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STUDY OF DIFFERENT SHAPES OF DIAGRID STRUCTURE SYSTEM USING BLAST LOADING ANALYSIS AND OTHER DESIGN PARAMETER

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Abstract: In the Diagrid structure we have applied blast load gain attendance due to accidental event and natural event on structures. As in this work of diagrid structure having different angle of diagrid in building and in that blast, load is also considered, because blast explosion can cause the damage on the building internal and external structure. After that effect the loss of life and injuries, structural collapse, derbies impact. The lots of terrorist attack in past has attendant the blast effect on building is serious matter. In this way so many efforts have been made during past decades to analysis the structure and blast resistance structure. We consider the various stand-off distance and various charge-weights to conduct this study. Modelling and analysis of structure complete in structural software. Blast load applies on the structure using the different types of function in structural software. To decrease the blast effects on building use various types of diagrid angle system on building. To results compare all the model aspects on the storey displacement and storey drift and their criteria.

Index Terms – ***Blast Phenomena, Standoff Distance, Charge Weight, Positive front Phase, diagrid structure, Diagrid angle, Conventional building, Storey displacement, Storey drift***

I. INTRODUCTION

A. DIAGRID STRUCTURE

In Diagrid is a specific type of room support. It comprises of border lattice comprised of a progression of located support framework Diagrid is shaped by converging the inclining and even parts. The utilization of vehicle bombs to go after downtown areas has been a component of missions by psychological oppressor associations all over the planet. A bomb blast inside or promptly close by a structure can cause disastrous harm on the structure's outer and interior primary casings, falling of dividers, smothering of enormous breadths of windows, and closing down of basic life-security frameworks. The setup and proficiency of a diagrid framework diminish the quantity of primary component expected on the veneer of the structures, consequently less Block to the external view Diagrid is an exterior structural system in which all perimeter vertical columns are eliminated and consists of only inclined columns on the façade of the building. Shear and over-turning moment developed are resisted by axial action of these diagonals compared to bending of vertical columns in framed tube structure.

B. BLAST LOAD

A bomb blast inside or promptly close by a structure can cause disastrous harm on the structure's outer and interior primary casings, falling of dividers, smothering of enormous breadths of windows, and closing down of basic life-security frameworks. Death toll and wounds to tenants can result from many causes, including direct impact impacts, underlying breakdown, garbage effect, fire, and smoke. The circuitous impacts can join to restrain or forestall opportune departure, in this manner adding to extra losses. Likewise, significant fiascoes coming about because of gas-substance blasts bring about enormous unique burdens, more prominent than the first plane loads, of many designs. Because of the danger from such outrageous stacking conditions, endeavors have been made during the beyond thirty years to foster strategies for underlying investigation and plan to oppose impact loads. Blast load is considered as given in IS Code formula and the values are taken from that and blast is applied on the joint of beam slab and column and after that result are taken and story displacement and story drift are compared with conventional building.

II. LITERATURE

After the studying number of literature finally fixed the angle of diagrid and the blast loading condition and also taken the stand-up distance ratio and refer the research papers.

METHODOLOGY

A. LITERATURE REVIEW:

[1] Analysis and comparison of diagrid and conventional Raghunath. Deshpande, Sadanand M. Patil, Subramanya Ratan Diagrid performs better across all the criterions of performance evaluation, such as, efficiency, expressiveness and sustainability. Diagrid structure have comparatively less deflection. Their structural weight is reduced to greater extent. Due to this structure has more resistance to lateral forces. Diagrid structures are cost effective and eco-friendly. Diagrid uses 11247 tons of steel which is 28% less compared to the conventional orthogonal building which uses 15255 tons. **[2]** Analysis of Tall Structure Project Considering Effect of Diagrid and Hybrid Diagrid Members (Prafull Kumar Yadav, Pratiksha Malviya) The configuration and efficiency of a diagrid system reduce the number of the structural element required on the façade of the buildings, therefore less obstruction to the outside view. The diagrid system structural efficiency also helps in avoiding interior and corner columns and therefore allowing significant flexibility with the floor plan. The magnitude and intensity of seismic forces are varying from region to region causing moderate to severe destructive energy on engineering properties as well as rising to great economic losses and threat to life. Determine that frame with diagrid results in less lateral forces in beam and columns. Structure with diagrid at approximately 60-degree diagrids become more stable. Determine that diagrid in tall structures reduces the effect of story drift. **[3]** After the Four major bombing incidents took place in Mainland UK within the last ten years; the 1992 St Mary's Axe, the 1993 Bishopsgate, the 1996 Docklands and Manchester bombs the author was involved in the investigation of damage and reinstatement of numerous commercial buildings, and in providing advice to building owners and occupiers on blast protection measures for both existing and proposed buildings. These detonation devices were estimated as 450 kg, 850 kg, 500 kg and 750 kg of TNT equivalent, respectively. As a result, the author was involved in the investigation of damage and assessing the dynamic response of these buildings and their floor slabs to blast loading. The finite element (FE) analysis technique used in this investigation is described, and the correlation between the results of the FE analysis and laboratory and on-site testing is highlighted. It was concluded that the ductility and natural period of vibration of a structure governs its response to an explosion. Ductile elements, such as steel and reinforced concrete, can absorb significant amount of strain energy, whereas brittle elements, such as timber, masonry, and monolithic glass, fail abruptly.**[4]** A brief increment in quantity and discharge of power in an excessive way, extra frequently than now no longer with the era of very excessive temperature and launch of gases is characterized as blast. Explosions both arise withinside the shape of deflagration or detonation relying on burning pace in the course of the explosion. Deflagration is propagated through the liberated response of thermal conductivity; the following layer of cold fabric is ignited through the new burning fabric and burns it and the technique proceeds like that. Most "fire" observed in regular life, from flares to blasts is deflagration. Modelling and evaluation of excessive upward push constructing for external (air blast) explosion. Analytically and numerically show the conduct of tall constructing tormented by blast. Assessing of consequences received for excessive upward push homes subjected to load from the evaluation.

III. OBJECTIVES

Objectives pertaining this research work are described as follows:

- To study focused on the correlation between different of diagrid structure using blast load analysis based on the result obtained from software.
- To Analysis and design of the diagrid structure for high rise building with blast load condition
- To Comparison of the structures based on the stiffness, relative displacement and resistance toward lateral loads in different shape of diagrid structure.
- To propose an optimum angle of the diagonal angle for better stability in the diagrid structure.
- To study the response of buildings in terms of story shear, story drifts, story stiffness and blast load analysis.
- To study the response of building in terms of story displacement & story drift.
- To study the behaviour of blast of building using different diagrid angle.
- To Modelling and analysing of building Models for front face of building.
- To study the result of blast load with different angle of diagrid structure and behavior of structure.
- To study the structure with different standoff distance as well as different charge weight.

IV. BUILDING CONFIGURATION

A. GEOMETRY & STRUCTURAL DATA:

No. of Story	G+10
Floor height	3m
Total height of building	33m
Plan area	17.25 x 20.49
Slab thickness	125mm
Concrete grade	M25
Steel grade	Fe500
Density of wall	20 KN/m^2
Wall thickness	230mm
Size of beam	230 X 450mm
Size of Column	230 X 600mm
Live load	3KN/m2
Location	Ahmedabad
Basic wind speed	39m/s
Terrain category	Class 2
Structure class	B
Risk factor k1	1.0
Topography factor k3	1.0
Cp	As per IS 875:1987
Load combination	1.5(DL + LL), 1.5(DL ± EQX), 1.5(DL ± EQY), 1.5(DL ± WLX), 1.5(DL ± WLY), 1.5(DL +LL ± EQX+BL), 1.5(DL + LL ± EQY+BL), 1.5(DL +LL ± WLX+BL), 1.5(DL + LL ± WLY+BL),

TABLE:1 BUILDING DATA

B. BLAST & DIAGRID CALCULATION:

- **DIAGRID ANGLE CALCULATION**: - The angle is obtained from the height of the story module to the base width of diagrid that is,
  - For example: 10 story building

Angle (*θ*) = $\tan^{-1}$ (Height of module/ base width)

= $\text{Tan}^{-1}(3/5)$

= $\text{Tan}^{-1}(0.6)$

= 30.96^0 (diagrid angle)

- **BLAST LOAD CALCULATION**: - Actual distance: The distance for each beam-column joint varies from the source which are calculated manually, considering blast source at a point (1.5,0,0) at left side corner.

$$(x, y, z) = ((x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2)^{0.5}$$
$$(x, y, z) = ((15 - 0)^2 + (3 - 1.5)^2 + (3 - 0)^2)^{0.5} = 21.412$$

- Scaled distance: Actual distance/Charge weight^0.33

  21.412 / (0.1^0.33) = 45.77

- Peak over pressure: after get value of scaled distance peak over pressure value find from IS-4991-1968 Table-1.
- Area: At the joint sum of half distance of upper and lower column multiply sum of half distance of upper and lower beam.

C. STAND-UP DISTANCE: -

- While accidental fires may occur, fires resulting from an attack may have a different kind of impact. For example, an accidental fire usually starts at one location and often, but not always, spreads relatively slowly. On the other hand, a fire from arson is often strategically set in multiple locations to maximize the rate of spread and damage This section discusses the effects of fire on four major structural construction materials: steel (structural steel), reinforced concrete, pre-stressed concrete, and timber.

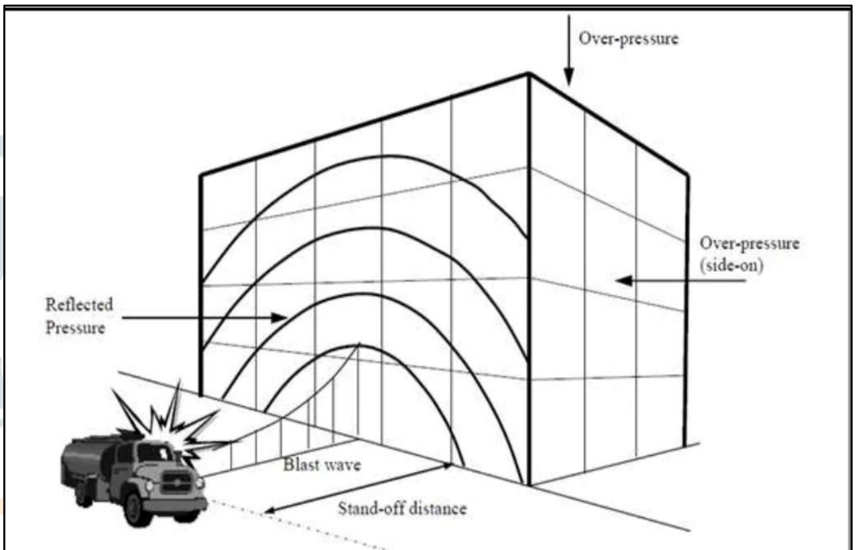


Fig : Reflected overpressure

FIG:1 BLAST OVERPRESSURE

- The detonation of a condensed high explosive generates hot gases under pressure up to 300 kilo bar and a temperature about 3000-4000°C. The resulted compressed air expands outward from the Centre of the blast and causes formation of wave in a wind medium having a velocity greater than sound. So, this blast wave causes air pressure to rise and which is known as side on overpressure.
- As the blast wave or shock wave traverses path the overpressure gradually decreases. Now a vacuum pressure zone gets generated behind the shock wave.

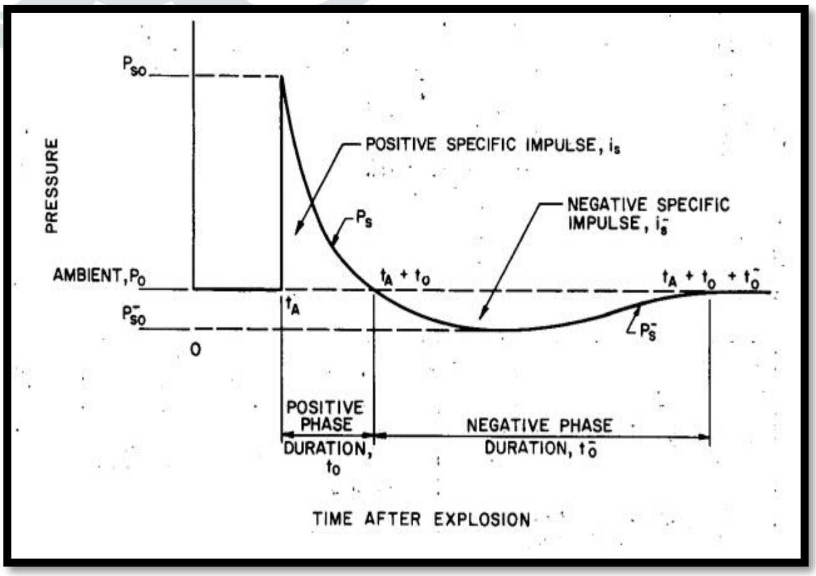


FIG:2 TIME OF EXPLOSION

D. STRUCTURAL PLAN: -

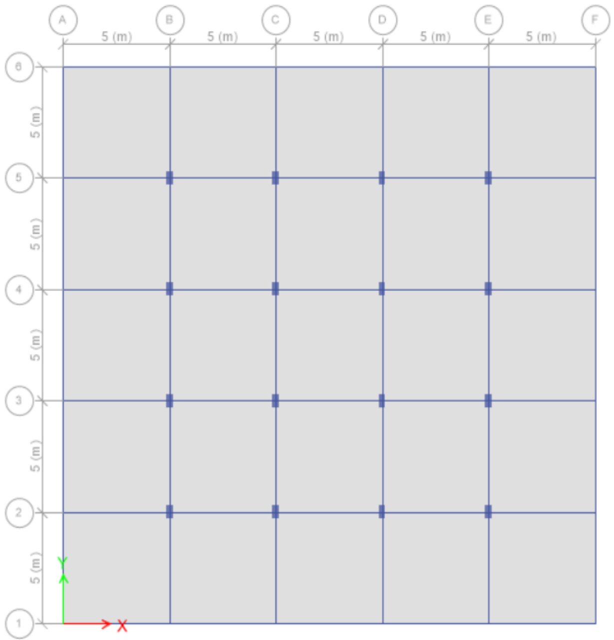


FIG:3 51^0 STRUCTURAL LAYOUT

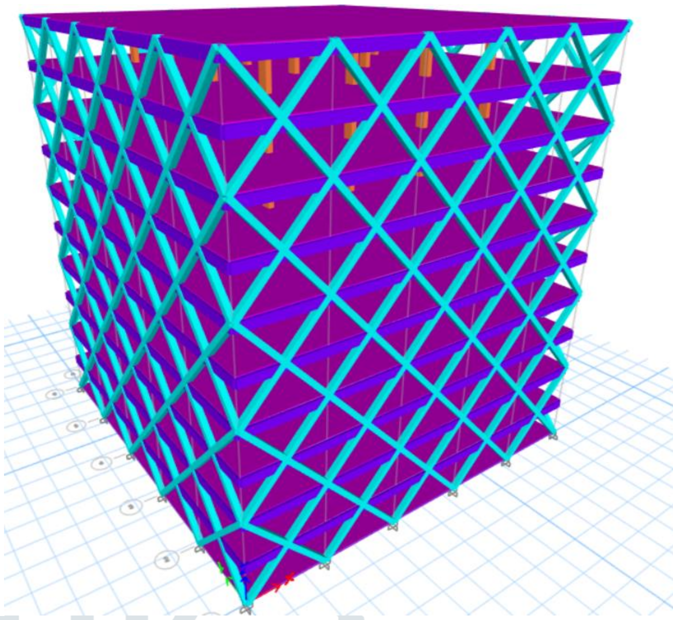


FIG:4 51^0 ELEVATION VIEW

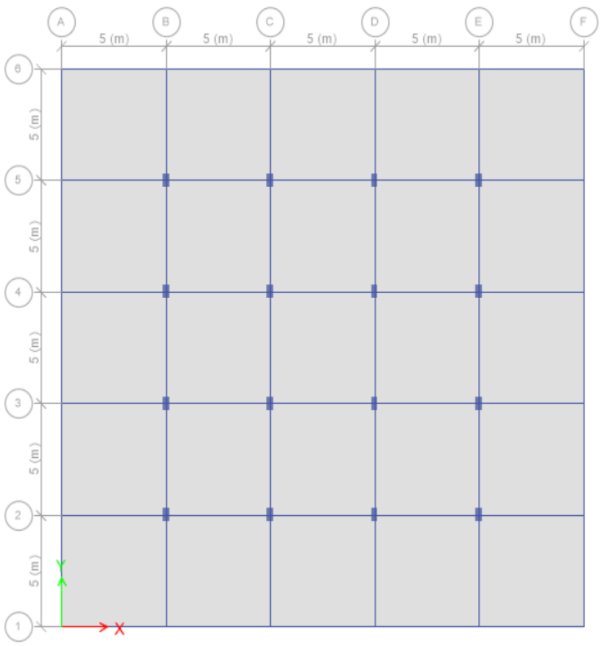


FIG:5 30^0 STRUCTURAL LAYOUT

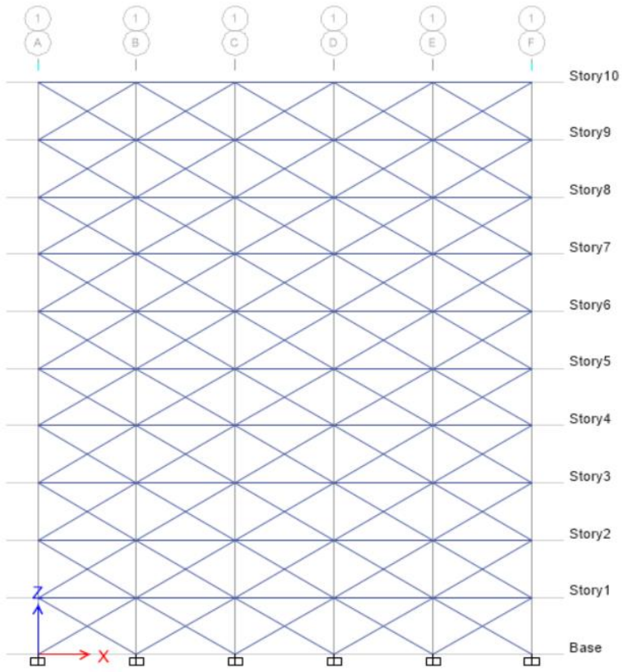


FIG:6 30^0 ELEVATION VIEW

No. of module	Beam size	Column size	Orientation	Story
Diagrid angle 30^0 structure	230 x 450 mm	230 x 600 mm	90^0	10
Diagrid angle 50^0 structure	230 x 450 mm	230 x 600 mm	90^0	10
Conventional structure	230 x 450 mm	230 x 600 mm	90^0	10

TABLE:2 MODULE & GEOMETRY

V. RESULT

After analysis, comparison of different parameters between Diagrid Angle with blast load condition are discussed below

A. Story displacement

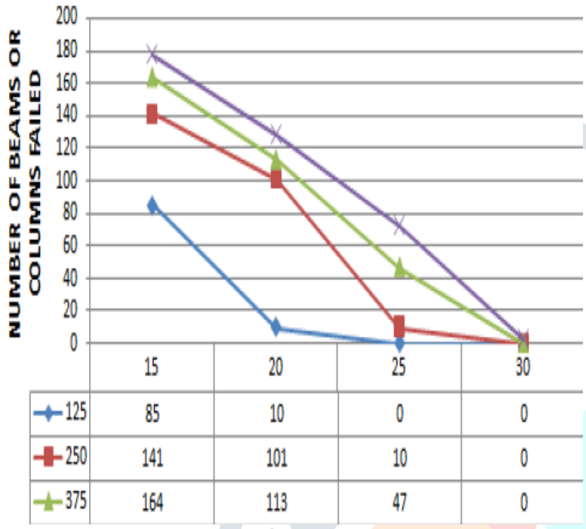


FIG:7 BEAM & COLUMN FAILURE

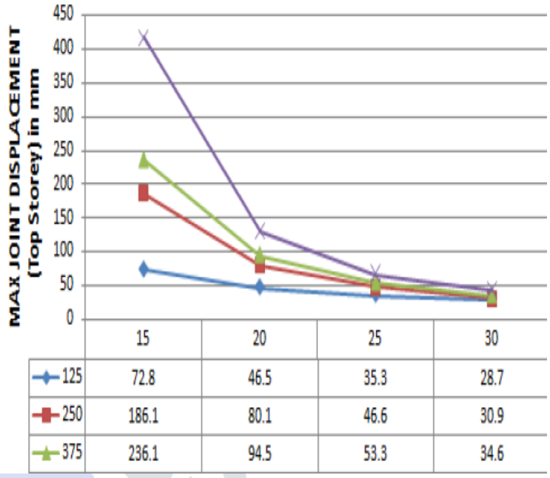


FIG:8 MAX. DISPLACEMENT GRAPH

- The given table shows the information about displacement of 125,250,375 KG charge weight 15,20,35 m standoff distance where charge weight applied on front face of building and left corner of building.
- As same above other displacement graph are carried out with different stand-up distance and different charge weight of blast with different diagrid angle.

B. Story drift

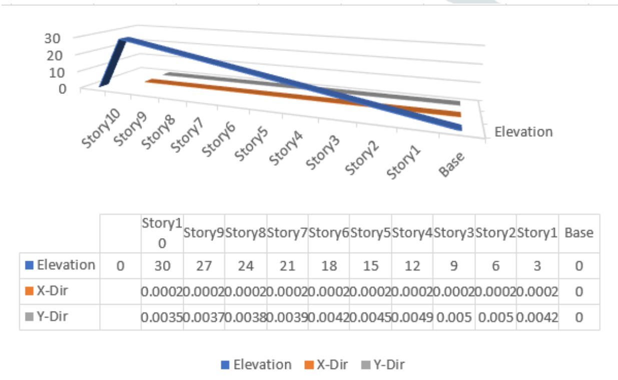
- 

FIG:9 MAX. DRIFT GRAPH

The given table shows the information about displacement of 125,250,375 KG charge weight 15,20,35 m standoff distance where charge weight applied on front face of building and left corner of building.

- As same above other drift graph are carried out with different stand-up distance and different charge weight of blast with different diagrid angle.

VI. REFERENCES

1. Khushbu Jania, Paresh V. Patel, "Analysis and Design of Diagrid Structural System for High Rise Steel Buildings", 3rd Nirma University International Conference on Engineering (NUICONE 2012)

2. Mir M. Ali and Kyoung Sun Moon, "Structural Developments in Tall Buildings: Current Trends and Future Prospects", Architectural Science Review, Volume 50.3, Pp 205-223

3. Terri Meyer Boake, Diagrids, "The New Stability System: Combining Architecture with engineering", Aei (Asce), 2013, P 578-583 Kyoung-Sun Moon, Jerome J. Connor and John E. Fernandez, "Diagrid Structural Systems for Tall Buildings: Characteristics and Methodology for Preliminary Design", Struct. Design Tall Spec. Build. 16, 205-230 (2007).

4. Anatol Longinow A, and Mniszewski KR., "Protecting buildings against vehicle bomb attacks," Practice Periodical on Structural Design and Construction, ASCE, New York, pp. 51-54, 1996.

5. B. Lu, P. Silva, A. Nanni, and J. Baird, Retrofit for Blast-Resistant RC Slabs with Composite Materials, University of Missouri- Rolla, SP-230-76

6. B.M. Luccioni1, R. D. Ambrosini & R.F. Danesi1, Assessment of blast loads on structures,

7. WIT Transactions on Engineering Sciences, Vol 49, 2005.

8. Mario Paz, Structural dynamics, second edition, CBS publishers and distributors, 2004.

9. Philip Esper, investigation of damage to buildings under blast loading and recommended protection measures, 9th International Structural Engineering Conference, Abu Dhabi, November 2003.

10. IS CODE 4991-1968 (Indian standard code)

11. Alok Goyal, Blast resistant design: Critical issues, proceedings of the sixth structural engineering convection, pp IPXI-1-10, Dec 2008.