Part 1): 2016, Criteria for Earthquake Resistant Design of Structures, Bureau of Indian Standards, New Delhi.
[2]. IS: 875 (Part 1and 2) -1987 Code of practice for design loads (other than earthquake) for buildings and structures.
[3]. “Textbook of seismic design”, Springer Science and business media LLC,2019.

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