

Effects of TNT Explosives having Different weights on G+5 Shopping Mall Building

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ABSTRACT

Explosives are very severe problem all over the world due to terrorist's activities. Their aim is to destroy the place where there is large amount of rush. As the shopping malls are having large amount of rush daily so such type of the building should be blast resistant. We are going to study the behavior of shopping mall against blast load. A comparative study is carried out using ETABS software with different weight of TNT explosive using time history calculations and then finally it is concluded that what is the exact difference in the effect of two different weights of TNT explosives. Different parameters are compared using graphical and tabular form. **Keywords:** Blast load, TNT Explosive, ETABS, Time history analysis.

I. INTRODUCTION

A bomb explosion can cause very serious damage on the building's external and internal structural frames. The blast of 100 kg and 500 kg is applied at 30 m distance and governing parameters such as lateral displacement, storey drift, storey shear etc. are studied under these loads.

II. METHODS AND MATERIAL

1. Planning and Details of Shopping Mall



Figure 1: Model of building generated in ETABS

Today there is very severe problem in whole world about explosion. The explosion is the most hazardous manmade disaster. Blast or explosion is the release of large amount of energy in fractions of seconds. Most of the commercial buildings such as shopping malls and multiplexes have large amount of rush daily so they should be blast resistant. So we are going to analyze the shopping mall against two different weights of TNT explosives. ETABS software is used and method of analysis is time history analysis.

Plan dimensions	55m X 33.4m
Total height of building	25m
Height of each storey	4.0m
Height of parapet	1.00m
Depth of foundation	1.0m
Size of primary beams	300mmX600mm
Size of secondary beams	300mmX450mm
Size of columns	300mmX750mm
Thickness of slab	150mm
Thickness of external walls	230mm
Seismic zone	II,III, IV & V
Soil condition	Medium soil
Response reduction factor	5
Importance factor	1

07

Floor finishes	1.8 kN/m^2
Live load at roof level	1.5 kN/m^2
Live load at all floors	4.0 kN/m^2
Live load at staircase, lobby and	5.0 kN/m^2
passage area	
Grade of Concrete	M25
Grade of Steel	Fe500
Density of Concrete	25 kN/m^3
Density of brick masonry	20 kN/m^3

III. RESULTS AND DISCUSSION

3. Blast load analysis

A bomb explosion can cause very serious damage on the building's external and internal structural frames. The blast of 100 kg and 500 kg is applied at 30 m distance and governing parameters such as lateral displacement, storey drift, storey shear etc. are studied under these loads.

3.1 Lateral Displacement

A graph is plotted taking floor level as the abscissa and the displacement as the ordinate, for different models in the transverse direction as shown in figure. The lateral displacement values in tabular form for transverse direction are given in table.

Table 1: Displacement values in transverse direction (Blast Load)

Storey/Model	100kg	500kg
5	246.4	629
4	217	551.2
3	181.1	455.8
2	137.2	339.8
1	87	209



Figure 1 : Displacement profile in transverse direction (Blast Load)

It is seen that there is increment in lateral displacement for increasing in amount of explosion from 100kg TNT to 500kg TNT. For model VI (500 Kg TNT) increment in lateral displacement is up to155% as compared with model V (100 Kg TNT) for the same stand-off distance. This is obvious since intensity of explosion is increased.

3.2 Storey drift

A graph is plotted taking floor level as the abscissa and the storey drift as the ordinate, for different models in the transverse direction as shown in figure. The storey drift values in tabular form for transverse direction are given in table.

Table 2: Drift values in transverse direction (Blast Load)

Storey/Model	100kg	500kg
5	29.408	78.1
4	36.04	95.9
3	43.948	116.676
2	50.876	132.48
1	49.624	127.132



Figure 2 : Drift profile in transverse direction (Blast Load)

8

It is seen that variation of storey drift is mostly similar for both the models and there is increment in storey drift for increasing in amount of explosion from 100kg TNT to 500kg TNT. For model VI (500 Kg TNT) increment in storey drift is up to160% as compared with model V (100 Kg TNT) for the same stand-off distance.

3.3 Storey Shear

A graph is plotted taking floor level as the abscissa and the storey shear as the ordinate, for different models in the transverse direction as shown in figure. The storey shear values in tabular form for transverse direction are given in table.

 Table 3: Displacement values in transverse direction

 (Blast Load)

(21050 2000)		
Storey/Model	100kg	500kg
5	5938.1	15732.5
4	18734.5	51477.21
3	32955.6	92741.99
2	48513.2	138829.7
1	65056.9	142004.9



Figure 3 : Storey shear profile in transverse direction (Blast Load)

It is seen there is increment in storey shear for increasing in amount of explosion from 100kg TNT to 500kg TNT. For model VI (500 Kg TNT) increment in storey shear is up to132% as compared with model V (100 Kg TNT) for the same stand-off distance.

3.4 Base Shear

A graph is plotted taking floor level as the abscissa and the base shear as the ordinate, for different models in the transverse direction as shown in figure. The base shear values in tabular form for transverse direction are given in table.

 Table 4: Displacement values in transverse direction

(Blast Load)		
Model	100kg	500kg
Base Shear	82542.8	192115.8



Figure 4: Base shear profile in transverse direction (Blast Load)

It is seen there is increment in base shear for increasing in amount of explosion from 100kg TNT to 500kg TNT. For model VI (500 Kg TNT) increment in base shear is up to132% as compared with model V (100 Kg TNT) for the same stand-off distance.

3.5 Column Axial Load

A graph is plotted taking floor level as the abscissa and the column axial load as the ordinate, for different models in the transverse direction as shown in figure. The column axial load values in tabular form for transverse direction are given in table.

(Blast Load)

Model	100kg	500kg
column axial		
load	1643.03	4351.64



Figure 5: Column axial load profile in transverse direction (Blast Load)

For comparison purpose front columns are considered. It is seen there is increment in column axial load for increasing in amount of explosion from 100kg TNT to 500kg TNT. For model VI (500 Kg TNT) increment in column axial load is up to164% as compared with model V (100 Kg TNT) for the same stand-off distance.

3.6 Column bending moment

A graph is plotted taking floor level as the abscissa and the column bending moment as the ordinate, for different models in the transverse direction as shown in figure. The column axial load values in tabular form for transverse direction are given in table.

Table 6: Displacement values in transverse direct	ion
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(Blast Load)		
Model	100kg	500kg
column bending		
moment	1139.62	2850.31





For comparison purpose front columns are considered. It is seen there is increment in column bending moment for increasing in amount of explosion from 100kg TNT to 500kg TNT. For model VI (500 Kg TNT) increment in column bending moment is up to150% as compared with model V (100 Kg TNT) for the same stand-off distance.

IV. CONCLUSION

The results from blast load analysis for amount of explosion 100Kg and 500 Kg are compared. The observations are as follows

- The lateral displacement and the inter storey drift comes out to be 150-160% more for 500kg TNT as compared with 100kg TNT.
- Maximum bending moments and axial loads in bottom storey front face column are found upto 150-165% more for 500kg TNT as compared with 100kg TNT.
- There is a difference of about 132% in base shear and storey shear for 500kg TNT as compared with 100kg TNT.
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