SIMULATION AND ANALYSIS OF BLAST RESISTANT STRCTURE DESIGN USING MATLAB

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Abstract— The increase in the number of terrorist attacks especially in the last few years has shown that the effect of blast loads on buildings is a serious matter that should be taken into consideration in the design process. Although these kinds of attacks are exceptional cases, man-made disasters; blast loads are in fact dynamic loads that need to be calculated just like earthquake and wind loads. The objective of this study is to shed light on blast resistant building design theories, the enhancement of building security against the effects of explosives in both architectural and structural design process and the design techniques that should be carried out. Firstly, explosives and explosion types have been explained briefly.

Keywords— Blast Explosion, Resistant Structure, SDOF

I. INTRODUCTION

Last few year the terrorist attacks on structure and human are common around the world so that load of blasting on structure or buildings are serious issues that should consideration of that types of design are required in era. Although these types of attacks are exceptional cases, artificial disasters; blast loads are calculating under fact dynamic loads that need to be calculated just like seismic loads and wind loads. The analysis and research on the blast effects on structures has been an area of formal technical investigation for over 65 years. External explosion or target attack like a bomb explosion within or immediately nearby a building can cause catastrophic damage on the building's internal and external structural frames, disintegration of walls, expectorate of large expanses of windows, and shutting down of critical life-safety systems. Damages to human lives and injuries to occupants can result from many reasons, including direct blasting-effect, structural damages of collapsing, debris impact, fire, and smoke. The indirect effects can combine to inhibit or prevent timely evacuation, thereby take part into additional casualties. In addition, major catastrophes resulting from gas-chemical explosions result in large dynamic loads, greater than the original design loads of many structures.

If the terrorist attacks become a normal in various countries so strategy for developing the blast resisting structure are required. Conventional structures are not considering the design for the resist blast loads and because the magnitudes of design loads are significantly below than generated by blasting, conventional structures are susceptible to damage from explosions. The civilians building are not able to withstand against the kind of extreme attack that would be happened on World Trade Centre in United State of America. Owner of various building and design professionals alike, however, can take steps for better understanding of the potential threats and protect the occupants and assets in an uncertain environment. Building owner, architects and civil engineers increasingly are seeking solutions for potential blast conditions, to provide safety to building occupants and the valuable structures.

The University of Illinois, and other well-known leading engineering firms and educational institutions. The September 11 attacks were a series of four coordinated terrorist attacks by the Islamic terrorist group al-Qaeda against the United States on the morning of Tuesday, September 11, 2001. In the WTO attacks 2996 people killed, injured over 6,000 others, and caused at least $10 billion in infrastructure and property damaged. Additional people died of 9/11-related cancer and respiratory diseases in the months and years following the attacks. In India the 2008 Mumbai attacks (also referred to as 26/11) were terrorist groups that took place in November 2008, when 10 members of Lashkar-e-Taiba under an Islamic terrorist organization based in Pakistan, carried out a series of 12 coordinated bombing attacks and shooting lasting 4 days across Mumbai. The attacks, which drew widespread global condemnation, started on Wednesday 26 November and lasted until Saturday 29 November 2008. At least 174 people lossed their lives, including 9 sharp attackers, and more than 300 were wounded. There was eight of the attacks occurred in South Mumbai at Chhatrapati Shivaji Terminus, The Oberoi Trident, The Taj Palace & Tower, Leopold Cafe, Hospital, The Nariman House Jewish community center, the Cinema, and in a lane behind the Times of India building and St. Xavier's College. There was big powerful attack on Mazagaon, in Mumbai's port area, and in a taxi at Vile Parle.

Now a day increase in public awareness about terrorist attacks in the United states of America and worldwide, many agencies and organizations are currently trying to work on secure methods of constructing facilities in that will survive blast loads due to explosions. Starting while the era of World War first, the military of various countries took an interest in the ability of concrete structures to resist bomb blasts. During time of World War II, the Department of Defence has funded many research and testing programs on RC framed Structure and research on structures elements under blast loading. During the 1960s, an extensive research program was funded by the department for developing criteria for the analysis and design of blast- resistant structures. A major part of the early academic research in the field of blast design was done at the University of Illinois at Urbana – Champaign and at the Massachusetts Institute of Technology. This resulted in the Tri- Services manual designed by the Army as "TM 5- 1300; Structures to Resist the Effects of Accidental Explosions," which was subsequently revised in 1990 [1].

Recent times, the blast loads have gained considerable attention due to various events, accidental or intentional, over important structures in all over the world. As a consequence, in the last ten year there was an important activity in the research of explosive loads. Initially, this work was mostly empirical, but in recent years, important new methods have been developed. The dynamic loads starting from explosions result in strain (ratio of changed length to original length) rates in the material of about 10-1 to 103 s-1. These super extreme loads generate a special properties in the material that is characterized, among other effects, by an increase in strength compared with normal, static properties. These types of attacks on property like important building as well as public building may not be eliminated completely, but the magnitude of these attacks on buildings and structures can be mitigated to a large extent with precautions and pre-emptive strategies related to security and by structural hardening. Security measures are effective and economical in reducing the rate of risk to a structure and its occupants however structural hardening is required to minimize the consequences of any security lapse. The value of upgrading the building for a "certain level" of barriers against terrorist threats may not be significant as compared to the overall lifetime costs of the building (including the Revenue, and security monitoring). Prediction on the exact response is difficult due to the large number of measuring elements involved and the rapid time varying nature of phenomenon therefore understanding the building and its functional utilisation, and possible warning due to terrorist attacks, is essential in identifying strategies that are likely to be most effective to prevent detrimental of the attacks.

An explosion by attack within or immediately nearby a building can cause calamitous damage on the building's internal and external structural members, collapsing of walls, blowing out of large expanses of windows, and shutting down of critical life-safety systems. Due to various accidental or intentional events, the behaviour of structural components subjected to blast loading has been the subject of considerable research effort in recent years. usual structures, particularly that above grade, normal case those are not able to resist blast loads; and because the value of design load is not more than blast load, normal structures are susceptible to damage from explosions. Owner, contractor, architects and civil engineers increasingly are seeking solutions for potential blast situations, to protect building occupants and the structures. Loss of life and injuries to occupants can result from many causes, including direct blast-effects, structural collapse, debris impact, fire, and smoke. The indirect effects can combine to inhibit or prevent timely evacuation, thereby contributing to additional casualties. In addition, major catastrophes resulting from gas-chemical explosions result in large dynamic loads, greater than the original design loads, of many structures. Due to the threat from such extreme loading conditions, efforts have been made during the past three decades to develop methods of structural analysis and design to resist blast loads.

Analysis on the properties of structural member likes RC framed and load bearing structure are subjected to blast loads. These studies are gradually enhanced the understanding of the role that structural details play in affecting the behavior. That's Kind of Bomb blasting creates fear in human and saving the life of human is very important in that type of critical problems. The Design and Construction of Administrative buildings, commercial buildings, hospital, schools, colleges and public places are necessary to develop with blast resistant techniques for safety and other considerations for human life. The design and analysis of structures subjected to blast loads require a detailed understanding of blast phenomena and the dynamic response of various structural elements. This gives a comprehensive overview of the effects of explosion on structures. The design of Residential and other building constructions is required to develop in such a manner due to which it can withstand the effect or impact of these kind of blast attacks at some level. For that kind of design defense structures are required for study and development. Due to implementation of defense (military) design structures the objectives are achieved like safety of people, safety of building and constructions and it will also save lives and evacuate victims.

II. REVIEW ON BLAST RESISTANT STRUCTURE

Explosive detonations create an incident blast wave, characterized by an almost instantaneous rise from atmospheric pressure to a peak overpressure. As the shock front expands pressure decays back to ambient pressure, a negative pressure phase occurs that is usually longer in duration than the positive phase as shown in Figure 1.1. The negative phase is usually less important in a design than the positive phase. When the incident pressure wave impinges on a structure that is not parallel to the direction of the wave's travel, it reflected and reinforced, producing what is known as reflected pressure. The reflected pressure is always greater than the incident pressure at the same distance from the explosion. When a shockwave strikes a surface, it is reflected. Due to the reflection and corresponding momentum change there is a rise in pressure called reflected overpressure on the surface

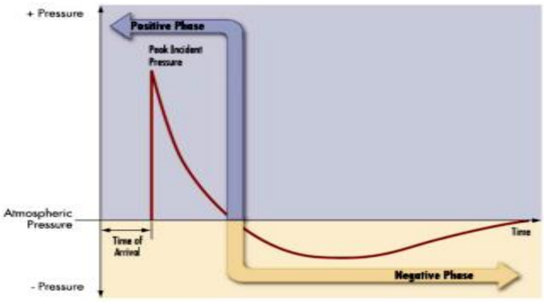

Fig 1: Overpressure-time history indicating sharp initial drop and extended negative phase (FEMA 426, 2003) [9]

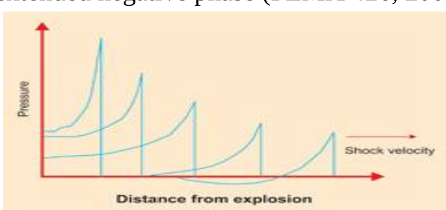

Figure 2: Blast wave propagation [10]

Shock Wave are defined as The rapid enlargement of hot or warm gases resulting from the detonation of an explosive charge gives rise to a compression wave (Figure), that's propagate throughout the air. In practice the shocked wave can considered steep in front of blast shock. That is the time required for compression of the undisturbed air just ahead of the wave to full pressure just behind the wave is essentially zero. From the figure 2 it can be concluded that if the explosive source is spherical, the resulting shock wave will be spherical, since its surface is continually increasing, the energy per unit area continually decreases. Consequently, as the shock wave travels outward from the charge, the pressure in the front of the wave, called the peak pressure, steadily decreases. At great distances from the charge, the peak pressure is infinitesimal, and the wave can be treated as a sound wave. Behind the shock wave front, the pressure in the wave decreases from its initial peak value. At some distance from the charge, the pressure behind the shock front falls to a value below that of the atmosphere and then rises again to a steady value equal to that of the atmosphere. The part of the shock wave in which the pressure is greater than that of the atmosphere is called the positive phase and, immediately following it, the part in which the pressure is less than that of the atmosphere is called the negative or suction phase.

The Chemical explosion develops by the rapid oxidation of the fuel. In this reaction generate the large amount of heat and gases, real, which expands. Low-end explosives create quasi static loads. High explosion (chemical and nuclear) in a surrounding medium, such as air or water, cause shock waves in the medium. The blast releases high-pressure gases at high tempera-tures.

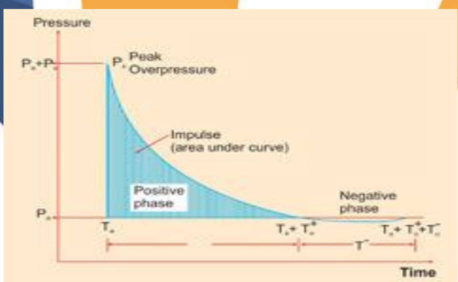

Figure 3: Generalized Blast Pressure History [11]

These gases naturally expand, and the surrounding medium is consequently compressed. The compressed medium, or for the specific case of air, forms a shock front. The shock front travels in a radial direction. As the explosive gases cool and slow their movement, the amount of "overpressure" the shock front carries decreases. The gases release energy to reach equilibrium towards the atmospheric pressure. However, due to the high pressure and mass of the gases, more expansion is necessary to reach equilibrium. This causes the pressure in the shock wave to drop below the atmospheric pressure. After enough "under pressure" is expended, the state returns to the atmospheric pressure. The air behind the shock front also places a load, a drag force, on objects encountered [11]. The general shape of a pulse shape is shown in Figure 3. Important factors pertinent to burst pressures include the peak pressure, the duration, the air density behind the shock front, the velocity of the shock front, and the impulse of the blast pressure.

Dynamic Loadings

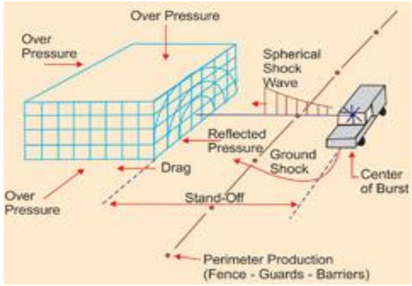

Figure 4: Blast loads on buildings [10]

Drag exerted by the blast winds required to form the blast wave [11]. Push of the winds, tear and tumble things. Blasting loads can generates pressure on structure that are many times more than conventional design loads (Fig 4), and blasting blow can be much more severe than gale. Structure with relatively breakable curtain walls of structure and interior partitions would probably be gutted very early during the blast phase, even at low over pressures. There the load transfer from slab to beam and beam to column then foundation. There are vertical and overturning pressure developed in Foundation. All the structural member design based maximum resist the external forces and stable under entire period of blast loading. Load bearing structure fully damaged under the blasting braces that weak compared of framed structure. The shock waves strike a surface of the structure when structures would experience the combined loading conditions caused by the incident overpressure, the dynamic and highly transient reflected pressure that develop. Possibility of protection of people in basement when sudden great damage caused because basement slabs are provided objection at time of blast phase.

Effects on Structures

Classification of blast effect listed –primary based and secondary.

1. Air blast- The Pressure of air surrounding the structure are increase suddenly by external attack and a wind blasting.
2. Direct ground shock: Ground shocks are defined as the explosive that are partially or complete buried below the ground surface(G.L).That is linear (and vertical, depending on the location of the explosion with regard to the structural foundation) oscillation or vibration of the ground, that is equal to an earthquake wave but frequency of loads are different.
3. Heat: Heat is not new but the part of explosion and that are only form of explosion. In higher rate of temperature any building material does not perform their function. Possibility of fire when temperature is high enough.
4. Primary fragments: In explosion process the micro or small particles separated from somethings with high velocity which are the responsible for structural damages that's are also for injury to human and animal around the building.

Classification of blast loading are (figure4) [9]

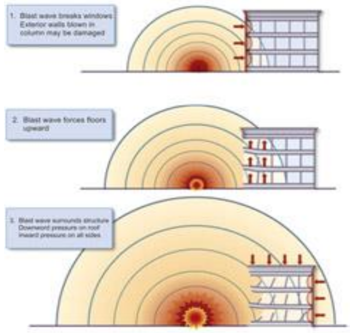

Figure 5: Blast Pressure Effects on a Structure [9]

In the first types of blasting, the consideration the magnitude of blast is high but its far away from structure so the possible damage on structure are relatively small as compared blasting magnitude. Capability of damage of blasting more but the important factor for less damages is distance. The structure is, however, massive enough to resist translation.

The second case of blasting also involves a relatively large blasting waves and a target much smaller than the previous case. The same phenomena happen during this case, but the target is sufficiently small enough to be moved by the dynamic, drag pressure.

In the third case the structure is big and blasting at target in perfection so there are the all components of buildings are damaged, the building becomes week and possibility of collapse.

Structural Response or Analysis to Blast Loading

Impulsive loads are defined as Short duration loading, the shock load similar the impulsive load. Sometime the wave load or shock load are treated as triangular loading system in base of mathematically. The natural period of vibration and ductility of a structure governs its response to an explosion.

in the building construction there are different material used like steel and concrete, the steel are well known example of ductile material and bricks and monolithic glass are example of brittle material. Different material absorbed significant amount of strain energy as per its property, below figure introduced relation between forces v/s times are followed

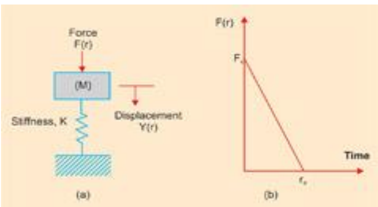

Figure 6: (a) SDOF system (b) Blast loading [8]

(a) Determination of blast properties (b) Determination of the natural response period of the structure (c) Comparisons between natural response period and positive phase of blast. Based on (c) above, the response of the structure can be defined as follows:

i. Impulsive response described as the positive phase duration of the blast pressure is shorter than the natural period of vibration of the structure. In this case, most of the deformation of the structure will occur after the blast loading has diminished.

ii. In quasi-static, the natural period of vibration are less compared to positive phase duration of the blast pressure. In this case, the blasting will cause the structure deformed whilst the loading is still being applied.

iii. In case of dynamic pressure, the value of positive phase duration and natural period of vibration are close in structures deformation in structure are determined by solving the equation of motion in structural Equation of motion for a undamped forced system is given by

MY(t) + KY(t) =F ……………….(a)

Force which is given by

$F(t) = F_0 (1- T / t_d)$ ………………….. (b)

In equation initial condition for triangular pulse is

$Y_0 = 0$ and Vo=0

The total displacement of an un-damped SDOF system is given by [6].

$Y(t) = Y_0 \cos\omega t + (V0/\omega) \sin\omega t + 1/m\omega \int^t_0 F(t) \sin\omega (t-T) dt$- - - - - - (c)

Displacement

Y(t)= Fm/K(1-cosωt)+ Fm/ktd ((sinωt/ω) –t) - - - - - - - - - - - - - -(d)

Velocity

Ý(t)=dy/dt= Fm/K[ωsinωt+1/td (cosωt-1)] - - - - - - - - - - - - - - - -(e)

In which ω is the natural circular frequency of vibration of the structure and T is the natural period of vibration of the structure which is given by equation

ω = 2π/T √=K/M - - - - - - - - - - - -(f)

The maximum response is defined by the maximum dynamic deflection Y_m which occurs at time tm. The maximum dynamic deflection Y_m can be evaluated by setting dy/dt in Equation (c) equal to zero, i.e. when the structural velocity is zero. The dynamic load factor, DLF, is defined as the ratio of the maximum dynamic deflection Y_m to the static deflection Y_{st} which would have resulted from the static application of the peak load F_m, which is shown as follows:

$DLF=Y_m / Y_{st}$ - - - - - - - - - - - - - - (g)

$DLF=1/(2\pi td/T) \{ \sin2\pi (t/T) - \sin2\pi (t/T - td/T) \} - \cos2\pi t/T$ - - - - - -(h)

The dynamic load factor of blast loading is given by equation (h) to be considered in evaluating the correctness of evaluating the dynamic stresses.

The methods available for prediction of blast effects on buildings structures are:

- Empirical (or analytical) methods
- Semi-empirical methods
- Numerical methods.

Empirical methods are essentially correlations with experimental data. Most of these approaches are limited by the extent of the underlying experimental database. The accuracy of all empirical equations diminishes as the explosive event becomes increasingly near field. Semi-empirical methods are based on simplified models of physical phenomena. The attempt is to model the underlying important physical processes in a simplified way. These methods are dependent on extensive data and case study. The predictive accuracy is generally better than that provided by the empirical methods. Numerical (or first principle) methods are based on mathematical equations that describe the basic laws of physics governing a problem. These principles include conservation of mass, momentum, and energy. In addition, the physical behavior of materials is described by constitutive relationships. These models are commonly termed computational fluid dynamics (CFD) models.

Anti- terrorist design

In an effort to minimize the threat of terrorist attack on government and public buildings, architects, engineers, and planners are trying to establish guidelines for “anti-terrorist design”, Recommendations range from general design issues to specific details. Before designing blast resistance into a structure, some evaluation needs to be done to determine the feasibility of such a design. This should include an estimate of what sorts of rational threats may be imposed on the building. The possible aggressors and their likely tactics should be considered. Once a plausible threat is determined, the associated structured loads of such an attack can be calculated. The United States had already begun implementing anti-terrorist planning in the design of its foreign embassies. In the fall of 1984, Congress passed a bill to spend over $350 million to ‘’fortify’’ the posts. Through carefully designing new embassies and increasing security measures at other. The government began determining what makes a building safe from attack.

Typically, explosive blasts lose their intensity as they move away from their source. Therefore, where possible, the most common cost- effective approach to keeping buildings safe is to increase the standoff distance, i.e., to keep potential bombs away from the building. Careful site planning and design can help in this matter. One non-architectural item that helps the most in improving safety is increasing the number and quality of security personnel.

PROPOSED WORK

Simulation of blast effect on building construction

In this section try to cover the model of finite element for RC framed in MATLAB software and detail study of various element of structure. A brief information of properties of ductile material and brittle material and stress stain curve for steel and concrete. Discussion of Codal provision for blast resistant construction (IS-13920), then introduce the MATLAB Software base analysis on Structure.

STRUCTURAL NONLINEARITY

Now in the World terrorist attacks are common for all the countries of world so that importance of nonlinear analysis of reinforced concrete structure are required. In this study are carried out up to perfectly failure of structure and study of possible damages and safety aspect, there are finding of its property are responsible for deformation. The theory of nonlinear analysis depends upon the types of load on material so selection of loads are important ,the Various analysis based on computer programming and software based analysis of reinforced concrete structure the application load for structure are consider as per standard that’s the limitation of analysis. In the fields sometimes accidental loads are more than design load. Individual property of reinforcement and concrete are different, and property of reinforced concrete are varied, the differ nature in cracking, inelasticity and relative property in sense of strength. For detail analysis of the nonlinearity of material the model development of cracked and untracked concrete the gives the load for all stages, in this types of study the model making for its are so difficult.

The major sources, which are responsible for the nonlinear behaviour of reinforced concrete, are: -

1. Appear cracks in concrete
2. Plastic behaviour of the reinforcement and of the Compression concrete

3. The property of concrete which depend on time like creep, shrinkage, temperature, and History of load.

NONLINEARITIES IN REINFORCED CEMENT CONCRETE

The reinforced concrete has complex mixing proportion of ingredient so behaviour of RCC are not taking under linear behaviour, than the strength of structure are changing year by year. The improvement is design philosophy the working stress method become old and the space of it's taken by plastic load method and ultimate strength method. The Reinforced concrete having two types of nonlinearity like material and geometrical. For higher level of deformation in R.C.C both are responsible.

GEOMETRIC NONLINEARITY

The bunch of small deformation and nature of materials are elastic under the loading is the base of Linear structural analysis. The procedure of analysis is based on the initial under formed shape of the structure. As the increase of applied loads, assumption factors are no longer accurate, because of that deformation may causes significantly changes in the structural shapes. The change in shape of structure due to elastic deformation are considered in limit of Geometric nonlinearity. There is large deformation in shape. For example, of 'Euler-Bernoulli Beam' in one dimensional flexural members modelled, the geometric nonlinearity can be reasonably represented by approximating the strains up to second order terms. That are responsible for variation in the stiffness matrix (with additional nonlinear terms, i.e., function of displacements) and the resulting analysis needs to be performed by iterative methods, like direct iteration or the Newton-Raphson method. In Reinforced concrete structures, among the varieties of geometrically nonlinearity, the structural instability or moment magnification caused by large compressive forces, stiffening of structures caused by large tensile forces, change in structural parameters due to applied loads are significant.

MATERIAL NONLINEARITY

The Reinforced concrete have combination of concrete and steel, both material are different in behaviour, than reinforcement is ductile material so it is strong in ductility or tension than concrete is rich in compression and it's under the brittle material. The relationship of tensile stress strain diagram for concrete represent almost linear in beginning then in compression its shows nonlinear. The tensile stress strain relation for steel is nonlinear from begging. The combination of both give nonlinear behaviour.

STRESS-STRAIN CURVES OF CONCRETE

In figure the stress strain curve for various grade of concrete under standard uniaxial compression test. There are showing the linearity and nonlinearity of various grade of concrete, initial phase of loading in various grade of concrete the occurred linearity. The nonlinearity in graph entered when stress level reaches up to one third of its maximum. In the concrete maximum stress is reached at a strain approximately equal to 0.002; beyond maximum, the stress value is decrease and strain in material is increase. For the usual range of concrete strengths, the strain at failure is in the range of 0.003 to 0.005. Internal cracks in mortar and mass concrete are formed when stress level reaches at 90-95 percentage of the maximum. Expansion of concrete is laterally, and Visibility of longitudinal cracks when the lateral strain (due to poison's effect) exceeds the limiting tensile strain of concrete 0.0001.

In figure the curve of stress strain for the lightweight and normal weight of concrete.respectively.in each figure there are presentation of strength of concrete only. In figure the values of higher strength of concrete represented by higher curves. Then changes in curvature when apply of loading is changed. The testing speed and density of concrete are affected on shape of stress and strain curve, but analysis of each figure concluded that, character of all curves are mutual characterize they all are undergoes in same loading in same stage. Various portions of concrete stress stain curve are discussed below:

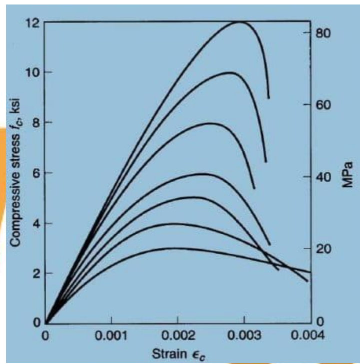

Fig. 7: Set of Stress Strain Curve for Normal Density Concrete

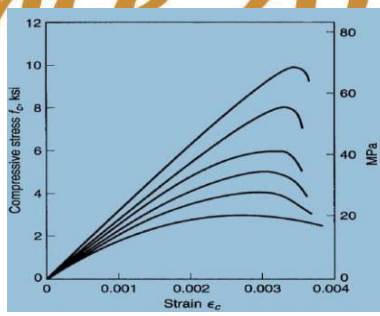

Fig.8: Stress Strain Curve for Lightweight Concrete

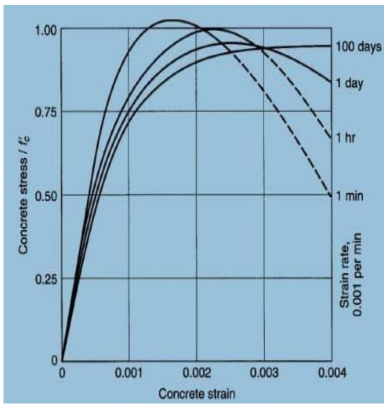

Fig. 9: Stress Strain Curve of Concrete Varies Based on Speed of Testing

1. Straight or Elastic Portion

In initial stage of loading the line is straight observed on graph (figure-7 and figure-8), the law of limit of proportionality follows (the value of stress is directly proportional to strain).The stage of loading the initial stage also known as elastic limit in which after removal of load material gain its original state. The concrete elastic range values continue up to 0.45fc.

Modulus of elasticity of concrete find out from the strain stress curve of elastic part. The modulus of elasticity represents the strength of material. Values and important equation of elasticity are providing in ACI code.

2. Peak Point or Maximum Compress Stress Point

Starting appear of elastic behaviour (Nonlinear) of concrete when load is exceed, Then further increase of applied load the curves of stress- strain becomes horizontal, its horizontal position up to maximum load. The maximum stress value observed at compressive strain ranges from 0.002 to 0.003 for the lightweight concrete in normal condition. However, for lightweight concrete, the maximum stress reached at strain ranges from 0.003 to 0. 0035. The larger length of curve represents for higher result of strain. ACI codes for normal weight concrete, ACI specified that value of strain 0.003 is maximum value of strain that value used in concrete for design purpose of structural element. In Europe the value of concrete assumed 0.0035 assumed by European countries codes.

3. DESCENDING PORTION

After analysis of stress strain curves of various grade all the curves indicates its descending trends when load is maximum, it's also depends on method of testing.

MODULUS OF ELASTICITY & POISSON'S RATIO

Modulus of elasticity is ratio of direct stress to strain and modulus of elasticity is property of material which represented the stiffness. The modulus of elasticity their validation of limit of proportionality and obeys the hook's law in stress strain curves.

The Indian Cods IS-456 gives empirical expression for elastic material is given which is following the terms for theory.

C ck E = 5000 *f*

The Poisson's Ratio is defined as the ratio of the lateral strain to the longitudinal strain, under uniform axial stress. Generally, the poison's ratio value for concrete lies between 0.1 to 0.3.

STRESS-STRAIN CURVE OF STEEL

The steel is ductile material which is subjected under high value of stress and showed plastic behaviour. In initially the acts under elastic material and furthers increase of loading its goes under plastic behaviour i.e. when external load is applied material goes for deformation and after removal of load its gain its original position. Typical uniaxial stress-strain curves are as shown in Figure 10 for various grades of steel.

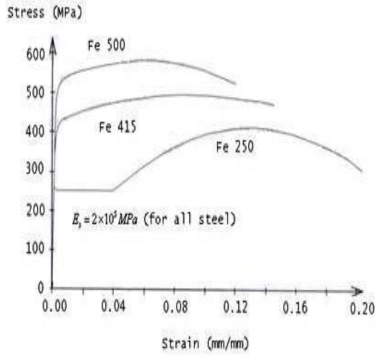

Figure 10 Uniaxial Stress-Strain curves of different steels

As per IS codes the value of Modulus of elasticity of steel (S E) is assumed 2 ×105 N / mm2 (IS-456). Further increase of loading the material goes in yield point. Than the further increasing of loading the material reaches up to the breaking point or at failure point .in that types of behaviour introduced two different possibility of stress strain relationship with two slopes one is tangential modulus (ET).After the point of yielding the slope could be greater equal or less than zero.

IV. SIMULATION RESULTS

Matlab Model of Blast Resistant Building Structure

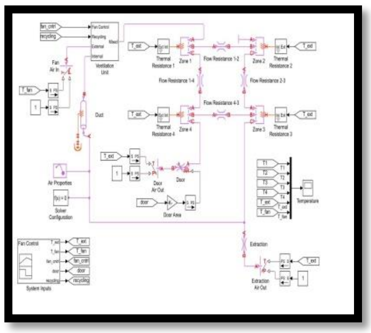

Fig.11- Main System of Building Design for blast resistant structure

In this Matlab Simulation we have design the Matlab model for Building structure for blast resistant effect and the proposed control system will provides temperature, heat and ventilation controlling for reducing the blast effect produced due to blast effect in commercial, home, and other building design structures.

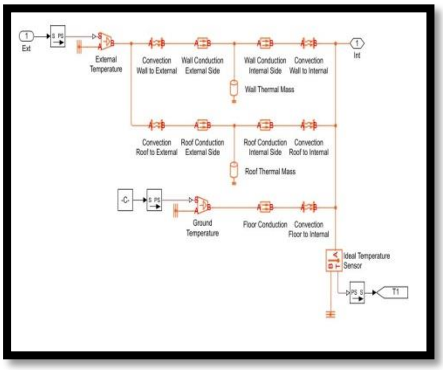

Fig.12- Thermal Effect control subsystem

The control subsystem of fig.12 shows the Thermal effect controlling for any blast effect mitigation or reduced the temperature effect in building design structures, the all block design of Building are shown in this subsystem

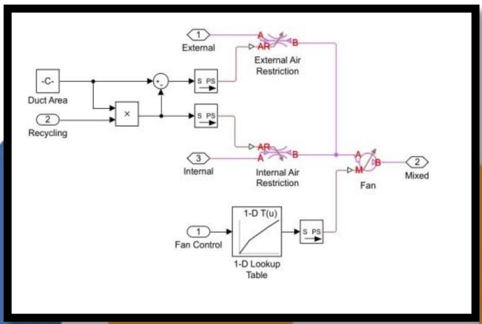

Fig.13- Ventilation Control subsystem

Simulation results of Blast Resistant Building Structure

Fig.14- Building Mass flow controlling subsystem

Fig.15- Blast effect Temperature control output

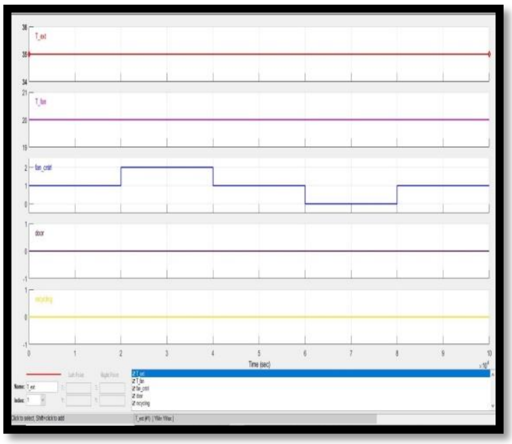

Fig.16- All block temperature output parameters

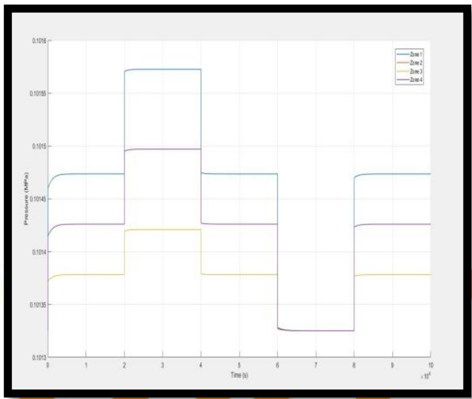

Fig.17- Pressure output parameters of the building structures

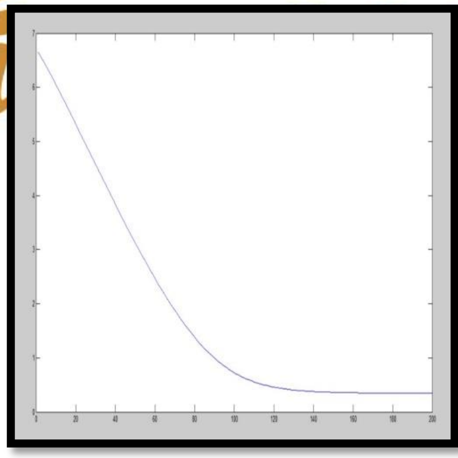

Fig.18- Speed variation control for blast effect variation

Conclusion

The aim in blast resistant building design is to prevent the overall collapse of the building and fatal damages. Despite the fact that, the magnitude of the explosion and the loads caused by it cannot be anticipated perfectly, the most possible scenarios will let to find the necessary engineering and architectural solutions for it. In the design process it is vital to determine the potential danger and the extent of this danger. Most importantly human safety should be provided.

Moreover, to achieve functional continuity after an explosion, architectural and structural factors should be considered in the design process, and an optimum building plan should be put together.

This study is motivated from making buildings in a blast resistant way, pioneering to put the necessary regulations into practice for preventing human and structural loss due to the blast and other human-sourced hazards and creating a common sense about the explosions that they are possible threats in daily life. In this context, architectural and structural design of buildings should be specially considered.

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