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RESPONSE OF BLAST LOAD ON FLOATING COLUMN

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Abstract: Need of designing certain important structures to resist blast loads is gaining importance day by day due to increase in terrorist activities from the recent years. Blast forces causes loss of structural integrity due to partial or complete collapse of structural members. Blast loads are dynamic loads that must be calculated carefully as that of other dynamic loads. In present study, the response of blast load on floating column. The effect of blast load was carried out on G+6 structure as per IS 4991:19968.the models were analyzed and designed in STAAD PRO soft ware and blast load was applied by varying charge weight, standoff distance and different bay's. The parameters like displacement and drift are studied out. The analyze the floating column structure are increased the story displacement compare to normal structure according to 70% to 80%. Story drift values are very high compare to the normal structure to the floating column structure.

***Index Terms* – Blast load, Floating column, Staad pro, Displacement, Story Drift.**

I. INTRODUCTION

The term "blast" refers to the arrival of a massive amount of energy from an impact source that lasts only a few milliseconds. Because configuration loads in view of blast are extremely high, general structures are not designed for shot loads. Blast stacks primarily rely on the weight of the charge taken and the distance between the source and the objective. Throughout the power time profile, the power over the surrounding level is a positive stage that lasts for a short time, and the power below the surrounding level is a negative period of span that lasts for a longer time.

A floating column is a vertical member that rests on a beam but does not immediately transfer load to the foundation. The floating column works as a point load on the beam, and the load is transferred to the columns below it by the beam. While resting on a beam, the column may begin on the first, second, or any other intermediary floor. To transfer load from slabs and beams, columns usually rest on the foundation. The floating column, on the other hand, is supported by the beam.

The current review is expected to study with variety of power because of impact is determined physically for drifting section and investigation is performed in Staad-Pro programming lastly make the design impervious to the applied impact loads.

II. METHODOLOGY

In the present study reinforced concrete frame building of G+6 story with floating column is considered. The plan layout and elevation of normal structure are shown in the below figures. The different configurations of buildings are modelled by Different charge weight and different standoff distance. The story height is kept uniform of 3m for all cases.

Plan dimension of building: 15 X 15m, X-Y direction had 5 bay, 5 bay spaced at 3m, Beam dimension: 400 X 400mm, Column dimension: 400 X 400mm, Floating column: 650 X 650mm, Story height: 3m, Grade of concrete and steel grade: M30 & HYSD 500, Slab thickness: 150mm, Dead load:4 kN/m^2, Live load:4 kN/m^2, Floor load: 2 kN/ m^2 and Blast load: Manual calculation of blast load according to IS 4991-1968.

Figure 1 3D view of structure

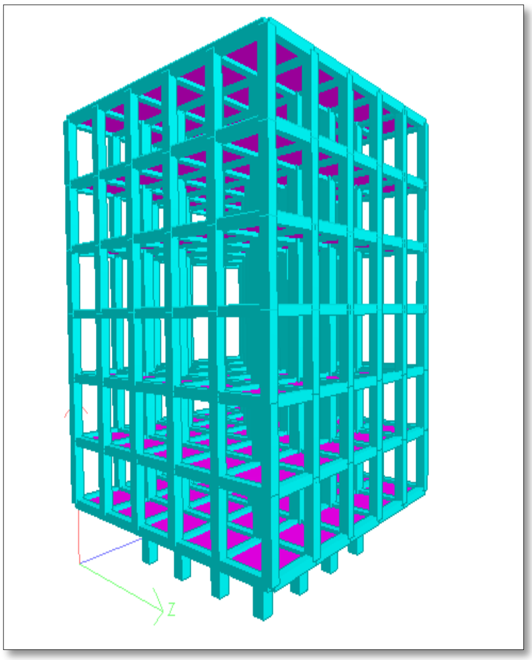
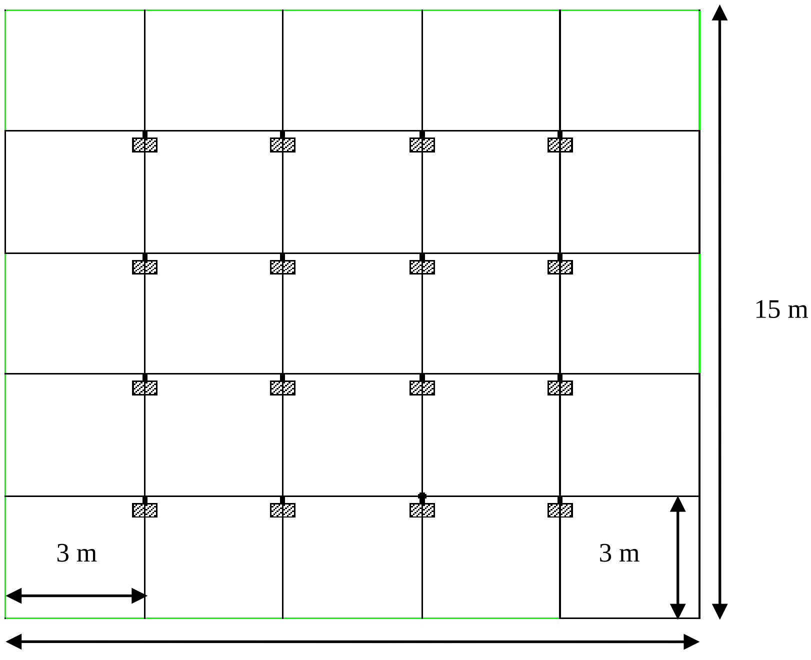


Figure 2 Plan of structure



2.1Model cases

In this study consider various charge weight and standoff distance consider for different model cases and their list below.

- Case 1: 100 kg charge weight applied on 1st bay of structure and 20 m standoff distance.
- Case 2: 100 kg charge weight applied on 1st bay of structure and 30 m standoff distance.
- Case 3: 100 kg charge weight applied on 1st bay of structure and 40 m standoff distance.
- Case 4: 200 kg charge weight applied on 1st bay of structure and 30 m standoff distance.
- Case 5: 200 kg charge weight applied on 1st bay of structure and 40 m standoff distance.
- Case 6: 300 kg charge weight applied on 1st bay of structure and 30 m standoff distance.
- Case 7: 300 kg charge weight applied on 1st bay of structure and 40 m standoff distance.
- Case 8: 100 kg charge weight applied on 3rd bay of structure and 20 m standoff distance.
- Case 9: 100 kg charge weight applied on 3rd bay of structure and 30 m standoff distance.
- Case 10: 100 kg charge weight applied on 3rd bay of structure and 40 m standoff distance.
- Case 11: 200 kg charge weight applied on 3rd bay of structure and 30 m standoff distance.
- Case 12: 200 kg charge weight applied on 3rd bay of structure and 40 m standoff distance.
- Case 13: 300 kg charge weight applied on 3rd bay of structure and 30 m standoff distance.
- Case 14: 300 kg charge weight applied on 3rd bay of structure and 40 m standoff distance.
- Case 15: 100 kg charge weight applied on 5th bay of structure and 20 m standoff distance.
- Case 16: 100 kg charge weight applied on 5th bay of structure and 30 m standoff distance.
- Case 17: 100 kg charge weight applied on 5th bay of structure and 40 m standoff distance.
- Case 18: 200 kg charge weight applied on 5th bay of structure and 30 m standoff distance.
- Case 19: 200 kg charge weight applied on 5th bay of structure and 40 m standoff distance.
- Case 20: 300 kg charge weight applied on 5th bay of structure and 30 m standoff distance.
- Case 21: 300 kg charge weight applied on 5th bay of structure and 40 m standoff distance.

The normal structure is also modelled for above cases for comparison of blast loading condition.

2.2Blast load calculation

The blast loads are applied on the exposed surface of the structure and then the loads are transmitted to the other elements of the structure. Structure analysed and designed to blast resist structure are completely different types of load than that considered in the conventional design.

Standoff distance(x): Blast location from building. Blast height (Y): Assume blast occur 1.5m above ground level. For at every joint is calculate by (Assume distance above ground level - Height of slab from ground level).Joint Distance (z): Distance from Center of building of blast face to beam column joint. Actual distance: The distance for each beam-column joint varies from the source which is calculated manually, considering blast source at a point (0, 1.5, and 0) at center.

$$(x, y, z) = ((x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2)^{0.5}$$

Scaled distance: $Actual\ distance/(Charge\ weight)^{1/3}$.Peak over pressure: After get value of scaled distance peak over pressure value find from IS-4991-1968.

For case where blast applies on 1st bay of corner on structure:

- Actual distance:

$$(x, y, z) = ((20 - 0)^2 + (3 - 1.5)^2 + (15 - 0)^2)^{0.5} = 25.045$$

- Scaled distance:

25.045 / (0.1^0.33) = 54.44

For case where blast applies on 3rd bay of corner on structure:

- Actual distance:

$$(x, y, z) = ((20 - 0)^2 + (3 - 1.5)^2 + (9 - 0)^2)^{0.5} = 21.983$$

- Scaled distance:

25.045 / (0.1^0.33) = 46.999

For case where blast applies on 5th bay of corner on structure:

- Actual distance:

$$(x, y, z) = ((20 - 0)^2 + (3 - 1.5)^2 + (9 - 0)^2)^{0.5} = 23.372$$

- Scaled distance:

25.045 / (0.1^0.33) = 49.968

III. RESULTS

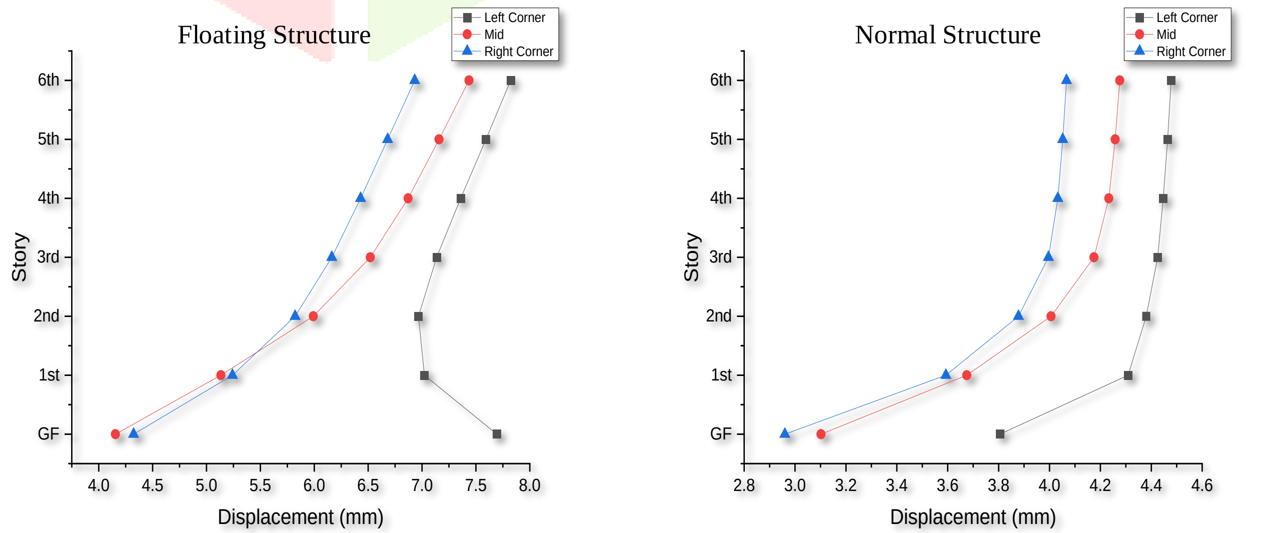
3.1Displacement

300 kg charge weight applied on 1st bay of structure and 30 m standoff distance:

(Table 1 comparison between floating column structure and normal structure)

Story Displacement						
Story	Floating structure			Normal Structure		
	Left corner	Mid Point	Right corner	Left corner	Mid Point	Right corner
GF	7.694	4.155	4.324	3.805	3.102	2.96
1st	7.022	5.134	5.241	4.309	3.675	3.593
2nd	6.967	5.991	5.823	4.38	4.006	3.878
3rd	7.136	6.52	6.163	4.425	4.175	3.996
4th	7.359	6.871	6.43	4.447	4.233	4.033
5th	7.593	7.158	6.681	4.464	4.258	4.052
6th	7.823	7.436	6.932	4.478	4.276	4.067

The given table showes the information about displacement of 300 kg charge weight 30 m standoff distance where charge weight applied on forant face of buliding and 1st bay of buliding, their results are varing from 4.324mm to 7.823mm in floating column structure where in normal structure displacement varing between 2.96mm to 4.478mm.



(Figure 3 Displacement comparison between floating column structure and normal structure)

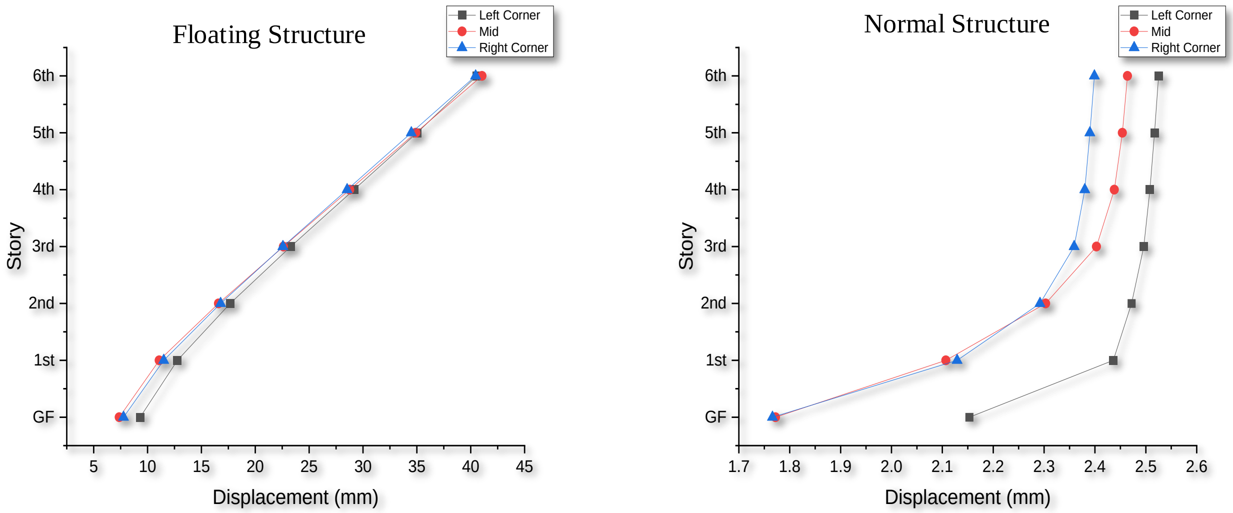
The graph suggests the assessment of story displacement values of 300 kg charge weight 30 m standoff distance in which charge weight carried out on the front face of building and 1st bay of building. The graph end result is dramatically increase by double of regular structure in which 3 different bay`s values are 74%, 73% and 70% (left, mid and right portion) greater displacement in floating column structure compared to the regular structure.

300 kg charge weight applied on 1st bay of structure and 40 m standoff distance:

(Table 2 comparison between floating column structure and normal structure)

Story Displacement						
Story	Floating structure			Normal Structure		
	Left corner	Mid Point	Right corner	Left corner	Mid Point	Right corner
GF	9.311	7.371	7.771	2.153	1.772	1.766
1st	12.771	11.087	11.5	2.436	2.107	2.129
2nd	17.678	16.585	16.779	2.472	2.303	2.292
3rd	23.296	22.615	22.572	2.496	2.403	2.359
4th	29.17	28.767	28.528	2.508	2.438	2.38
5th	35.021	34.9	34.485	2.517	2.454	2.39
6th	40.568	41.049	40.459	2.525	2.464	2.399

The given table showes the information about displacement of 300 kg charge weight 40 m standoff distance where charge weight applied on forant face of buliding and left corner of buliding, their results are varing from 7.371mm to 41.049mm in floating column structure where in normal structure displacement varing between 1.766mm to 2.525mm.



(Figure 4 Displacement comparison between floating column structure and normal structure)

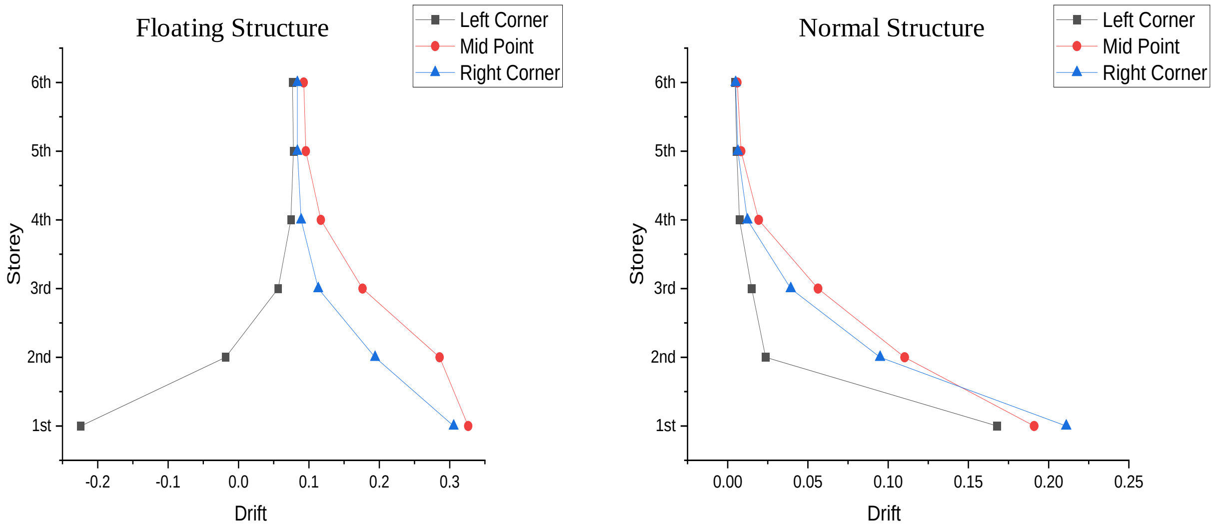
3.2STORY DRIFT

300 kg charge weight applied on 1ST bay of structure and 30 m standoff distance:

(Table 3 comparison between floating column structure and normal structure)

Story Drift						
Story	Floating Structure			Normal Structure		
	Left corner	Mid Point	Right corner	Left corner	Mid Point	Right corner
1st	-0.224	0.326333333	0.305666667	0.168	0.191	0.211
2nd	-0.018333333	0.285666667	0.194	0.023666667	0.110333333	0.095
3rd	0.056333333	0.176333333	0.113333333	0.015	0.056333333	0.039333333
4th	0.074333333	0.117	0.089	0.007333333	0.019333333	0.012333333
5th	0.078	0.095666667	0.083666667	0.005666667	0.008333333	0.006333333
6th	0.076666667	0.092666667	0.083666667	0.004666667	0.006	0.005

The given table showes the information about story drift of 300 kg charge weight 30 m standoff distance where charge weight applied on forant face of buliding and left cornor of buliding, their results are varing from -0.018 to 0.32 in floating column structure where in normal structure displacement varing between 0.005 to 0.211.



(Figure 5 Drift comparison between floating column structure and normal structure)

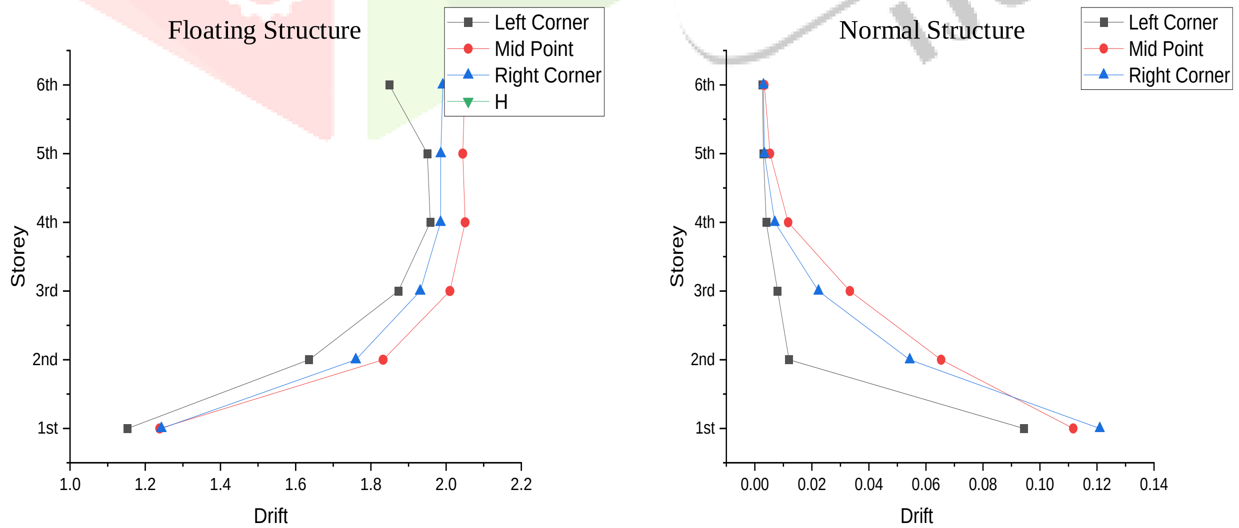
The graph shows the assessment of story drift values of 300 kg charge weight 30 m standoff distance where charge weight carried out on the front face of building and left corner of building. As the end result of normal structure are much higher the story drift of floating column structure.

300 kg charge weight applied on 1st bay of structure and 40 m standoff distance:

(Table 4 comparison between floating column structure and normal structure)

Story Drift						
Story	Floating Structure			Normal Structure		
	Left corner	Mid Point	Right corner	Left corner	Mid Point	Right corner
1st	1.153333333	1.238666667	1.243	0.094333333	0.111666667	0.121
2nd	1.635666667	1.832666667	1.759666667	0.012	0.065333333	0.054333333
3rd	1.872666667	2.01	1.931	0.008	0.033333333	0.022333333
4th	1.958	2.050666667	1.985333333	0.004	0.011666667	0.007
5th	1.950333333	2.044333333	1.985666667	0.003	0.005333333	0.003333333
6th	1.849	2.049666667	1.991333333	0.002666667	0.003333333	0.003

The given table showes the information about story drift of 300 kg charge weight 40 m standoff distance where charge weight applied on forant face of buliding and left cornor of buliding, their results are varing from 1.15 to 2.05 in floating column structure where in normal structure displacement varing between 0.011 to 0.111.



(Figure 6 Drift comparison between floating column structure and normal structure)

As per this process all the above condition is calculate and conclusion is below.

IV. CONCLUSION

Based on the above analyzed perform, the following conclusion are as follow

- Displacement and story drift is increase with increase in the weight of blast load and decrease as increase in standoff distance.
- As standoff distance increase, the maximum nodal displacement decreased.
- As weight of blast increase, the maximum nodal displacement increased.
- As the bay length increases there is decrease in story displacement and story drift.
- From the comparison of nodal displacement it could be seen that the displacement of floating column structure is increased through 70% to 80% them to the normal structure wherein standoff distance and charge weight is important.
- From the comparison of story drift it could be seen that the displacement of floating column structure is increased through double or much higher than the to the normal structure wherein standoff distance and charge weight is important.

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