Performance of The Earthquake Resistant R.C.C. Frame Structure Under Blast Explosion

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Abstract- *A bomb explosion in or near a building can cause catastrophic damage to the building's exterior and interior structures like collapsing walls, exploding large windows and closing critical safety systems . Loss of life and injury to occupants can result from many causes, including direct blast effects, structural collapse, debris impacts, fire and smoke. Indirect effects can combine to prevent or prevent rapid evacuation, thus contributing to additional losses. In addition, major disasters resulting from gas-chemical explosions result in significant dynamic loads, higher than the original design loads, of many structures. Due to the threat posed by these extreme loading conditions, efforts have been made over the last three decades to develop structural analysis and design methods to withstand blast loads. Studies have been conducted on the behaviour of structural concrete subjected to blast loads. These studies have gradually improved understanding of the role structural details play in behaviour. The response of earthquake resistant building is subjected to blast load was examined. The work is carried out in SAP 2000v19 and the main purpose of the respect presented in this thesis is to study deeply what the structural behaviour of blast loading at different condition*

Keywords- Earthquake resistant building, Blast loading, R.C.C. frame structure, SAP 2000v19.

I. INTRODUCTION

In the past few decades considerable emphasis has been given to problems of blast and earthquake. The earthquake problem is rather old, but most of the knowledge on this subject has been accumulated during the past fifty years. The blast problem is rather new information about the development in this field is made available mostly through publication of the Army Corps of Engineers, Department of Defense, and other governmental office and public institutes. Due to different accidental or intentional events, the behavior of structural components subjected to blast loading has been the subject of conside rable research effort in recent years. Conventional structures, particularly that above grade, normally are not designed to resist blast loads and because the magnitudes of design loads are significantly lower than those produced by most explosions, conventional structures are susceptible to damage from explosions. With this in mind, developers, architects and engineers increasingly are seeking solutions for potential blast situations, to protect building occupants and the structures. Disasters such as the terrorist bombings of the U.S. embassies in Nairobi, Kenya and Dares Salaam, Tanzania in 1998, the Khobar Towers military barracks in Dhahran, Saudi Arabia in 1996, the Murrah Federal Building in Oklahoma City in 1995, and the World Trade Center in New York in 1993 have demonstrated the need for a thorough examination of the behavior of columns subjected to blast loads. To provide adequate protection against explosions, the design and construction of public buildings are receiving renewed attention of structural engineers. Difficulties that arise with the complexity of the problem, which involves time dependent finite deformations, high strain rates, and non-linear inelastic material behavior, have motivated various assumptions and approximations to simplify the models. This study is carried out for the performance earthquake resistant building under blast explosion condition

II. BACKGROUND

A. EXPLOSION AND BLAST PHENOMENON

In general, an explosion is the result of a very quick release of large amounts of energy in a limited space. Explosions can be classified according to their nature as physical, nuclear and chemical events.

In case of a physical explosion: - The energy can be released by the catastrophic failure of a compressed gas cylinder, the volcanic eruption or even the mixing of two liquids at different temperatures.

In nuclear explosion: - The energy is released from the formation of different atomic nuclei by the redistribution of protons and neutrons in the nuclei acting inside.

In chemical explosion: - The rapid oxidation of fuel elements (carbon atoms and hydrogen) is the main source of energy.

The type of burst mainly classified as

a. Air burst
b. High altitude burst
c. Under water burst
d. Underground burst
e. Surface burst

The destructive action of nuclear weapon is much more severe than that of a conventional weapon and is due to blast or shock. In a typical air burst at an altitude below 100,000 ft. an approximate distribution of energy would consist of 50% blast and shock, 35% thermal radiation, 10% residual nuclear radiation and 5% initial nuclear radiation.

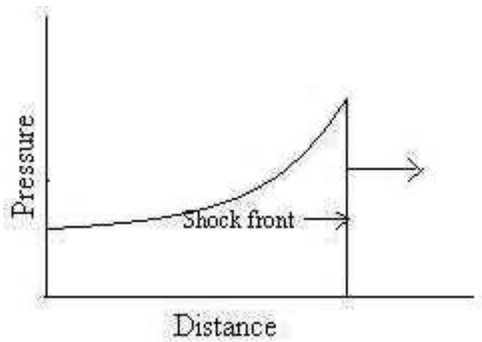

Fig.1 Variation of pressure with distance

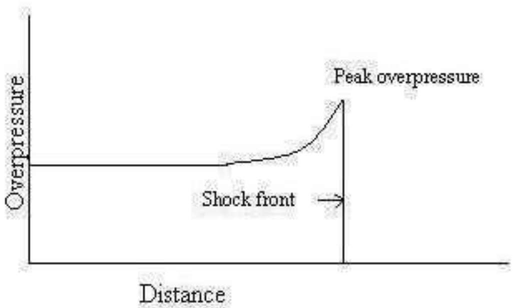

Fig.2 Formation of shock front in a shock wave.

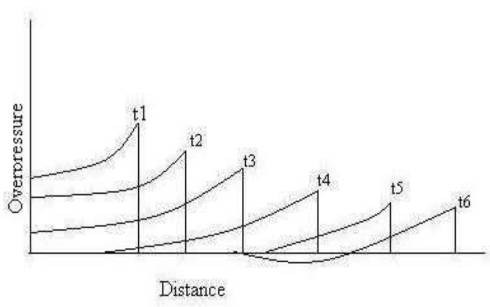

Fig.3 Variation of overpressure with distance from centre of explosion at various times.

The front of the blast waves weakens as it progresses outward, and its velocity drops towards the velocity of the sound in the undisturbed atmosphere. This sequence of events is shown in Fig.3, the overpressure at time t1, t2…..t6 are indicated. In the curves marked t1 to t5 the pressure in the blast has not fallen below that of the atmosphere. In the curve t6 at some distance behind the shock front, the overpressure becomes negative. This is better illustrated in Fig.1.

B. CHARACTERISTICS OF IDEAL BLAST WAVES AND PRESSURE TIME HISTORY CURVE

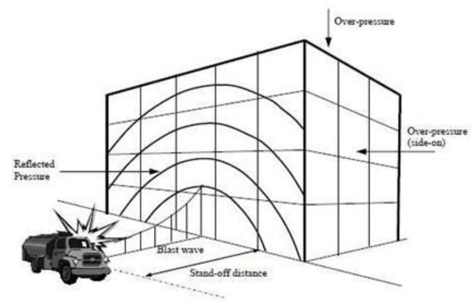

Fig.4 Blast load on building

If the exterior building walls are capable of resisting the blast load, the shock front penetrates through window and door openings, subjecting the floors, ceilings, walls, contents, and people to sudden pressures and fragments from shattered windows, doors, etc. Building components not capable of resisting the blast wave will fracture and be further fragmented and moved by the dynamic pressure that immediately follows the shock front. Building contents and people will be displaced and tumbled in the direction of blast wave propagation. In this manner the blast will propagate through the building.

III. METHODOLOGY

A. BLAST FORCE-TIME HISTORY

The force for the assumed charge weight and scaled distance is calculated manually by using IS:4991-1968 and the variation of force for different time intervals is also calculated manually for each beam-column joint.

B. MEMBER AND LOAD SPECIFICATIONS

Column	0.300 m x 0.750 m
Beams	0.300 m x 0.450 m
Slab	125 mm
Dead	4.14 KN/m^2 for slab
Live loads	3 KN/m^2 for slab
Blast load	calculated manually as per IS:4991-1968
Combination load	1.5 (Dead load +Live load)
	1.2 (Dead load+ Live load) + F.B.L. + S.B.L.

Materials used M30, Fe415

C. DIFFERENT STRUCTURAL SYSTEM FOR BLAST LOADING

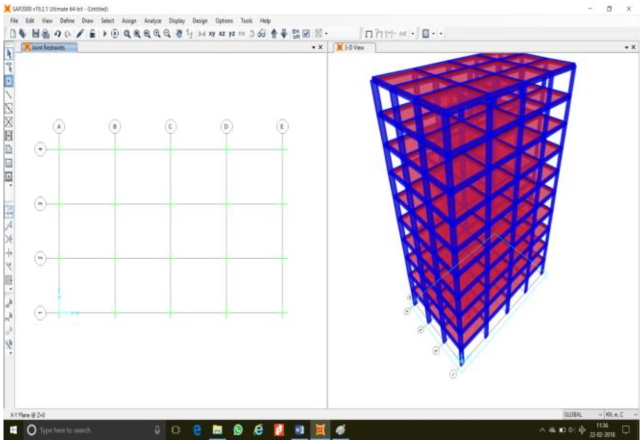

Fig.5 Blast load on simple RCC bare frame

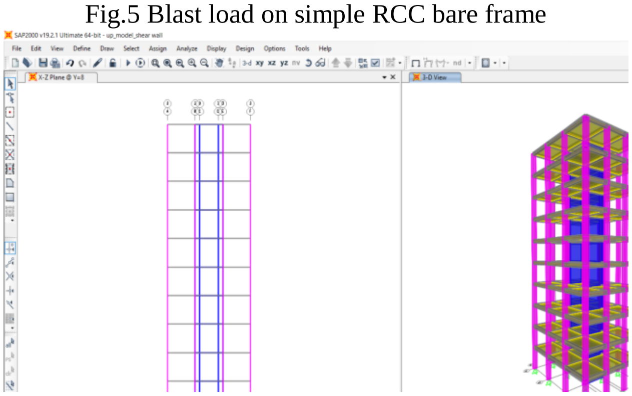

Fig.6 Blast load on simple RCC bare frame with shear wall

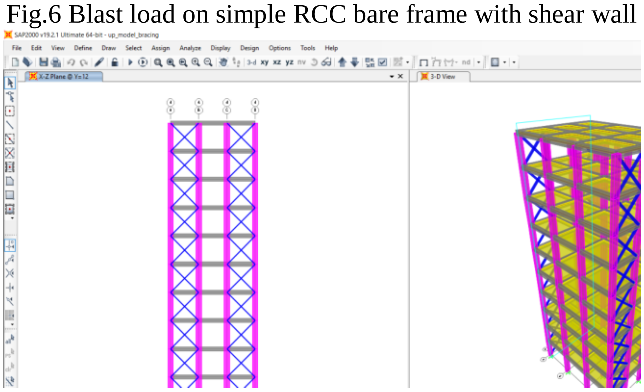

Fig.7 Blast load on simple RCC bare frame with bracing

IV. RESULT AND ANALYSIS

Table 1 Storey drift for 0.1T TNT at 20m away from building

Storey	Bare Frame	Bracing	Shear Wall
1	32.14714	156.7523	393.1824
2	80.89423	267.3172	599.9811
3	141.545	366.7282	754.5847
4	206.2275	456.0681	882.3629
5	270.1514	529.7273	989.6594
6	331.2176	592.9998	1077.075
7	385.5422	646.8069	1146.841
8	433.2044	691.9347	1200.819
9	476.9264	729.362	1240.767
10	516.0975	760.184	1270.053

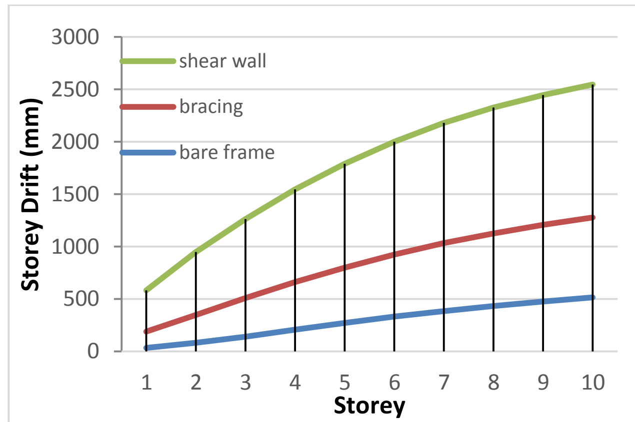

Fig.8 Storey drift for 0.1T TNT at 20m away from building

Table 2 Storey drift for 0.2T TNT at 20m away from building

Storey	Bare Frame	Bracing	Shear Wall
1	652.941	138.5493	46.73506
2	985.7766	257.5053	115.5805
3	1228.227	373.7681	199.8081
4	1425.15	483.1741	288.2921
5	1586.007	582.8315	374.3724
6	1715.832	671.6308	454.78
7	1818.665	749.5383	527.9834
8	1898.062	817.2501	593.9067
9	1957.371	876.0267	653.6259
10	2001.067	927.0401	707.0134

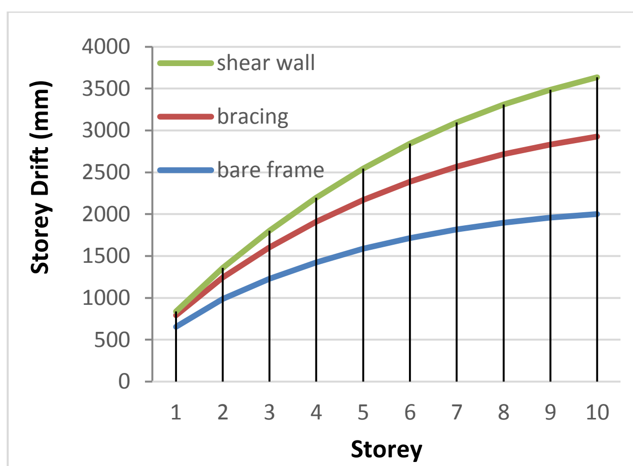

Fig.9 Storey drift for 0.2T TNT at 20m away from building

Table 3 Storey drift for 0.3T TNT at 20m away from building

Storey	Bare Frame	Bracing	Shear Wall
1	858.1172	188.6692	63.12646
2	1303.428	350.1411	155.4065
3	1630.3	507.2329	267.7924
4	1894.711	654.2517	385.1813
5	2109.986	787.8708	498.9992
6	2283.339	906.7656	604.8941
7	2420.216	1010.872	700.8446
8	2525.673	1101.273	786.9166
9	2604.396	1179.744	864.6064
10	2662.47	1247.91	933.7316

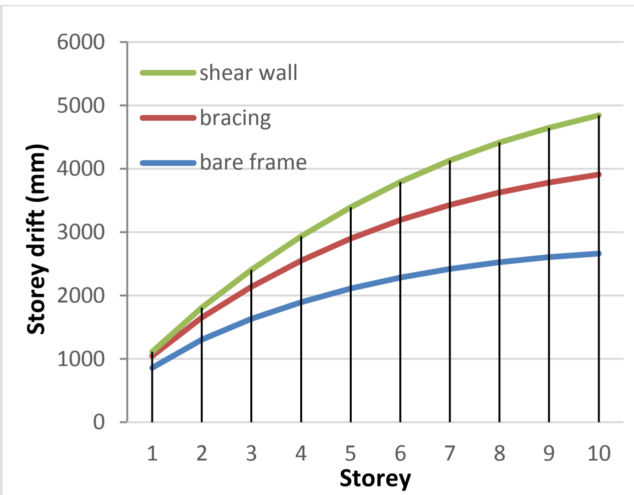

Fig.10 Storey drift for 0.3T TNT at 20m away from building

V. CONCLUSIONS

1. The pressure is less when the point of explosion is far away from the building.
2. For the 0.3T TNT at 20m away from building, blast pressure is high compared to 0.1T & 0.2T TNT.
3. The safe stand of distance for building chosen is 50m.
4. The pressure decreases exponentially as the charge of the explosive decrease.
5. The pressure is directly proportional to the charge weight of explosive.

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