© 2016 IJSRST | Volume 2 | Issue 3 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science and Technology

Comparative Study of Earthquake and Blast Load on Commercial Building

Prof. N.N. Shinde[1], Prasad R. Gayaki[2]

[1]Professor, Pankaj Laddhad Institute of Technology and Management studies, Amravati University, Buldana, Maharashtra, India
[2]Student, Department of Civil Engineering, Pankaj Laddhad Institute of Technology and Management studies, Amravati University, Buldana, Maharashtra, India

ABSTRACT

It is very necessary to protect the buildings, specially commercial buildings such as shopping mall, multiplexes, big bazaars etc. From earthquake and explosions occurred due to terrorist attacks or accidents. So in this paper a commercial building is analysed using ETABS software using response spectrum method for seismic analysis and time history function for blast load analysis. Most severe zone i,e zone V results were compared with the two different weights of TNT explosives And then conclusions were made.
Keywords : ETABS, time history analysis, response spectrum method, TNT explosives

I. INTRODUCTION

Nowadays earthquake problems are very severe and also one severe problem is there i,e explosion which is mostly done due to the terrorist attacks. To overcome such types of problems and to protect the structure from such disaster this study is done.

II. METHODS AND MATERIAL

Details of building and analysis

The building considered is the shopping mall building having G+5 stories. The plan dimension of the building is 55m by 33.4m. Height of each storey is kept same as 4m. The details of all models are mentioned below.

Table 1 : Analysis data for building

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
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 passage area	5.0 kN/m^2
Grade of Concrete	M25
Grade of Steel	Fe500
Density of Concrete	25 kN/m^3
Density of brick masonry	20 kN/m^3

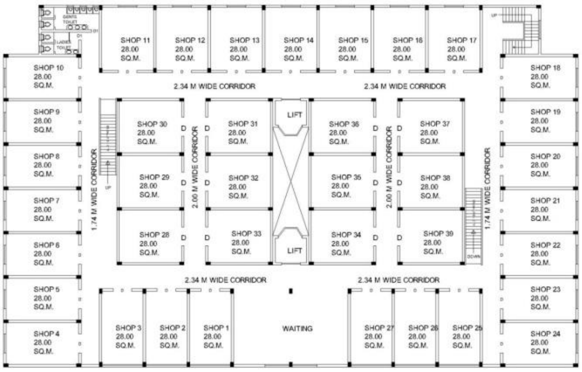

Figure 1: 3rd, 4th and 5th floor plan of building

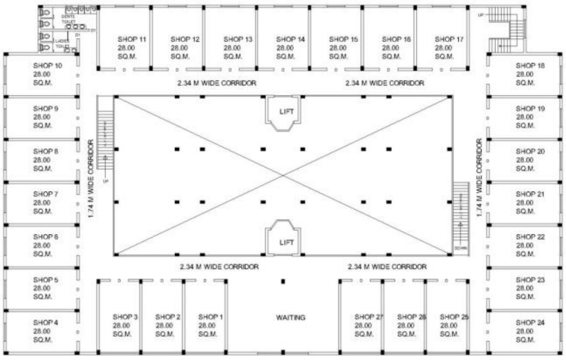

Figure 2: 1st and 2nd floor plan of building

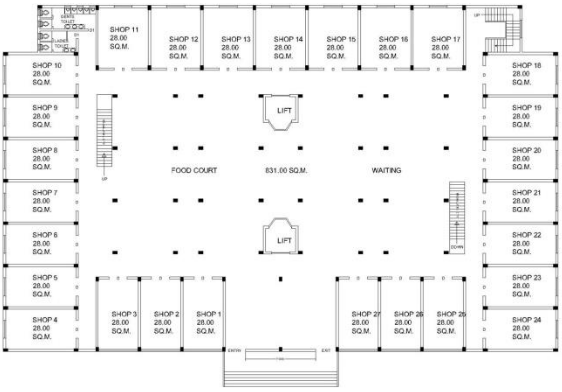

Figure 3: Ground floor plan of building

III. RESULT, COMPARISON AND DISCUSSION

To study severity of blast load, response of building under blast load is compared with response spectrum analysis. Building is considered to be situated in zone V and governing parameters such as displacement, drift, storey shear, axial forces and bending moments in column are compared with blast loading of 100kg TNT to 500kg TNT. The results are presented in the form of tables and graphs.

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 2: Displacement values in transverse direction (Blast Load)

Storey/Model	EQZ-V	100kg	500kg
5	68.5	246.4	629
4	58.8	217	551.2
3	47.4	181.1	455.8
2	34.4	137.2	339.8
1	20.7	87	209

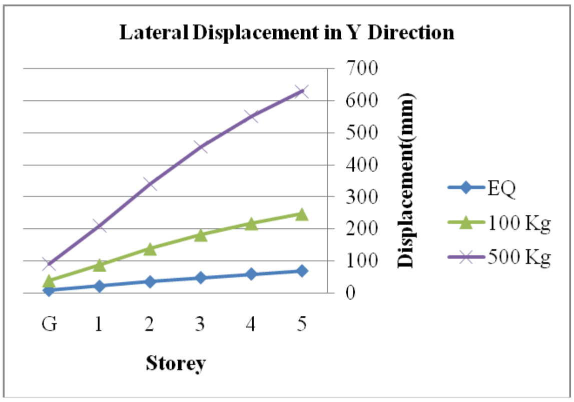

Figure 4: Displacement profile in transverse direction

It is seen that there is increment in lateral displacement in transverse direction for blast load of 100kg TNT and 500kg TNT than earthquake loads in zone V. For model V (100kg TNT) increment in lateral displacement is up to 260% as compared with model IV (EQZ-V) in transverse direction. For model VI (500kg TNT) increment in lateral displacement is up to 818% as compared with model IV (EQZ-V) in transverse direction. It can be concluded that blast is more severe than earthquake for design of some members.

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 3: Drift values in transversedirection

Storey/Model	EQZ-V	100kg	500kg
5	10.184	29.408	78.1

4	11.908	36.04	95.9
3	13.292	43.948	116.676
2	13.916	50.876	132.48
1	12.472	49.624	127.132

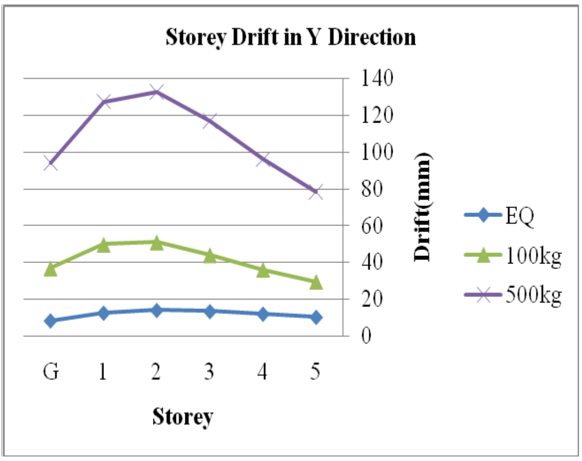

Figure 4.26: Drift profile in transverse direction

It is seen that there is increment in storey drift in transverse direction for blast load of 100kg TNT and 500kg TNT than earthquake loads in zone V. For model V (100kg TNT) increment in storey drift is up to 265% as compared with model IV (EQZ-V) in transverse direction. For model VI (500kg TNT) increment in storey drift is up to 850% as compared with model IV (EQZ-V) in transverse direction.

3. Storey shear

No more than 3 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 4: Storey shear values in transverse direction

Storey/Model	EQZ-V	100kg	500kg
5	4558.92	5938.1	15732.5
4	8827.94	18734.5	51477.21
3	11552.42	32955.6	92741.99
2	13893.42	48513.2	138829.7
1	15538.4	65056.9	142004.9

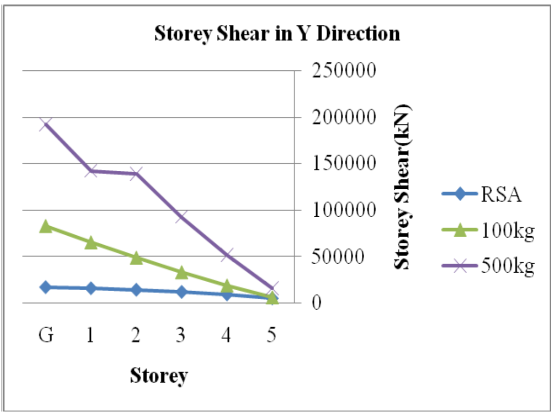

Figure 5: Storey shear profile in transverse direction

It is seen that there is increment in storey shear in transverse direction for blast load of 100kg TNT and 500kg TNT than earthquake loads in zone V. For model V (100kg TNT) increment in storey shear is up to 394% as compared with model IV (EQZ-V) in transverse direction. For model VI (500kg TNT) increment in storey shear is up to 1050% as compared with model IV (EQZ-V) in transverse direction.

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 lateral displacement values in tabular form for transverse direction are given in table.

Table 6: Base shear values in transverse direction

Model	EQZ-V	100kg	500kg
Base shear	16710.41	82542.8	192115.8

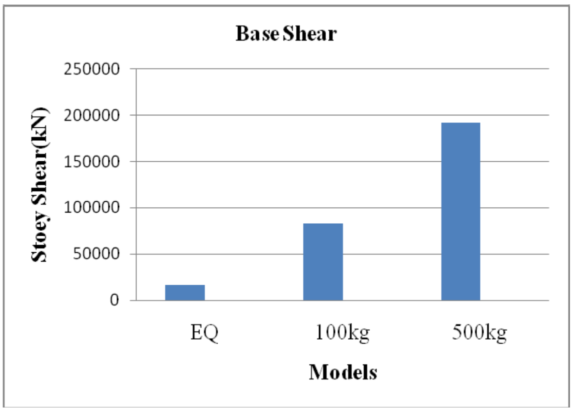

Figure 6: Base shear profile in transverse direction

It is seen that there is increment in base shear in transverse direction for blast load of 100kg TNT and 500kg TNT than earthquake loads in zone V. For model

V (100kg TNT) increment in base shear is up to 394% as compared with model IV (EQZ-V) in transverse direction. For model VI (500kg TNT) increment in base shears is up to 1050% as compared with model IV (EQZ-V) in transverse direction.

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.

Table 7: column axial load values in transverse direction

Model	EQZ-V	100kg	500kg
column axial load	457.92	1643.03	4351.64

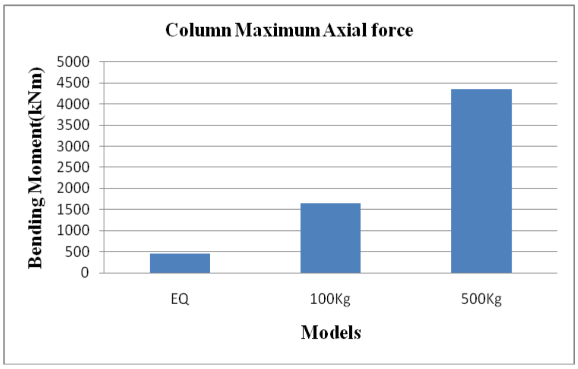

Figure 7: column axial load profile in transverse direction

It is seen that there is increment in column axial load in transverse direction for blast load of 100kg TNT and 500kg TNT than earthquake loads in zone V. For model V (100kg TNT) increment in column axial load is up to 258% as compared with model IV (EQZ-V) in transverse direction. For model VI (500kg TNT) increment in column axial load is up to 850% as compared with model IV (EQZ-V) in transverse direction.

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 bending moment values in tabular form for transverse direction are given in table.

Table 8: column B.M. values in transverse direction

Model	EQZ-V	100kg	500kg
column bending moment	246.88	1139.62	2850.31

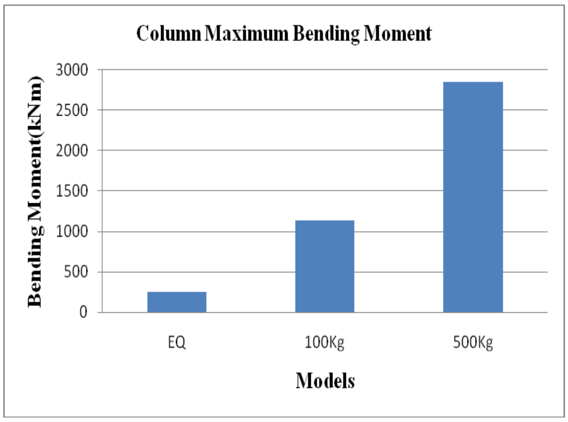

Figure 7: column bending moment profile in transverse direction

It is seen that there is increment in column bending moment in transverse direction for blast load of 100kg TNT and 500kg TNT than earthquake loads in zone V. For model V (100kg TNT) increment in column bending moment is up to 360% as compared with model IV (EQZ-V) in transverse direction. For model VI (500kg TNT) increment in column bending moment is up to 1050% as compared with model IV (EQZ-V) in transverse direction.

IV. CONCLUSION

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

- The lateral displacement and the inter storey drift comes out to be 260% more for blast load as compared with earthquake loads of zone V.
- Maximum bending moments in bottom storey front face column are found upto 360% more for blast load as compared with earthquake loads of zone V.
- Maximum axial load in bottom storey front face column are found upto 260% more for blast load as compared with earthquake loads of zone V.
- There is a difference of about 394% in base shear and storey shear more for blast load as compared with earthquake loads of zone V.

V. REFERENCES

[1] Hrvoje Dragenic, Vladmir Sigmund: “Blast loading on structure” (ISSN1330-365,1UKC/UDK 624.01.04:662.15)

[2] Ruwan Jayasoorya. David P. Thambiratnam, Nirmal J. Parera, Vladis Kosse: “Blast and residual capacity analysis of reinforced concrete framed Building” (Engineering structures 33 (2011) 3483-3495)

[3] Sonia Longjam, S. Aravindan: “Analysis and design of shopping mall against lateral forces” (International journal of engineering science invention ISSN online: 2319-6734, ISSN print: 2319-6729)

[4] Mahesh N. Patil, Yogesh N. Sonawane: “Seismic analysis of multistoried building” (International journal of engineering and innovative technology ISSN: 2277-3754, ISO 9001:2008 certified)

[5] Quazi Kashif, Dr. M. B. Varma: “Effect of Blast load on G+4 RCC frame structure” (International journal of emerging technology and advanced engineering ISSN: 2250-2459, ISO 9001:2008 certified)

[6] Raghvendra C., Mr. Pradeep A R: “Progressive collapse analysis of reinforced concrete framed structure” (International journal of civil and structural engineering research ISSN: 2348-7607)

[7] T.H. Almusallam, P. Mendis, T. Ngo, H.M. Elsanadedy, H. Abbas, S.H. Al-sayed, Y.A. Al-Salloum, M.S. Al-Haddad “Progressive collapse analysis of typical RC building of Riyadh” (Proceeding of the IMPLAST 2010 conference)

[8] Zeynep Koccaz , Fatih Sutcu , Necdet Torunbalci “Architectural and structural design for blast resistant building” (The 14th world conference on earthquake engineering October 12-17, 2008, Beijing, China)

[9] R. Zhang , B.M. Phillips: “Numerical study on the benefits of base isolation for blast loading” (6th international conference on advances in experimental structural engineering, 11th international on advance smart materials and smart structures technology workshop)

[10] Y. Reichman , M. Adan: “Improved design of concrete flat slab buildings for seismic effectiveness and prevention of blast induced progressive collapse” (EJSE Special Issue: Loading on Structures 2007)

[11] John R. HAYES , Stanley C. WOODSON , Chris D. POLAND: “Earthquake resistance and blast resistance: a structural comparison” (13th World Conference on Earthquake Engineering Paper No. 887)