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Performance of Reinforced Concrete Structure subjected to Blast Loading using ANSYS Workbench 14.5

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Abstract : In the recent years due the increase in terror attacks, the effects of blasting become largely topical for the structures. In this regard, the present work deals with analysis of blast loaded structures. Over the last three decades, efforts have been undertaken to create techniques of structural analysis and design that can sustain burst loads because of the potential of such overloading scenarios. Blast loads on structural concrete have been the focus of investigations on how the material responds. In the course of these investigations, we gained a better knowledge of the influence of structural features on behavior. A basic reinforced concrete structure's reaction to continuous axial loads and lateral burst stresses has been studied in detail in this research. For the RC construction, the meshless approach was employed to eliminate mesh distortions by using ANSYS's finite element programmed. The detonation point is considered near the structures with varying blasting distances and the height of the structure is varied to measure structural parameters. The various structural parameters like total deformation, stress, strain intensities and velocity are recorded. An in-depth understanding of the dynamics of various structural elements is required for the study or design of structures subjected to a blast load. This is an in-depth look at the damage caused by the explosion.

Index Terms - Blast, Structure, Explosion impact, Dynamic stresses, Structural elements, ANSYS.

introduction

There has been a lot of focus on explosion and earthquake issues in the previous few decades. It's been a long time since much of the knowledge regarding earthquakes has been gathered. Government agencies and departments are frequently consulted for updates in this area, including the US Army Corps of Engineers, the US Department of Defence, the US Air Force, and others. Academic institutions and engineering organisations such as Massachusetts Institute of Technology are responsible for a large portion of this effort.

There has been a lot of interest in the study of structural components that have been exposed to blast loads in recent years. Because the magnitudes of design loads are substantially smaller than the magnitudes produced by most explosions, conventional buildings, particularly those above class, are vulnerable to damage from explosions because they are not generally intended to handle burst loads. Developers, architects, and engineers are increasingly looking for ways to protect both inhabitants and infrastructure in the event of an explosion.

Shock Wave - There is a shock wave created by the explosion that travels outward in all directions at great speed, causing pressure and suction effects depending on the time it passes through each point in its path as it travels as seen in fig.1 Frictional effects on whatever obstructions it encounters are responsible for the dynamic pressures that accompany the shock wave. Pressure builds up immediately, but it dissipates over time as the size of the barrier surface influences the amount of diffraction.

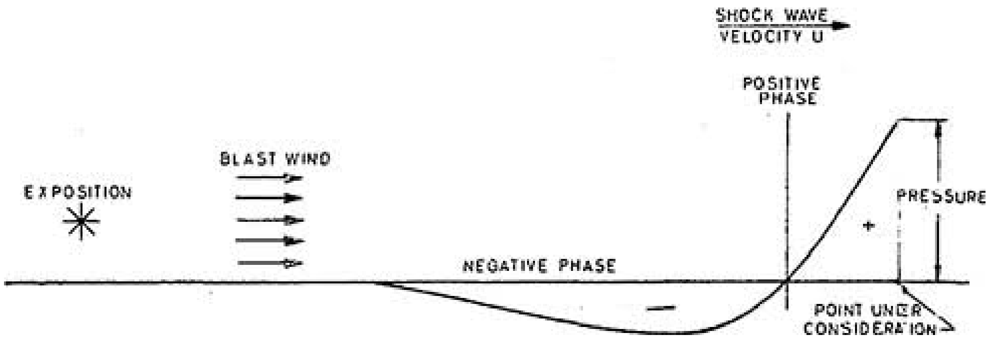


Fig.1: Shock wave produced by blast

Pressure - Pressure increases nearly immediately to the peak values of the side overpressure and dynamic pressure or their reflected pressure at any surface where the shock wave hits. There are a variety of variables that influence peak pressure and temperature, such as the magnitude and location of the explosion and the distance from the surface.

Scaling Rules - Cube root scaling rules may be used to find peak pressures for any explosion other than a reference blast using the peak values and the laws below.

Scaled distance x = Actual distance / $W^{1/3}$ ……… (1)

Scaled time to = Actual time / $W^{1/3}$ ……… (2)

were,

W = yield of explosion in equivalent weight of the reference explosive measured in tones,

x = scaled distance for entering the for reading peak values, and

to = scaled time

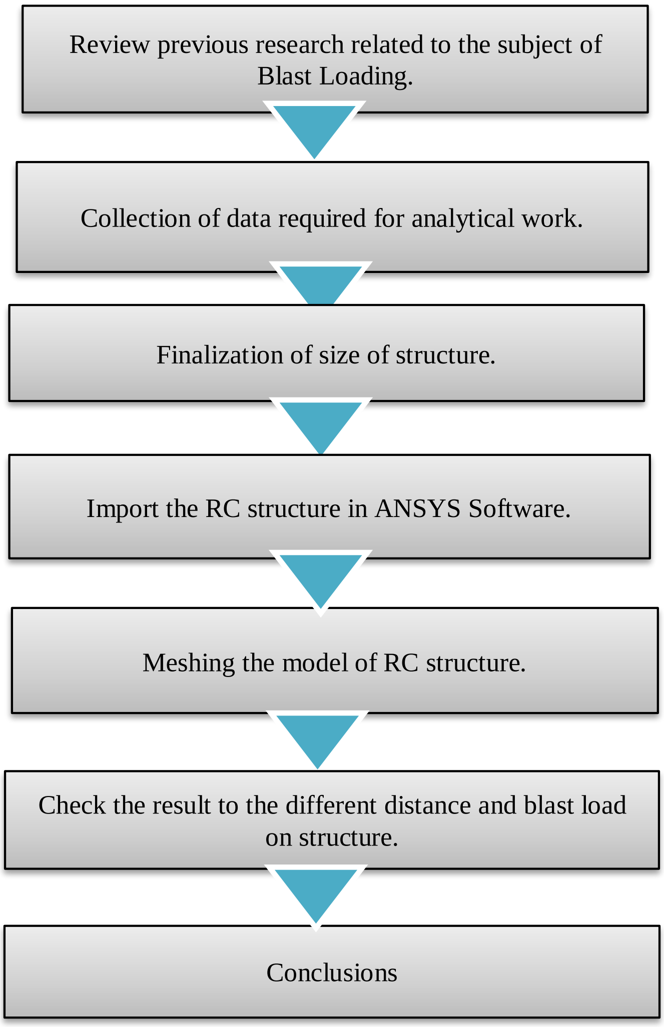
Objective of the Present Work

- To study the basic phenomenon of an explosion and its impacts on regular RC building structures.
- To model of RC structures using ANSYS workbench 14.5
- To study explicit dynamics response in ANSYS workbench 14.5
- To analyse RCC structure with height and scaled distance to validate performance of RC structure.

RESEARCH METHODOLOGY

Analytical Methodology of RCC Structure Using ANSYS Workbench 14.5

When using ANSYS to do structural analysis, certain inputs, such as material properties, element types, boundary conditions, and correct meshing are necessary in order to obtain accurate outcomes.



Model Description:

The model of RC structure in ANSYS workbench as per following dimensions.

Table No.1: Model description.

Length	Width	Height
10m	8m	3m

RESULTS AND DISCUSSION

In explicit dynamics, the various parameters like total deformation, directional deformation, total velocity, directional velocity, equivalent elastic strain, elastic strain intensity, equivalent stress, stress intensity were measured under different height condition.

Parametric Study Results
Height=3m, Width=8m, Length=10m

Table No.2: Parametric Study Result

Scaled distance	Total deformation	Directional deformation	Total velocity	Directional velocity
15	1.045	-0.111	842.25	-115.138
30	0.800	-0.084	761.15	-83.056
45	0.584	-0.061	667.56	-65.2992
60	0.372	-0.039	623.89	-57.28

Based on the analytical results as the scaled distance increases with 15m interval the value of total deformation decreases linearly. The impact of shock wave on front face of structure reduced to the certain extant with increases 15m scaled distance the value of total deformation decreases with 23 to 24 percentage respectively.

The result of total deformation vs scaled distance shows Fig. 2

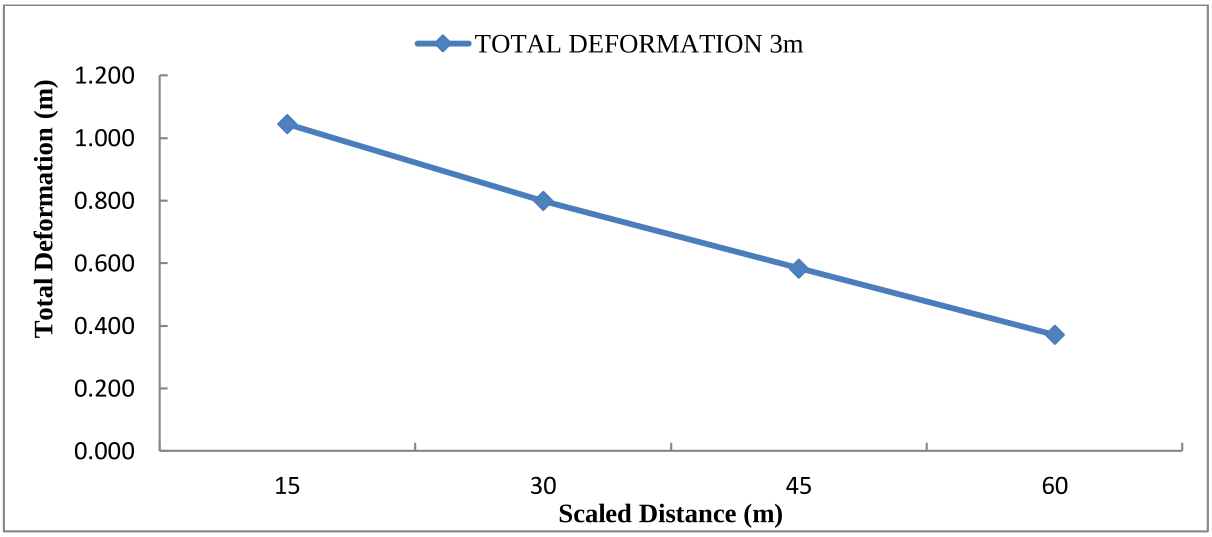


Fig. 2: Total deformation vs Scaled distance

Based on the analytical results as the scaled distance increases with 15m interval the value of directional deformation decreases linearly. The impact of shock wave on front face of structure reduced to the certain extant with increases 15m scaled distance the value of directional deformation decreases with 20 to 22 percentage respectively.

The result of directional deformation vs scaled distance shows Fig. 3

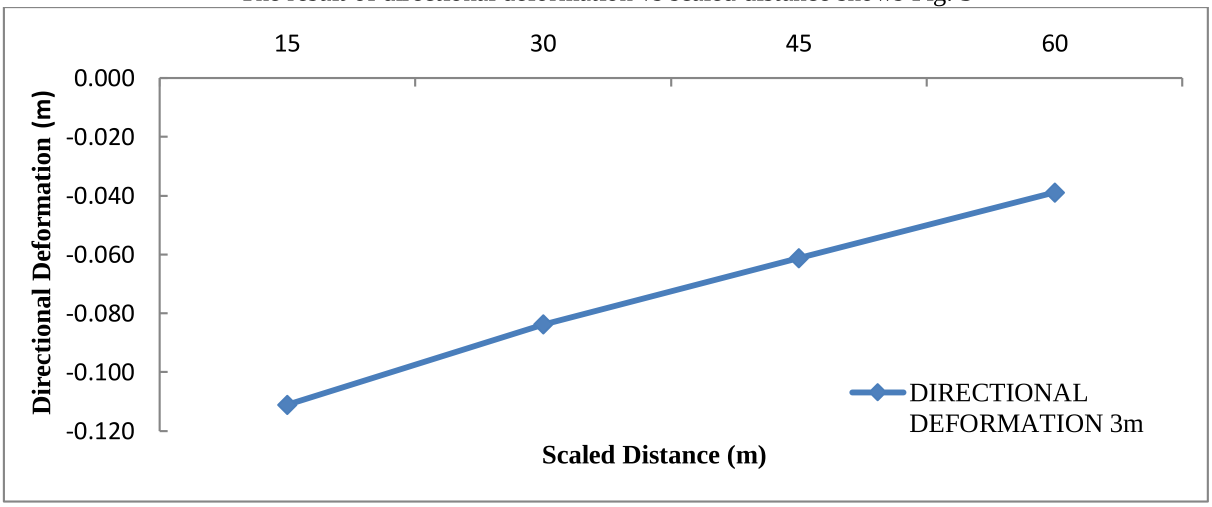


Fig. 3: Directional deformation vs Scaled distance

Based on the analytical results as the scaled distance increases with 15m interval the value of total velocity decreases linearly. The impact of shock wave on front face of structure reduced to the certain extant with increases 15m scaled distance the value of total velocity decreases with 9 to 12 percentage respectively.

The result of total velocity vs scaled distance shows fig. 4

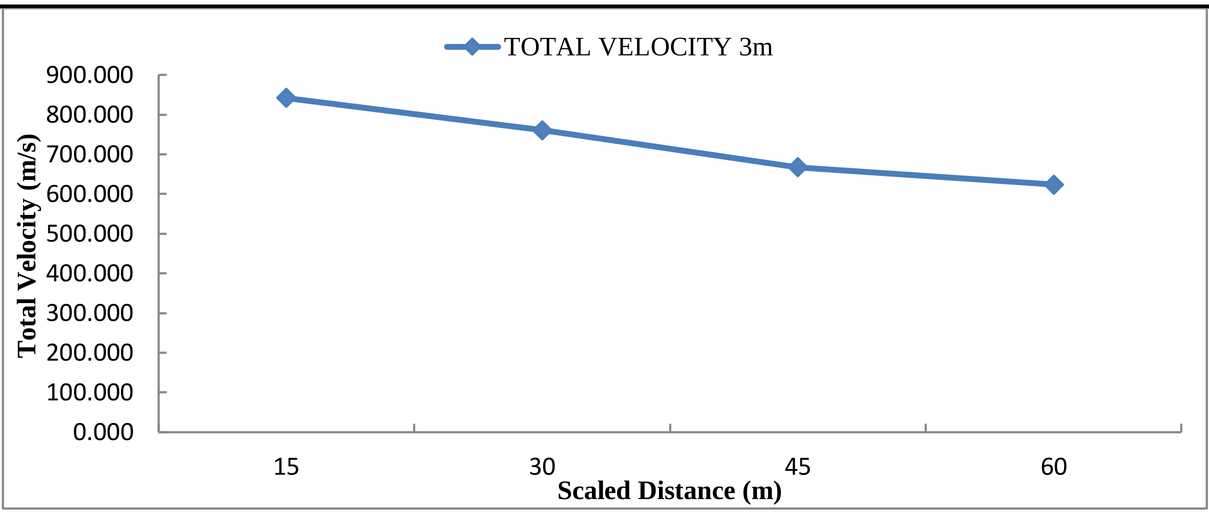


Fig. 4: Total velocity vs Scaled distance

Based on the analytical results as the scaled distance increases with 15m interval the value of directional velocity decreases linearly. The impact of shock wave on front face of structure reduced to the certain extant with increases 15m scaled distance the value of directional velocity decreases with 21 to 22 percentage respectively.

The result of directional velocity vs scaled distance shows fig. 5

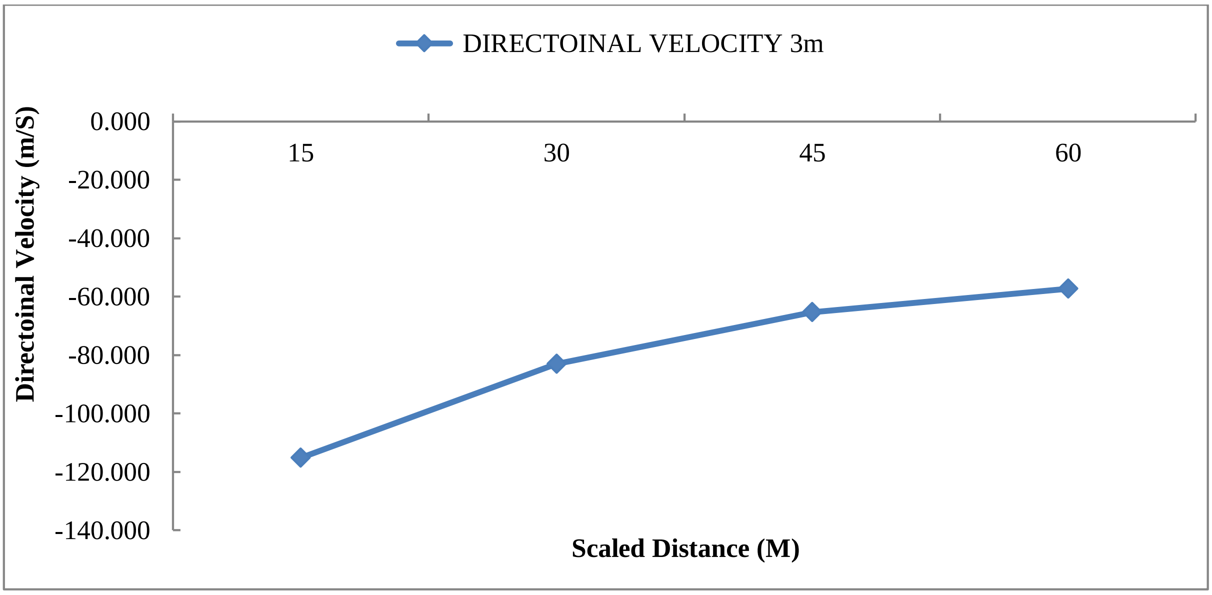


Fig. 5: Directional velocity vs Scaled distance

Height=3m, Width=8m, Length=10m

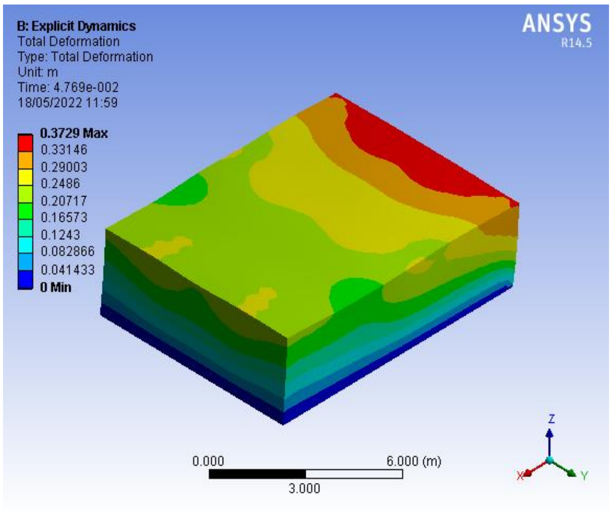


Fig. 6: (a) Total deformation

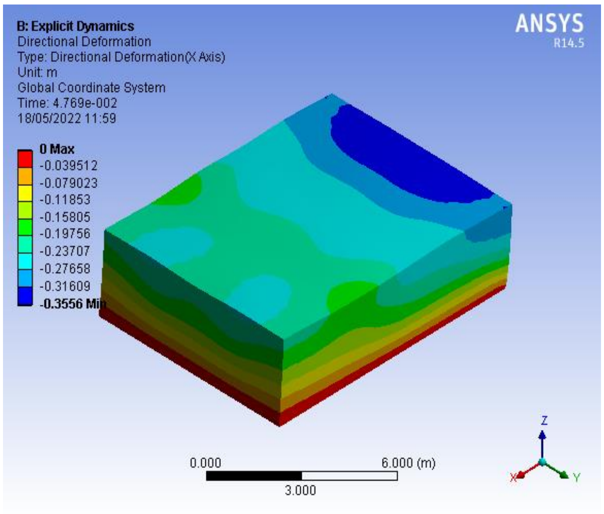


Fig. 6: (b) Directional deformation

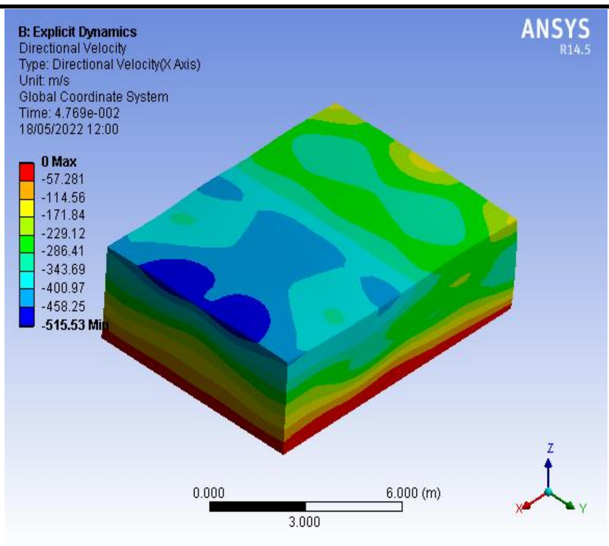


Fig. 6: (c) Directional velocity

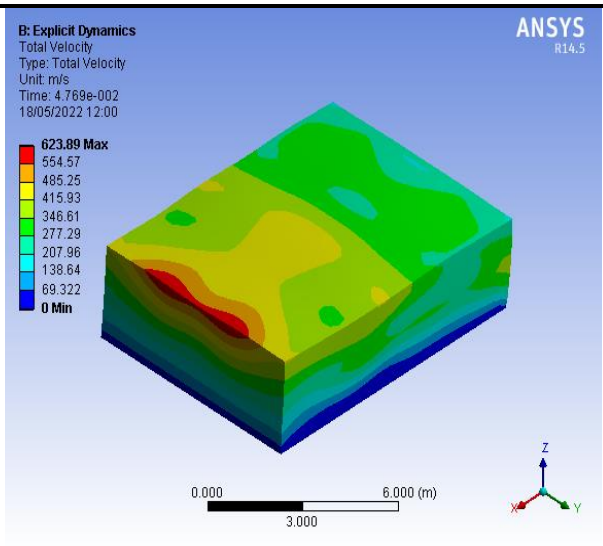


Fig. 6: (d)Total velocity

CONCLUSIONS

following are the findings and implications that may be derived from the research:

- As the scaled distance increases with 15m interval the value of total deformation decreases for each height i.e., for 3m.
- The directional deformation along x-axis decreases with increases in scaled distance, so according to result 20 to 22 percentage decreases directional deformation.
- As the scaled distance increases with decreases total velocity, so according to result 9 to 12 percentage decreases total velocity.
- The directional velocity along x-axis decreases with increases in scaled distance, so according to result 21 to 22 percentage decreases directional velocity.

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