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Seismic Comparison of Building with or without Deep Beam

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***Abstract*— Tall structure developments are increasing rapidly now a days throughout the world. Due to earthquake which happens rarely around the world, so the structure have to made earthquake resisting structure.**

The present study reviews that seismic analysis of reinforced concrete building with and without deep beam. The proposed building consists of 10 stories bottom storey height is 3.5m and the remaining storey height is 3.2m and building is 24m length, 24m width and 32.3m above from the ground level. It is considered under the seismic zone 5. The structure analysis of proposed building is carried out by E-tabs 2013 software. The proposed building model has been done. Models are analyzed by equivalent static method and dynamic method to resist the lateral load.

From the study on the behavior of the models with and without deep beams it is seen that deep beam has a significant impact on the entire structure and hence deep beams can be one of the solutions for resisting effect of earthquake on the structure.

Keywords*— Deep beam, Equivalent static analysis, Dynamic analysis, Base reaction, Time period, Storey Stiffness

I. INTRODUCTION

Earthquake (otherwise called a shudder, tremor or temblor) is the detectable shaking of the surface of the Earth, coming about because of the sudden arrival of vitality in the Earth's outside that makes seismic waves. This tremor can be the reason for the failure of soil, rupture of surfaces, damages to the structures and human deaths. At the Earth's surface, tremor show itself by shaking and once in a while uprooting of the ground. This is the point when the epicenter of a substantial seismic tremor is found offshore, the seabed might be displaced adequately to create Tsunami. The word tremor is utilized to portray any seismic occasion whether characteristic or created by humans that produces seismic waves. Tremors are brought about generally by crack of topographical faults, additionally by for example, volcanic action, avalanches, mine impacts, and atomic tests. A quake's purpose of introductory burst is called its center or hypocenter. The epicenter is the point at earth surface straightforwardly over the hypocenter.

A. Deep beam concept

Deep beams are basic structural components loaded as beams in which a significant measure of the load is exchanged to the supports by compression push joining the load and the reaction. As result, the strain distribution in no longer considered linear and the shear disfigurements get to be critical when thought about unadulterated flexure

A few specialists have chosen that the shear span effective depth proportion l/d is more significant to characterize deep beam, and that a. beam could be viewed as deep if shear span to depth proportion (l/d) <2 for simply supported deep beam and l/d ratio is less than 2.5 for continuous deep beam.

Especially, the utilization of deep beams at the lower levels in tall structures for both private and business purposes has expanded quickly as a result of their accommodation and sparing productivity. R.C deep beams have numerous helpful applications in structures, for example, transfer girders, wall footings, foundation pile tops, floor diaphragm and shear dividers. Beams such sort frequently emerge in the development of containers or comparative structures, and additionally pile tops and transfer girders.

II. METHODOLOGY

A. problem definition

A 10 storey building with 3m and 3.2m deep beam and 10 storey conventional building of symmetric plan dimension of 24mx24m bay spacing 6m along each direction and bottom storey height is 3.5m and remaining storey height is 3.2m is considered

1. Size of bay : 6m x 6m
2. Size of column : 600mm x 600mm
3. Size of beam : 300mm x 400mm
4. Deep beam size :300mm x 3000mm
5. Deep beam size :300mm x 3200mm
6. Column size bottom storey : 950mm x 950m

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Table 1: physical properties of concrete and steel

Properties of concrete	
Grade of concrete	M30
Modulus elasticity	27386.12MPa
Poisson's ratio	0.2
Properties of reinforcement steel and masonry	
Grade of steel	Fe 415
Modulus elasticity	210000 MPa
Density of concrete	$25kN/m^3$
Poisson's ratio	0.3
Density of brick wall including plaster	$20kN/m^3$

Table 2: seismic parameters

Seismic parameters (IS 1893-2002)	
Zone	V
Soil type	1(HARD SOIL)
Impact factor	1

B. *Modeling of the structure*

Generally this study consists of 3 different type of models which is listed below in Table 3 and building with 3m deep beam at ground storey that is named as model 1 similarly model 2 which consists of 3.2m deep beam at ground storey the structure analysis of proposed building is carried out by E-tabs 2013 software. The proposed building model has been done. Models are analyzed by equivalent static method and dynamic method to resist the lateral load**.**

Table 3: details of typical models

Serial number	Description of models
1	Bare Frame Model
2	Bare Frame Model With 3m Deep at Ground Storey
3	Bare Frame Model With 3.2m Deep Beam at Ground Storey

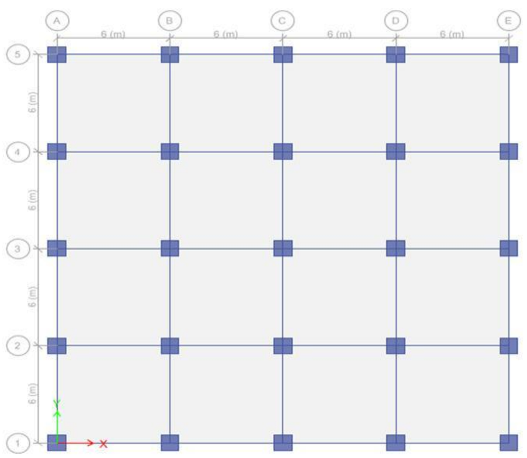

Fig 1. Plan view of conventional building

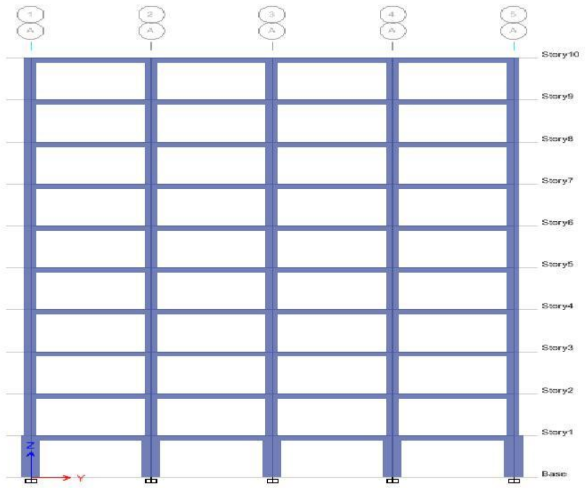

Fig 2. Elevation for Conventional Building

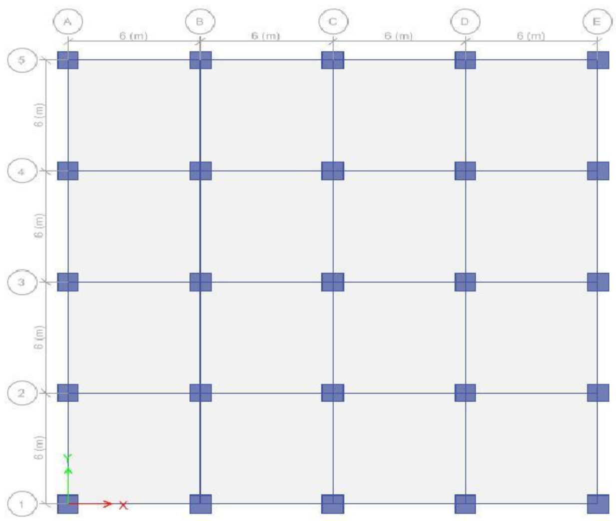

Fig 3: Plan View of Bare Frame Building with 3m Deep Beam at Ground Storey

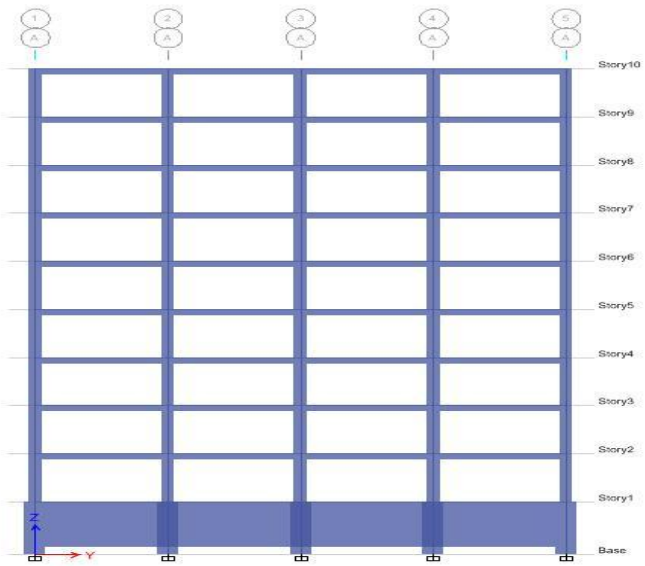

Fig 4: Elevation for Bare Frame Building with 3m Deep Beam at Ground Storey

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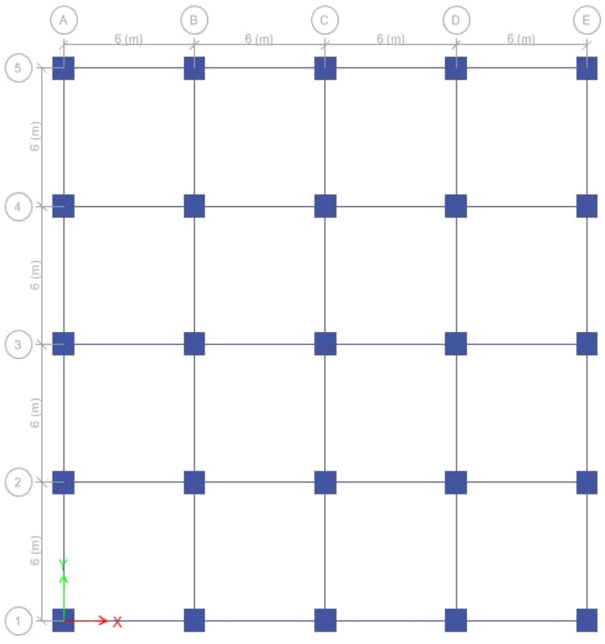


Fig 5. Plan view for bare frame building with 3.2m deep beam at Ground Storey

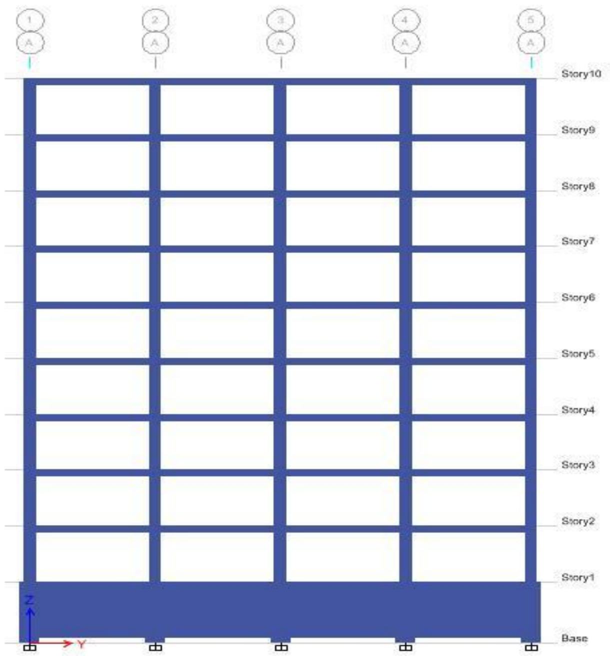


Fig 6. Elevation for Building with 3.2m Deep Beam at Ground Storey

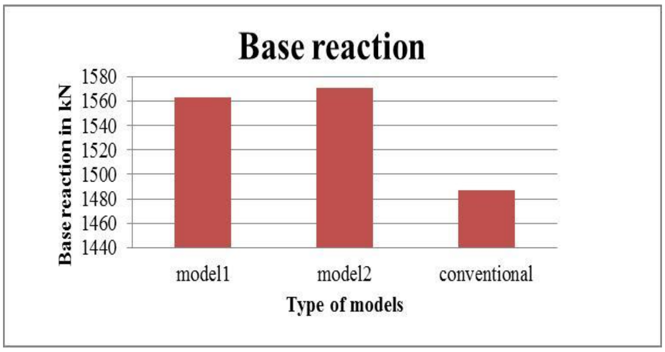
III. RESULT AND DISCUSSION

In this chapter results are shown in form of tables and figures for different type of building models and parameters such as storey stiffness, natural period, and base reactions are considered. Results for comparison between bare frame conventional building and building with deep beam are below.

A. Base reaction

Table 4: Maximum Base reaction for bare frame building

	Model 1	Model 2	Conventional
Base Reaction(kN)	**1563.45**	**1570.94**	**1487.13**



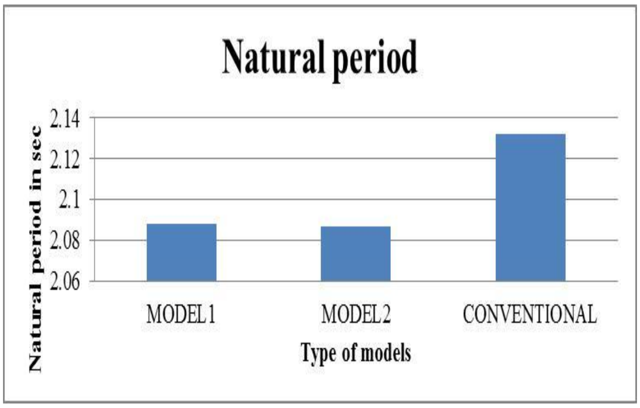
Graph 1: maximum base reaction

Table 4 and Graph .1 it is seen that base reaction of building with deep beam is more compared to the conventional building. The average increase in base reaction for deep beam building is about 5.35%and 0.46%. It is also observed that the base reaction is increases significantly in building with deep beam as compared with conventional building, since mass of the structure with deep beam is more compared to conventional building.

B. Natural period

Table 5: Natural period for bare frame building

	Model 1	Model 2	Conventional
Natural period in (sec)	2.088	2.087	2.132



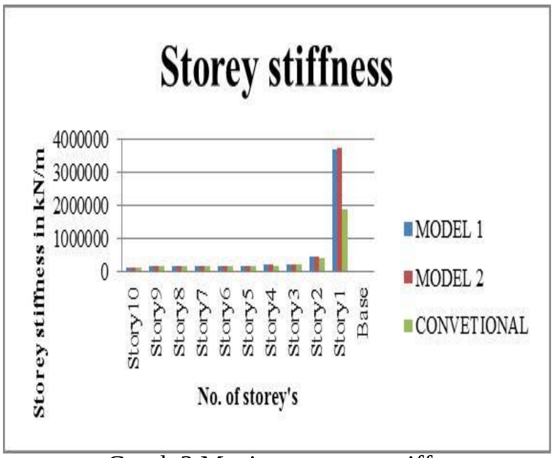
Graph 2: maximum. Natural period

From the analysis and from Table 5 Graph 2 it is observed that the natural period obtained has a very slight difference for both type of analysis methods this is due to same structural configurations. Graph 4.4 indicates that there is increase in natural period in conventional building as compared to building with deep beam. The percentage of increase in natural period is 2.06% and 2.11%.The natural period decreases in building with deep beam compared with conventional building because as stiffness increases natural period decreases.

C. Stiffness

Table 6: maximum storey stiffness

Stiffness in (kN/m)			
Storey	Model 1	Model 2	Conventional
Storey10	112765.8	112807	117493.206
Storey9	176940	176970.8	176964.176
Stoery8	179813.4	179826.6	180285.415
Storey7	177173.9	177190.1	177573.601
Storey6	175119.9	175134.4	174643.818
Storey5	177823.5	177845.2	177333.377
Storey4	192802.3	192855.1	188862.722
Storey3	236341.8	236470.3	226144.838
Storey2	465277.2	466330.6	390784.044
Storey1	3683292	3734948	1883875.283
Base	0	0	0



Graph 3.Maximum storey stiffness

From Table 6 and Graph 3 it is seen that storey stiffness is more for building with deep beam as compared to conventional building, there is twice increase in the value of the stiffness at ground storey due to deep beam provided at ground storey.

V.CONCLUSION

The seismic behavior of deep beam is studied considering the deep beam at ground storey of the structure by using equivalent static method and response spectrum method. Based on analytic analysis result has been made.

1. It is been observed that base reaction increases in building with deep beam as compared to conventional building
2. Considering the effect of deep beam in building, the stiffness of the structure increases rapidly for ground storey up to 49.56% and it considerably changes in higher stories.
3. Natural period is significantly lowered after introducing deep beam in building at ground storey.

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