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# Investigation on the Response of High Rise Structures Subjected to Blast loads & Earthquake Loads

**Rishabh Gupta[1], Prof. Indrajeet Singh Chouhan [2], Prof. Nilesh Kadam[3]**
*[1]M.Tech Scholar, Department of Civil Engineering, Sushila Devi Bansal College of Engineering, Indore*
*[2]Guide, Department of Civil Engineering, Sushila Devi Bansal College of Engineering, Indore*
*[3]Co-Guide, Department of Civil Engineering, Sushila Devi Bansal College of Engineering, Indore*

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***Abstract:** In this research we have analyzed structure with the different floor numbers for blast & seismic loading to get relative results. In this study the blast parameters are obtained from IS Codes. The structure is analyzed using ETABS software & result obtained from this analysis. In this study we have compare different parameters such as storey displacement, storey shear, base shear, max moments and shear. The results help to get an understanding about the effects that would be caused by the loads acting such as, type of blast load and earthquake loads and their comparative results would help us to understand how a structure acts for same earthquake and blast loads and how will the structure behave for the case.*
***Keywords:** ETABS, Blast Load, Earthquake load, Base shear, displacement*

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## I. INTRODUCTION

Incidents of explosive loading on structures incidents have become a very serious problem that needs to be addressed frequently. As we know mostly buildings can be loaded by explosive incident are moment resistant frames also concrete or steel structures, and their performance under blast loads is of enormous significance. This process will occur in continuation until the point where the structure can obtain equilibrium either by shedding load, as a byproduct of other elements failing, or by finding stable and effective different paths for load".

Mostly blast events are often times are accounted as destructive and very costly, it is important to understand that there are cases where engineered controlled blast events can be of benefit. Such cases include destruction of high-rise structures to use the land for another purpose or preparing it for a new construction or in military for some specific purposes. Considering the growing number of the terrorist attacks around the world, blast design became more attractive to the scientists in the field. Nowadays, explosive devices are becoming smaller and more powerful compared to the past. Many scientists and structural engineers are working to improve and strengthen the structures to make them withstand against blast waves (shock waves) and try to reduce the amount of damages to the people and the structure itself.

## II. OBJECTIVE OF STUDY

a) The aim of the present study is to find various plans of blast and seismic activity phenomenon and to recognize how they influence a building.

b) Due to this loads possibility of occurrence of an explosion in the full lifetime of a building & the impact that would occur on the building

c) Using ETABS software we have to determine the responses caused on a building due to the blast loads and seismic loads.

d) To get better understanding of the results for the analysis process and results of a building with different construction elements and techniques

## III. POINT OF COMPARISON

The study would be giving us comparative results for the building subjected to this loads having different building heights i.e. building with different floor no. The different aspects for the comparative results that are taken in this study are the lateral storey displacement, storey drift, base shear moments for same element and the moments. These aspects would give us very clear results of the effects on the building for the comparative results.

## IV.PROBLEM FORMULATION

| S.NO. | MODELS | CASES |
|---|---|---|
| 1 | MODEL 1- TEN STOREY BUILDING | Building affected by the blast load of 150kg with the standoff distance of 35meters with normal Frame |
| 2 | | Building affected by the blast load of 150kg with the standoff distance of 35meters with shear walls. |
| 3 | | Building affected by the Earthquake load of same amount of lateral loads as by blast loads. |

| | | |
|---|---|---|
| 4 | | Building affected by the Earthquake load of same amount of lateral loads as by blast loads with shear walls |
| 5 | MODEL 2- FIFTEEN STOREY BUILDING | Building affected by the blast load of 150kg with the standoff distance of 35meters with normal Frame |
| 6 | | Building affected by the blast load of 150kg with the standoff distance of 35meters with shear walls. |
| 7 | | Building affected by the Earthquake load of same amount of lateral loads as by blast loads. |
| 8 | | Building affected by the Earthquake load of same amount of lateral loads as by blast loads with shear walls |
| 9 | MODEL 3- TWENTY STOREY BUILDING | Building affected by the blast load of 150kg with the standoff distance of 35meters with normal Frame |
| 10 | | Building affected by the blast load of 150kg with the standoff distance of 35meters with shear walls. |
| 11 | | Building affected by the Earthquake load of same amount of lateral loads as by blast loads. |
| 12 | | Building affected by the Earthquake load of same amount of lateral loads as by blast loads with shear walls |

## V.METHODOLOGY & MODELLING APPROACH

**Building Description**

Material Properties: Density of concrete = 30kN/m3,

Density of steel = 78.5 kN/m3

Grade of concrete = M30,

Grade of rebar (steel) = Fe500

Sectional Properties:

Beam = 600mm × 400mm

Column=500*1000 (10 Storey)

Column=600*1200 (15 Storey)

Column=600*1200 (20 Storey)

**Load Combination:-**

Combination 1 = 1.2DL + 1.2LL + 1.2BL/EQ

Combination 2 = 1DL + 0.8LL + 0.8BL/EQ

Combination 3 = 1.5DL + 1.5LL

**Modeling Approach**

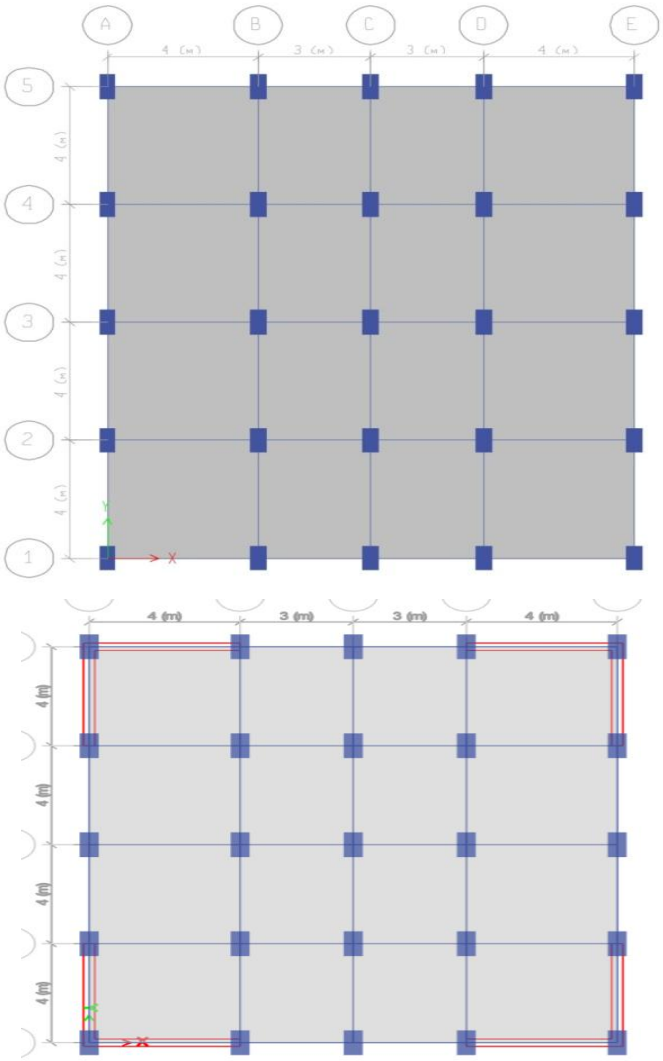



**Fig 5.1 Plan of the Model Fig**

**Fig 5.2 Plan of the Model With shear wall**

**10 FLOOR BUILDINNG**

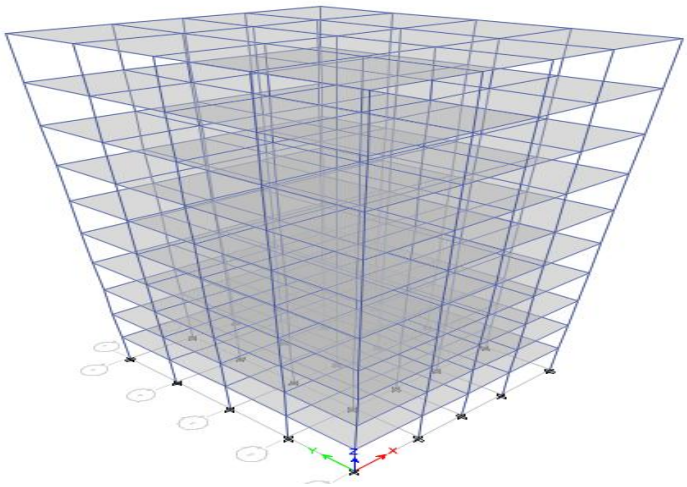


**Fig 5.3 - 10 FLOOR BUILDINNG**

**10 FLOOR BUILDINNG WITH SHEAR WALL**

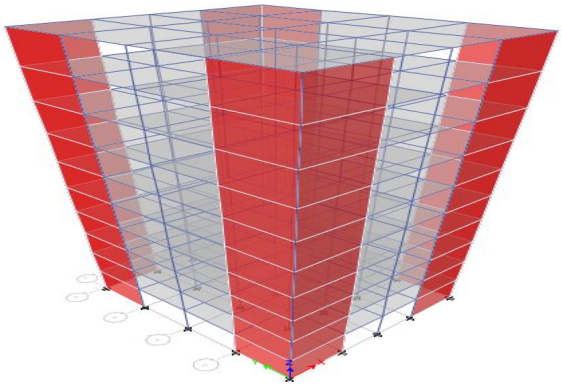


**Fig 5.4 - 10 FLOOR BUILDINNG WITH SHEAR WALL**

**15 FLOOR BUILDINNG**

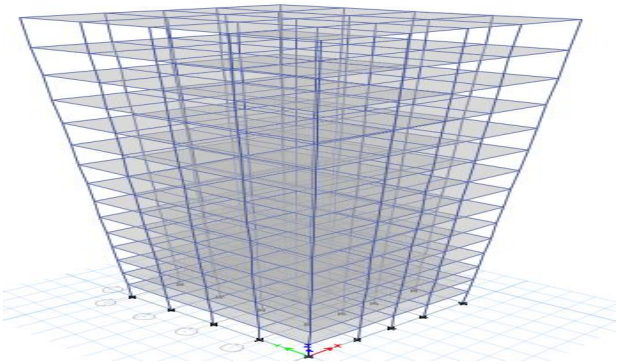


**Fig 5.5 - 15 FLOOR BUILDINNG**

**15 FLOOR BUILDINNG WITH SHEAR WALL**

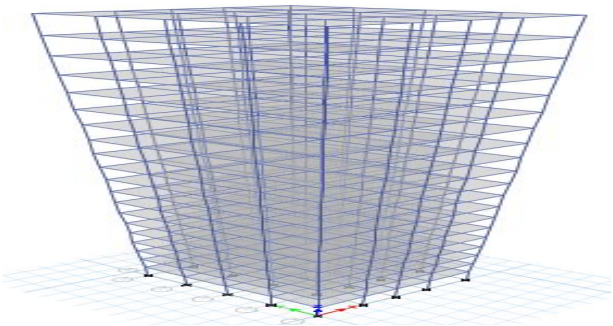


**Fig 5.6 - 20 FLOOR BUILDINNG**

**20 FLOOR BUILDINNG WITH A SHEAR WALL**

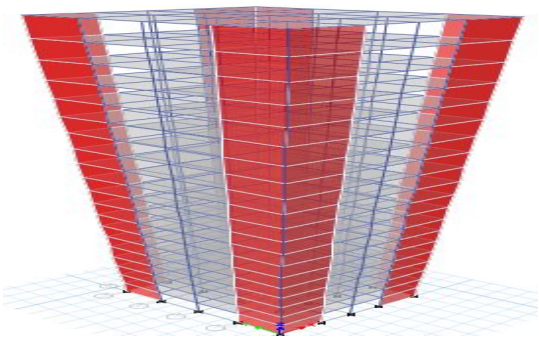


**Fig 5.7 - 20 FLOOR BUILDINNG WITH SHEAR WALL**

## VI.RESULT & DISCUSSION

### 6.1 Results

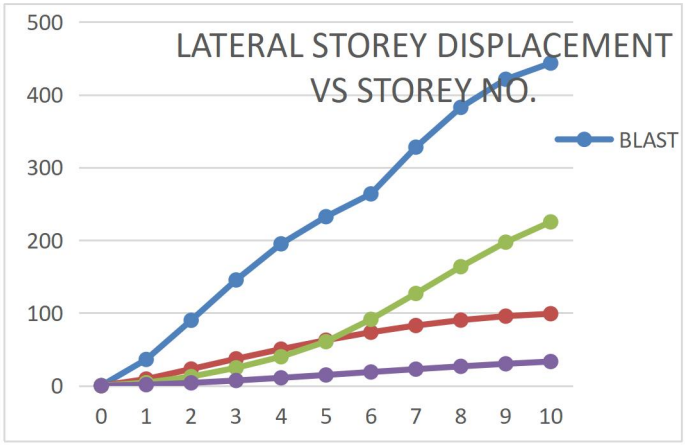
The analysis results are obtained and the different aspects are obtained in the form of tables and graphs. The results are tabulated for the three models and their all the cases are obtained and given.

### 6.2 Building Displacements and storey drift 10 Floors

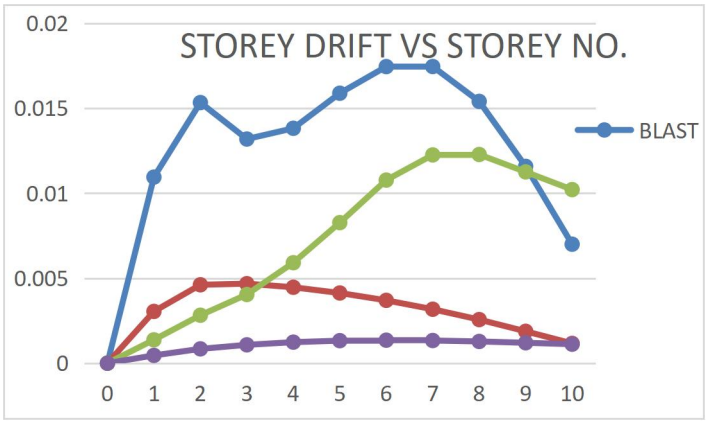
**Table 1: Model 1- Building Displacements and storey drift**

| S.NO | LOAD CASE | MAX STOREY DISPLACEMENT | MAX STOREY DRIFT |
|---|---|---|---|
| 1 | BLAST LOAD | 443.60 | 0.0213 |
| 2 | BLAST LOAD WITH SHEAR WALL | 225.20 | 0.0122 |
| 3 | EARTHQUAKE LOAD | 98.96 | 0.00467 |
| 4 | EARTQUAKE LOAD WITH SHEAR WALL | 33.2 | 0.00135 |

**For 10 floors**




**Graph 1- Lateral Storey Displacement Vs Storey No.**



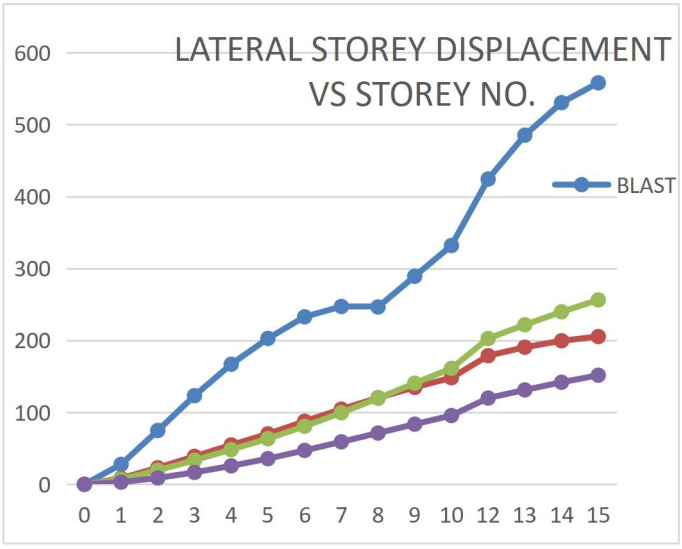
Graph 2 - Storey Drift Vs Storey No.

### 6.2 Building Displacements and storey drift 15 Floors

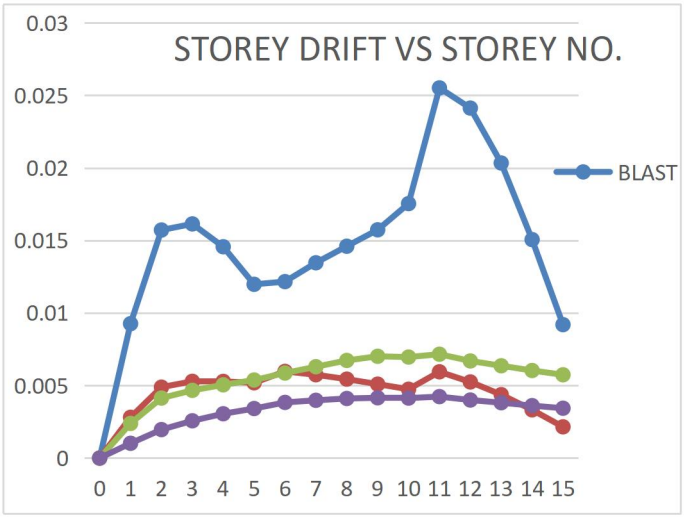
**TABLE –2: Model 2- Building Displacement and storey drift**

| S.NO | LOAD CASE | MAX STOREY DISPLACEMENT | MAX STOREY DRIFT |
|---|---|---|---|
| 1 | BLAST LOAD | 558 | 0.0251 |
| 2 | EARTHQUAKE LOAD | 256.8 | 0.00715 |
| 3 | BLAST LOAD WITH SHEAR WALL | 205.21 | 0.00597 |
| 4 | EARTQUAKE LOAD WITH SHEAR WALL | 151.3 | 0.00423 |

**15 floors**




**Graph 3 - Lateral Storey Displacement Vs Storey No.**



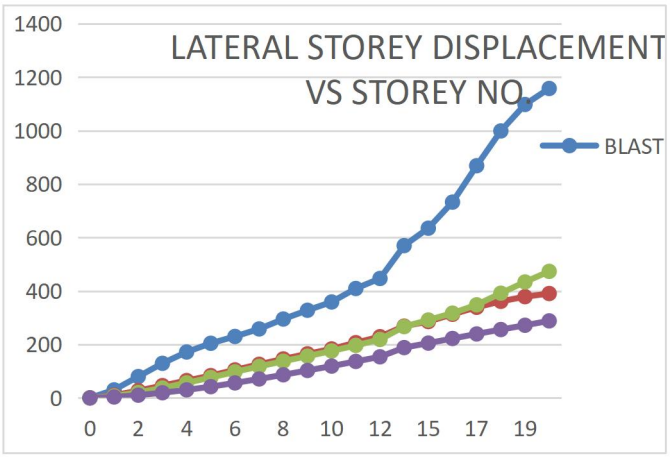

**Graph 4 - Storey Drift Vs Storey No.**

### 6.3 Building Displacements and storey drift 20 FLOORS

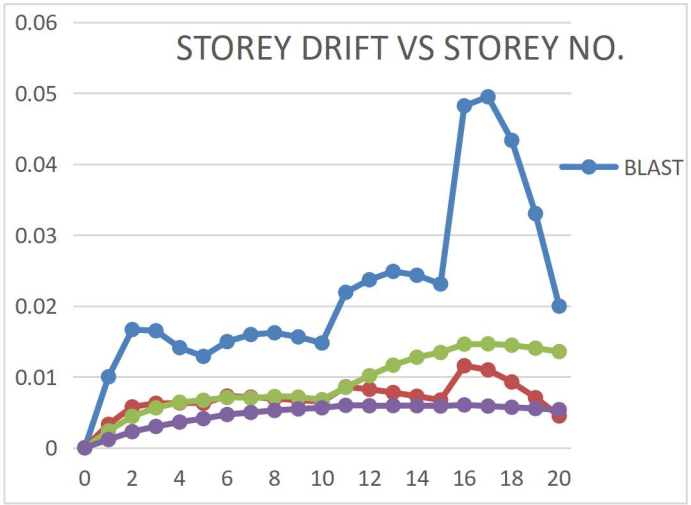
**TABLE –3:Model 3- Building Displacement and storey drift**

| S.NO | LOAD CASE | MAXSTOREY DISPLACEMENT | MAX STOREY DRIFT |
|---|---|---|---|
| 1 | BLAST LOAD | 1157.08 | 0.04948 |
| 2 | EARTHQUAKE LOAD | 473.71 | 0.01464 |
| 3 | BLAST LOAD WITH SHEAR WALL | 390.54 | 0.01156 |
| 4 | EARTQUAKE LOAD WITH SHEAR WALL | 288.11 | 0.00608 |

### 6.4 Building Displacements and storey drift 20 floors




**Graph 5 Lateral Storey Displacement Vs Storey No.**




**Graph 6 Storey Drift Vs Storey No.**

## VI. CONCLUSION

From the above results following conclusion has been drawn.

1. the magnitude for both the types of dynamic loads are same the building is more dangerous in a blast loads case in all the terms as, storey displacement, storey drift, moments and shear.

2. The effect of the blast waves reduces as the distance and magnitude of the blast load reduces such as a higher floor is less affected when a blast explosion occurs at the ground level.

3. The top stories of a building are more displaced as compared to bottom stories.

4. Shear wall works as a very effective addition to the building and highly reduces the effect of any kind of dynamic load and an approx. 45 percent of reduction in the displacement occurs due to shear walls.

We can conclude that building subjected to blast and earthquake load of same magnitude would have more effect of blast load on to the lateral storey displacement, storey drift, moments, shear and other aspects.

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