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A Comparative Study on Seismic Analysis of Multi-Storey Building with and without Steel Bracings

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Abstract: ***In general, the structure in high seismic areas may be susceptible to the severe damage due to gravity load and seismic load. The columns and beams are used to transfer the major portion of the gravity loads and some part of lateral loads to the earth. This transfer of loads is not applicable during earthquake. In this project, a research is conducted to check the performance of different bracing system [Steel bracing] for different conditions. For this research G+15 storey RC frame structure 25m x 25 m has been analyzed for 5 days in each direction for seismic zone V. The soil is considered to be as hard soil and soft soil. For this research FE based software ETABS is chosen. Totally 13 models are analyzed for different bracing system with different sections and performance is checked by calculating time period, natural frequency, storey drift and base shear.***

KEYWORDS: RC frame, braced frame, lateral load resisting frame, response spectrum analyses, base shear.

Introduction

In modern life styles people requirements also modern and different to fulfill and also scarcity of land to construct preferring high raised building with proper facilities. The high raised multistory buildings having height is more then 30 meters. These using for different purposes like residential, educational institutes, commercial, healthcare and storage power generation etc. from the past few years the many structures are damaged and collapsed by earthquake, it shows that need of seismic adequacy for the existing building structures. The earthquake measures in terms of loss of life and country properties. Building should sustain and bearing loads from gravity and lateral loads. The characteristics of material used to construct decides the strength of the structure. The geometrical and cross sectional properties are depends on stiffness.

The building is subjected to the the lateral load due to the wind and earthquake hence we considering the mainly lateral loads while designing the high raised building. The members of framed structure is is main work to transfers the lateral and gravity loads to foundations. The main loads are gravity loads it consists of dead load live load and service load, probability building frame undergoes through lateral forces due to seismic activities and fire blasts etc. hence to reducing this by providing retrofitting methods by dampers bracing systems and shear wall constructions. In this project G+15 storey framed structure with 5X5 bays located at earthquake zone V is analysis in hard and soft soil conditions using different bracing systems of different sections.

Umesh.R.Biradar,In this project 7 models which contains the different bracings systems is analyzed for reinforcement building located at zone 5. They are analyzed the linear static analysis , linear dynamic analysis, non linear dynamic analysis by using E Tabs.

The following parameters are concluded by using different types of bracings system is used to reduces of the fundamental time. The base shear values are obtained from ESA and RSA using E Tabs those values are not same as code of Indian standards . The values of displacements of linear and non linear under the limits. Here concluded the X bracings are good performance in both direction compared to other types of bracings systems.

Viswanath.K.G,In this paper explained about concentric bracings about seismic performance of RCC building. The four storey building provided with concentric bracings at zone 4.the software used STAD pro for modeling and analyzed. Similarly analyzed by increasing 8 storey, 12 storey and 16 storey which are compared . This paper concluded that the outer fitting technique with alternate bays used the bracings. They are analyzed un braced and braced building of parameters of displacements. Their reduction of fluxed using bracings. Here they suggested that X bracings are best to minimize the building moment compared to other bracing system.

METHOD OF ANALYSIS

The present study undertaken with linear methods i.e.
Linear static analysis (Equivalent static method

STRUCTURAL MODELING

For the analysis work, 13 models of the hard &soft soil models for the high rise RC frame building (G+15) storey are made to known the realistic behavior of building during earthquake. The length of the building is 48m and width is 25X25m. The columns are assumed to be fixed at the ground level. Linear static and dynamic analysis is used. **5.1. Studied structural**

configuration Following two types of structural configuration is studied for the hard & soft soil.
1. G+15 RC Framed structure without bracing
2. G+15 RC Framed structure with different bracing patterns.

A. *PLAN*

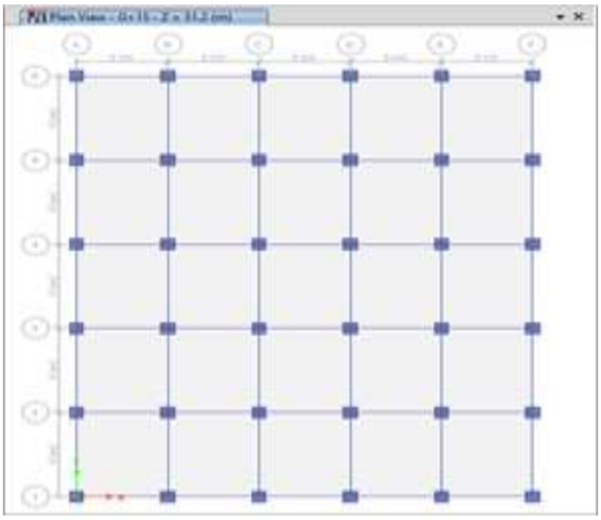


Fig 1 : .RC Frame model plan.

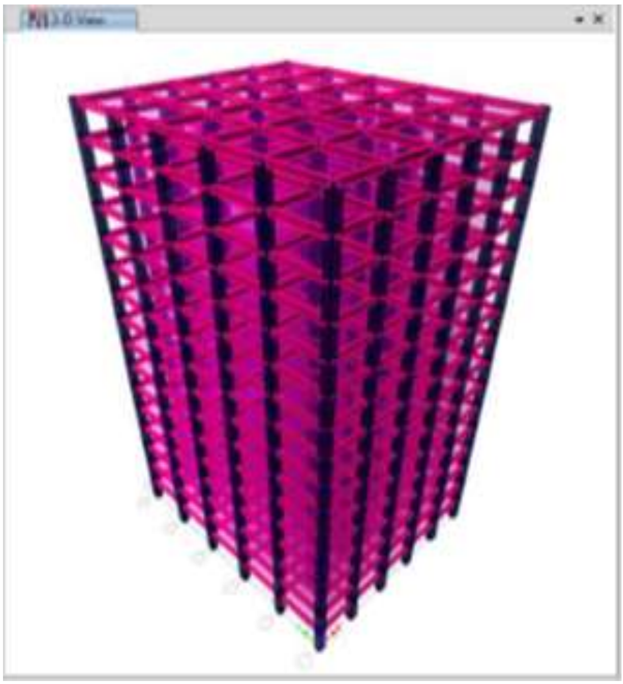


Fig.2: RC Frame 3D-model.

Table 1: **Building Description:**

sl no	Building description	Details	
1	Zone	5	
2	Zone factor	0.36	
	Response Reduction Factor	5	
3	Importance factor	1	
4	Soil condition	Hard and Soft	
5	Damping	5	
6	Building Height	48	
7	Column Details	650x650 mm	
8	Beam Deatails	300x600mm	
9	Bracing	1.ISA150x150x12	
		2.ISMC 400	
		3. ISMB400	
10	Slab Thickness	125mm	
11	Floor to Floor Height	3m	
12	Plan	5 m x 5 m	
13	Grade of Steel for Rebar Section	fe 415	
14	Grade of Steel Section	fe 250	
15	Grade of Concrete	Beam	M20
16	Grade of Concrete	Column	M25

B. Design

The RC frames comprises of columns, beams and slabs. Analysis of the frames is done using ETABS 2013 software. Dead load, imposed load, and earthquake load are considered for analysis.

Dead load (DL) & Imposed Load (LL) :
The dead load and imposed load is considered as per IS 875-1987 (Part I-Dead loads and Part-II Imposed load), "Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures".

C. Different Type of Bracing Patterns used in the Study

Different types of bracing patterns used in the study are shown in below figures.

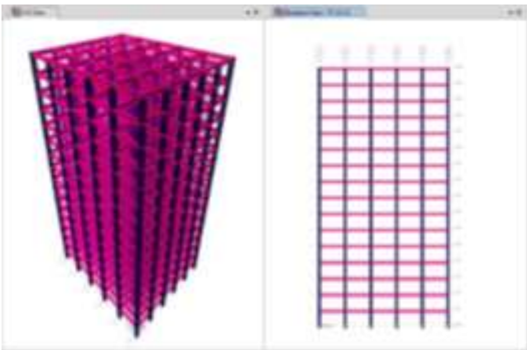


Fig.3: RC Frame model of building without bracin

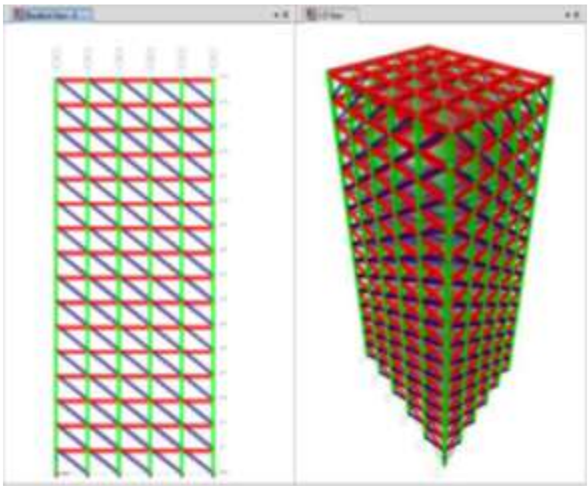


Fig.4 RC Frame model of building diagonal bracing

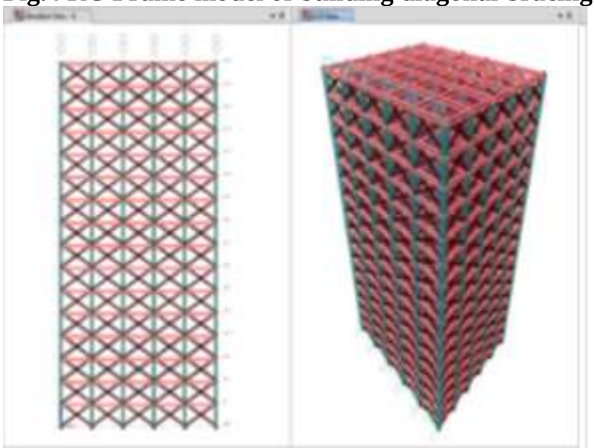


Fig.5 RC Frame model of building with X bracing

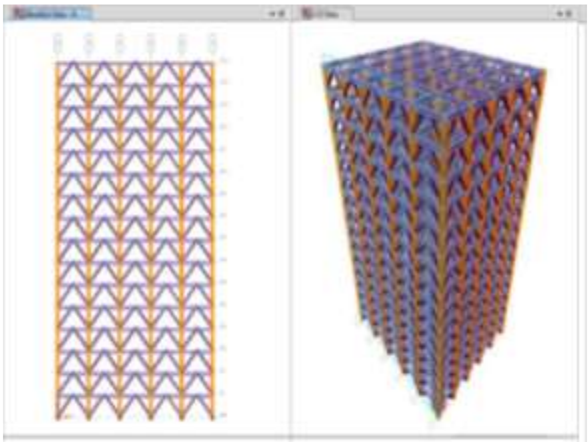


Fig.6 RC Frame model of building with Inverted V bracing.

IV RESULTS AND DISCUSSIONS.

A. DISPLACEMENTS

DISPLACEMENTS in mm					
STOREY	BARE	ISA X	ISA IN V	ISA DIA	ISA V
16	39.9	15.1	15.8	26.3	20.4
15	39	14.6	15.3	25.7	19.9
14	37.7	14	14.7	24.9	19.2
13	36.1	13.3	14	23.9	18.3
12	34.1	12.5	13.2	22.4	17.3
11	31.7	11.6	12.3	20.9	16.1
10	29.1	10.7	11.3	19.3	14.8
9	26.2	9.7	10.2	17.5	13.4
8	23.2	8.7	9.1	15.5	12
7	19.9	7.6	8	13.6	10.5
6	16.6	6.5	6.9	11.5	9
5	13.2	5.5	5.7	9.4	7.4
4	9.9	4.4	4.6	7.3	5.9
3	6.6	3.4	3.5	5.2	4.4
2	3.5	2.4	2.4	3.7	2.8
1	1.1	1.2	1.3	1.1	1.3
BASE	0	0	0	0	0

Table.2 Comparison Storey displacement and No of storey for the bare frame with ISA 150x150x12 bracing for the hard soil

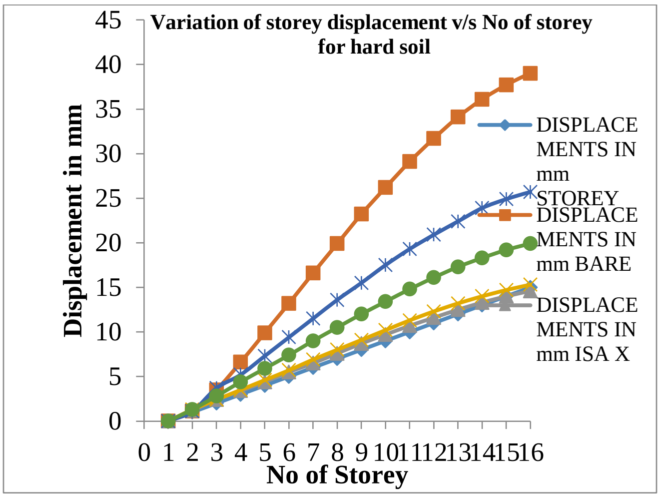


Figure 7: Variation of storey displacement v/s no of storey for ISA 200 X 200 X 15

B. BASE SHEAR

Table 3: Comparison of Base Shear for Hard soil

	BASE SHEAR
MODEL 1	1047
MODEL 2	2839
MODEL 3	2671
MODEL 4	3140
MODEL 5	2955
MODEL 6	2922
MODEL 7	2747
MODEL 8	1582
MODEL 9	2047
MODEL 10	1592
MODEL 11	2142
MODEL 12	1258
MODEL 13	2074

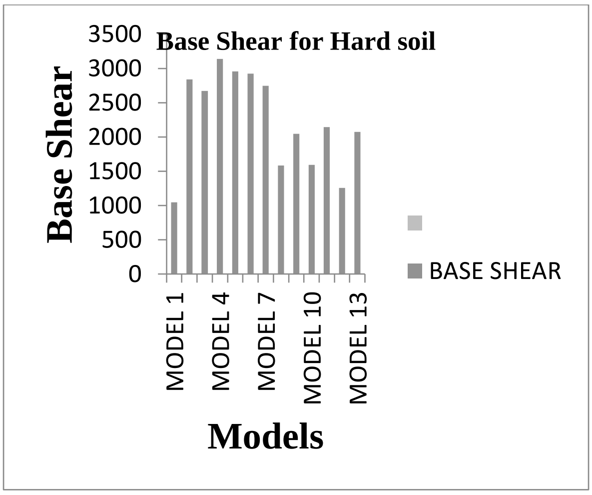


Fig 8: Base shear in kN for hard Soil

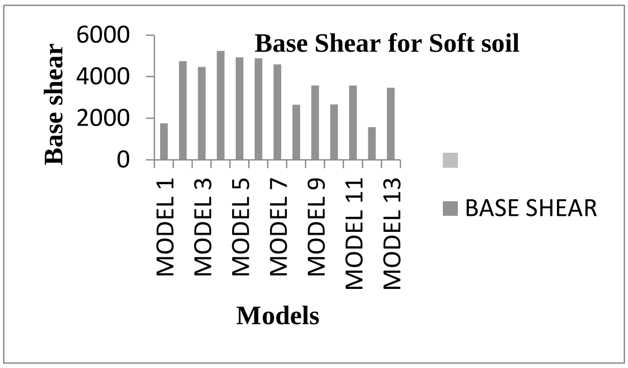
By observing results from table and graph the structure with ISMB 400 of X bracing providing

more base shear for hard soil condition compared to ISA and ISMC of inverted v , diagonal and v.

Table 4. Comparison of Base Shear for Soft soil

	BASE SHEAR
MODEL 1	1748
MODEL 2	4742
MODEL 3	4461
MODEL 4	5243
MODEL 5	4935
MODEL 6	4880
MODEL 7	4589
MODEL 8	2648
MODEL 9	3576
MODEL 10	2658
MODEL 11	3577
MODEL 12	1569
MODEL 13	3464

Fig 9 : Base shear in kN for Soft Soil



CONCLUSION

1. Observing results from table and graph , displacements for hard soil condition is more in bare frame and decreased by using bracing systems. Bracing ISA 150x150x12 of X type reduced 62 percentage compared inverted v, diagonal, and v bracings.
2. By observing results from table and graph the structure with ISMB 400 of X bracing providing more base shear for hard soil condition compared to ISA and ISMC of inverted v , diagonal and v bracings.
3. By observing results from table and graph the structure with ISMB 400 of X bracing providing more base shear for hard soil condition compared to ISA and ISMC of inverted v , diagonal and v bracings.

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