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# AN ADVANCE STUDY OF HIGH RISE STRUCTURE CONSIDERING BLAST LOAD AND SECURED BY SHEAR WALL

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***Abstract:*** Shear walls are specifically designed, inside and out, to resist vertical forces carried forward by wind, earthquakes, and other forces acting in the wall's plane. They are often made of a flexible material and installed in tall structures to prevent the buildings from collapsing as a result of seismic forces. Shear walls are strong and flat, and they can carry both heavy gravity loads and strong vertical loads. The joints, however, are quite complete if the building is tall, say more than 12 stories, the beams and columns are very large, and the steel holding the beams and columns together is very heavy. Because in these locations it is challenging to pour and vibrate, this is bad for the security of the building. Shear barriers have been added to tall buildings as a result of these practical challenges. Past few years have seen lot of focus on the issue of earthquakes and explosions. The first issue to be noted in the previous 60 years, explosives, was preceded by problems relating to earthquakes. Due to the difficulty of assessing the dynamic reaction of structures to blast loads, traditional structures are typically not built to sustain blast loads. High strain rates, non-linear frictional material behaviour, and inaccurate blast load estimations are just a few consequences of this complexity. Deterministic and temporal intervals, or expensive design and construction. In the meantime, the number of terrorist strikes on infrastructure increased. These elements focus on the importance of researching explosive processes and how they affect structures. In this research work prepare three different shape of models with different symmetric conditions. Use M-30 grade of concrete and fe-250 of steel to prepare models. Also use shear wall at different location. Time history analysis used in all models with application of blast loading.

***Shear wall, Blast load, Time history analysis, Plus shape models, C-shape models and Unsymmetrical Models etc.***

## I. INTRODUCTION

S Shear walls are structural components developed specifically in structural engineering to resist horizontal stresses caused in the wall's plane by wind, earthquakes, and other lateral forces. High-rise buildings usually have core walls built as flexural features to prevent complete building collapse from seismic pressures. In comparison to earlier buildings in Indian urban areas, high-rises have become as efficient as possible. More accurate structural features, like shear walls and pipe structures, as well as changes in material qualities, are used to improve the structural system of tall buildings to manage their dynamic response. The base of load-bearing wall systems is a mixture of soil and building systems, in addition to the static effects of the walls. While lateral loads (such as wind and seismic loads) are carried to the walls and foundation, the roof system supports vertical loads and serves as a skin. This shear wall's principal purpose is to resist sliding and impact. This study describes several wall performance tests based on wall location, structure, and building material.

**Shear wall**

Shear structures are often the main structure of several buildings, tall buildings, or buildings near seismic and wind stresses. Shear walls are used to stop the structure from being subjected to identical loads from the wind, draught, earth, or hydrostatic pressure. These loads typically follow the phenotypic plasticity of seismic and wind vibrations and behave linearly in all directions. A tissue wall is a structure that resists two forces because the load applied in the direction of the plane of action causes the bone to bend in keeping with the plane's wall. A plane shear and a plane bending are the shear moments. Shear walls are also resistant to buckling as a separate structural unit because of larger permanent loads and vertical plane shear (which results directly from horizontal shear). One of three methods—lateral cracking, heel cracking, vertical heel cracking, or buckling—can cause shear walls to fail. Shear walls are often constructed using steel-bearing frames or solid walls consisting of plywood or masonry, taking into account the above parameters.

Attacks by terrorists and acts of terrorism have significantly grown in recent decades. These calamities are caused by people. Unexpected energy is released into the environment after an explosion, affecting the material's physical and chemical properties. It happens when energy that has been stored is abruptly converted into mechanical work, which produces a shock and a lot of noise. The atomic nucleus, which typically contains trinitrotropin as the explosive component, produces energy by releasing protons and neutrons, which result in nuclear explosions. Trinitrotoluene is an energy-producing compound based on atom rearrangement. Explosives are intense, short-term, complicated problems that force adjustments in organizational responses. It's critical to estimate the destruction brought on by an unexpected man-made calamity. Policies by themselves are insufficient to cut down on damages. To reduce damage, appropriate mitigation methods will be used. The pressure produced by a quick surge of energy is known as an explosion or blast.

**Martials used in shear walls**

- Wood frame with vertical studs and sheathing
- Steel. For large buildings
- Steel or other material diagonal braces
- Momentary Frames

**Shapes of shear walls**

Many shear walls are simple rectangular plans but can be built in a variety of shapes to resist wind and earthquakes more effectively.

- A "core wall" is a box-shaped shear wall that forms a square or rectangle around a central core that contains the building's elevators and mechanical systems.
- C-shaped walls have short extensions at each end of the main plane.
- L-shaped walls have long legs at one end of the face.
- The alphabet follows T, U, and W, and other permutations named after nearly the same letter.
- Perfect shape for use in all situations. Some absorb the effects of earthquakes more effectively, while others are better suited to high winds. This is determined by the structural engineer.

**Functions of shear walls**

- Location of lateral loads, seismic loads, and vertical forces (gravity)
- Reduce the lateral approach of the building.
- Provides great strength and rigidity to the building in relation to its orientation.
- Rigid vertical diaphragms transfer loads to the foundation.
- Provides high strength and stiffness in the orientation direction.
- Significantly reduces side footage.
- Reinforcements are well distributed.
- Minimize damage to structural and non-structural elements.

**Location and design classification of the shear wall**

The location of the shear wall depends on the;

1. Structure plan
2. Core location
3. Building symmetry
4. The lateral force of the structure

**Types of shear walls**

- Reinforced Concrete Shear Wall
- Concrete Block Shear Wall
- Steel Shear Wall
- Plywood Shear Wall
- Mid-Ply Shear Wall

## II. OBJECTIVES

- To analyse the parameters like bending moment, shear force, joint displacement, and story drift in different types of models with blast load.
- To study the different types of symmetric and unsymmetrical models.
- To study the effect of shear walls at different locations.
- To compare the results of models using shear walls at corners and shear walls used as belt walls.

## III. METHODOLOGY

In this section, three different shaped models with shear wall at different locations are prepared. Analysis of models is done to understand the working process.

**Model geometry**

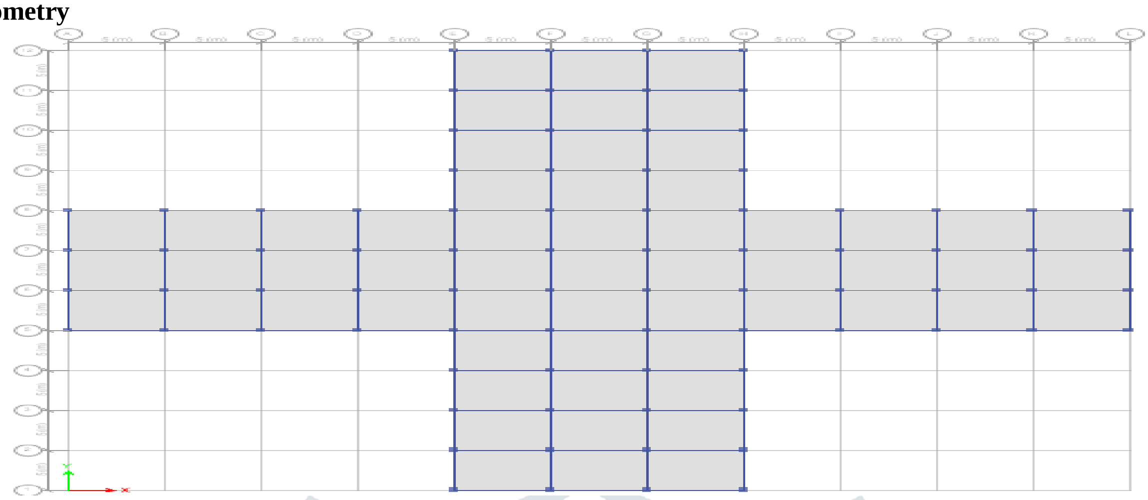

Fig. 1 Plan view of plus shape with blast loading

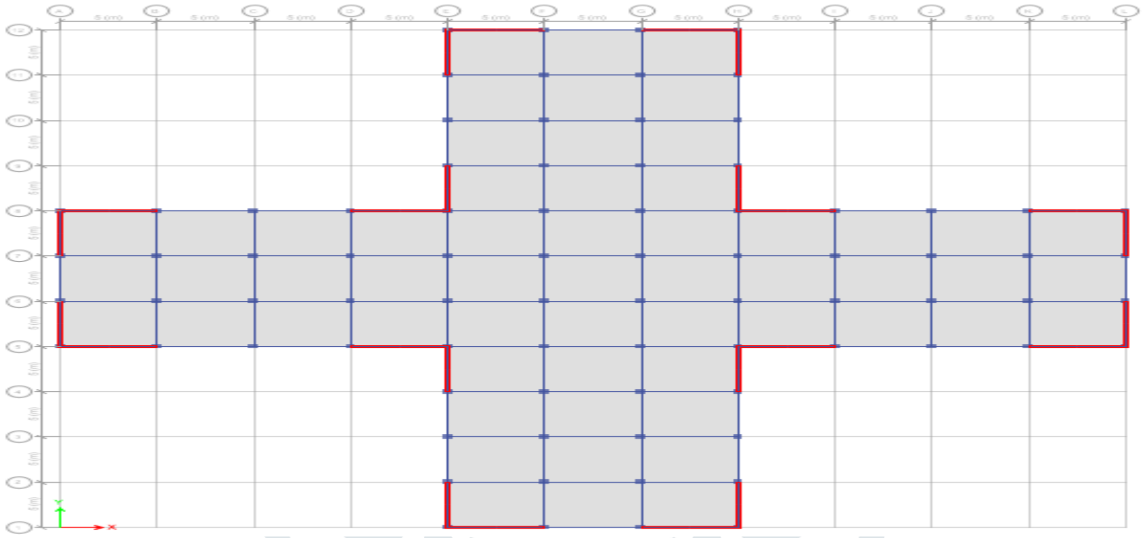

Fig. 2 Plan view of plus shape with Shear wall at Corners with blast loading

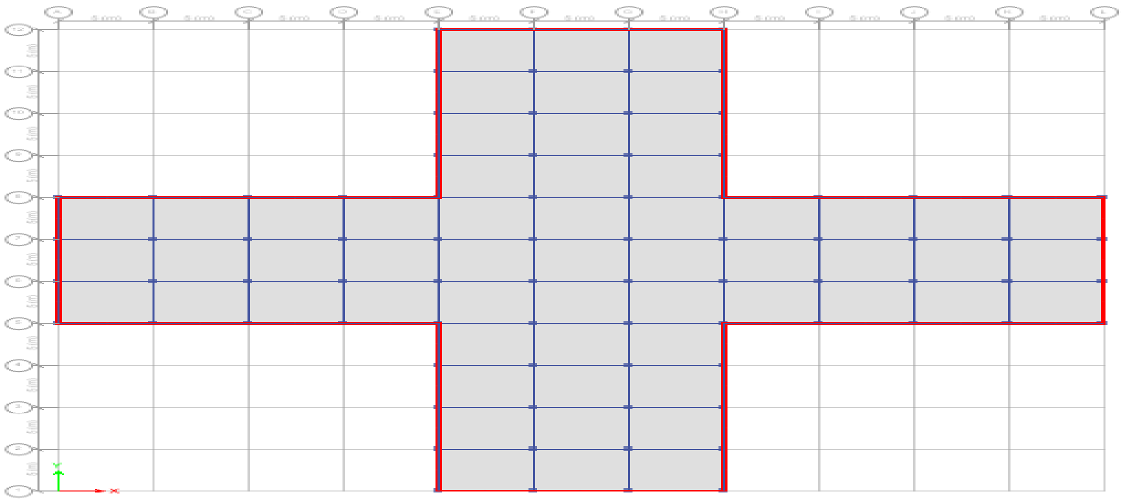

Fig. 3 Plan view of plus shape with Shear wall at Alternate floor with blast loading

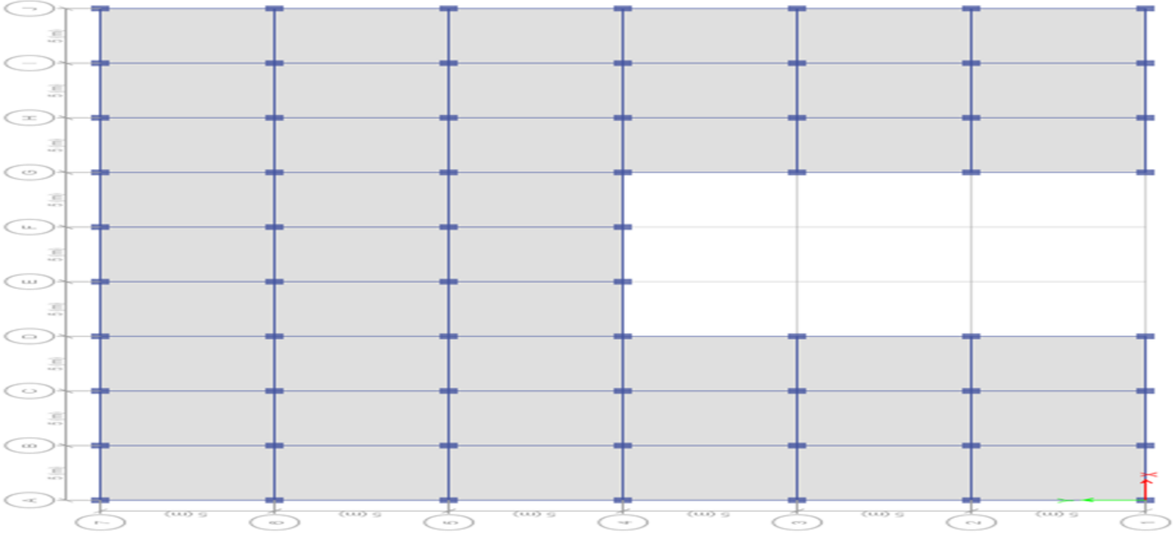

Fig. 4 Plan view of C-Type with blast loading

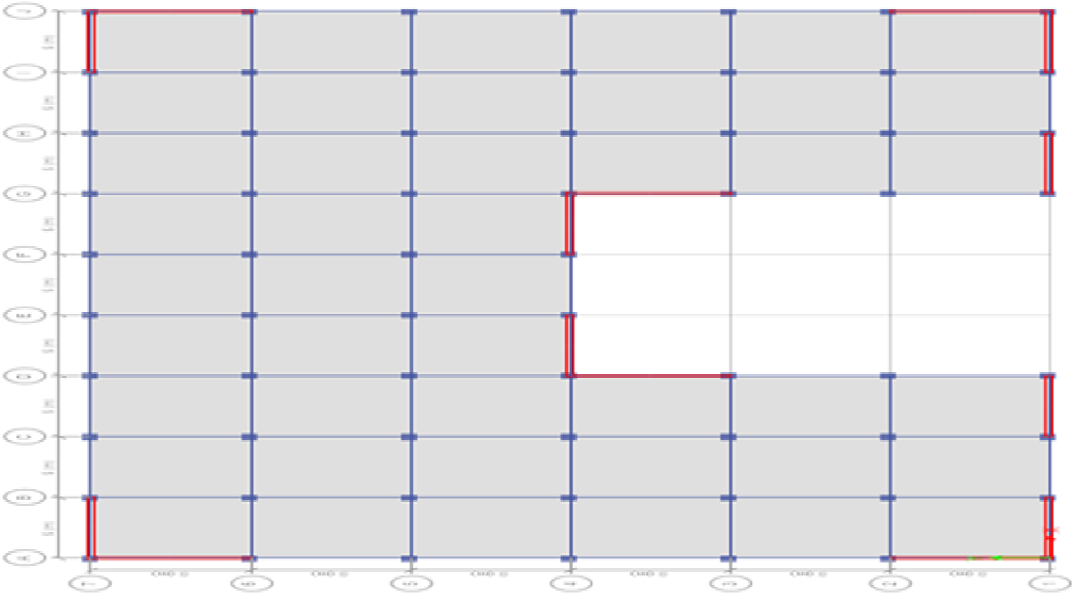

Fig. 5 Plan view of C-Type with Shear wall at Corners with blast loading

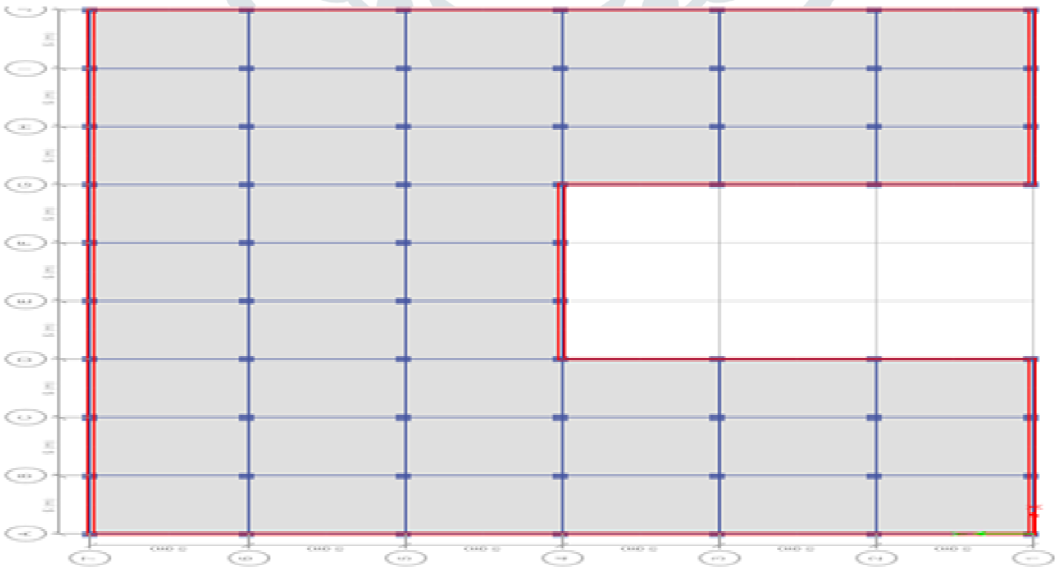

Fig. 6 Plan view of C-Type with Shear wall at Alternate floor with blast loading

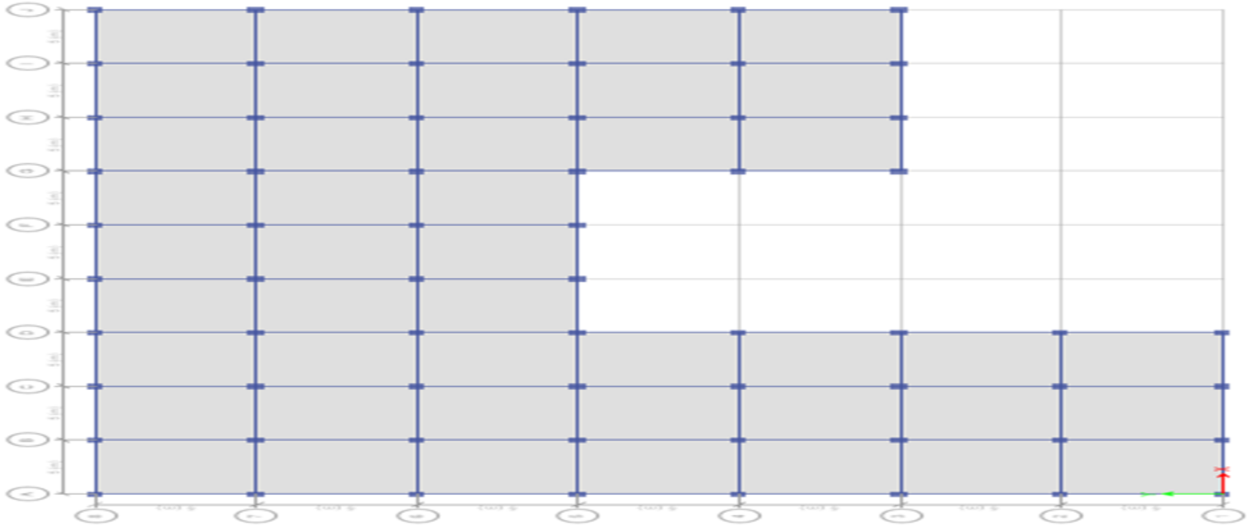

Fig. 7 Plan view of C- Unsymmetrical type with blast loading

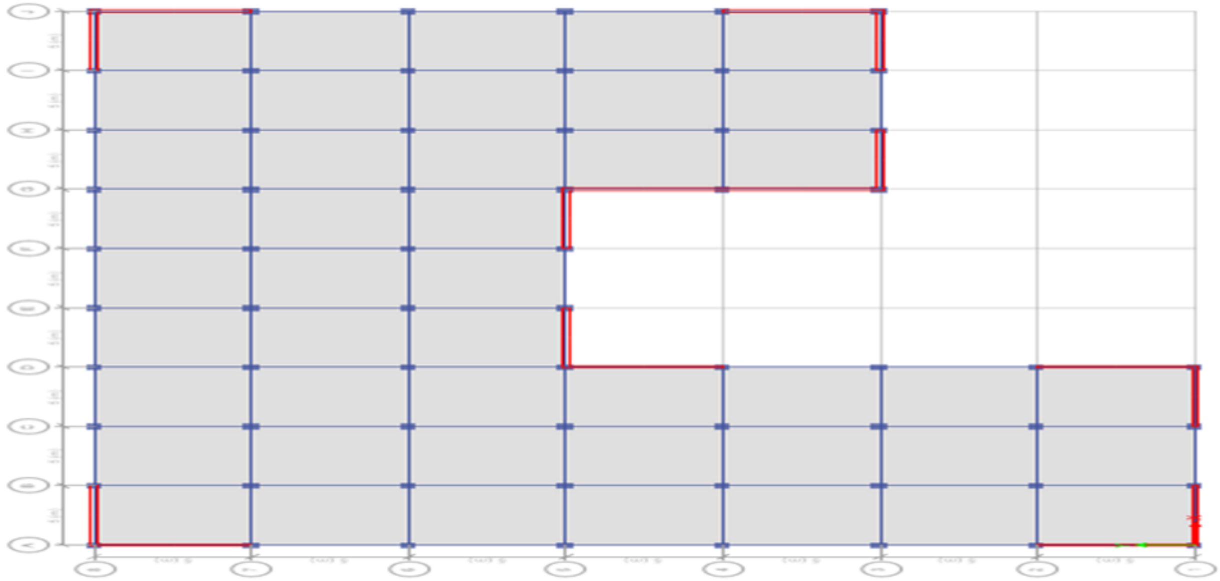

Fig. 8 Plan view of C- Unsymmetrical type with Shear wall at Corners with blast loading

Fig. 9 Plan view of and C- Unsymmetrical type with Shear wall at Alternate floor with blast loading

**Material properties**

Table 1: Material Properties– Basic Mechanical Properties

| Material | Unit Weight | E1 | F1 |
|---|---|---|---|
| | KN/m3 | E1 | Fy |
| Fe250 | 76.972 | 2.100E+08 | 250000 |
| HYSD415 | 76.972 | 2.000E+08 | 415000 |
| M-30 | 24.992 | 273861280 | 30000 |

**Load patterns, cases and combinations**

Table 2: Load Pattern Definitions

| Load Pattern Definitions | | | |
|---|---|---|---|
| **Load Pattern** | **Design Type** | **Self-Weight Multiplier** | **Auto Lateral Load** |
| Dead | Dead | 1. | |
| Live | Live | 0 | |
| EQL+X | **Quake** | **0** | **IS 1893-2002** |

Table 3: Load cases

| Load Cases | |
|---|---|
| **Load cases name** | **Load Case Type** |
| Dead | Liner static |
| Live | Liner static |
| EQL+X | Nonlinear Model history (FNA) |

Table 4: Load Combinations

| Sr. no | Load Combination |
|---|---|
| 1 | 1.0 (Dead Load + Blast Loading) |
| 2 | 1.2 (Dead Load + Live Load + Blast Loading) |
| 3 | 1.5 (Dead Load + Blast Loading) |
| 4 | 1.5 (Dead Load + Live Load) |

## IV. RESULTS AND ANALYSIS

In this section, we discussed about the outcomes of software for blast loading on all type of models. Various parameters like bending moment, shear force, joint displacement, storey drift and drift reaction were considered for the analysis.

Table 5: Models Definition

| Models | Type of Model |
|---|---|
| Plus shape | Symmetrical to X and Y-Axis |
| C-Type | Symmetrical to X-axis |
| C-Type Unsymmetrical | Unsymmetrical to X and Y-Axis |

**Results of Joint Displacement**

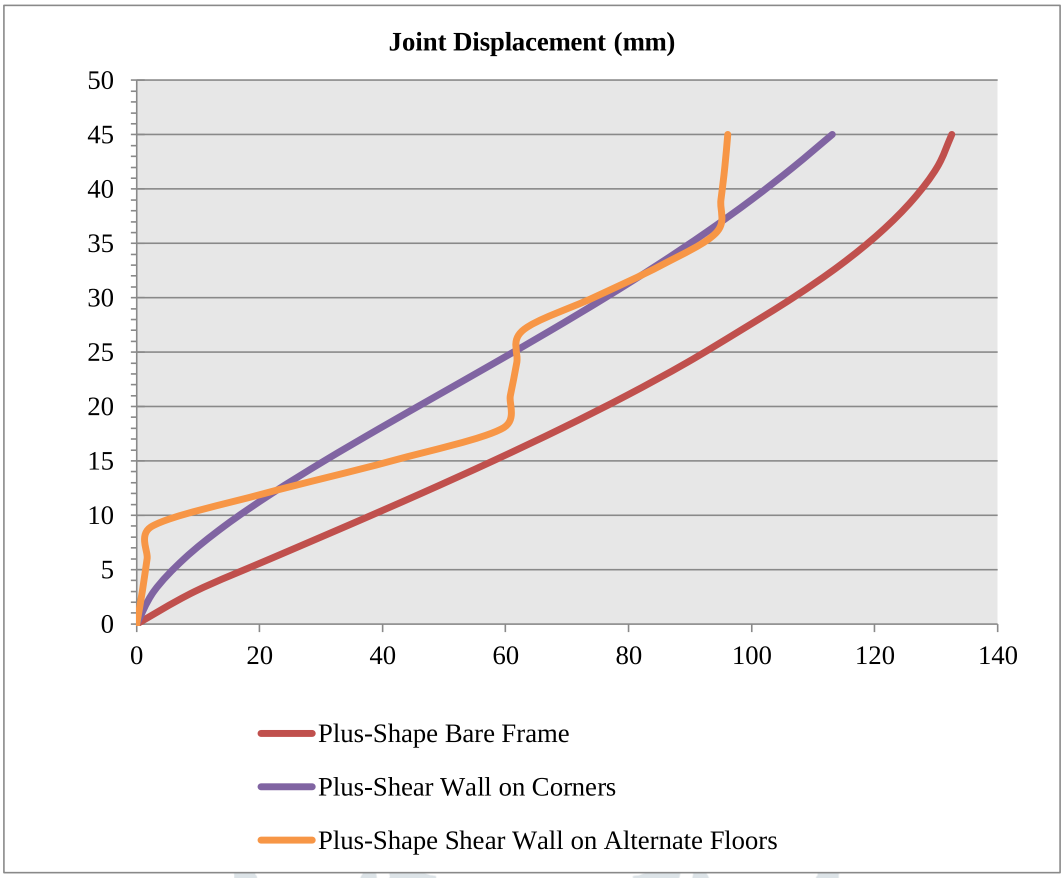


Fig. 10 Joint Displacement of Plus shape different models due to Load Combination 1.0 (DL+BL)

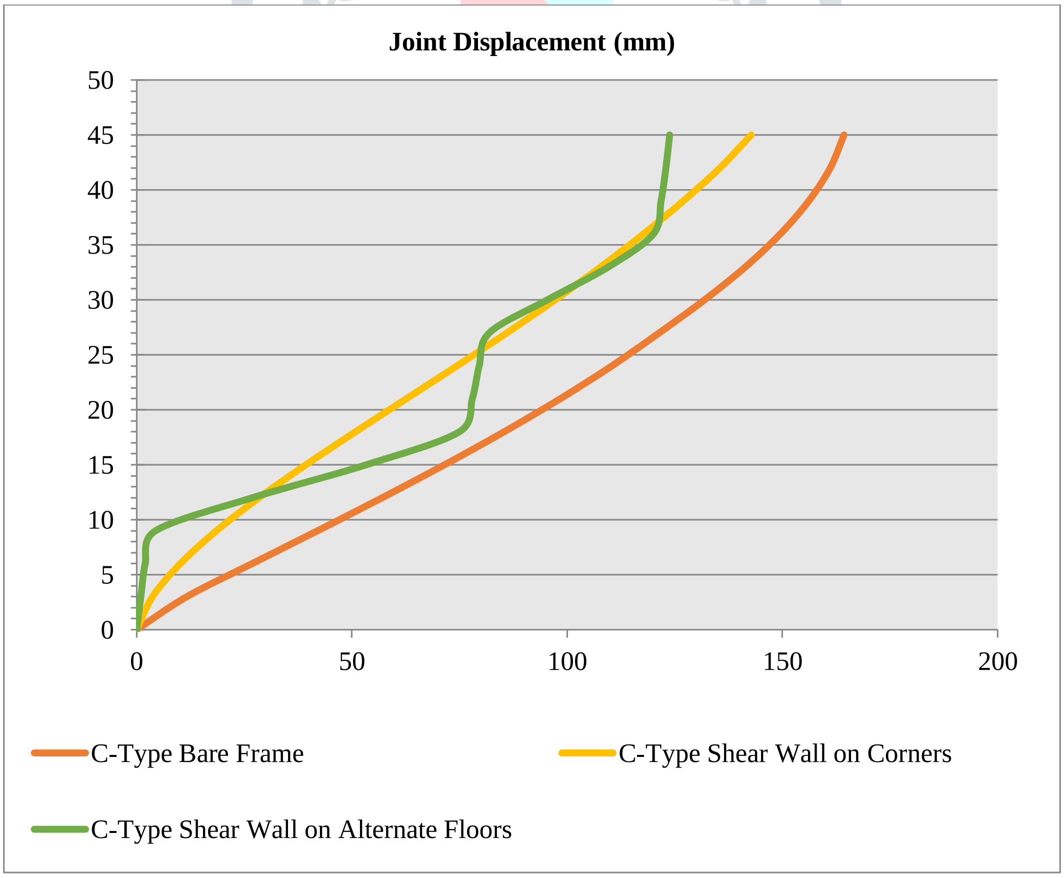


Fig. 11 Joint Displacement of C-Type different models due to Load Combination 1.0 (DL+BL)


Fig. 12 Joint Displacement of C-Type Unsymmetrical different models due to Load Combination 1.0 (DL+BL)

**Results of Storey Drift**

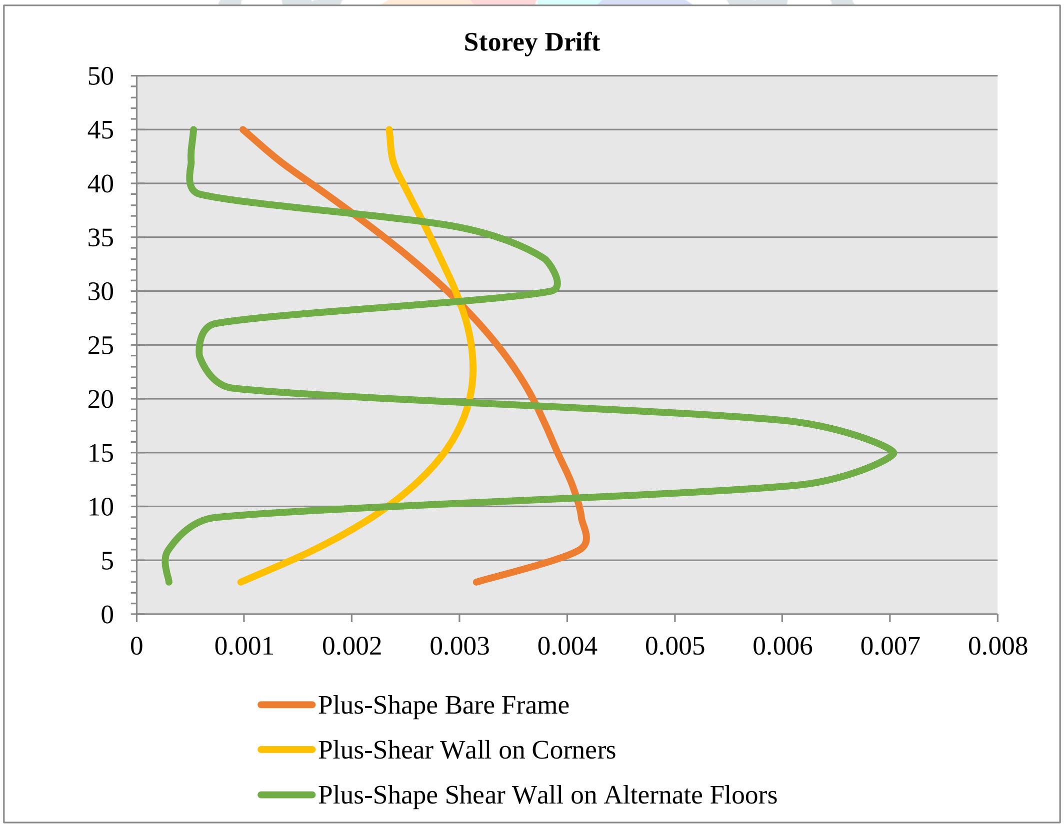


Fig. 13 Storey Drift of Plus shape different models due to Load Combination 1.0 (DL+BL)

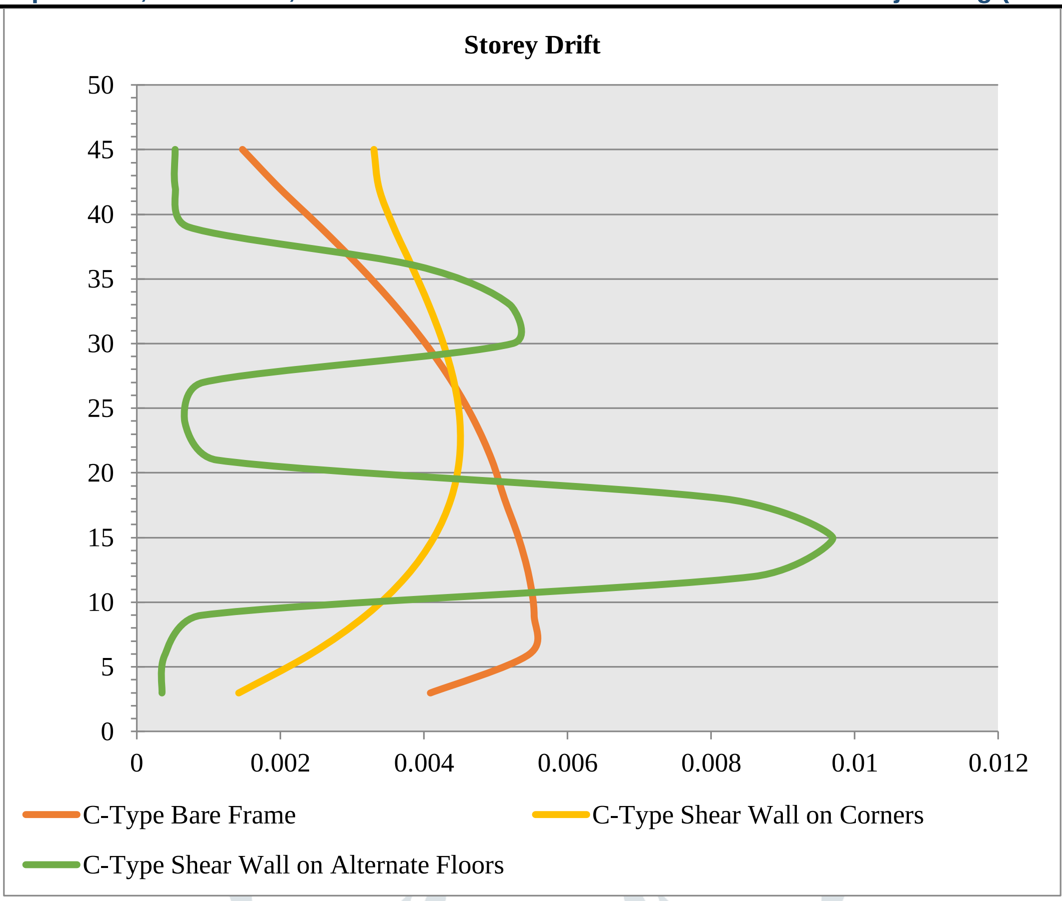


Fig. 14 Storey Drift of C-Type different models due to Load Combination 1.0 (DL+BL)

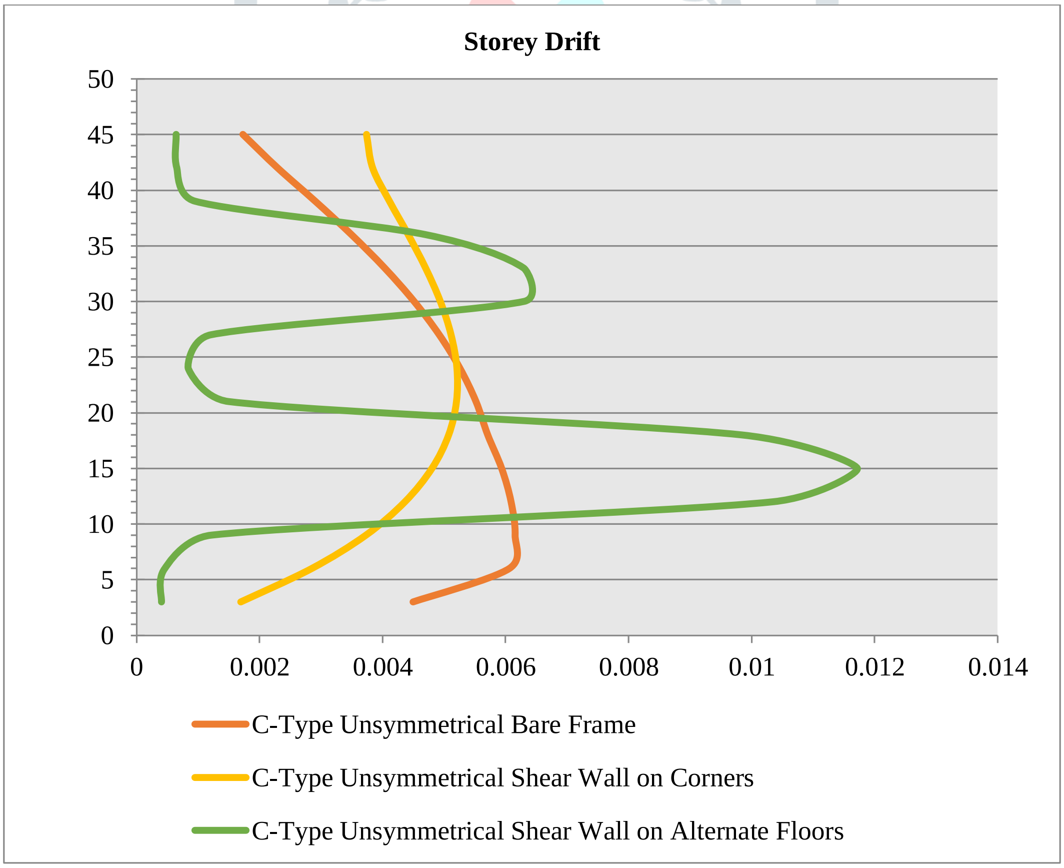


Fig. 15 Storey Drift of C-Type Unsymmetrical different models due to Load Combination 1.0 (DL+BL)

**Results of Drift Ratio**

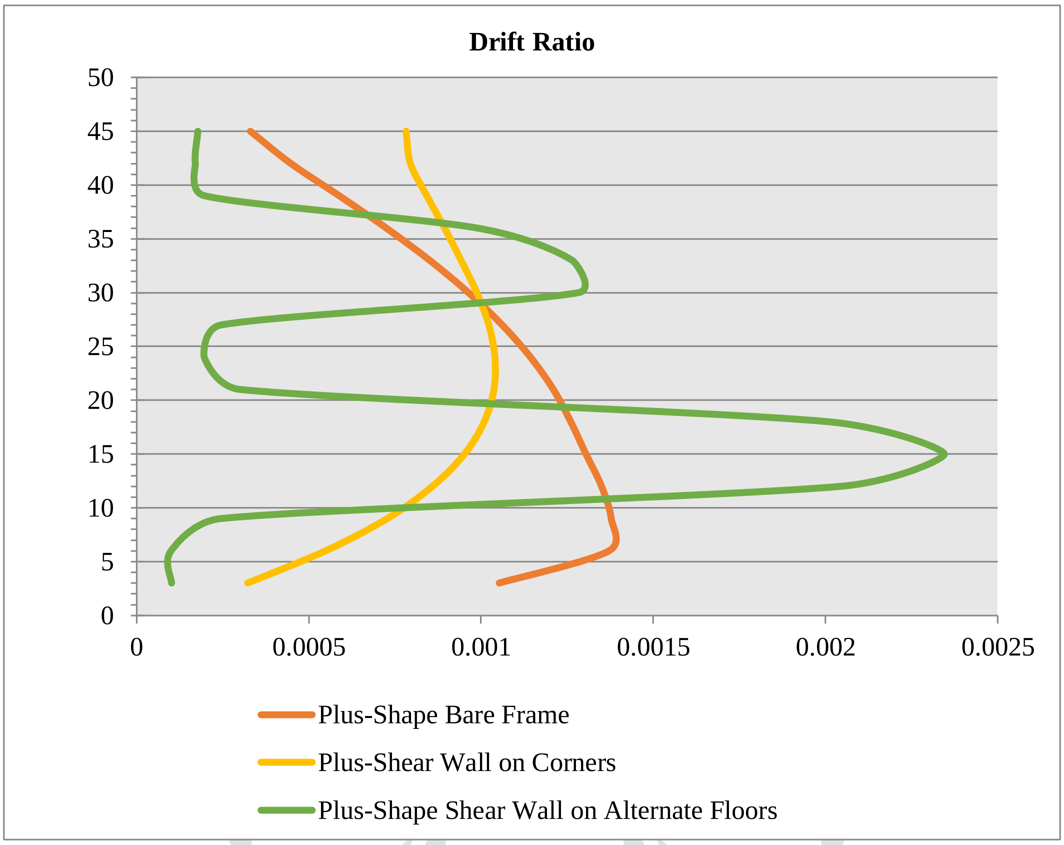


Fig. 16 Drift Ratio of Plus shape different models due to Load Combination 1.0 (DL+BL)

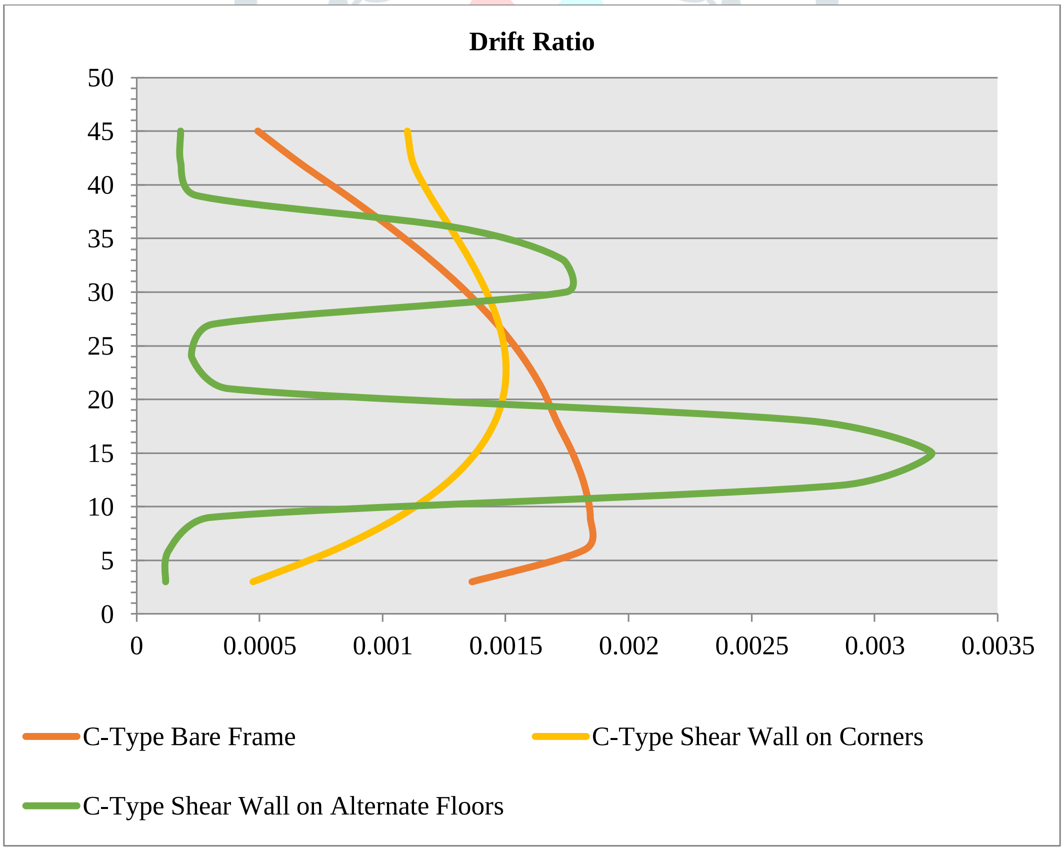


Fig. 17 Drift Ratio of C-Type different models due to Load Combination 1.0 (DL+BL)

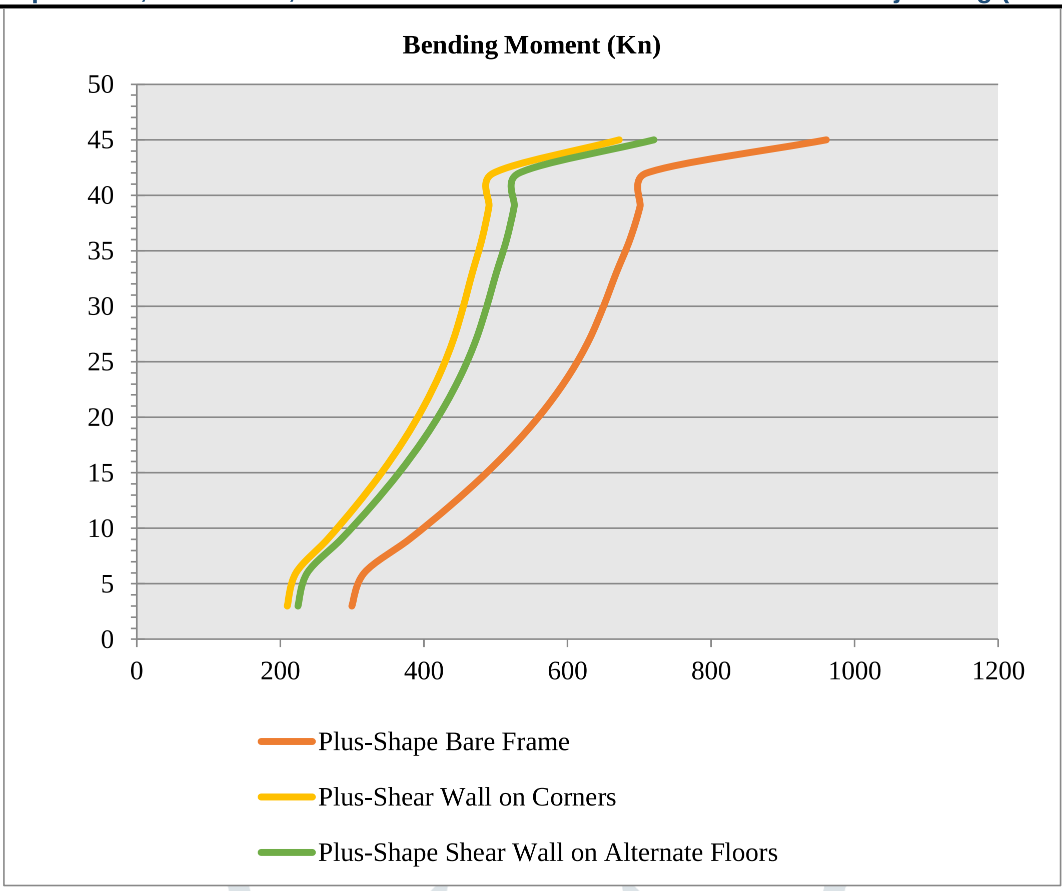


Fig. 18 Bending Moment of Plus shape different models due to Load Combination 1.5 (DL+BL)

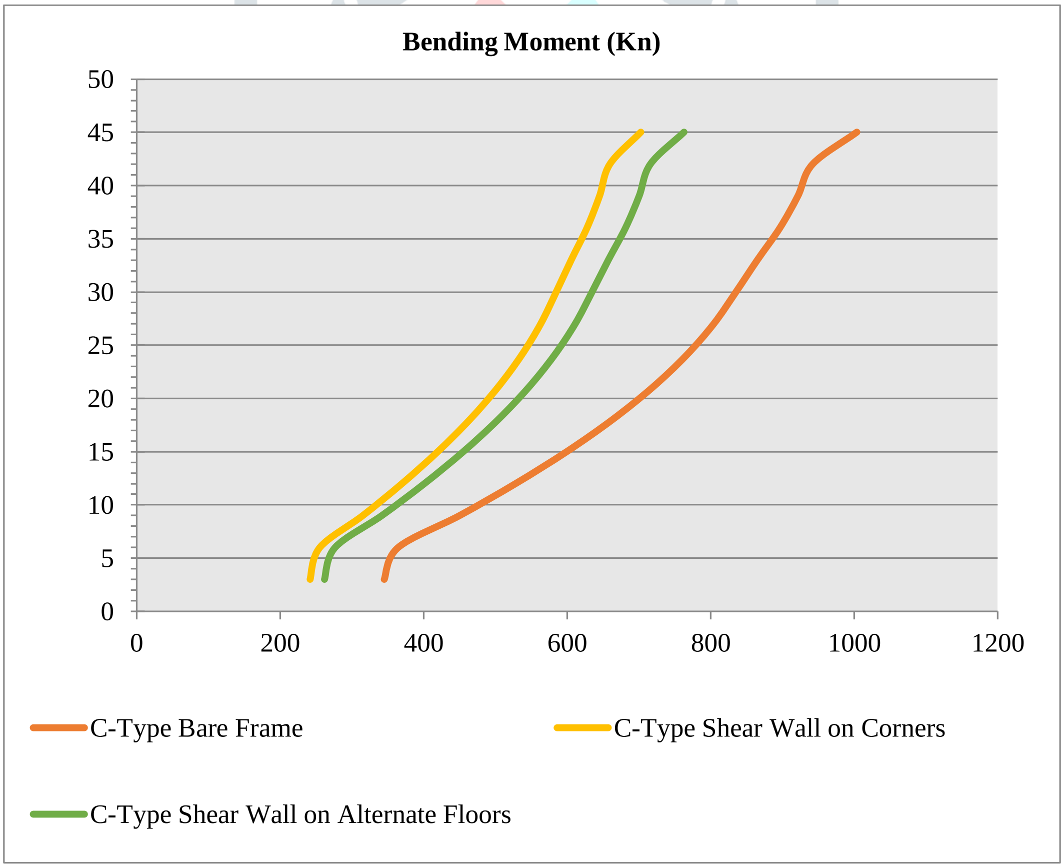


Fig. 19 Bending Moment of C-Type different models due to Load Combination 1.5 (DL+BL)

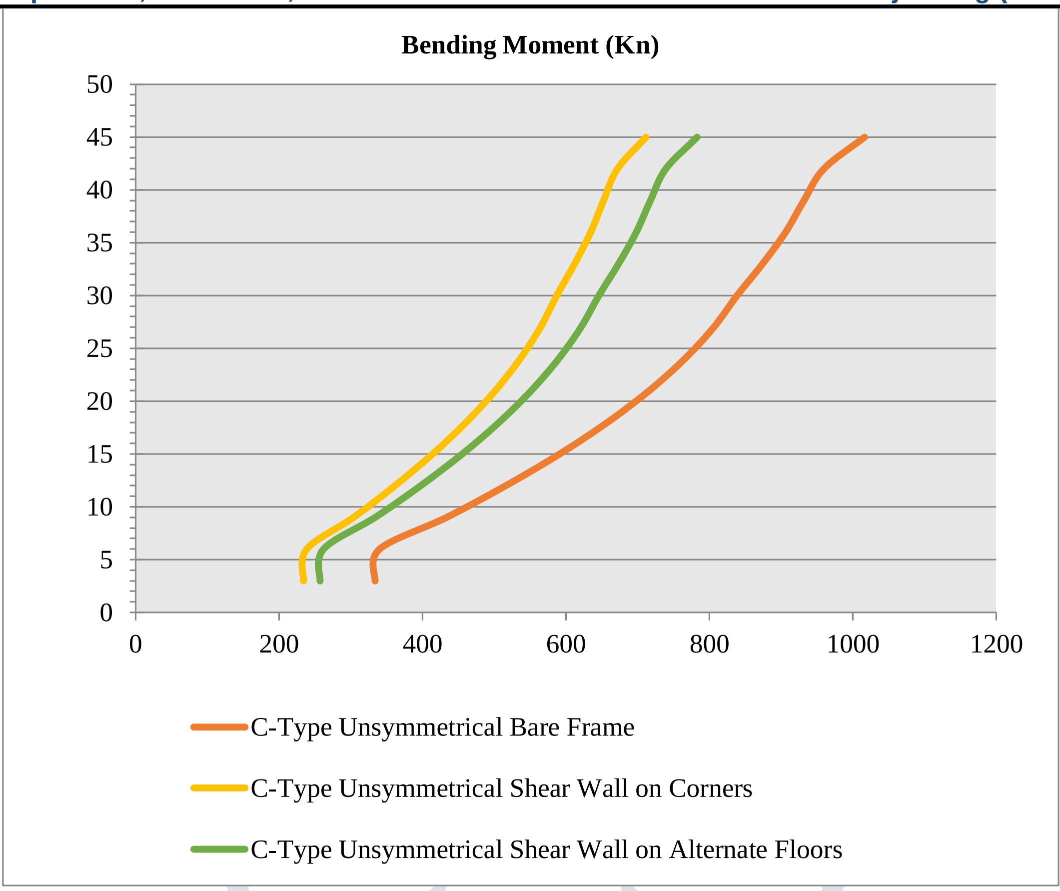


Fig. 20 Bending Moment of C-Type Unsymmetrical different models due to Load Combination 1.5 (DL+BL)

**Base Reaction**

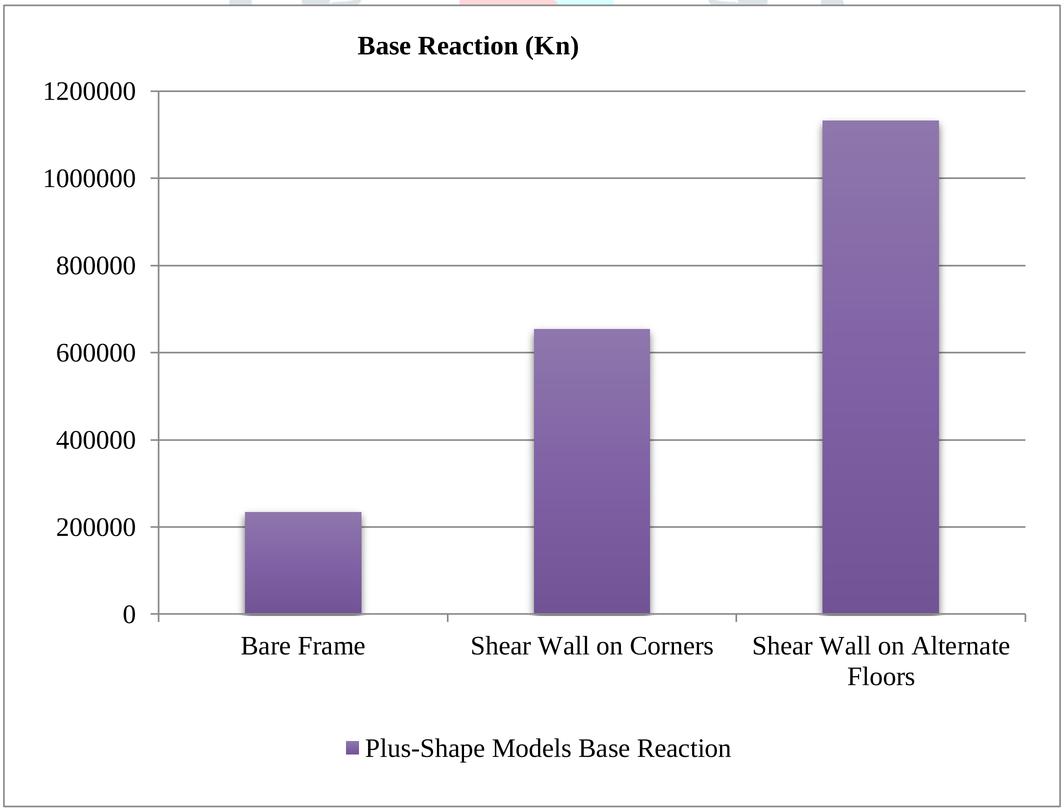


Fig. 21 Base Reaction of Plus-Shape Due to Load combination 1.5 (DL+BL)

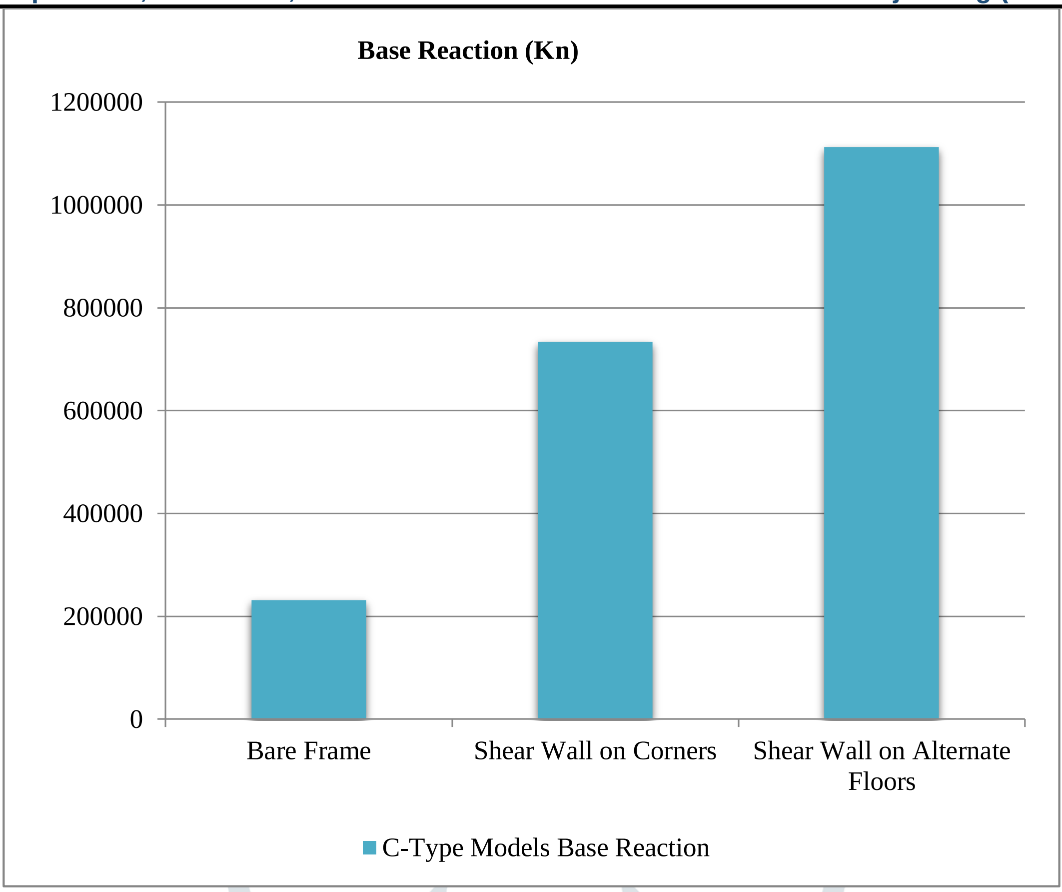


Fig. 22 Base Reaction of C-Type Due to Load combination 1.5 (DL+BL)

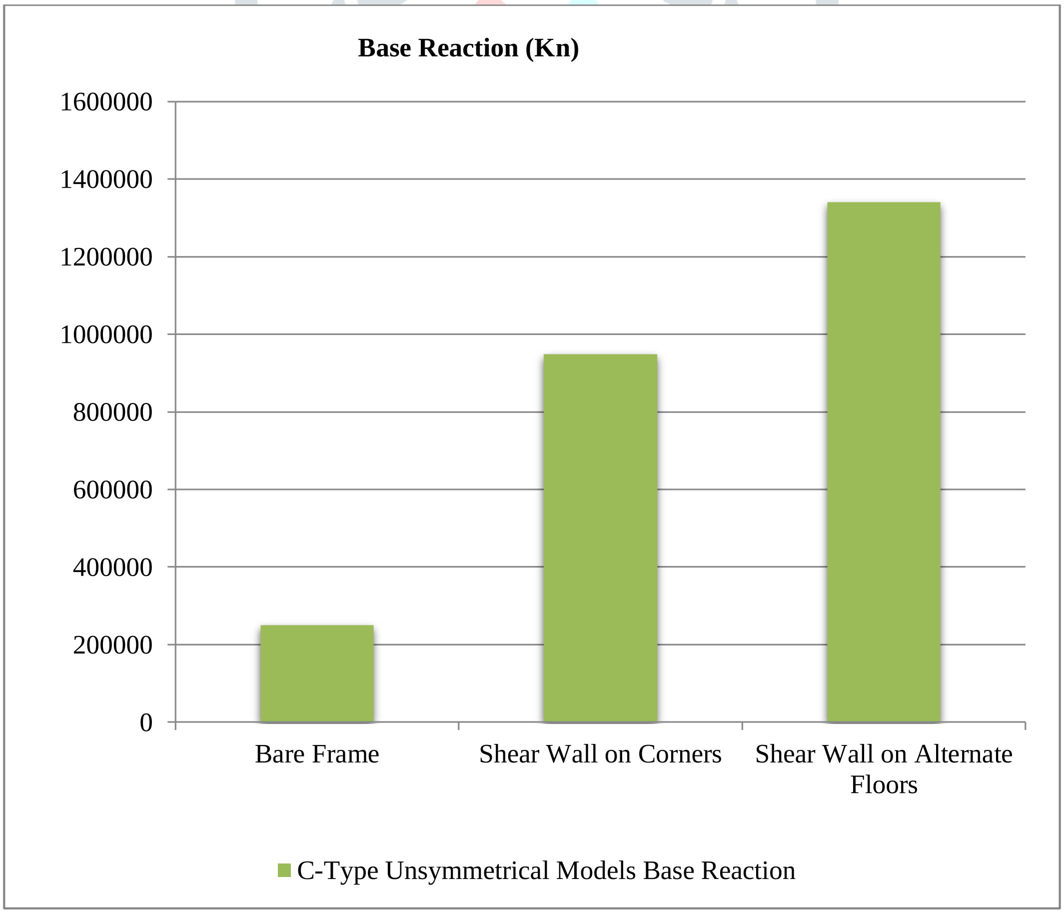


Fig. 23 Base Reaction of C-Type Unsymmetrical Due to Load combination 1.5 (DL+BL)

## V. CONCLUSSION

**Conclusions for Joint Displacement Results**

- The maximum joint displacement of a Plus shape model with bare frame is 132.553mm at top floor and when use shear wall 113.092mm at corner, and 96.153mm at alternate floors due to Load Combination 1.0 (DL+BL).

- The maximum joint displacement of a C type model with bare frame is 164.326 mm at top floor and when use shear wall 142.745mm at corner, and 164.326 mm at alternate floors due to Load Combination 1.0 (DL+BL).
- The maximum joint displacement of a C type unsymmetrical model with bare frame is 192.337mm at top floor and when use shear wall 155.332mm at corner, and 131.152mm at alternate floors due to Load Combination 1.0 (DL+BL).

**Conclusions for Storey Drift Results**

- Minimum Storey Drift of Plus shape model with bare frame occurs 0.00099 mm in top floor and 0.000532 mm in alternate floors due to Load Combination 1.0 (DL+BL). When shear wall is placed, storey drift reduces majorly, but when not placed, storey drift increases.
- C-Type model with bare frame has 0.001478 mm of storey drift in top floor, while Plus shape model with bare frame has 0.000535 mm of storey drift in top floor and alternate floors due to Load Combination 1.0 (DL+BL). When shear wall is not placed, storey drift increases.
- Minimum Storey Drift of C-Type Unsymmetrical model with bare frame occurs 0.001733 mm in top floor and 0.000646 mm in alternate floors due to Load Combination 1.0 (DL+BL). Storey Drift reduced majorly when shear wall is placed, but increased when not placed.

**Conclusions for Drift Ratio Results**

- The minimum drift ratio of a Plus shape model with bare frame is 0.00033 mm in the top floor and 0.0001773 mm in alternate floors due to Load Combination 1.0 (DL+BL). When shear wall is placed, the drift ratio decreases, but when not placed, it increases.
- The minimum drift ratio of a C-Type model with bare frame is 0.0004927 mm in the top floor, while a Plus shape model with bare frame is 0.0001783 mm in the top floor. When the shear wall is placed, the drift ratio decreases, but when not placed, it increases.
- Minimum Drift Ratio of C-Type Unsymmetrical model with bare frame is 0.0005777 mm in top floor and 0.0002153 mm in alternate floors due to Load Combination 1.0 (DL+BL). When shear wall not placed, Drift Ratio increases.

**Conclusions for Bending Moment Results**

- The maximum Bending Moment of a Plus shape model with bare frame is 960.41 KN at top floor and 672.29 KN at corner due to Load Combination 1.5 (DL+BL). At alternate floors, it is 720.31 KN.
- The maximum Bending Moment of a C Type model with bare frame is 1003.70 KN at top floor and 702.595 KN at corner due to Load Combination 1.5 (DL+BL). At alternate floors, it increases to 762.81 KN.
- The maximum Bending Moment of C Type Unsymmetrical model with bare frame is 1016.74 KN at top floor and 711.72 KN at alternate floors due to Load Combination 1.5 (DL+BL).

**Conclusions for Base Reaction Results**

- The maximum Base Reaction of a Plus shape model with bare frame is 233351.1742 KN, while when using Shear walls on corner or alternate, it increases to 653749.471 KN and 1131599.68 KN.
- The maximum Base Reaction of C Type model with bare frame is 230959.5074 KN, while when using Shear wall on corner, it increases to 733278.7175 KN and 1112385.228 KN.
- The maximum Base Reaction of C Type Unsymmetrical model with bare frame is 249430.3641 KN, while when using Shear wall on corner it increases to 948251.4691 KN and 1340046.753 KN.

## VI. FUTURE SCOPE OF THIS WORK

- To study High Rise Structure wind load and earthquake load can be used further.
- Different Combination of shear wall and belt wall can be used.
- Outrigger and damper can also be used to study the effect of blast load.

## REFERENCES


[1] Priyatham, B. P. R. V. S., D. V. S. R. K. Chaitanya, and Girma Eshete. "Study on Response of Regular RC Space Frames Subjected to Equivalent Static Blast Load." Advances in Materials Science and Engineering 2022 (2022).

[2] Raghavendraa, Rathlavath, and Sravani Pachipalab. Non-linear Analysis Of A G+ 10 Reinforced Concrete Framed Structure Subjected To Blast Load. No. 8921. EasyChair, 2022.

[3] Toy, Ahmet Tuğrul, and Barış Sevim. "Structural response of multi-story building subjected to blast load." J. Struct. Eng. Appl. Mech. 5.1 (2022): 13-21.

[4] Autade, Mr Mohan Lande1 Prof Pb. "Dynamic Analysis of High Rise Normal and Unsymmetrical Steel Building with Eccentric Bracing System." International Journal 6.6 (2021).

[5] Ambavaram, Venkata Sudha, et al. "Dynamic performance of multi-storey buildings under surface blast: a case study." Innovative infrastructure solutions 6.4 (2021): 1-20.

[6] Sree, T. Minu, and P. Vishnu Priya. "Analysis of Vertical Irregularity Building with Shear Wall Using ETABS." International Research Journal of Engineering and Technology (Irjet), E-ISSN (2021): 2395-0056.

[7] Shabanlou, Mohammad, Hassan Moghaddam, and Amir Saedi Daryan. "The Effect of Geometry on Structural Behavior of Buildings with Steel Plate Shear Wall System Subjected to Blast Loading." International Journal of Steel Structures 21.2 (2021): 650-665.

[8] Ahamad, Shaik Akhil, and K. V. Pratap. "Dynamic analysis of G+ 20 multi storied building by using shear walls in various locations for different seismic zones by using Etabs." Materials Today: Proceedings 43 (2021): 1043-1048.

[9] Putlaiah, B., and P. Hanuma. "Comparative Study of Usage of Outrigger and Bellt Truss System for High-Rise Concrete Buildings." (2019).

[10] Khade, Rohit B., and Prashant Kulkarni. "Effect of wind load on structural performance of dimensionally regular & irregular high rise buildings with different outrigger systems." International Journal of Engineering and Management Research 9 (2019).

[11] Tavakoli, Reihaneh, Reza Kamgar, and Reza Rahgozar. "The best location of belt truss system in tall buildings using multiple criteria subjected to blast loading." Civil Engineering Journal 4.6 (2018): 1338-1353.

[12] Hosseini, Mahdi. "Study the impact of the drift (lateral deflection) of the tall buildings due to seismic load in concrete frame structures with different type of RC shear walls." Global Journals of Research in Engineering 18.E1 (2018): 59-83.

[13] Syed, Zubair I., et al. "Performance of earthquake-resistant RCC frame structures under blast explosions."Procedia Engineering 180 (2017): 82-90.

[14] Khandelwal, Dipika N., and Monica Mhetre. "Review on Performance and Optimum Position of Shear Wall in High Rise Building." (2017).

[15] Najam, Fawad Ahmed, and Pennung Warnitchai. "A modified response spectrum analysis procedure to determine nonlinear seismic demands of high-rise buildings with shear walls." The Structural Design of Tall and Special Buildings 27.1 (2018): e1409.

[16] Begum, DGVS Shamshad, and G. Vani. "Seisimic Analysis of a High Rise Unsymmetrical Building with Dampers Using ETABS." International Journal of Scientific Research in Science and Technology (www. ijsrst. com) 2.3 (2016).

[17] Natarajan, S., and S. Veeraragavan. "A Review on Analysis and Design of Shear Walls in High Rise Irregular Building." International Journal of Scientific Engineering and Technology Research 5.05 (2016).

[18] Seo, Junwon, Jong Wan Hu, and Burte Davaajamts. "Seismic performance evaluation of multistory reinforced concrete moment resisting frame structure with shear walls." Sustainability 7.10 (2015): 14287-14308.

[19] Kang, Thomas H-K. et al. "Tall building with steel plate shear walls subject to load reversal." The Structural Design of Tall and Special Buildings 22.6 (2013): 500-520.

[20] Miao, Zhiwei, et al. "Evaluation of modal and traditional pushover analyses in frame-shear-wall structures." Advances in Structural Engineering 14.5 (2011): 815-836.

[21] Králik, Juraj, and Peter Rozsár. "Safety and reliability analysis of the high rise buildings considering the exterior explosion effect." Journal of Konbin 14.2010 (2010): 49-60.