A Review On Behavior Of Tall Structure Under Blast Loading

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Abstract - *Today's bomb explosion close to a structure can seriously harm both the interior and exterior of the structure. The building may sustain mild, moderate, or significant damage as a result. This study's primary goal is to compare building models and determine how they react to blast loads using ETABS software. In this investigation, an 11-story building is charged with 100 kg and 200 kg of TNT at 20-and 40-meter stands. The formula for blast parameters is IS 4991-1968.Four more models are examined by putting various structural systems into practice. The models' responses in terms of storey displacement and storey drift are examined in order to identify the model that has the structural component that helps resist blast effects.*

Key Words: Dia-Grid Structure, Structural Design, Seismic Load, E-tabs Software.

1.INTRODUCTION

The investigation of blast impacts on structures has been the subject of formal technical investigation for more than sixty years. An explosion caused by a bomb inside or in close proximity to a building can led to damage to the building's external and internal structural frameworks, the collapse of walls, the fragmentation of large areas of windows, and so forth. Loss of life and injuries to occupants can occur due to various factors, including direct blast effects, structural collapse, fire, and smoke.

Traditional structures are generally not designed to withstand blast loads, and because the magnitudes of design loads are significantly lower than those produced by most explosions, traditional structures are susceptible to damage from explosions. The loading from a blast and its effects on a structure are influenced by several factors, including the weight of the charge, the location of the blast (or standoff distance), and the geometric configuration and orientation of the structure (or direction of the blast). The structural response will vary depending on how these factors come together. Therefore, understanding the impact of a building under blast load is crucial for the safeguarding of a structure.

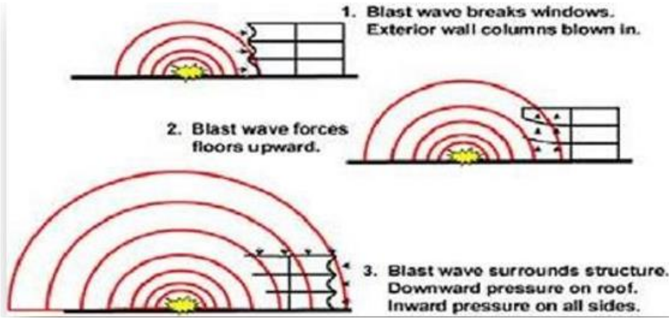

Figure 1: Collapse mechanism due to blast wave.

The initial manifestation of the explosion's shock wave is observed to induce the fragmentation of windows, exterior walls, and exterior columns, as illustrated in the visual representation displayed in figure 1.

Following this, the vigorous character of the shock wave impels the elevation of the floors and slabs, as depicted in the graphical depiction provided in figure 1.

Lastly, the shock wave envelops the edifice, leading to a downward force exerted on the roof and inward pressure exerted on all sides of the structure, as presented in the illustrated representation appearing in figure 1.

The occurrence recognized as air blast encompasses a blast wave that provokes an augmentation in air pressure in the proximity of a architectural formation.

In the event of immediate ground disturbance, when an explosive is either partially or fully submerged beneath the exterior of the ground, it yields a lateral oscillation of the ground, resembling an earthquake but with a discernible frequency.

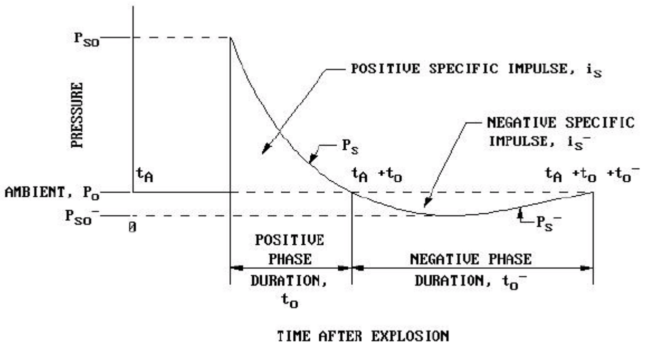

Figure 2: Incident and reflected pressures on building

The An abrupt increase in magnitude and release of energy in an extreme manner, typically accompanied by the production of exceedingly high temperatures and the expulsion of gases, is defined as an explosion. Explosions can manifest in either the form of deflagration or detonation, contingent upon the rate of combustion during the event. Deflagration occurs as a result of the ignited reaction of thermal conductivity, whereby the subsequent layer of colder material is ignited by the hot burning material and subsequently combusted. which entails a supersonic exothermic front that rapidly accelerates through a medium, ultimately leading to the propagation of a shock front directly in its path.

1.2 Objective

- The study aims to model and analyze the impact of external (air blast) explosions on high-rise buildings. Through analytical and numerical methods.
- The objective is to provide evidence of the behavior exhibited by tall structures when exposed to blasts. The obtained results will be thoroughly assessed to evaluate the effects of the analysis on high-rise buildings. Additionally.
- The performance of the Diagrid structure will be analyzed in relation to various parameters, including story drift, story displacement, and base shear. The focus will be on investigating.
- The primary objective of designing an earthquake-resistant structure is to guarantee sufficient ductility to withstand lateral loads.

2. Literature Review

[1] Pranali R. Nikure, Dr. Valsson Varghese A review on study and analysis of blast resistance structure IJEDR 2019

Research on the behavior of blast loading has shown that when standoff distance and charge weight drop, blast pressure increases. Charge weight, standoff distance, and structural configuration are a few examples of these variables that influence how structures respond to blast loads.

Programs like LS-Dyna and AUTODYN have been used to analyze and quantitatively study the behavior of structures under blast loading. To increase the blast resistance of reinforced concrete panels, the use of glass fiber reinforced polymer (GFRP) composites in retrofitting has been studied. Building designs that are resistant to explosions have been examined and evaluated using the Analytical Hierarchy Process (AHP) and Delphi approach. AHP is thought to be precise and effective in decision-making.

In this investigation, the responses of buildings to seismic and blast loads can be compared. A twenty-story structure in earthquake zone 5, for instance, might respond differently to being hit with a specific quantity of TNT at a varied standoff distance. The design of blast-resistant structures requires a deep understanding of blast phenomena, blast load prediction methods, and the dynamic response of structural elements.

[2] Jiji Madonna, Mrs. Vijaya G, Er. Kirankumar K Analysis of high rise rcc building subjected to blast load IRJET 2016.

The acquired results show that when the standoff distance decreases and the charge weight increases, the system is considerably impacted. The length of the standoff becomes the most critical element in safeguarding a building since it affects the blast pressure. Examining the graphical representation of the blast pressure in relation to the storey level makes it evident that the intensity of the blast pressure decreases as storey height increases. This makes sense because the explosion occurs at a lower story level, where there is more pressure.

The graphs demonstrate that while storey drift rises with increasing charge weight, it reduces with increasing standoff. It's also critical to keep in mind that the heavily stressed columns of the first story initially warp and lose their essential capacity to support weight. As a result, the building's geometry collapses along with the columns. Uneven buildings are particularly vulnerable since they have the highest values of inter-story drift.

[3] Shubham Pathak, VishalKoli, Vishwambhar Khomane, Sakharam Shelke, Aditya Nalawade, Behaviour of RCC Structure Subjected ToBlasting

IJIRSET 2018

The system is significantly impacted by both an increase in charge weight and a decrease in standoff distance, according to the results. The length of the standoff, which influences the blast pressure, is the main determinant of whether or not a structure is protected. A graphic representation of the blast pressure vs storey level shows that as storey height rises, the blast pressure intensity falls because the explosion occurs at lower storey levels, where there is high pressure. The graphs demonstrate how the storey drift rises as the charge weight increases and falls as the standoff increases. Moreover, it is seen that the first-floor columns undergo deformation due to elevated pressure, which causes an abrupt loss of vital load-bearing ability.

The most vulnerable kind of structure, with the highest values of inter-story drift, is an irregular building. The top floors have low pressure intensity, therefore the increase in standoff distance between the lower and upper floors has little effect on them. As such, the standoff distance will affect the pressure at different floors.

[4] Bharadwaj Vangipuram, Md. Abdul Jabbar Sharief, B. Bala Sandeep Behaviour of reinforced concrete Structural members under the Infulence of implicit blast loading IJCIET 2019

The structural component analysis reveals that the center of conventional members experiences the most inertial force. Nonetheless, blast resistant members can withstand the load and still have the same explosive impact because of a 20% increase in mass. It has been demonstrated that the member's economic viability is maintained when mass is used as a metaphor for inertial resistance. Furthermore, the supports of the conventional members bear the brunt of the explosion force. Strain energy graphs are used to calculate the energy expenditure for both conventional and blast resistant members. The results show that blast resistant members have an energy level of 0.85 unit. The stark difference here shows how much the conventional members are distorted. Usually, beams suffer bending moments and columns receive axial stresses.

The results In order for the member to withstand both axial and bending loads, it is crucial to maintain equilibrium. It's interesting to note that typical members exhibit strain energy saturation, which indicates severe deformation. On the other hand, blast-resistant members never saturate

[5] Shreya Vedpathak, Prof. Ajay Hamane Analysis of blast resistant structure IRJET 2022

The modelling of blast force increases and the standoff distance falls, the study of the four instances shows a considerable increase in storey displacements and storey drifts. The standoff distance and charge weight values determine the blast's parameters and effects.The analysis of the models shows that the inclusion of different structural elements significantly alters storey displacement and storey drift, resulting in a decrease in these displacements and drifts. which entails making the columns and beams larger, suggests that the construction will be more resistant. However, in some circumstances its application may be limited due to the demand for considerable cross sections of columns and beams.

[6] Nadi A. Swadi and Hussam K. Risan Comparison of blast load main parameters based on Indian standard RJOAS 2017

The American Standard UFC, the 1968 edition of the Indian Standard (IS 4991) did not discriminate between free air bursts and hemispherical surface bursts on the ground. This could certainly lead to a variety of on-ground and on-air explosions with unclear and incorrect designs. In terms of peak pressures, the Indian standard Code produces a notably high number at a short standoff distance when the explosion closed in on the target with respect to UFC.

The research did not recommend employing IS for the construction of buildings subjected to blast loads with short standoff distances because to the impractical design outputs. Moreover, the Indian standard might not provide a sufficient description of the blast load requirements for a close short standoff distance.

3. CONCLUSIONS

The comparison between the combined structure. Several numerical models were developed to investigate how inserting an air layer or aluminum foam layer between two layers of concrete and changing wall thickness could lessen the impact of blast waves on the construction walls.

- Generally speaking, a reasonable amount of the deflection and impulse of various walls are decreased when concrete wall thickness increases.
- It is established that when walls are made thicker from 20 to 40 cm—displace lowers dramatically by an average of 94.25%. This is because the increased thickness of the walls increases their integrity and rigidity.
- Increasing the thickness of the walls is observed to reduce the impulse applied to the walls for all four walls, whether they are reinforced or not. As a result,
- The average blast force applied to the walls is lessened when the thickness of the walls increases.
- While it may have a positive impact on damage and fragmentation, wall reinforcement has little effect on the walls'

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