Dynamic Analysis of a Building for Blast Loading At Various Locations in Etabs

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Abstract: ***A research paper presents dynamic reaction of tall structure exposed to influence stacking (bomb blast). It is tied in with understanding the blast phenomena and examining the dynamic reaction of three different building system as Frame Structure, Bracing Structure and Dia. Grid Structure of Concrete by using ETABS 2016. The building is of 15 stories is presented to 100 kg TNT, 200 kg TNT and 300 kg TNT with three distinctive standoff separation of 15 m, 20m and 25m separately. A non-straight three-dimensional is utilize for investigation the non-linear reaction of a building. In current circumstance, building under effect stacking (bomb impact) are acting in a word length with the high-mass power of stun wave.***

The point of this paper is to research the execution of tall structure structures under impact stacking, blast phenomena and the dynamic reaction of three different concrete building system structure by using ETABS 2016 computer modelling, analysis and designing software. The outcome obtained by a time history function is in terms of story displacement as well as story drift, overturning moments and other important impacted parameter consider of the structure which helps to resist the impact of the blast. In this way, for diminishing the front of surrounding structures, modest hazardous vitality utilized to controller the basic harms because of the blast.

Index Terms: Impact stacking (bomb blast), TNT, Standoff separation, Shock Wave, Frame Structure, Bracing Structure, Dia. Grid Structure, Story Displacement and Story Drift.

I. INTRODUCTION

In the course of the most recent couple of decades, psychological oppressor assaults and unintentional blasts are increments gradually, in the event that we cannot make any move to stop the fear-based oppressor assaults. Therefore we have to investigate in the zone of planning the structures to completely impact safe isn't a reasonable and practical choice, anyway current dynamic reaction of structure for impact stacking (bomb blast) are representing brief time span with high-mass force of stun wave it can improve the fresh and standing structures direct the belongings of a bomb impact.

Planning and examination the structure reaction exposed to blast loading with every single other load, similar to dead load, wind load and seismic loadingconditions. With the goal that we could limit the factor of the impact, that is harm or disappointment of the basic as well as harm to the advantages, loss of human just as creature's life and social frenzy.

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In this examination dynamic reaction of three different building system as Frame Structure, Bracing Structure and Dia. Grid Structure of Concrete by using ETABS 2016. Building is of G+15 stories with work of the material of cement is utilization of the evaluation M30 and M40 likewise steel is utilization of Fe500 and presented three different mass of blasting material of 100 kg TNT, 200 kg TNT and 300 kg TNT with three distinctive standoff separation of 15 m, 20 m and 25 m separately and look at the imperative parameters of the structure like of time history function, story displacement, as well as story drift and impact of the parameter, consider the opposition of structure.

To keep the structure from this sort of catastrophe, research support to know the effect ponders and a reaction of a building under effect stacking situations is basic. Affecting material release a great deal of vitality over an outstandingly concise range as individually warmth and stun waves with high heats up to 4,000°C and mass up to a couple of multiple times air (NRC 2003). Enormous quantities of the hurting impacts of a blast originate from the stun wave made, as an earth incorporating the impact is push back because of a compressive heartbeat voyaging outward from the point of convergence of the impact (Kinney and Graham 1985). The forward facing of the wave, generally called the stun forward facing has an overpressure significantly greater than temperature behind stun forward and thusly, adjacent load on time spoils as stun wave makes apparent (Beshara 1994). The stun waves can replicate surfaces in their way, making a replicated stun wave at a greater mass and speed. Replicated wave will be push capable of speed to an occurrence wave to sort a usual front, usually because of waves replicating off an unbendable exterior face of a building.

Structures experience the effects of shoot stacking in a couple of phases. The hidden stun wave ordinarily restrains divider, breaks, portals, windows and makes hurt the front face building. In second phase, the stun wave come into the structure and applies weight onto the building. A applies weight can be hurting to inside sections, bars and segments. Improved by the potential for returned waves. In the last phase, the structure plot is stacked all around, reacting just as empowered by a present moment, extraordinary force shudder.

An investigation of the auxiliary components under blast with given two noteworthy parameters that are the charge mass and standoff separation. These factors can be, as which separation impact safe highlights to moderate harm and death toll. On behalf of littler the standoff separations with the little measure of the charge mass material can obliterate burden-bearing individuals prompting a dynamic breakdown.

The bigger measure of the charge mass material at extensive standoff separations can deliver increasingly constant stacking over outside the structure, affecting both nearby also worldwide harm.

The examination of the assistant parts under impact with given two essential parameters that are the charge mass and standoff separation. These parameters will in like manner affect what sway safe features given to direct mischief and loss of life. For example, littler the standoff separations with the little measure of the charge mass material can obliterate burden-bearing individuals prompting a dynamic breakdown. The bigger measure of the charge mass material at more standoff separations will deliver progressively constant stacking in excess of the outside of the structure.

1.1 Types of building system consider in this paper are the following:

1.1.1 Frame Building Structure System: This is the generally used frame building structure system, which is form by using a combination of beams and column in a square or rectangular shape. It carries the only axial load on the frame of beam and column.

1.1.2 Braced Building System: This is similar to the above building system but it introduces a braced member (diagonal member) which is use in building structure system to resist horizontal loads. The position of braces are important point to assign and design a bracing building system. Some types of braces are (i) **Cross Bracing (which is use in this paper)**, (ii) Single Diagonals, (iii) K Bracing and (iv) V Bracing.

1.1.3 Dia. Grid Structure System: Dia. grid structure is a type of a space support which is viable in decreasing shear deformation, as they convey the sidelong burden by a hub activity of corner to corner individuals. The utilization of supports in the structure is exceptionally useful for the plan of tall structures. The supporting point is basic in opposing both sidelong burden and gravity load. These types of dia. grid structure result of resisting the blast or explosive to the finite limit effect without damage or collapse an element of the structure. There is no outer column are in Dia. Grid Structure, which saves material, time as well as money.

1.2 Time history analysis: It utilized for a nonlinear count of the dynamic response of the structure under stacking, which may shift as indicated by the predetermined timework, or brief time span or in different words, a given info are gotten and an outcome. Time history examination strategy in ETABS 2016 utilized in this paper for investigation of the dynamic response of structure for effect stacking (bomb impact) is representing a brief time span with the high power of stun wave.

II. RESEARCH METHODOLOGY

The goal of present a study compares the dynamic analysis responses of the three different types of a building system as Frame Structure, Bracing Structure and Dia. Grid Structure of G+15 story. RCC Building having symmetry along X and Z direction with the rectangular shape of 20m X 20m. The number of bays 4 in each X and Z Direction of 5m each.

Table 1 Model Specification

Sr. No.	Description	DIA GRID	BRACED	FRAME
1.	No. Of Story	16 Story's	16 Story's	16 Story's
2.	Area Of Building Base Grid	20m X 20m	20m X 20m	20m X 20m
3.	No. Of bays in X & Z Dir.	4 X 4	4 X 4	4 X 4
4.	Height Of Building	48m	48m	48m
5.	Typical Story Height (m)	3m	3m	3m
6.	Bottom Story Height (m)	3m	3m	3m
7.	Beam Size	600mm X 600mm	600mm X 600mm	600mm X 600mm
8.	Column Size	800mm X 800mm	800mm X 800mm	800mm X 800mm
9.	Bracing Size	N.A.	600mm X 600mm	N.A.
10.	Dia. Grid Column Size	600mm X 600mm	N.A.	N.A.
11.	Angle Of Incline Member	67.38 Degree	30.94 Degree	N.A
12.	Slab Thickness	200mm	200mm	200mm
13.	Shear Wall	300mm	300mm	300mm
14.	Concrete Grade	M30	M30	M30
15.	Steel Grade	Fe500	Fe500	Fe500

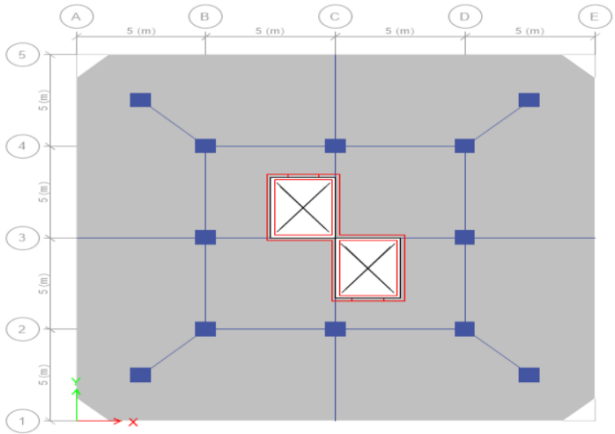


Fig. 1 Plain View Dia. Grid Building

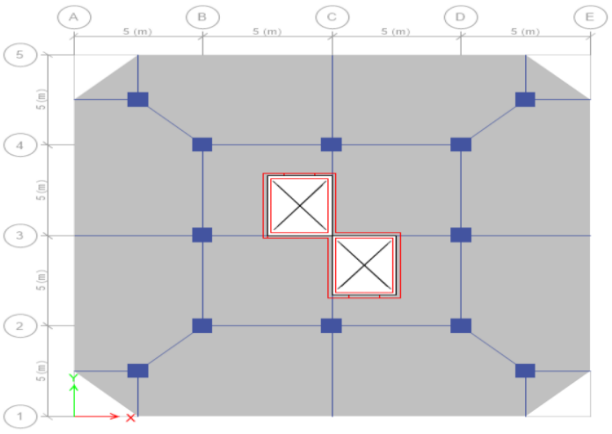


Fig. 2 Plain View Dia. Grid Building

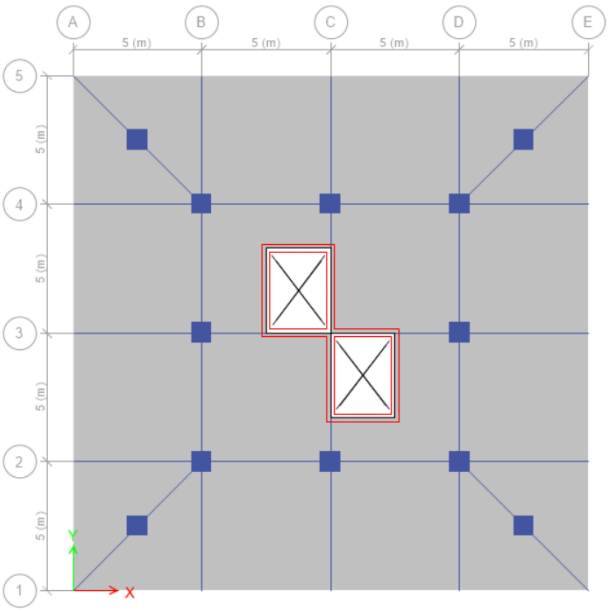


Fig. 3 Plain View Dia. Grid Building

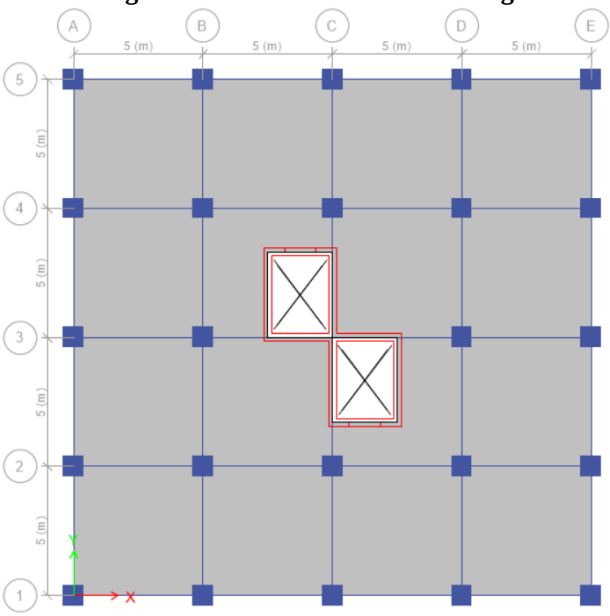


Fig. 4 Plain View Braced & Frame Building

In the above show, figures show a plain view of the buildings. The first figure shows a plan view of the story of 1, 3, 5, 7, 9, 11, 13 and 15 of Dia. Gird Building. The second figure shows a plan view of the story of 2, 6, 10 and 14 of Dia. Gird Building. The third figure shows a plan view of the story of 4, 8, 12 and 16 of Dia. Gird Building. The fourth figure shows a plan view of the Frame Building and Braced Building. In a Frame Building and Braced Building, the plain of every story is the same as shown above Figure 4. The span length is 5m in both the X and Z direction.

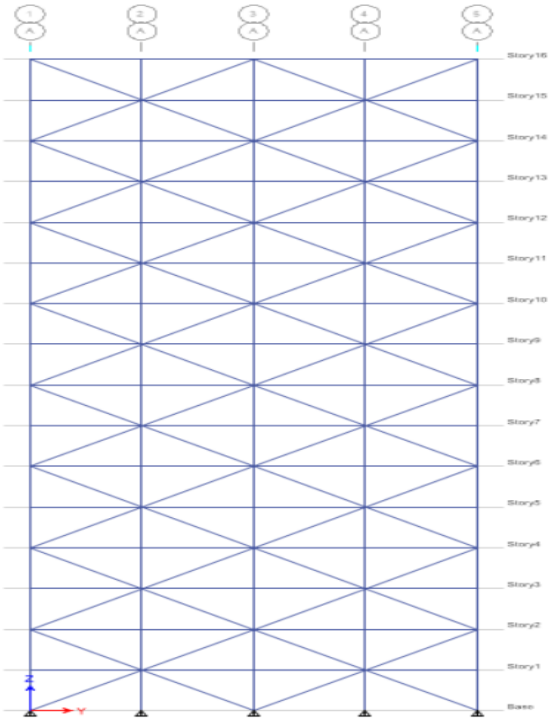


Fig. 5 Front View Braced Building

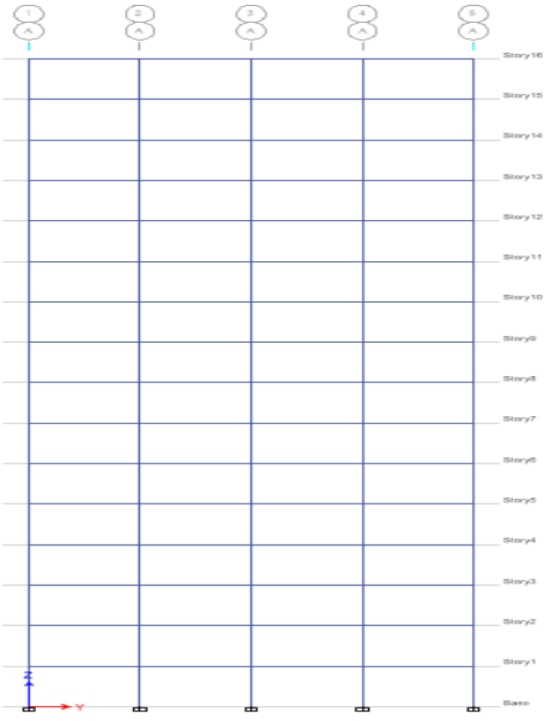


Fig. 6 Front View Frame Building

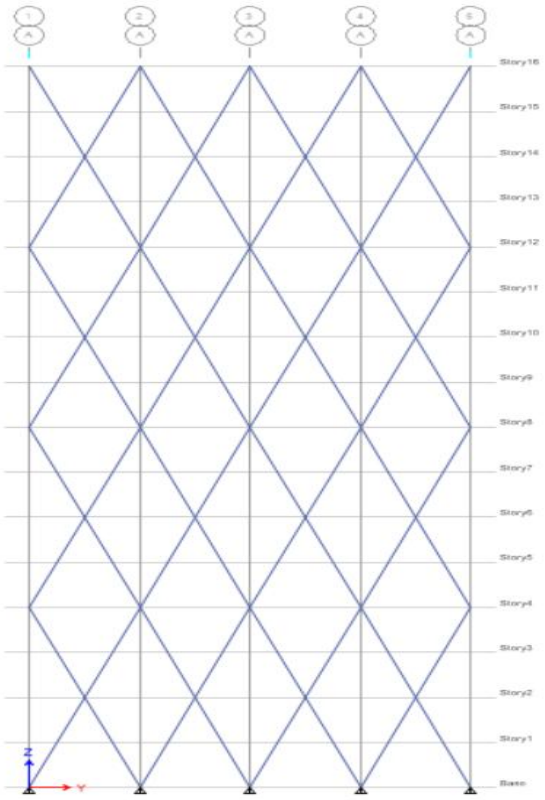


Fig. 7 Front View Dia. Grid Building

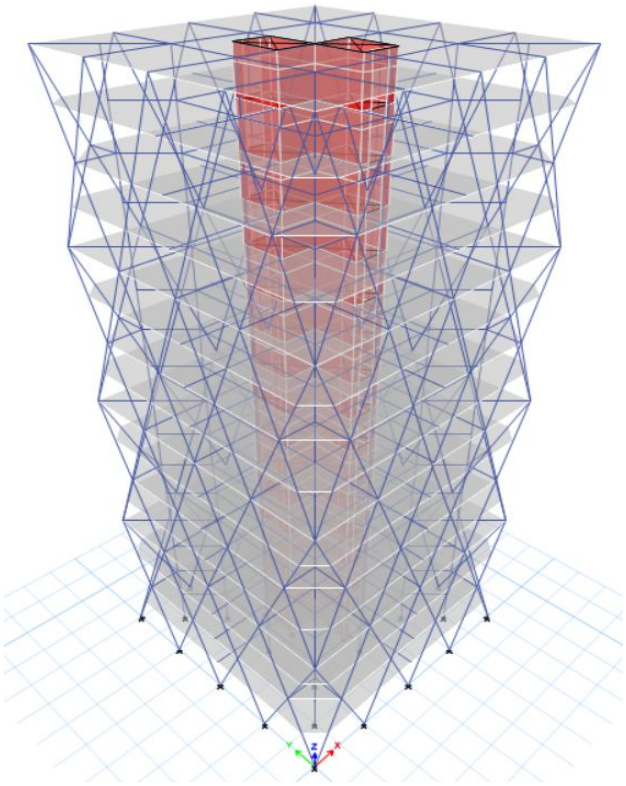
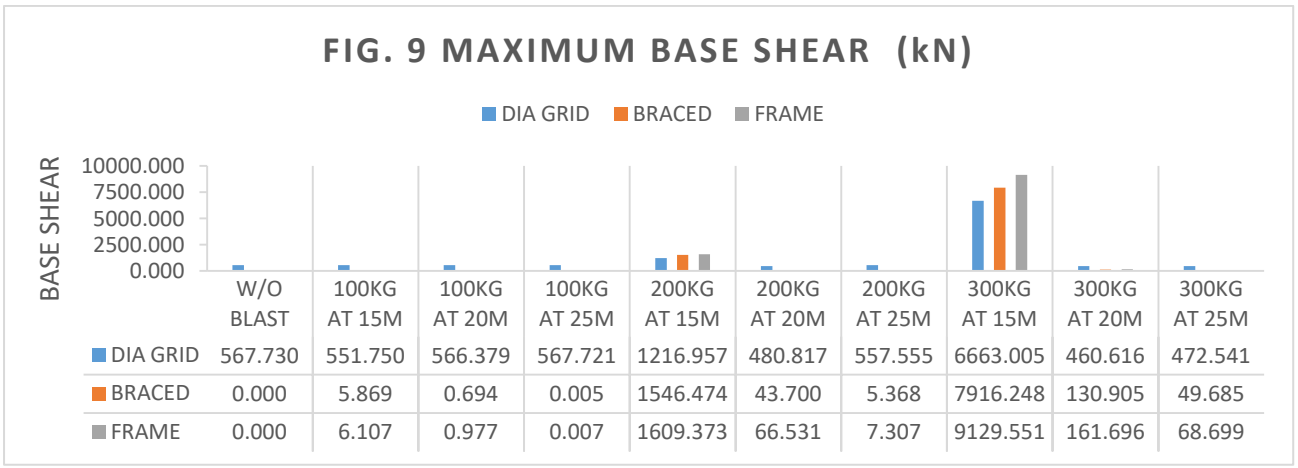


Fig. 8 3D View Dia. Grid Building

In the following figure five, six and seven are a front view of the building Braced Building, Frame Building and Dia. Grid Building respectfully. Figure 8 shows a 3D isometric view of the Dia. Grid Building. There are no outer columns in the Dia. Grid Building of G+15 Story with story height 3m each. Total building height is 48m.

III. RESULTS ANDDISCUSSIONS

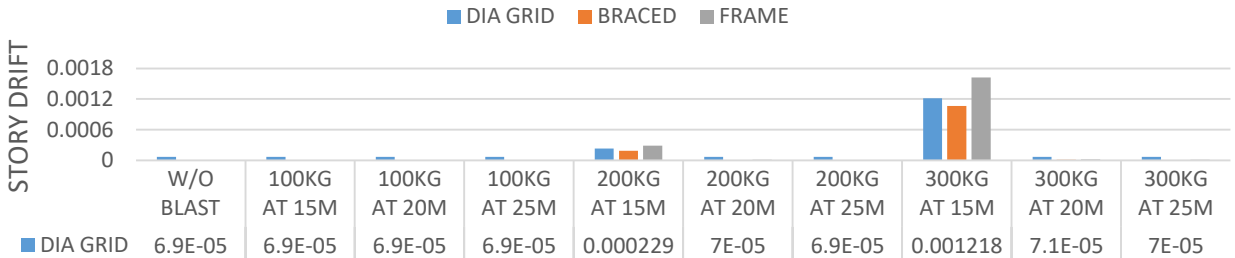
The outcomes of the analysis of the three different types of building models in ETABS 2016 are compare with each other with considering the applied loading condition are Dead Load, Live Load of intensity 3kN/m, Super Dead Load of intensity 3kN/m and Brick Load of intensity 15kN/m and Time History Function of non-linear model history (FNA) loading case.. The compare parameter are base shear, story displacement, overturning moments and story drift are following respectfully.



	W/O BLAST	100KG AT 15M	100KG AT 20M	100KG AT 25M	200KG AT 15M	200KG AT 20M	200KG AT 25M	300KG AT 15M	300KG AT 20M	300KG AT 25M
DIA GRID	567.730	551.750	566.379	567.721	1216.957	480.817	557.555	6663.005	460.616	472.541
BRACED	0.000	5.869	0.694	0.005	1546.474	43.700	5.368	7916.248	130.905	49.685
FRAME	0.000	6.107	0.977	0.007	1609.373	66.531	7.307	9129.551	161.696	68.699

From the above fig. 9, maximum base shear are found in frame structure in all cases with increase in mass and reduce distance but in case of 100 kg found negligible effect on structures. Dia. grid building and then braced building are found minimum base shear and perform better in all cases.

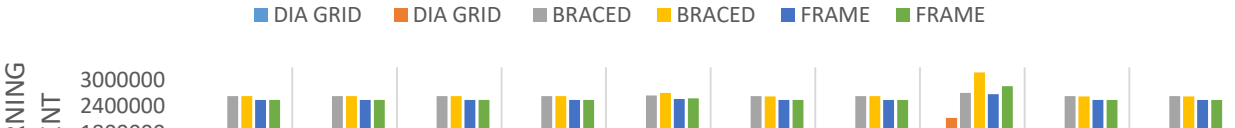
FIG. 10 MAXIMUM STORY DRIFT



	W/O BLAST	100KG AT 15M	100KG AT 20M	100KG AT 25M	200KG AT 15M	200KG AT 20M	200KG AT 25M	300KG AT 15M	300KG AT 20M	300KG AT 25M
DIA GRID	6.9E-05	6.9E-05	6.9E-05	6.9E-05	0.000229	7E-05	6.9E-05	0.001218	7.1E-05	7E-05
BRACED	0.000001	0.000001	0.000001	0.000001	0.000185	5E-06	0.000001	0.001065	0.00001	5E-06
FRAME	6E-06	7E-06	6E-06	6E-06	0.000288	0.000013	7E-06	0.001621	0.000015	0.000013

From the above fig 10, maximum story drift found in frame building then other building in case of high intensity of forced applied on building dia. The minimum value of story drift found in braced building, which little bit less then dia. grid building.

FIG. 11 MAXIMUM OVERTURNING MOMENT (kN-m)



	W/O BLAST	100KG AT 15M	100KG AT 20M	100KG AT 25M	200KG AT 15M	200KG AT 20M	200KG AT 25M	300KG AT 15M	300KG AT 20M	300KG AT 25M
DIA GRID	1707786	1707735	1707780	1707786	1694819	1707362	1707739	1634107	1706905	1707339
DIA GRID	1688321	1688552	1688264	1688232	1771541	1690414	1688472	2143368	1690944	1690502
BRACED	2636354	2636407	2636362	2636354	2650197	2636857	2636410	2710735	2637025	2636880
BRACED	2636354	2636009	2636304	2636354	2712101	2633076	2635982	3179828	2631857	2632858
FRAME	2550511	2550595	2550523	2550511	2574043	2551284	2550600	2682195	2551375	2551323
FRAME	2550511	2550320	2550480	2550511	2585147	2548424	2550282	2866067	2548100	2548340

From the above fig 11, maximum overturning moment found in both direction in both braced and frame building respectively then minimum in dia. grid building in all cases.

FIG. 12 MAXIMUM STORY DISPLACEMENT (mm)

	W/O BLAST	100KG AT 15M	100KG AT 20M	100KG AT 25M	200KG AT 15M	200KG AT 20M	200KG AT 25M	300KG AT 15M	300KG AT 20M	300KG AT 25M
DIA GRID	0.430	0.423	0.430	0.431	7.899	0.452	0.426	43.591	0.468	0.456
BRACED	0.108	0.108	0.108	0.108	6.659	0.179	0.108	38.100	0.318	0.193
FRAME	0.233	0.237	0.237	0.233	10.212	0.507	0.263	58.310	0.555	0.521

From the above fig. 12, maximum story displacement found in frame structure in all cases but in the dia. Grid building and then braced building reduced respectively. Minimum displacement found in braced building as

compare to other. 100kg is no effect on any structure at any separation distance.

IV. CONCLUSION

From the above result discussion the following conclusion comes:

1. The impact of the shock wave of the blast on the building increases with the increasing the blasting material also decrease in standoff separation from the structure. There is negligible effects of 100kg blast mass and other 200kg & 300kg at more than 25m separation distance from building are negligible effect.
2. The base shear of the dia. Grid is decrease by 27% & 18% than braced building and by 32% & 37% than frame building for respectively loading case 200kg and 300kg at 15m but in case of braced building is 4% & 15% less than the frame building for same loading.
3. The story displacement and story drift are less in both a Braced Building and dia. Grid building as compare to the frame building.
4. Overturning moments are decreased in both X Dir. and Y Dir. in a Dia. Grid building as compare to two other building are as Braced Building as compare to the frame building
5. Some parameter of braced building show the little bit good as compare to dia. Grid building. In a Dia. Grid Building construction the less material used than other building without affecting the structural efficiency. It also gives an aesthetic look as compare to others.
6. Dia. Grid Building has better resistance to the lateral forces on the building due to the diagonal outer column. Due to this, the inner column gets relaxed and carry mainly gravity load. However, in the other building, the outer and inner column designs for both the forces.

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