BLAST PROOF RCC BUILDING BY USING ETABs

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ABSTRACT

The rise in terrorist attacks, particularly in recent years, has demonstrated how important it is to take into account the impact of blast loads on buildings during the design phase. Even though these attacks are rare instances of man-made disasters, blast loads are dynamic loads that require careful calculation, much like wind and earthquake loads. This study aims to clarify ideas surrounding blast-resistant building design, improve building security against explosive impacts in the structural and architectural design processes, and identify appropriate design solutions. For studying the response of the blast loading on structures the seven story building has been taking that is modeled in the ETABs. The response of different loading are studied on the structure. IS 4991-1968 are used for comparable study of the behavior of the structure on different applied loads. First, a quick explanation of explosives and their various varieties has been provided. Furthermore, the general characteristics of the explosion process have been studied on different loadings

Keywords: Blast load, blast waves, High explosive effects, TNT

INTRODUCTION

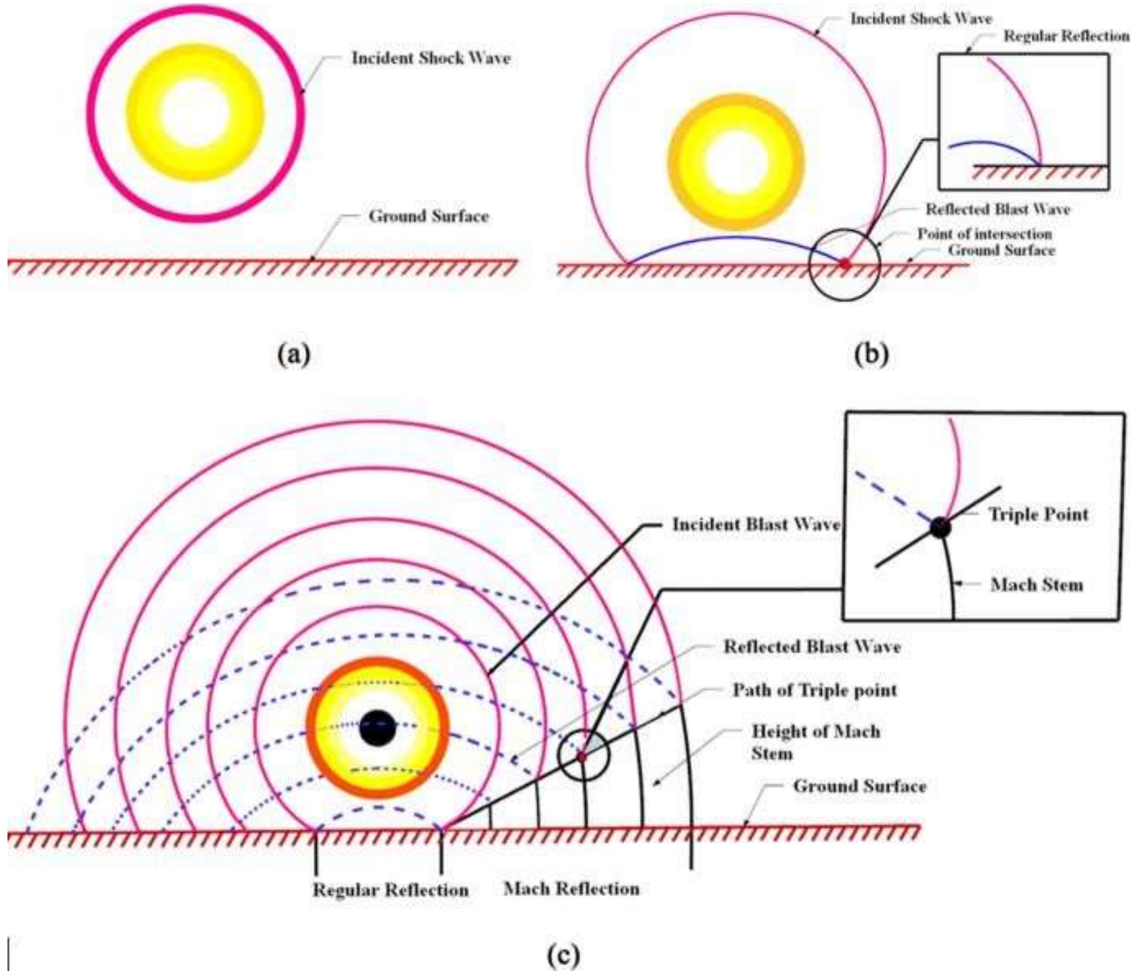
India's tryst with terrorism and violent extremism can be traced back partly to the religion based partition in 1947, which ripped the sub-continent into two nations: India and Pakistan. This territorial dispute lies at the core of the long standing conflict between the two nations with both nations each vehemently rejecting the other's claims. With the rise of terrorism and other threats around the world in the last few years, it has become essential to think about blast load effects from the design stage of a structure, just like we think about earthquake loads, wind loads, etc. The threat of terrorism has become a major concern, and the prevention, prevention and mitigation of terrorism have become a priority for citizens.

The main purpose of this review is to gain insight into the management of the blast induced effects in the design and planning stages of a structure, and to understand the reaction of the structure when subjected to blast loading, with importance given to different Standoff Separations of the impact, as well as different charge loads (TNT) as according to ISO 4991, using ETABS Software. The impa idea should be taken into account at the idea level as it helps to build a highly engineered structure that can show enhanced blast resistance as well as aesthetic appeal. To ensure the safety of existing structures against impacts, a plan for assessment, research and retrofitting should be implemented. Understanding the characteristics of blast will allow us to design buildings to be blast resilient more efficiently. Basic methods for improving a building's blast resistance should be based on both architectural and structural principles. The primary goal of the study is to provide guidance for the design of blast resistant buildings and the use of ETABS software for determining a structure's response to blast load with emphasis placed on the range of Standoff distances of the blast on a building and different charge weights of TNT in accordance with IS'Code 4991. Dead loads, partition wall loads and live loads are included in the study of the building according to IS'Code 875-1987 based on the needs and purpose of the building.

This study's primary goal is to advise engineers and architects in situations where protection against explosions brought on by high explosive detonation is required. The guidelines provide countermeasures to lessen the impact of explosions, protecting people, property, and priceless equipment. Within Information on explosives, blast loading requirements, and improvements for blast-resistant building design from an architectural and structural perspective are also included in the study.

BASIC PRINCIPLE OF BLAST EFFECT

There are ways to blast happen which will differential the working of severity to effect on any construct structure. So what happen is every blast will generate blast wave that will propagate from blast point to nearby structures as we see in this figure, it will reflect from the ground in the air and collide through the building structure in a phase of Mach stem.



The main goal of this study is to advise engineers and designers in situations where safety precautions against explosions caused by high-explosive detonations are required. The guidelines include countermeasures to lessen the effects of explosions, providing protection for people, buildings, and the valuable systems therein. Data on explosives, blast loading factors, and enhancements for blast-resistant structure design, each with a structural and architectural approach, are all included in this study. In the analysis, only explosions resulting from high explosives (chemical reactions) are considered. Condensed explosives are the usual phrase for excessive explosives, which have a stable form. Trinitrotoluene, or TNT, is the most well-known example. Explosions can be classified into three types: unconfined explosions, confined explosions and explosions due to explosives connected to the structure

Air or floor explosions are two possible forms of unconfined explosions

When there is an air burst explosion, the excessive explosive detonates above ground, and the wave is amplified intermediately by floor reflections before the building's original blast wave manifests itself.The interaction of the preparatory wave and the meditating wave forms a front sometimes referred to as

a Mach stem as the surprise wave continues to spread outward alongside the floor.

On the other hand, when the explosion happens close to or on the floor, it results in a surface burst explosion. The floor surface reflects and amplifies the initial surprise wave, creating a pondered wave. Unlike the air burst, the meditative wave documents an unmarried wave by combining with the incident wave at the site of detonation. The majority of terrorist attacks occurred in urbanized settings, where devices are typically installed on or very close to the ground.

Objective Of The Blast Proof Building

The two main goals of blast-resistant building design are:

- Controlled shutdown
- Worker safety.

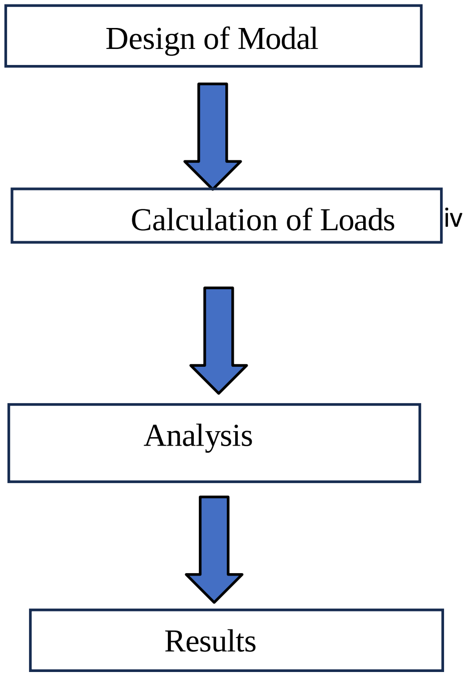
In the case of an explosion,those within the building should have the same level of safety as those outside thanks to blast-resistant architecture. Evidence from earlier instances has demonstrated that a large number of fatalities and significant injuries were caused by buildings collapsing on people who were within them.

The goal is to lessen the likelihood that an explosion will turn the structure into a danger.Another goal of blast resistant design is to prevent cascade events caused by the loss of control of process units not engaged in the incident. The safe operation or orderly shutdown of other units should not be impacted by an event in one of those units.

Another goal of blast resistant architecture is to prevent or minimize financial damages. Structures holding confidential company information, expensive, high-demand equipment, vital or crucial equipment, or equipment that, in the event of destruction, would result in a major disruption or financial loss for the owner should all be safeguard

Methodology:

Steps involved in Methodology of the proposed project works can be explained through given flow chart



Detail of Modal

Building	Specification
Bay Frame Structure	G+6
Column	500mm X 500mm
Beam	400mm X 500mm
Wall	480mm
Slab	180mm

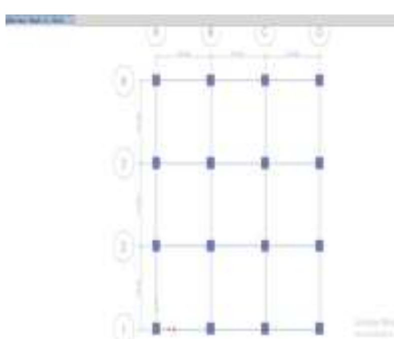


Fig-1 Plan of Building

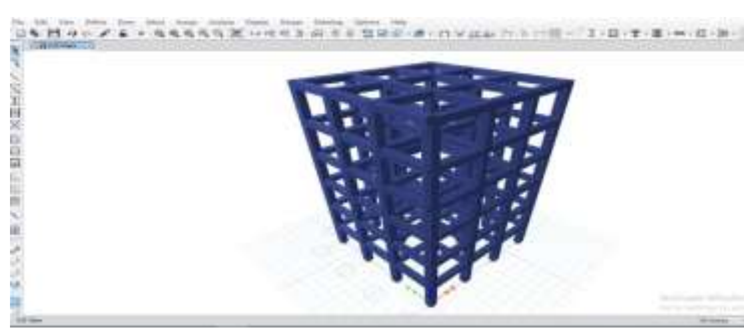


Fig -2 Bay frame structure on ETABs

WALL THICKNESSES AS (IS4991-1968)

For protection against splinters from bombs with equivalent bare charges exploding at a distance of 15 m, the wall thicknesses given in Table 8 will be adequate. Wall thickness taken 48cm for 100kg charge

TABLE 8 MINIMUM WALL THICKNESSES AGAINST FLYING SPLINTERS

Material of Wall	Wall Thickness, cm	
	For Bomb with Equivalent Bare Charge of 50 kg	For Bomb with Equivalent Bare Charge of 100 kg
(1)	(2)	(3)
Reinforced concrete	30	38
Plain concrete or brickwork	34	45

Loads On Building

- **Dead Load (**As per IS 875-I) : 31 KN/m Outer Wall
  : 7.9 KN/m Inner Wall
  : 6.0 KN/m for Parapet Wall
  : 4.5 KN/m^2 for slab
- **Live Load (**As per IS 875-II) :3 KN/m^2 for slab
- **Earthquake Load** :IS 1893 Part -1
- **Wind Load** : IS 875 Part –III

Calculation of blast Load in form Blast Force for a 100 kg charge of explosive (TNT)

The blast masses are calculated by way of the use of this formulation

Scaled distance (m) = actual distance/ Charged weight in lots
Actual distance is received from the code e book IS4991:1968 from table no: 7 primarily based on the sort of constructing The corresponding values of seasoned, Pso are taken from desk 1 of IS: 4991-1968. We adopt the source at a point (0, 1, 0).

Law of scaling

Equation describes how a dimensional scaled distance is given in accordance with Hopkinson-

Cranz regulation.

$$Z = \frac{R}{\sqrt[3]{W}}$$

Where,

R = distance from the detonation source to the point of interest [m]

W = weight (more precisely: the mass) of the explosive [kg]

Table for Presentation of distance from the detonation source to the point of interest

Coordinates of point of interest			Distance between source to target	SLAB
40	1	0	40.0	SLAB -1
40	1	6	40.4	
40	1	9	41.0	
40	4	0	40.1	SLAB -2
40	4	6	40.6	
40	4	9	41.1	
40	7	0	40.4	SLAB -3
40	7	6	40.9	
40	7	9	41.4	
40	10	0	41.0	SLAB -4
40	10	6	41.4	
40	10	9	42.0	
40	11	0	41.2	SLAB -5
40	11	6	41.7	
40	11	9	42.2	
40	14	0	42.1	SLAB -6
40	14	6	42.5	
40	14	9	43.0	
40	17	0	43.1	SLAB -7
40	17	6	43.5	
40	17	9	44.0	

Table for (Pro) Blast load on front face of the building

SLAN	SCALED DISTANCE	Pro (kg/cm²)	Pro (KN/m²)	A (m²)	Force (KN)
SLAB -1	75	0.62	61	3	182
	76	0.61	60	3	179
	77	0.59	58	3	174
SLAB -2	75	0.62	61	3	182
	76	0.61	60	3	179
	77	0.59	58	3	174
SLAB -3	76	0.61	60	3	179
	77	0.59	58	3	174
	78	0.58	57	3	171
	77	0.59	58	3	174

SLAB -4	78	0.58	57	3	171
	79	0.57	56	3	168
SLAB -5	78	0.58	57	3	171
	78	0.58	57	3	171
	79	0.57	56	3	168
SLAB -6	79	0.57	56	3	168
	80	0.56	55	3	165
	81	0.55	54	3	162
SLAB -7	81	0.55	54	3	162
	82	0.54	53	3	159
	83	0.54	53	3	159

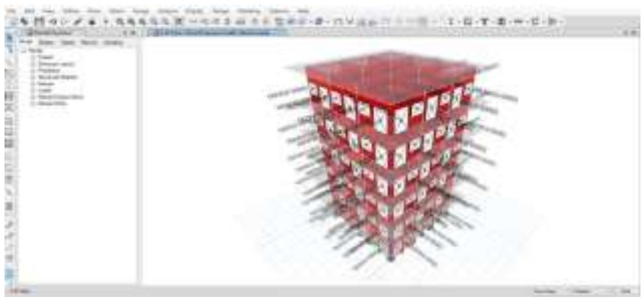


Fig-3 Assign max. blast force on the blast proof building

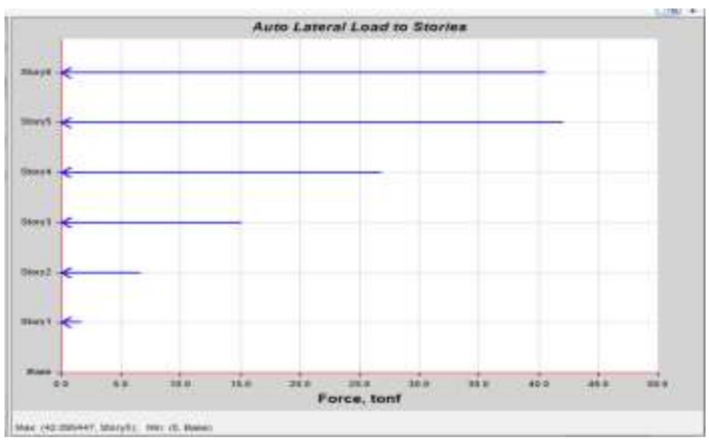


Fig -4 Lateral Blast load to the story

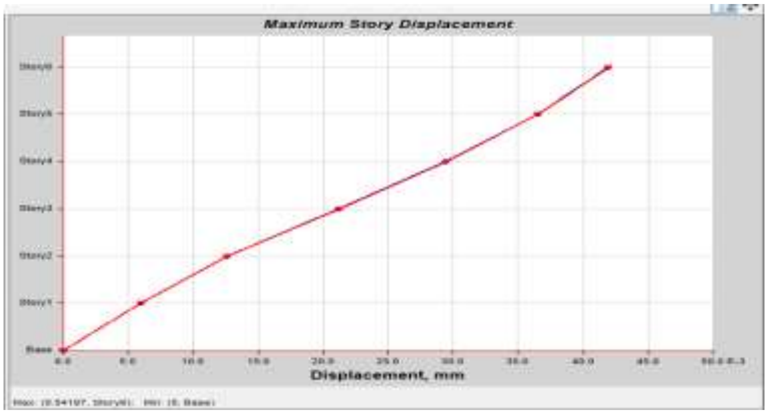


Fig-5 Total resultant displacement if the blast occurred on the face of x& y- direction

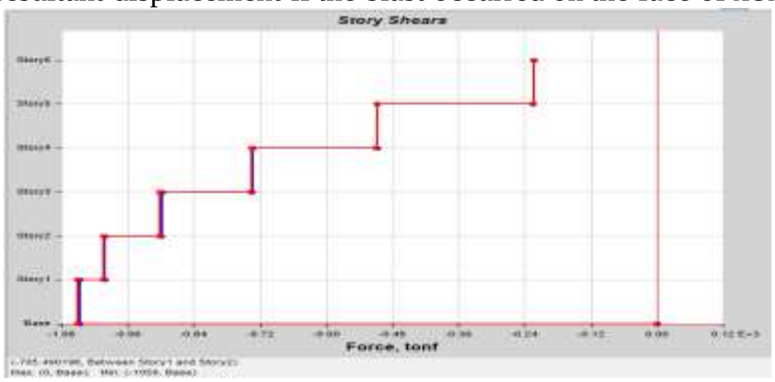


Fig-6 Total resultant Shear if the blast occurred on the face of x& y- direction.

CONCLUSION

The term "blast resistant diagram" describes an improved structural design. The goal of a blast resistant building format is to prevent fatal damages and the fundamental collapse of the structure. Even if it is impossible to precisely forecast the size of the explosion and the hundreds of casualties it would cause, the most likely scenarios will enable the identification of the most suitable engineering and architectural solutions.

Preventing fatalities and complete building collapse is the aim of designing buildings resistant to blasts. Even if it is impossible to forecast the exact size and magnitude of the explosion, the most likely situations will enable the engineering and architectural solution to be found. Determining the risk and its extent is crucial throughout the design stage. The protection of people should come first. Architectural and structural considerations should be made throughout the design phase to guarantee functional continuity in the event of an explosion. Additionally, an ideal building plan needs to be created.

The goal of this research is to design buildings that are resistant to explosions, to be the first in implementing the rules required to prevent structural and human casualties from explosions and other human-caused hazards, and to raise public awareness of the possibility of explosions in daily life. This analysis should take structural and architectural design into account.

The behavior of the structural form under excessive compression stress, such as walls, flooring, and secondary structural elements like cladding and glazing, should be carefully taken into account during the architectural design process

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