

Study of Blast Load and Blast Resistant Building

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Abstract— Terrorist attacks are increasing day by day hence the need for blast resistant structures increases. Blast forces causes partial or complete collapse of the structure based on the intensity. Blast loads are progressive loads that must be calculated carefully. This paper presents effect of blast loads on 5 storey

R.C.C building. 100 kg TNT which is kept at 30m away from the building is considered for analysis and designed. Blast loads are calculated manually using ETABS. The influence of blast loads on structure is compared to that of same structure in static condition, Peak displacements, velocity and acceleration are studied.

Key words: - Etabs, TNT, Blast load

1.INTRODUCTION

Instant release of energy from a blast source is termed as blast energy which lasts for few seconds. Intensity of the blast depends upon the distance between the target and the source also the TNT exposition capacity. It is evident that the structural integrity of the blast affected building loses due to the impact. Blast loads may even endanger the life of humans. Recent blast incidents gave engineers and architects new ideas in saving people's life and assets from blast disaster. The explosion is a process of rapid release of energy from a point and it propagates around the spherical point of explosion. This can be of two phases a positive phase and a negative phase. When the gases are exposed to heat or spark explosion occurs. Explosives may of different types such as TNT, RDX, HMX are most common.

Blast loads cannot be avoided but its effects can be minimized by proper evaluation and by providing proper reinforcement. Rapid propagation of energy from one point to another is termed as blasting. Increasing the ductility of the RCC helps the building to withstand blast load up to a greater extend. Proper design and adequate study of the load helps in minimizing the effects. The significance of blast resistant buildings are more common in areas prone to terrorist attacks or near chemical factories. Explosions may of different types mechanical, chemical and nuclear. Mechanical is manually done on purpose for causing damage, chemical and nuclear are accidental. Meenambakkam bomb blast in Aug 12th 1984 is one such incident where so many people were killed at an airport in Chennai. The bombing of Alfred Federal building at Okolona city is also an instance where around 136 lives were lost.

TNT explosive is used to conduct a study Variation in force is calculated in each storey using ETABS. Finally a structure resistant to blast load is obtained.

1.1PROBLEM

In this modern world with advanced technologies proliferating day by day the need to preserve a country's reserve is necessary. Public and commercial buildings are most prone to explosions as they are either thickly occupied or either they might be a country's pride.

Care has to be taken from the initial stage of design itself. Proper planning helps to minimize the damage caused due to the blast and also its repair. Less damaged structures still has the possibility of regain to its original stage compared to a perished one. Although no structure is completely blast resistant effects and impacts can be reduced.

2.BLAST PHENOMENON

Blast or explosion is the rapid release of energy within a space. When an explosion occurs as a result of the spark a pressure wave is created called shock wave. This wave propagates from one point to another. During an explosion the expansion of hot gases produces a pressure wave in the surrounding this wave causes rise in temperature and pressure causing a velocity increase. After a short time the pressure wave front becomes abrupt forming a shock front. The maximum overpressure occurs at the shock front and is called peak over pressure. As expansion proceeds, the overpressure in the shock decreases steadily; the pressure behind the front does not remain constant, but instead, falloff in a regular manner. Another quantity of the equivalent importance is the force that is developed from the strong winds accompanying the blast wave known as the dynamic pressure; this is proportional to the square of the wind velocity, u and the density of the air behind the shock front

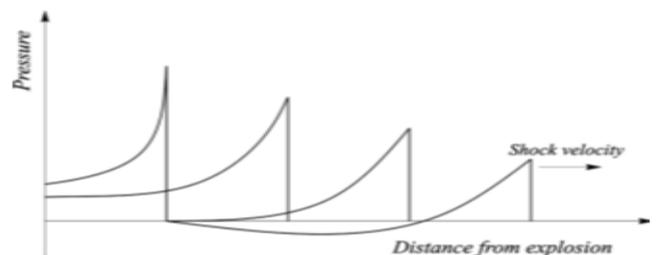


Figure 2.1 Shock wave

3. BUILDING EFFECTS UNDER BLAST LOAD

The response of the building undergone blasting is very complex it involves time depended deformations high strain rate and inelastic behavior. Changes in the building depends upon the intensity of explosive and the distance from which it is used. Loading can cause heat emission, random

projectiles, ground shock, wind and it may even cause damage to the life of people. Thermal effects or heat emission is most common in explosions it emits large amount of heat as fireballs weakening structural members and damaging windows and fire resistant coatings too. The strength of fire depends upon the gases that causes explosion This heat emission might affect the nearby buildings too apart from the main one. Partially deformed structures can be recovered compared to fully affected ones.

Energized projectiles may also be a part of this they may be in the form of fragments, missiles etc. which can hit people and structure causing loss. Objects are thrown away from the explosion with varying velocity and force which moves a certain distance and hits the ground.

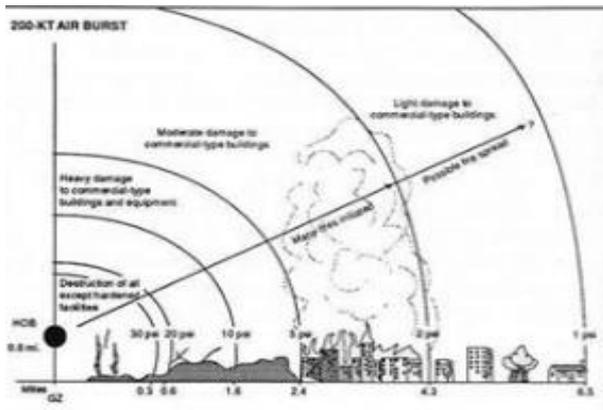


Figure 3.1 Projectile Fragments

When an explosion occurs debris and fragments are thrown away through the air hitting land. This may be of two types primary and secondary fragments. Primary fragments are basically fragments from the explosion while secondary fragments are fragments from windows doors etc. The velocity of the trajectory depends on the size shape and weight of the debris impact too depend on this.

4. BLAST RESISTANT STRUCTURES

Study of blast resistant structures has been a major discussion among architects and engineers since a long time. Although no structure can be completely blast resistant the impact of loads on the building can be minimized to a very great extent if proper planning and implementation is done. Blast resistant structures are mostly needed in areas that are prone to terrorist attack or natural chemical attacks. A structure can be made to withstand blast loads if proper bracing and reinforcements are done accordingly. It is uneconomical to provide each and every buildings with blast resistance capacity but that is an essential factor in areas endangered to terrorists. Not only terrorist attack prone areas these structures can also be used in chemical explosion or leakage risk areas such as chemical factories. This ensures employee safety in extreme environment those usually are subjected to risk of explosions.

Blast resistant structures or prefabricated modules are often used in mining sites and hazardous material storing facilities. These modules are prefabricated with sufficient materials and are transported to the site according to the need. More ductile structure do have the capacity to tolerate

shock. If the structure is brittle chances of settlement are more. Hence it is advised to improve the ductility of the structure to make it stand for the additional load acting on it. Steel is considered as one of the common materials under ductile ones. Steel framed structures seem to be more durable and ductile. Structural steel management study holds immense significance in foreign countries. When a blast wave impacts the surface of a steel blast resistant building, steel walls move minimum referred to us flex. The minimal movement absorbs the energy caused by blast wave and protects the buildings occupant. Other precast concrete do not flex like that of steel. Hence steel is proven to be more resistant to loads.



Figure 4.1 Blast Resistant Building Model

5. RESULTS AND DISCUSSION

Blast phenomenon, blast properties and effects on buildings were evaluated. As per the study it is found that buildings withstand load by providing additional reinforcement bracings and by increasing ductility. Steel structures too help in areas that are prone to explosions.

6. CONCLUSION

The explosion in or near to the structure can cause catastrophic damage to the structure release of thermal energy and debris causing overpressure. Injuries and deaths can be caused by exposure of wave front. Blast resistant structures do help in saving life and assets to a far extend. Steel framed structures too are ductile hence they save the building from shock front.

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