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COMPARITIVE ANALYSIS OF HIGH STRENGTH CONCRETE AND NORMAL STRENGTH CONCRETE COLUMN UNDER BLAST LOAD

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Abstract ---*A bomb explosion nearby a structure can cause catastrophic damage on the structure's external and internal structural frames, collapsing of walls, blowing out of large expanses of windows, and shutting down of critical life-safety systems. 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 removal, thereby contributing to additional fatalities. The analysis and design of structures subjected to blast loads require a detailed understanding of blast phenomena and the dynamic response of various structural elements. This gives a complete overview of the effects of blast on structures. The aim of this study is to prevent the collapse of the building Despite the fact that, the magnitude of the explosion and the loads caused by it cannot be predicted perfectly, the most possible scenarios will let to find the necessary engineering solutions for it. Present study includes the comparative study between high strength concrete column and normal strength concrete column under blast load.*

Keywords *-Blast Load, Normal Strength Concrete Column, Total Deformation, ANSYS 15.0.*

I. INTRODUCTION

In the past few years significant importance has been given to problems of blast and earthquake. The earthquake problem is relatively old, but most of the knowledge on this subject has been assembled during the past fifty years. The blast problem is relatively new.In the large number of terrorist attacks whether in India or abroad, use of explosives in different forms has been the main medium for producing the desired fatality of human beings.Such explosions cause mainly two types of disastrous effects: firstly, the blast pressure acting on the target which if beyond the capacity of the resisting elements destroys it through shattering of the element and, secondly, to produce large number of crumbles which may have the energy not only to penetrate through the human bodies but also through the walls. Sometimes there is third effect, creation of fire in combustible materials. Conventional buildings are not designed to resist blast loads because the extents of design loads are unusually lower than those produced by most blasts& their rare probability of the blasts. To provide sufficient protection against explosions, the design and construction of public structures are receiving renewed attention of structural engineers. Difficulties that arise with the complexity of the problem, which involves time dependent finite deformations, high strain rates, and non-linear inelastic material behaviour, have motivated various assumptions and approximations to simplify the models. These models span the full range of difficulty from single degree of freedom systems to general purpose finite element programs such as ABAQUS, ANSYS, and NASTRAN etc

Figure 1: blast on Buildings

The main intension of providing such design is to protect the people inside the structure when a blast takes place and hardening structure. The design must be such that there would be neither fatality to take place. Indeed, the designer must be aware of the egress of stayers and the safe removal of wounded after the event. It is virtually impossible to prevent fatalities in a blast environment.

II. OBJECTIVES OF THE STUDY

- To study blast Phenomenon in detail.
- To perform structural behaviour of normal strength concrete and high strength concrete column subjected to blast loadanalytically.

III. METHODOLOGY

In transient analysis load is applied, material models to be considered to create finite element model and for steps involved in modelling and analysis of the blast resistant column using ANSYS software. A brief analytical study is done for determining total deflection generated in the column under blast load.

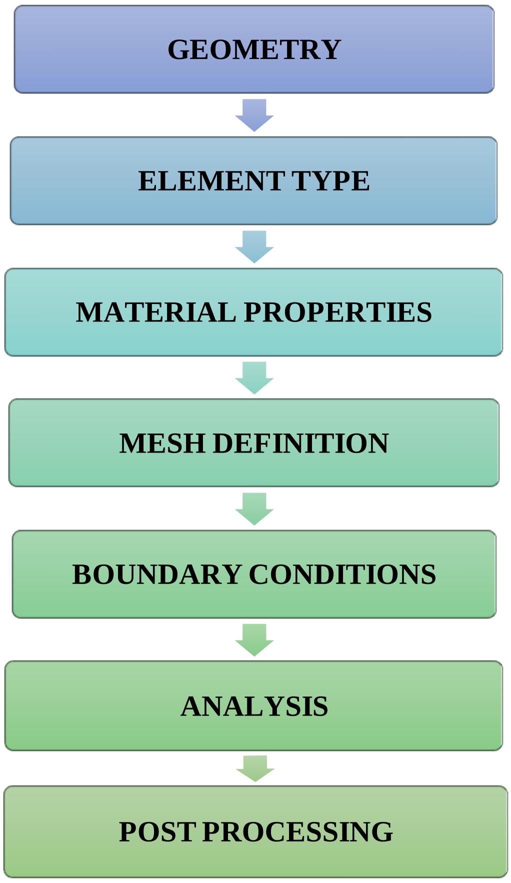

Figure 2: Flow chart depicting procedure for modelling

Modelling with ANSYS – Defining Geometry and Element type:
We create geometry and the element type collectively
A) Modelling with ANSYS – Create Geometry and Element typeCommand to define the element type(Geometry definition takes place using key points which are well connected to obtain an area or volume)
B) Modelling with ANSYS – Material properties
1. Determining engineering coefficients
2. Implementation in ANSYS
C) Modelling with ANSYS – Mesh definitionBefore meshing, it is necessary
1. To select the geometry to mesh
2. To give a material type
3. To give an element type
4. To select the mesh type Free or mapped meshing
5. To define the mesh refinement

D) Modelling with ANSYS – Boundary Conditions
1. To apply boundary conditions
2. To apply displacements constraints
3. To apply loads introduction
E) Modelling with ANSYS – Analysis
F) Modelling with ANSYS- Post Processing

IV. TRANSIENT ANALYSIS OF NORMAL STRENGTH CONCRETE COLUMN IN ANSYS

- Boundary Conditions:

1) Both the Ends are fixed.

- Size of Column:

1) Length - 450 mm
2) Width - 230 mm

- Material Properties:

1) Grade of Concrete- 20.
2) Grade of Steel- 500.
3) Young Modulus- 22360 N/mm^2.
4) Density- 25.
5) Ultimate Tensile Strength- 545 N/mm^2.
6) Tensile Yield Strength- 500 N/mm^2.
7) Compressive Yield Strength- 250 Mpa.
8) Compressive Ultimate Strength- 250 Mpa.
9) Poisson's Ratio- 0.125.

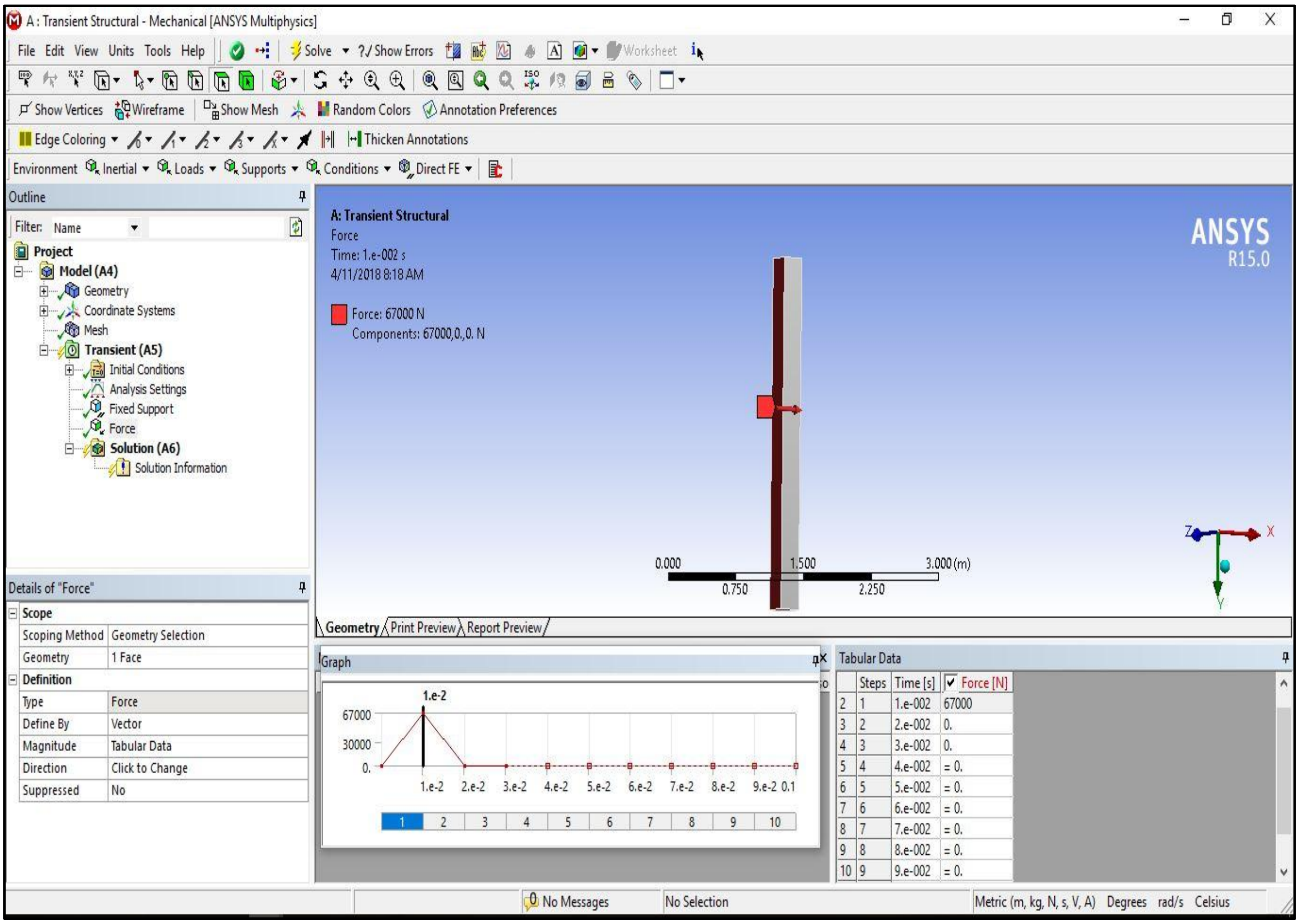

Figure 3: Ansys Model & Inserting the Values of Time and Blast Force on Column.

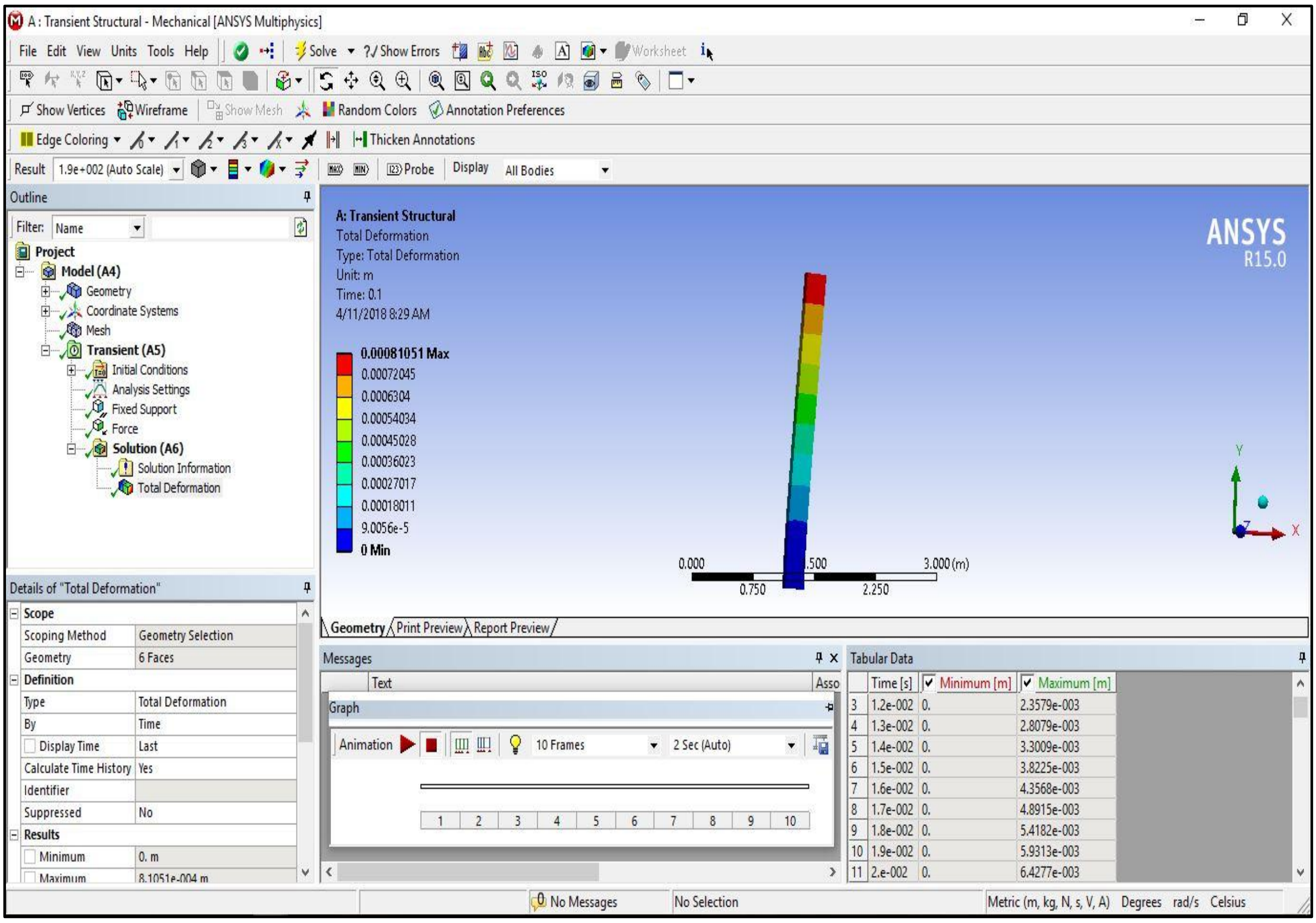

Figure 4: Total Deformation of the Column

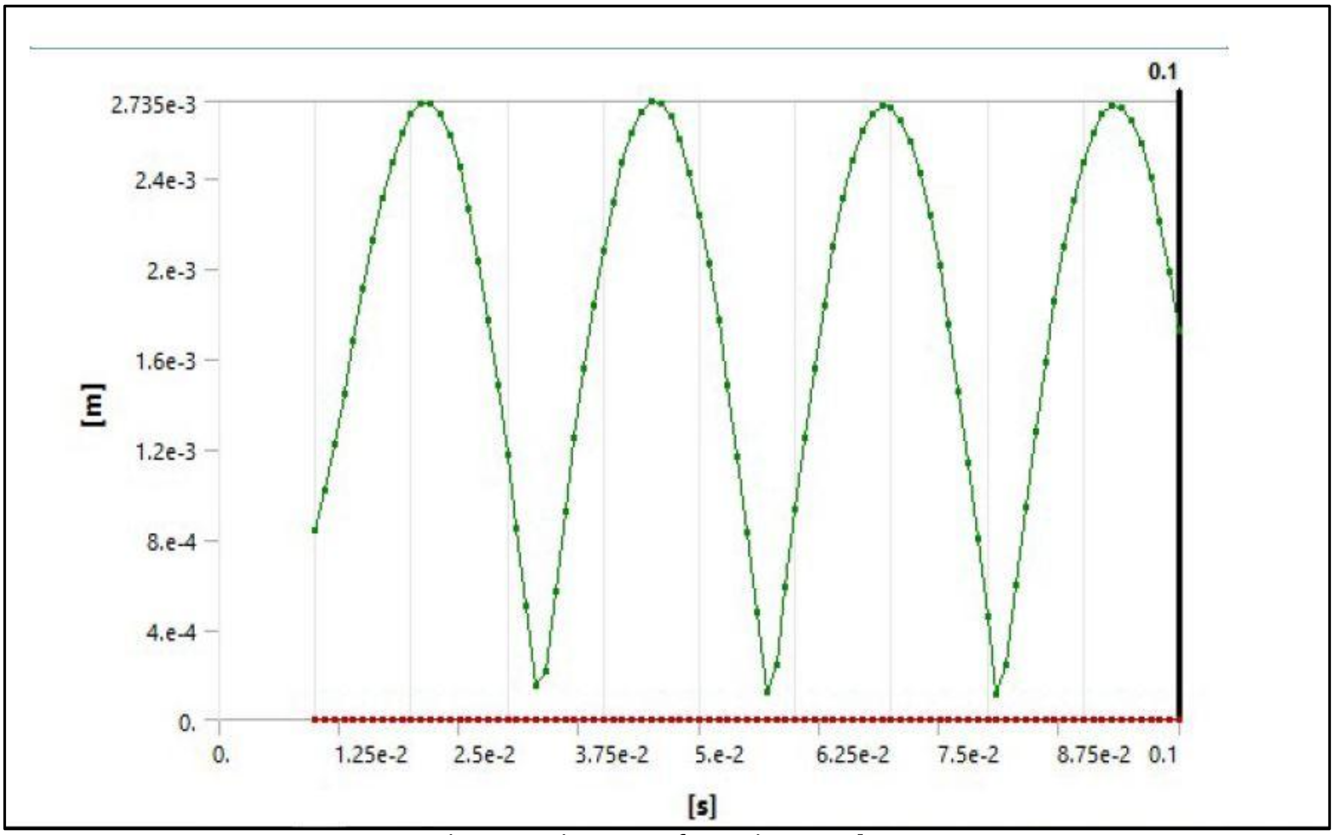

Figure 5: Time vs. Deformation Graph

V. TRANSIENT ANALYSIS OF HIGH STRENGTH CONCRETE COLUMN IN ANSYS

- Boundary Conditions:

1) Both the Ends are fixed.

- Size of Column:

1) Length - 450 mm
2) Width - 230 mm

- Material Properties:

1) Grade of Concrete- 55
2) Grade of Steel- 500.
3) Young Modulus- 37080 N/mm^2.
4) Density- 25.
5) Tensile Yield Strength- 500 N/mm^2.
6) Ultimate Tensile Strength- 545 N/mm^2.
7) Compressive Ultimate Strength- 250 Mpa.
8) Compressive Yield Strength- 250 Mpa.

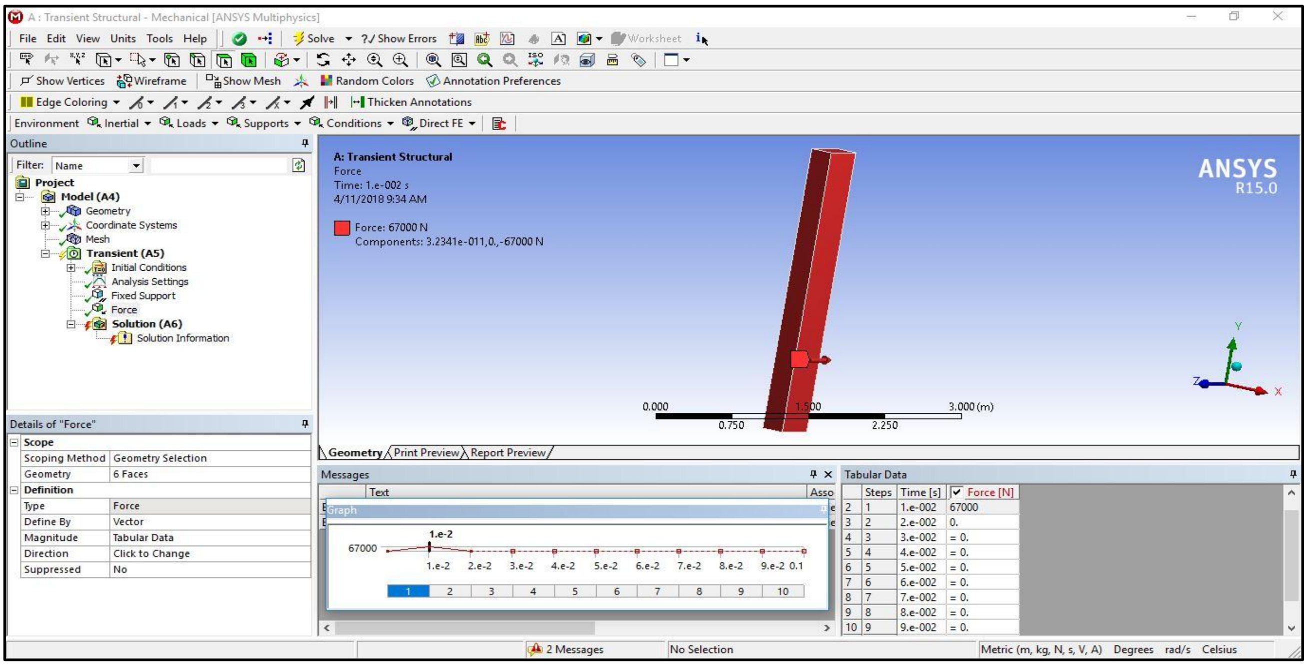

Figure 6: Ansys Model & Inserting the Values of Time and Blast Force on Column.

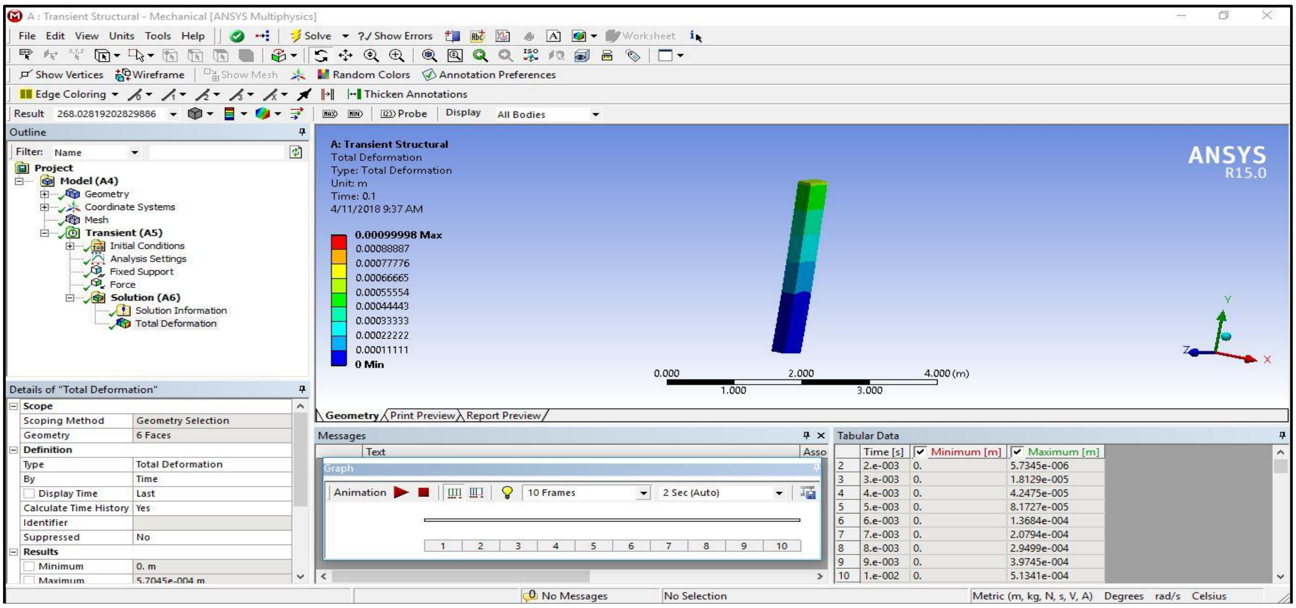

Figure 7: Total Deformation of the Column

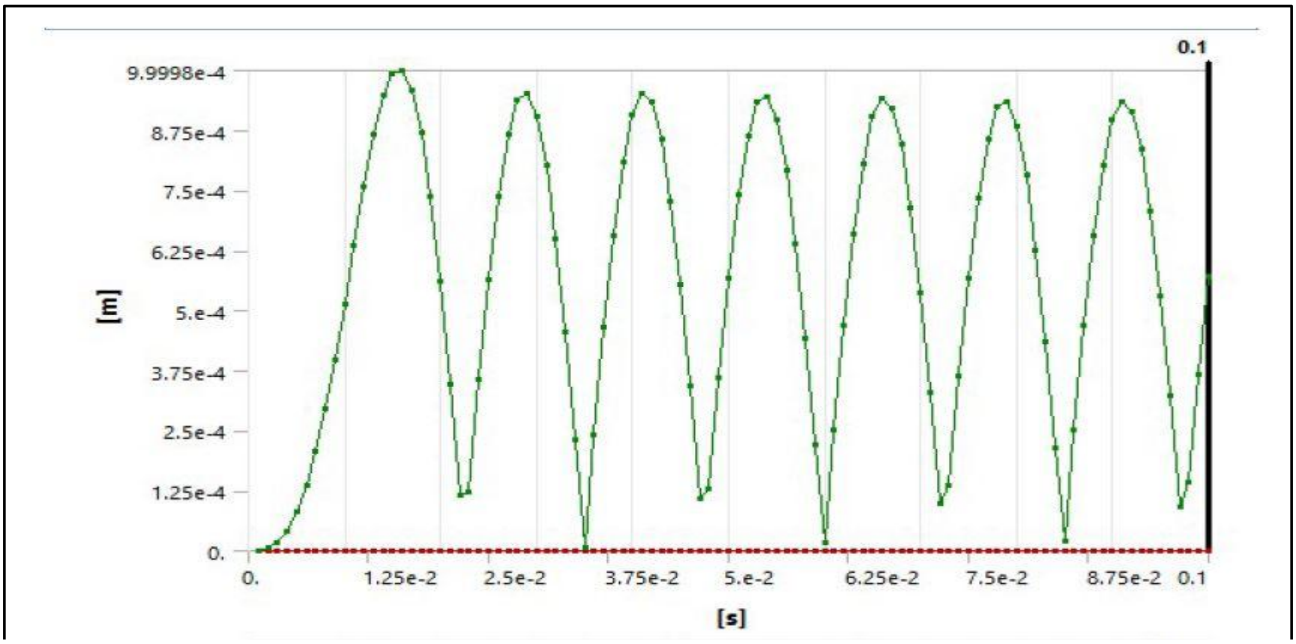

Figure 8: Time vs. Deformation Graph

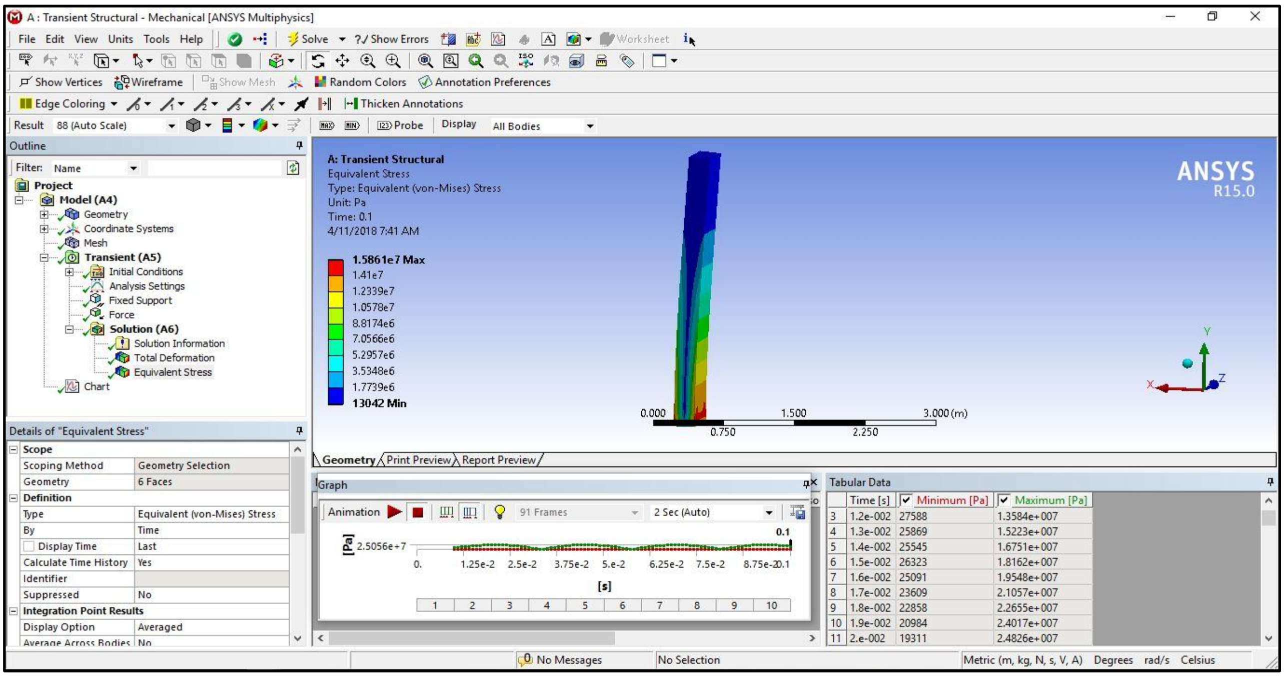

Figure 9: Von-mises Stress of the Column

VI. RESULTS

Table 1: Comparison of Results of Normal Strength Concrete and High Strength Concrete in ANSYS

Support Condition	Deformation (mm)	
	Normal Strength Concrete	High Strength Concrete
Fixed	5.104 mm	4.057 mm

VII. CONCLUSIONS

- Deformation Value on High Strength Concrete column is less as compared to Normal Strength Concrete Column So High Strength Concrete Column is Safe as compared to Normal Strength Concrete Column.
- Assessment of DLF resulting due to blast loading under several conditions must be included in the design process to get into the accurate assessment of the stress characteristics of the material under consideration.

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