The Effect of Standoff Distance and Blast Yield over Structure in Blast Test

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Abstract— In recent years the explosive loads have received considerable attention due to different events, accidental or intentional, that have occurred over important structures all over the world. In consequence, in the last decade there was an important activity in the research of explosive loads. Initially, this works were mostly empirical but in the last years, important researches have begun to be developed. The main objective of this paper is to study is to see the variation of storey displacement and storey drift when the standoff distance and the amount of blast yield (TNT) is change

Keywords: Standoff Distance, Blast Yield, Storey Displacement, Storey Drift

I. Introduction

Blasting loads have come to be forefront of attention in recent years due to a number of accidental and intentional events that affected important structures all over the world, clearly indicating that this issue is important for purposes of structural design and reliability analysis. In consequence, extensive research activities in the field of blast loads have taken place in the last few decades. Compared to the extensive previous research available on seismic and wind load effects on structures, much less research has been done on the behavior of structures subjected to blast loading. With increased awareness of blast hazards on critical infrastructure, increased number of research programs has begun with the objectives of developing blast resistant design methodologies for new buildings.

II. Structural Modeling and Loading over the Structure

A G+3 storey symmetrical models have been made in Etabs 2015. Model is 12m x 12m in plan and height of building is 14m. Height of each storey is 3.5m and height of plinth is 1.5m. Beam having size of 300x400mm and column having size of 450x450 mm have been provided. Slab of 200mm thickness have been provided. Grade of steel and concrete are fe500 and M30 respectively.

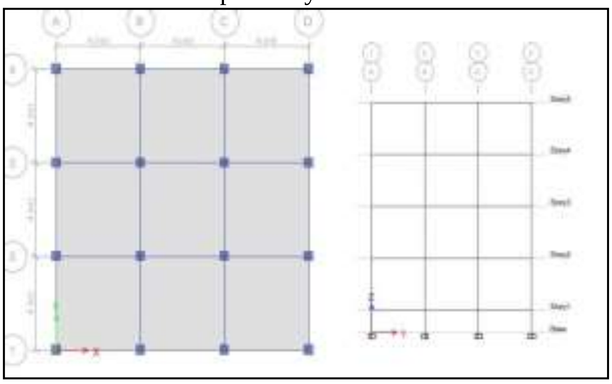


Fig. 1: Plan and elevation of model

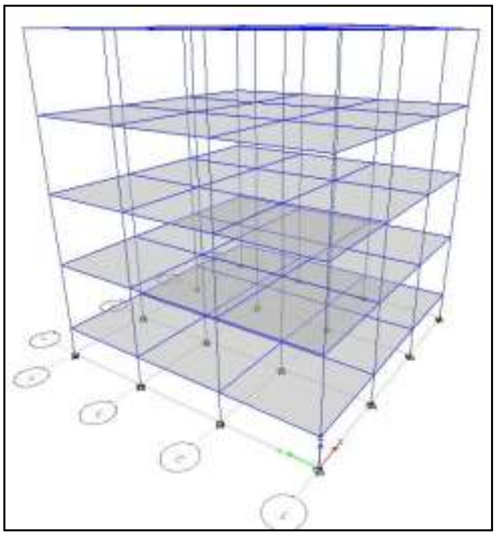


Fig. 2: 3D view of model Fig.2: 3D view of model

III. Type of Loads Applied on Structure

– Dead load (self-weight)
– Live load (3KN)
– Super imposed load (floor loads) (1KN)
– Blast loads (according to IS 4991-1968 code)

IV. Type of Case Analyzed

1) CASE 1: Without infill structure with 300
2) kg TNT at 30 m standoff distance.
3) CASE 2: Without infill structure with 300 kg TNT at 60 m standoff distance.
4) CASE 3: Without infill structure with 150 kg TNT at 30 m standoff distance.

1) Case 1: 300 kg TNT at 30 m standoff distance for without infill structure

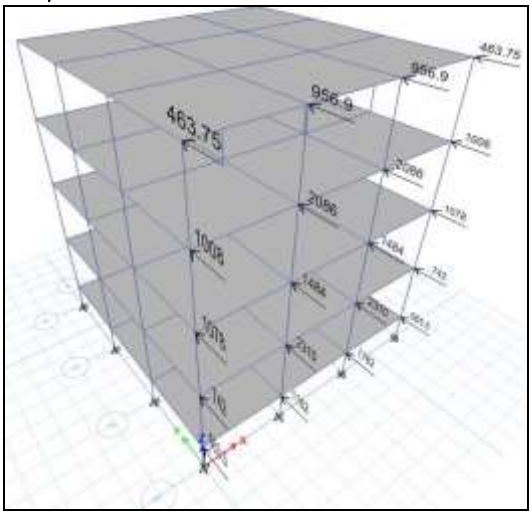


Fig. 3: Blast load applied over the structure

2) Case 2: 300 kg TNT at 60 m standoff distance for without infill structure

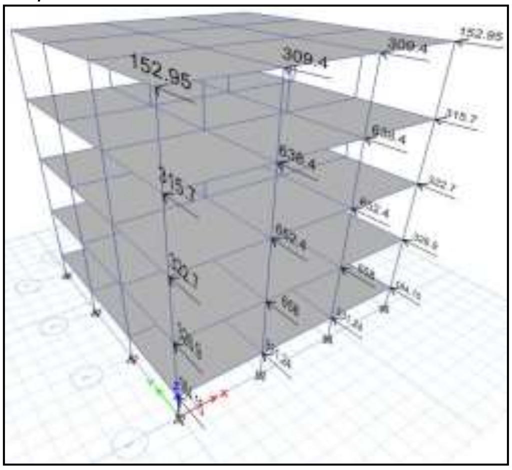


Fig. 4: Blast load applied over the structure

3) Case 3: 150 kg TNT at 30 m standoff distance for without infill structure

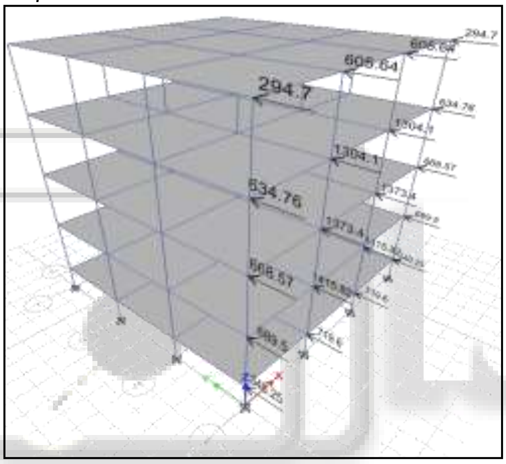


Fig. 5: Blast load applied over the structure

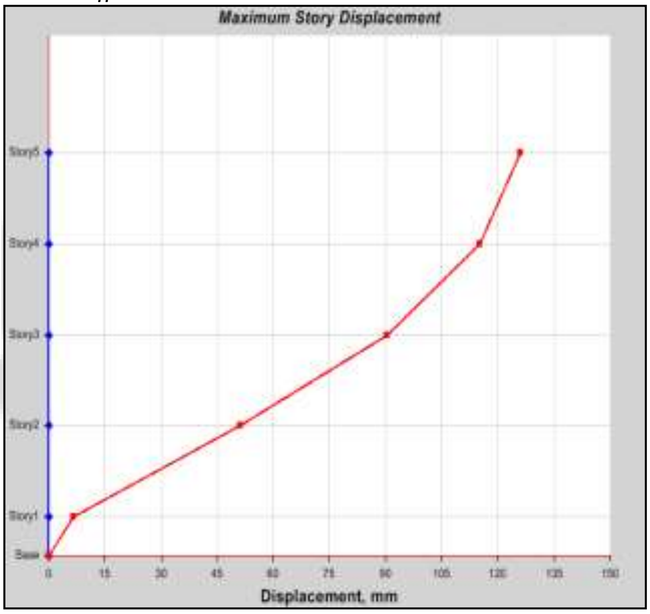
V. ANALYSIS RESULTS

1) CASE 1: Without infill structure with 300 kg TNT at 30 m standoff distance

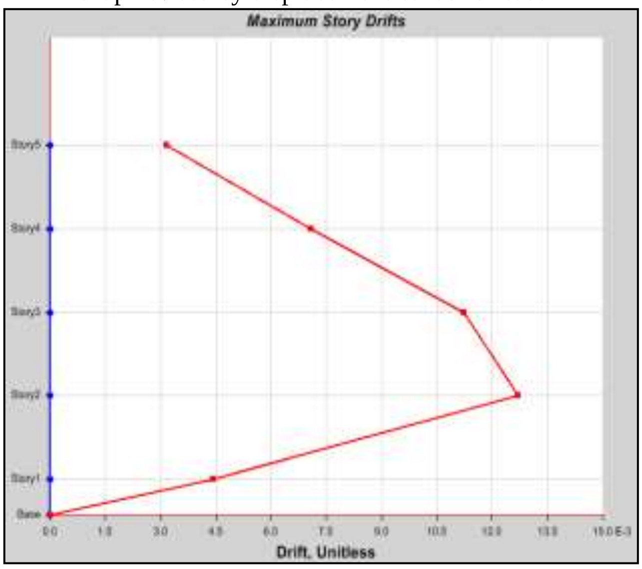
Graph 1: Storey displacement curve for case 1

Graph 2: Storey drift curve for case 1

2) CASE 2: Without infill structure with 300 kg TNT at 60 m standoff distance

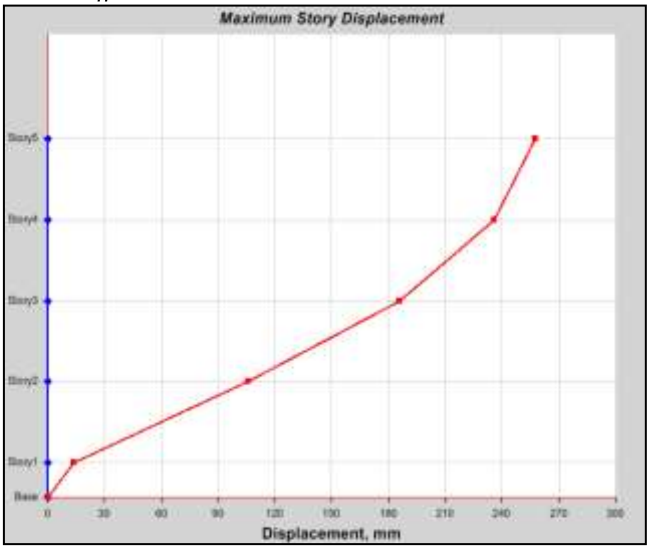


Graph 3: Storey displacement curve for case 2

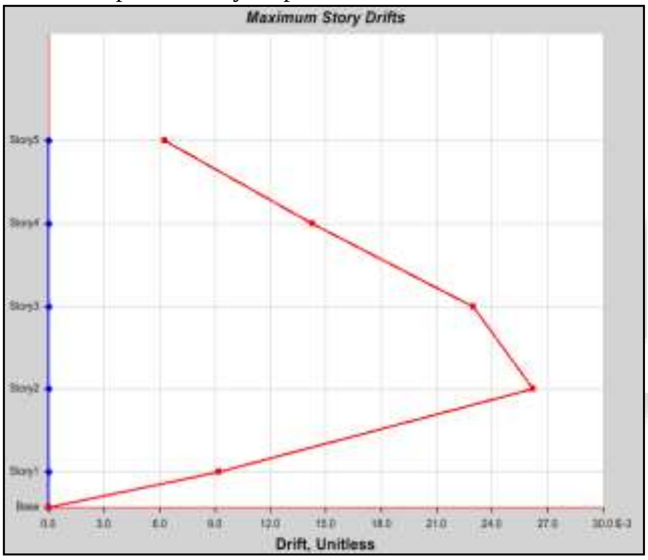


Graph 4: Storey drift curve for case 2

3) CASE 3: Without infill structure with 150 kg TNT at 30 m standoff distance



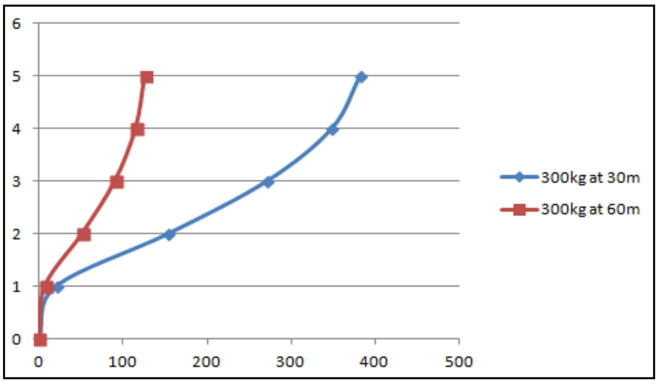
Graph 5: Storey displacement curve for case 3



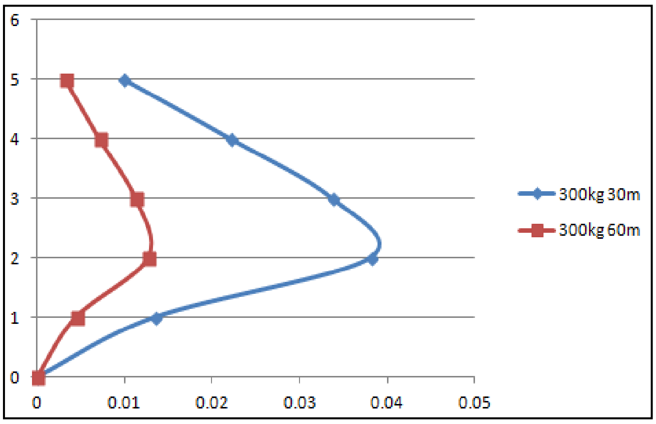
Graph 6: Storey drift curve for case 3

B. Variation in Storey Displacement and Storey Drift When Standoff Distance is Varied

CASE 1: Without infill structure with 300 kg TNT at 30 m standoff distance
CASE 2: Without infill structure with 300 kg TNT at 60 m standoff distance



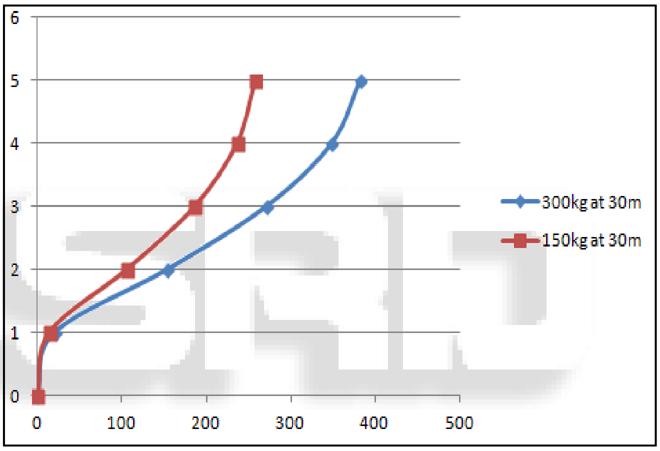
Graph 7: Variation in storey displacement for case 1 and case 2



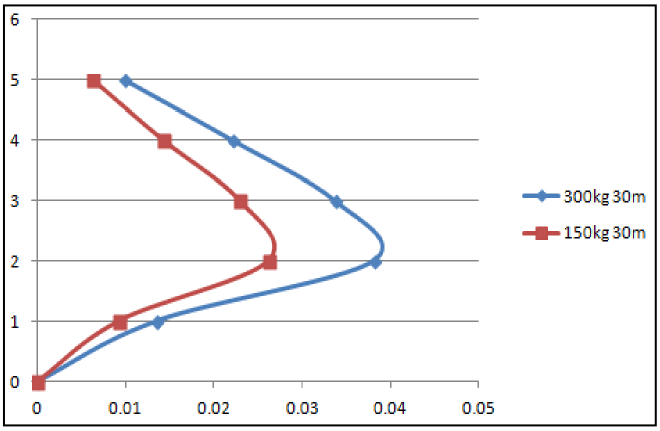
Graph 8: Variation in storey drift for case 1 and case 2

C. Variation in Storey Displacement and Storey Drift When Yield of Explosion is Varied

CASE 1: Without infill structure with 300 kg TNT at 30 m standoff distance
CASE 3: Without infill structure with 150 kg TNT at 30 m standoff distance



Graph 9: Variation in storey displacement for case 1 and case 3



Graph 10: Variation in storey drift for case 1 and case 3

VI. Conclusion

From a thorough analysis of reinforced concrete structure exposed to blast load, it can be drawn as a conclusion that structure designed for normal loads are not safe when it exposed to an explosion. For the safety of civilians and for the valuables, the important structures should be analyzed by blast criteria given by IS 4991-1968.

Following conclusions can be made from the analysis:-

1) In without infill structure when standoff distance is increased from 30 m to 60 m (increased two times) without changing the yield of explosion then the maximum storey displacement are reduced by around 67 %., and maximum storey drift reduced by around 66.70%.
2) In without infill structure when yield of explosion is reduce from 300 kg TNT to 150 kg TNT without changing the standoff distance the maximum storey displacement are reduced by around 33 %., and maximum storey drift reduced by around 31%.
3) As we decrease the standoff distance by factor 0.5 times then the maximum storey displacement increase three times the initial storey displacement when yield of explosion is constant.
4) As the amount of explosion is double the then maximum storey displacement is become 1.5 times the initial value when standoff distance is constant.

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