

A Review on “Analysis, design and study of behavior of RC Structure under Blast loading of various intensities”

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Abstract - This review paper covers the study the behaviour of RC structure under blast load and accordingly decide structural aspect for building. terrorism is the most dangerous problem the world is facing today. Blast loads resulting from various types of explosives generates pressure waves that impose dynamic loading on nearby structure, which can lead to failure and loss of lives. Therefore the analysis and design of structure subjected to blast load require a detailed understanding of blast phenomena the study is carrying to understand the properties of blast load wave parameters for the charge amount (100kg TNT) placed at various distances.

Key Words: Force time-history, time displacement, storey drifts, Uplift force.

1. INTRODUCTION

An Explosion is defined as a rapid chemical reaction that occurs in the few milliseconds resulting in the very fast release of energy and hot gases into the surrounding atmosphere. It results in the generation of high pressure and temperature.

The type explosion mainly classified as,

1. Surface burst.
2. Air Burst.

The rapid discharge of energy causes waveform of a pressure in the surrounding space described as Shock front. Due to the explosion, accumulation of hot gases occurs. As a result of this, a wave of a pressure is generated in the medium. The absolute maximum pressure over and above the atmospheric pressure occurring at the shock wave is called as maximum or peak value of Overpressure. The phase in which pressure due to explosion is greater than the atmospheric pressure is called as Positive phase. As the standoff distance ascends, the effect of overpressure in a shock front decreases uniformly and its speed reduces to the speed of the sound of a un-disturbed surrounding medium. After a certain time, the overpressure in the shock front reduces to value

less than that of the medium and hence it is called as a Negative phase.

There are Three kinds of explosions which are unconfined explosions, confined explosions and explosions caused by explosives attached to the structure. Unconfined explosions can occur as an air-burst or a surface burst. In an air burst explosion, the explosion of the high explosive occurs above the ground level and intermediate amplification of the wave caused by ground reflections occurs prior to the arrival of the initial blast wave at a building. As the shock wave continues to propagate outwards along the ground surface, a front commonly called a Mach stem is formed by the interaction of the initial wave and the reflected wave.

A surface burst explosion occurs when the detonation occurs close to or on the ground surface. The initial shock wave is reflected and amplified by the ground surface to produce a reflected wave. the reflected wave merges with the incident wave at the point of detonation and forms a single wave.

The peak pressure is developed when the blast waves strike the surface of the building which is perpendicular to the direction of propagation of the wave and gradually decreases to zero, The Peak side-on over pressure develops when blast waves does not have obstruction in their direction of propagation of wave but develop the drag force on the members and the pressures obtained in Table 1 of IS:4991-1968 are converted into force by multiplying with area contributing to beam column and acting on front face of the building which lasts for 20millisecond's.

2. RELEVANCE

Blast protection have become an important consideration for structural designers due to increase in terrorist attack in the recent days. Conventional structures are not designed to resist blast loads hence they are susceptible to damage from explosion. Designing the structure blast resistant is not a realistic and economical, however current object of civil engineers is to minimize the effect of

explosion and describes measures for minimizing the effect of explosion and providing protection to human, structure and valuable things inside.

3. LITERATURE REVIEW

Zeynep Koccaz Fatih Sutcu and Necdet Torunbalci(2008) During the architectural design, the behavior under extreme compression loading of the structural form, structural elements e.g. walls, flooring and secondary structural elements like cladding and glazing should be considered carefully. In conventional design, all structural elements are designed to resist the structural loads. But it should be remembered that, blast loads are unpredictable, instantaneous and extreme. Therefore, it is obvious that a building will receive less damage with a selected safety level and a blast resistant architectural design. On the other hand, these kinds of buildings will less attract the terrorist attacks.

Structural design after an environmental and architectural blast resistant design, as well stands for a great importance to prevent the overall collapse of a building. With correct selection of the structural system, well designed beam-column connections, structural elements designed adequately, moment frames that transfer sufficient load and high quality material; it's possible to build a blast resistant building. Every single member should be designed to bear the possible blast loading. For the existing structures, retrofitting of the structural elements might be essential. Although these precautions will increase the cost of construction, to protect special buildings with terrorist attack risk like embassies, federal buildings or trade centers is unquestionable.[1]

Aditya kmar singh,Asif Akbari and P. Saha(2014) A blast loading is a very rapid release of stored energy characterized by an audible blast. It imposes extreme loading on window glazing which produces high velocity airborne sharp glass fragments that causes large percent of all nonfatal injuries from the bomb and major part of the energy is transmitted as a shock wave through the surrounding air at a supersonic velocity. The pressure due to blast entering the building can cause bodily harm to occupants and source of extensive property damage. The propagation of blast energy in all directions cause extensive damage to both the object structure and nearby buildings. The design and construction of buildings which resist these kinds of explosions started during World War II in response to air attacks, continued through the cold war and more recently this concern has grown with the increase of terrorism worldwide. Today the modern explosive devices are being used in majority of terrorist attacks because of the ease of access of information on the construction of bomb devices, relative ease of manufacturing, mobility and portability, coupled with significant property damage and injuries. No one can deny the strength of these attacks after 09/11 World Trade

Centre bombing. The terrorist activity has increased and the present tendency suggests that it will be even larger in the future. The fact is that many of the government buildings, civilian buildings, embassy buildings and bridges are at risk to terrorist attacks. That's why the issue of protecting infrastructure against multiple extreme events is gaining importance in civil engineering. Research into methods for protecting buildings against such bomb attacks is required.[2]

NaveenkumarKhatavkar,B.K.RaghuPrasadand

Amarnath K(2016) Design and Structural Evaluation of the Building systems subjected to blast load form the important task of the present generation. Unlike earthquake design, blast resistant design is a new concept which has gained huge importance in order to make structures safe again blast effect. Due to different accidental and intentional acts, the response of the structures for these high impulse, impact loads forms a necessary subject in the recent times. An explosion such as a bomb blast, gas cylinder explosion within or near a building frame system causes a series of effects which are grievous in nature, such as shattering of window panels, damage to the structural elements, collapse of walls and floors, etc. All these situations along with after blast effects such as structural affliction, smoke, fire and debris lead to the loss of life, damage to the surrounding properties and social havoc.

An Explosion is defined as a rapid chemical reaction that occurs in the few milliseconds resulting in the very fast release of energy and hot gases into the surrounding atmosphere. It results in the generation of high pressure and temperature. During explosion the hot gases that are generated occupy the space surrounding, resulting in wave propagation through space which is transmitted spherically or hemispherically through a surrounding medium. Explosions can be differentiated based on the nuclear, chemical and physical chaos,

Physical Explosion - Energy release may be due to the dangerous explosion of compressed gas cylinders or a combination of two liquids at very high temperature etc.

Nuclear Explosion - Energy release due to redistribution of protons and neutrons within in nucleus resulting in the formation of atomic nuclei.

Chemical Explosion - Energy release is due to high rate oxidation of hydrocarbon elements such as carbon and hydrogen atoms.[3]

Amol B Unde, Dr.S.C.Potnis In present work a study of distant blast on the structure is made to find the variation of forces in column foundation like axial force, shear force and bending moment by varying amount of explosive and also by varying the distance of explosion from the building. Building of various height are analyzed so that

effect of height to resist blast is also studied. Load is applied in the form of time history loading. In this paper the blast wave parameters for TNT (trinitro-toulene) charge of 0.1Tonne (T), 0.2T,0.4T, & 0.6T at distances of 30m, 35m and 40m are estimated. The blast wave parameters like scaled distance, peak-overpressure, peak-reflected overpressure, positive phase duration, equivalent triangular phase duration, Mach number are calculated using IS 4991. Using blast wave parameters an analysis is made on a model building with three bay each having 3m span & floor height is assumed to be 3m. Likewise building of 3, 4, 5 6, 7,8,10 & 12 are modeled .The effects of ground shock due to explosion are not considered during the analysis in order to justify this assumption the blast is assumed to be occur at 1.5m above ground level. The loads are assumed to be acting at the beam-column junction on the face of the building subjected to blast wave in the form of concentrated load. To calculate this concentrated load the blast pressure is multiplied by the area contributing to the node. The pressure acting on the side face of the building is calculated by the criteria mentioned in IS 4991.[4]

M. Meghanadh (2017)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. Time history loads are applied for each beam-column joint along dead and live loads and analysis is performed by using finite element method in STAAD Pro for the structural model. Time history loads developed due to blast loads have high intensity initially and gradually decrease to zero in very small interval of time, application of blast load is similar to wind load application on structure but the difference is blast is impulse load which lasts for very short period of time say few milli second's .[5]

4. OBJECTIVES

- To study the explosion types.
- To introduce with blasting material.
- To study Structural aspect of building in military area where possibility of blast due to terrorist attack.
- To study the behavior of structure under blast loading.
- To study the comparison of influence of blast loads on structure in static condition .

5. METHODOLOGY

The study work is to analyse the RC structure(G+5) under blasting. The blast load is calculate as per IS 4991,1968. Analysis is carried out on FEM of analysis to be developed for design and analysis purpose. For successful result analysis will be carried out on different model for various standoff distance of 100kg TNT charge. The comparative report prepare before arriving at the final conclusion. Following methodology will be followed for proposed work:

- Collection of review of journals and articles to get idea of research work conducted on proposed subject of work.
- Studying the phenomenon of blast.
- Selecting Building plan.
- Modelling of structure on stadd pro.
- Load calculation of blast load along with DL+LL using IS4991-1968, And IS 875-1987
- Modelling the different model on staddpro v8i for different stand off distance and type of structure.
- Application of Blast load.
- Analysis of blast load and redesign the structure using Time history analysis in stadd pro.
- Check the stability of structure.
- Plotting result and preparation of Report.

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