

# Comparative Study on Unsymmetrical G+15, G+20, G+25 Story Building with Flat Slab, Conventional Slab, And Flat Slab Without Drop

Parikshit Kharat<sup>1,\*</sup>, Rahul Patil<sup>2</sup>

## Abstract

*There are different types of slabs from which the slab supported by column and beam is called as Conventional slab and the slab which is supported by Column and drop but the beam is not used in this slab is called as flat slab. Live and dead loads are transferred from slab to drop and then it is transfer to columns. This type of slab mostly preferred for long span areas or plain ceiling etc. these types of buildings can be analyzed against earthquake and this earthquake forces are dangerous for building if these buildings are not analyzed for resist the earthquake forces. In this study we considered the earthquake affect and obtaining the effect and behavior of the that seismic analysis for different model of flat slab with drop and without drop for G+15, 20 and 25 story in terms of model time period, displacement, drift and base shear.*

**Keywords:** Flat slab with drop flat slab without drop, IS 1893-2016, IS-1893, ETAB-2016

## INTRODUCTION

Flat slab is the most important type of slab which is mostly used for commercial, industrial purposes' life safety for such type of structure is most important. The flat slab is the assembly of the slab, Column drop, Column head which consist of different thickness.

The slab is the most upper part of the assembly and the drop and column with column head is mostly used. in case of conventional slab the slab is mostly used for each and every project such type of assembly is not used for long span and plan surfaces that's the reason we have to move toward flat slab concept. Following are the details of flat slab, flat slab without drop and conventional slab [1–5].

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## PRELIMINARY DETAILS

### Plan Details

- Type of Structure: Commercial building
- Frame Type: RCC
- Floor to Floor height: 3.0 m

### Earthquake Parameters Considered

- Zone: IV (Aurangabad)
- Soil type: Medium soil
- Importance factor: 1.5
- Response reduction factor: 5

### Codes Used for Analysis of the Structure

- Earthquake design: IS1893: 2016
- Code for Dead load: IS875: Part 1
- Code for Live load: IS875: Part 2

## MODELLING WITH ETAB

### Model Details

1. Flat slab model with G+15, G+20, G+25 storey
2. conventional Slab model with G+15, G+20, G+25 storey
3. Flat slab without drop model with G+15, G+20, G+25 storey (1-4)

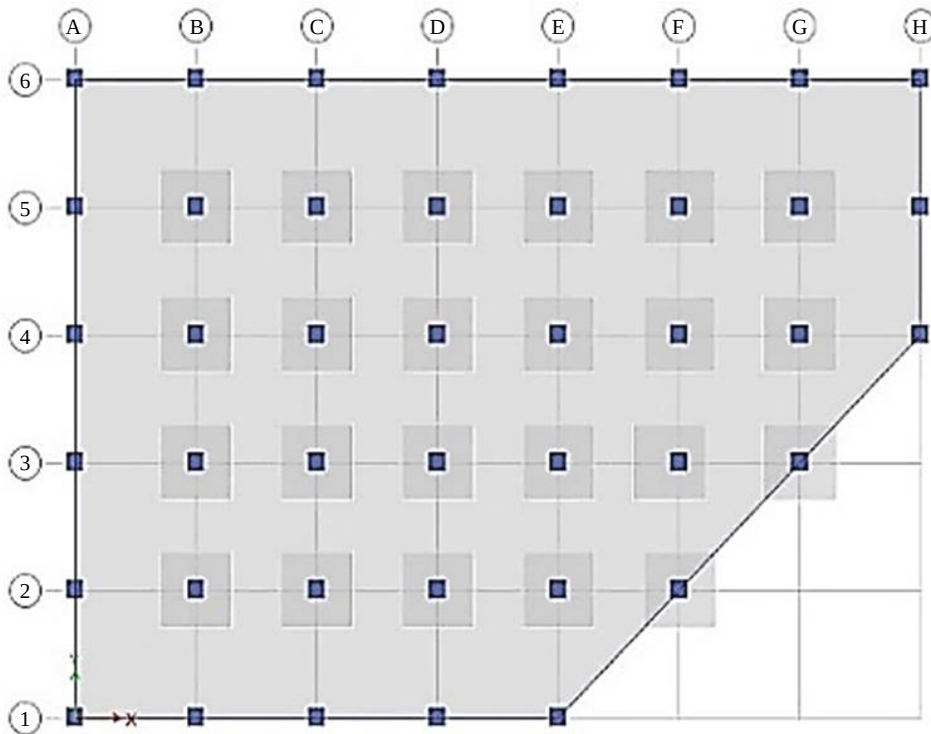


**Figure 1.** Building of flat slab.

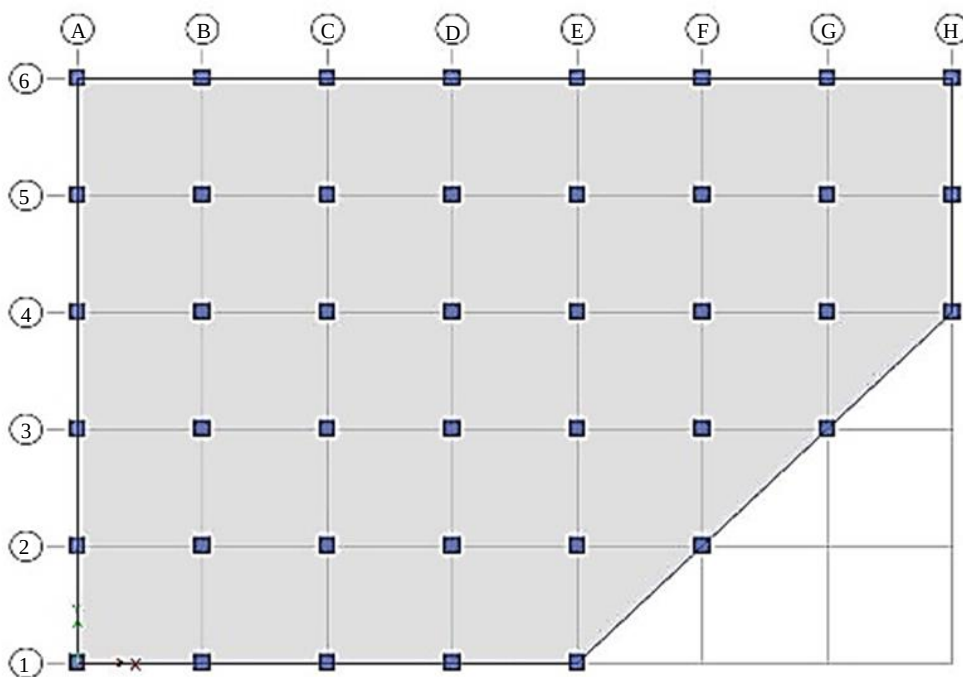


**Figure 2.** Building of flat slab without drop panel.

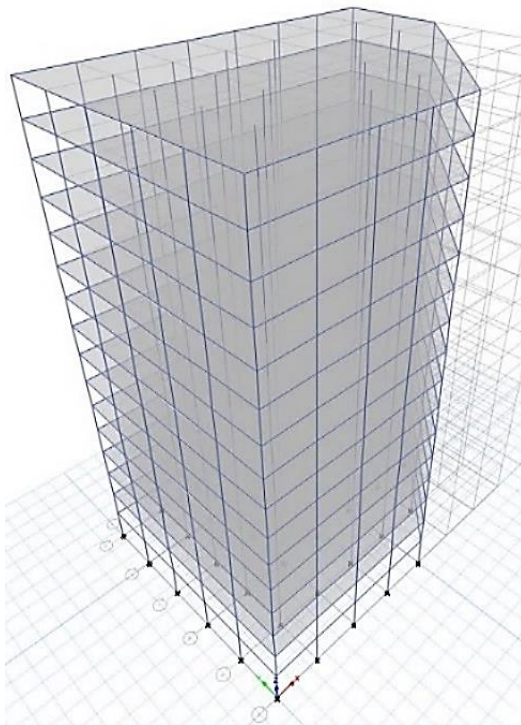


**Figure 3.** View of the Structure with flat slab.

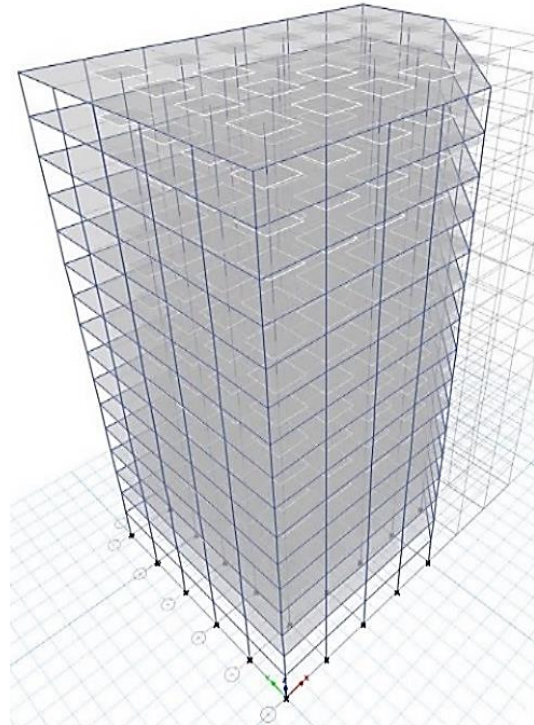


**Figure 4.** Structure flat slab without drop.

## RESULTS AND DISCUSSION

The analysis of multistoried (G+15, 20, 25) building under earthquake by using conventional slab, flat slab with drop and flat slab without drop with the help of IS-1893 by using ETAB provisions in the terms of model time period, base shear, and displacement etc. as shown in the graphical representation of the results is shown.

### Displacement Details (for G+15 Stories)

The Table shows the displacement values for G+15 story building for Flat slab and flat slab without drop. The displacement values are in mm. each story shows its own displacement respectively Table 1 and Figure 5 [6].

**Table 1.** Displacement details in X for seismic condition.

| Story | Flat slab G+15 story Displacement (mm) | Flat slab without drop G+15 story Displacement (mm) |
|-------|----------------------------------------|-----------------------------------------------------|
| G     | 2.5                                    | 1.91                                                |
| 1     | 4.87                                   | 4.82                                                |
| 2     | 7.69                                   | 8.36                                                |
| 3     | 10.47                                  | 12.12                                               |
| 4     | 13.22                                  | 16.05                                               |
| 5     | 15.93                                  | 19.92                                               |
| 6     | 18.58                                  | 23.73                                               |
| 7     | 21.14                                  | 27.41                                               |
| 8     | 23.59                                  | 30.92                                               |
| 9     | 25.89                                  | 34.22                                               |
| 10    | 28.00                                  | 37.24                                               |
| 11    | 29.89                                  | 39.94                                               |
| 12    | 31.52                                  | 42.28                                               |
| 13    | 32.84                                  | 44.20                                               |
| 14    | 33.84                                  | 45.71                                               |
| 15    | 34.52                                  | 46.86                                               |

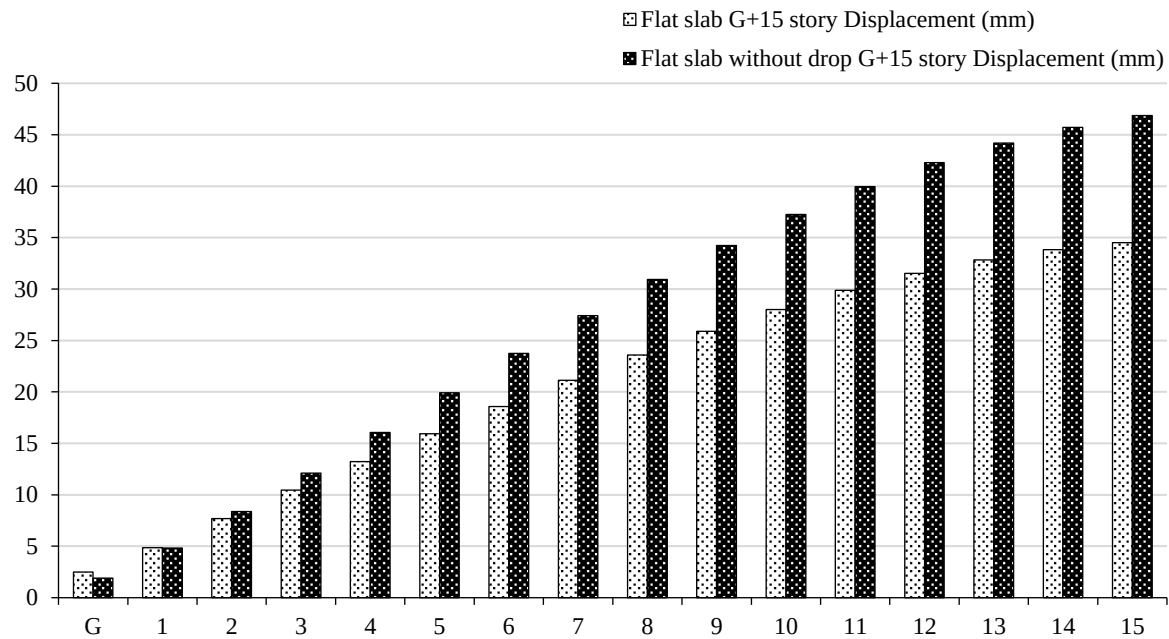


**Figure 5.** Displacement details for G+15 storey.

#### Displacement Details (for G+20 Stories)

The Table shows the displacement values for G+20 story building for Flat slab and flat slab without drop. The displacement values are in mm. Each story shows its own displacement respectively Table 2 and Figure 6 [7].

**Table 2.** Displacement details in X for seismic condition.

| Story | Flat slab G+20 story Displacement (mm) | Flat slab without drop G+20 story Displacement (mm) |
|-------|----------------------------------------|-----------------------------------------------------|
| G     | 2.06                                   | 1.90                                                |
| 1     | 4.91                                   | 4.80                                                |
| 2     | 7.77                                   | 8.36                                                |
| 3     | 10.60                                  | 12.2                                                |
| 4     | 13.43                                  | 16.15                                               |
| 5     | 16.25                                  | 20.14                                               |
| 6     | 19.06                                  | 24.13                                               |
| 7     | 21.84                                  | 28.08                                               |
| 8     | 24.57                                  | 31.97                                               |
| 9     | 27.25                                  | 35.78                                               |
| 10    | 29.80                                  | 39.46                                               |
| 11    | 32.35                                  | 43.01                                               |
| 12    | 34.74                                  | 46.38                                               |
| 13    | 36.99                                  | 49.55                                               |
| 14    | 39.08                                  | 52.49                                               |
| 15    | 40.98                                  | 55.15                                               |
| 16    | 42.6                                   | 57.51                                               |
| 17    | 44.12                                  | 59.53                                               |
| 18    | 45.32                                  | 61.21                                               |
| 19    | 46.22                                  | 62.54                                               |
| 20    | 46.88                                  | 63.58                                               |

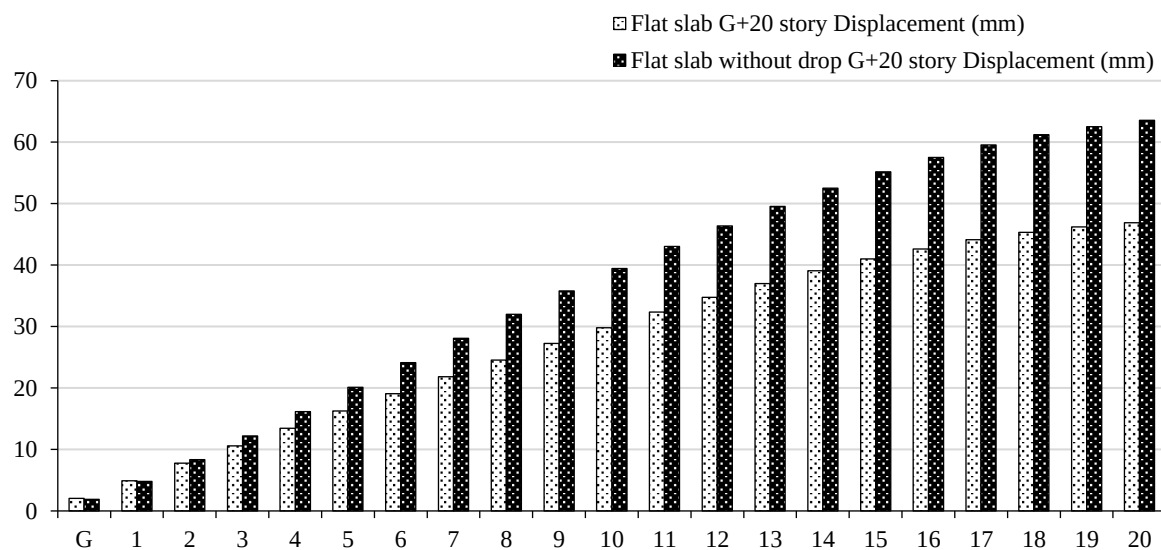


**Figure 6.** Displacement Details for G+20 storey.

#### Displacement Details (for G+25 stories)

The Table shows the displacement values for G+25 story building for Flat slab and flat slab without drop. The displacement values are in mm. each story shows its own displacement respectively Table 3 and Figure 7 [8].

**Table 3.** Displacement Details in X for Seismic Condition.

| Story | Flat slab G+25 story Displacement (mm) | Flat slab without drop G+25 story Displacement (mm) |
|-------|----------------------------------------|-----------------------------------------------------|
| G     | 2.06                                   | 2.29                                                |
| 1     | 4.92                                   | 5.7                                                 |
| 2     | 7.7                                    | 10.07                                               |
| 3     | 10.64                                  | 14.7                                                |
| 4     | 13.51                                  | 19.5                                                |
| 5     | 16.38                                  | 18.5                                                |
| 6     | 19.26                                  | 21.5                                                |
| 7     | 22.14                                  | 24.5                                                |
| 8     | 25.00                                  | 27.5                                                |
| 9     | 27.84                                  | 30.5                                                |
| 10    | 30.66                                  | 33.5                                                |
| 11    | 33.43                                  | 36.5                                                |
| 12    | 36.14                                  | 39.5                                                |
| 13    | 38.80                                  | 42.5                                                |
| 14    | 41.37                                  | 45.5                                                |
| 15    | 43.84                                  | 48.5                                                |
| 16    | 46.21                                  | 51.5                                                |
| 17    | 48.45                                  | 54.5                                                |
| 18    | 50.56                                  | 57.5                                                |
| 19    | 52.50                                  | 60.5                                                |
| 20    | 54.27                                  | 63.5                                                |
| 21    | 55.84                                  | 66.5                                                |
| 22    | 57.20                                  | 69.5                                                |
| 23    | 58.33                                  | 94.99                                               |
| 24    | 59.23                                  | 96.50                                               |
| 25    | 59.91                                  | 97.71                                               |

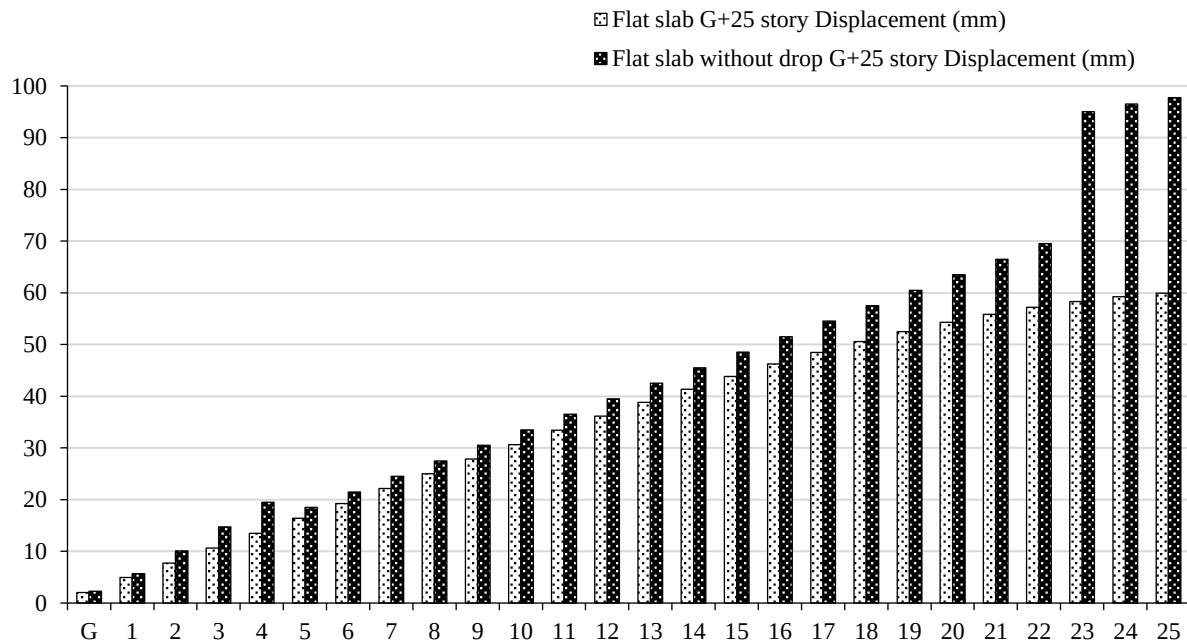


**Figure 7.** Displacement details for G+25 storey.

#### Drift Details (G+15)

The Table shows the Drift values for G+15 story building for Flat slab and flat slab without drop. The drift values are in mm. Each story shows its own Drift values respectively Table 4 and Figure 8 [9].

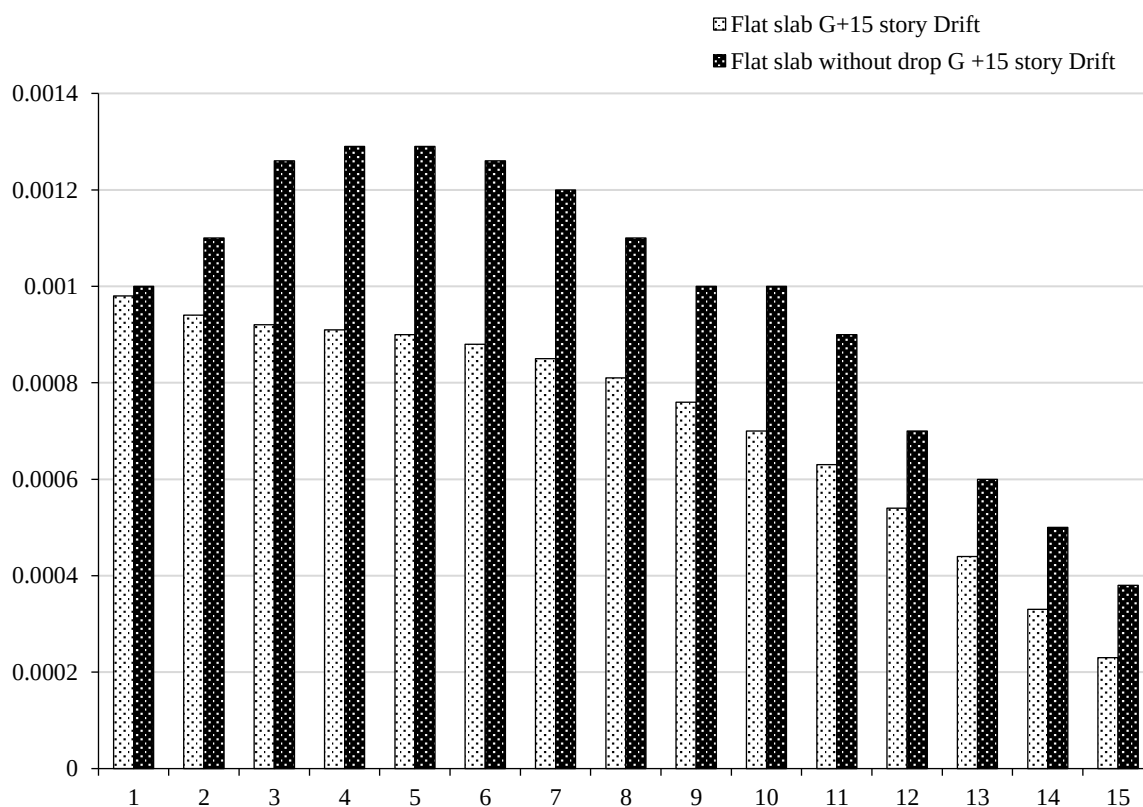


**Figure 8.** Drift details for G+15 storey.

**Table 4.** Drift details for seismic condition.

| Story | Flat slab G+15 story Drift | Flat slab without drop G +15 story Drift |
|-------|----------------------------|------------------------------------------|
| 1     | 0.00098                    | 0.0010                                   |
| 2     | 0.00094                    | 0.0011                                   |
| 3     | 0.00092                    | 0.00126                                  |
| 4     | 0.00091                    | 0.00129                                  |
| 5     | 0.00090                    | 0.00129                                  |
| 6     | 0.00088                    | 0.00126                                  |
| 7     | 0.00085                    | 0.0012                                   |
| 8     | 0.00081                    | 0.0011                                   |
| 9     | 0.00076                    | 0.0010                                   |
| 10    | 0.00070                    | 0.001                                    |
| 11    | 0.00063                    | 0.00090                                  |
| 12    | 0.00054                    | 0.0007                                   |
| 13    | 0.00044                    | 0.0006                                   |
| 14    | 0.00033                    | 0.0005                                   |
| 15    | 0.00023                    | 0.00038                                  |

#### **Drift Details (G+20)**

The Table shows the Drift values for G+20 story building for Flat slab and flat slab without drop. The drift values are in mm. each story shows its own Drift values respectively Table 5 and Figure 9 [10].

**Table 5.** Drift Details for Seismic Condition for G+20 story.

| Story | Flat slab G+20 story Drift | Flat slab without drop G+20 story Drift |
|-------|----------------------------|-----------------------------------------|
| 1     | 0.000994                   | 0.0010                                  |
| 2     | 0.00095                    | 0.00118                                 |
| 3     | 0.00094                    | 0.00128                                 |
| 4     | 0.00094                    | 0.00131                                 |
| 5     | 0.00094                    | 0.00131                                 |
| 6     | 0.00093                    | 0.00133                                 |
| 7     | 0.00092                    | 0.00131                                 |
| 8     | 0.00091                    | 0.00129                                 |
| 9     | 0.00089                    | 0.00126                                 |
| 10    | 0.00086                    | 0.0012                                  |
| 11    | 0.00083                    | 0.00118                                 |
| 12    | 0.00079                    | 0.0011                                  |
| 13    | 0.00075                    | 0.0010                                  |
| 14    | 0.00069                    | 0.000978                                |
| 15    | 0.00063                    | 0.00088                                 |
| 16    | 0.00056                    | 0.000787                                |
| 17    | 0.00048                    | 0.000676                                |
| 18    | 0.00094                    | 0.000559                                |
| 19    | 0.00099                    | 0.000445                                |
| 20    | 0.00099                    | 0.000348                                |

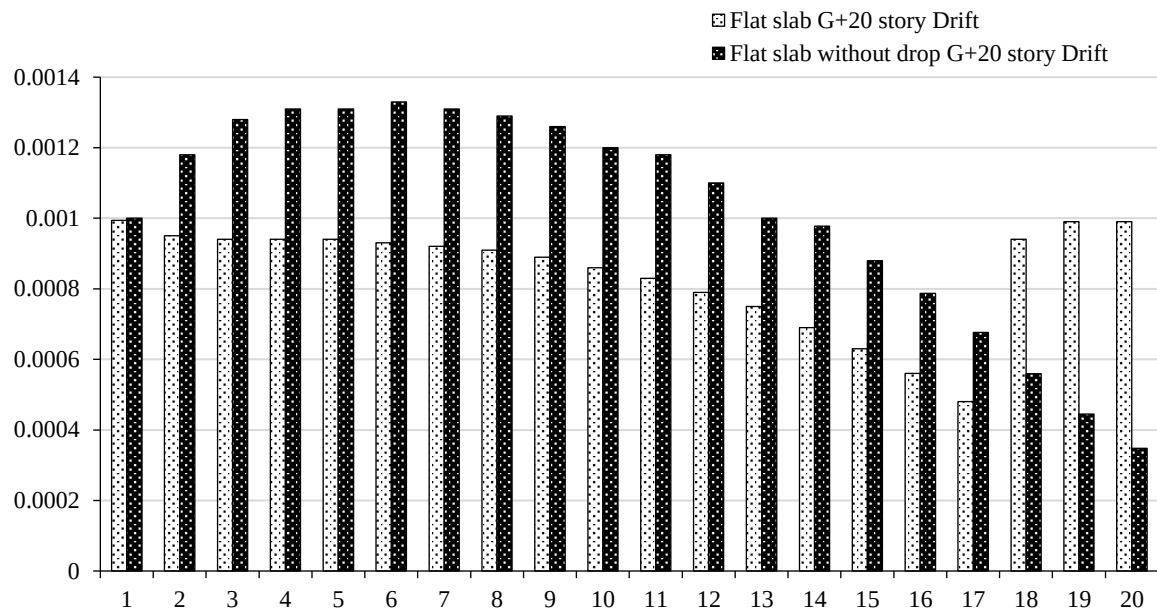


**Figure 9.** Drift Details for G+20 storey.

#### Drift Details (G+25)

The Table shows the Drift values for G+25 story building for Flat slab and flat slab without drop. The drift values are in mm. Each story shows its own Drift values respectively Table 6 and Figure 10 [10].

**Table 6.** Drift details for seismic condition for G+25 story.

| Story | Flat slab G+25 story Drift | Flat slab without drop G+25 story Drift |
|-------|----------------------------|-----------------------------------------|
| 1     | 0.000996                   | 0.0012                                  |
| 2     | 0.000962                   | 0.00143                                 |
| 3     | 0.000954                   | 0.00154                                 |
| 4     | 0.000956                   | 0.0016                                  |
| 5     | 0.00095                    | 0.00162                                 |
| 6     | 0.00096                    | 0.00163                                 |
| 7     | 0.00095                    | 0.00163                                 |
| 8     | 0.00095                    | 0.00162                                 |
| 9     | 0.00094                    | 0.00161                                 |
| 10    | 0.00093                    | 0.00159                                 |
| 11    | 0.00092                    | 0.00156                                 |
| 12    | 0.000906                   | 0.00153                                 |
| 13    | 0.00088                    | 0.00149                                 |
| 14    | 0.00085                    | 0.00144                                 |
| 15    | 0.00082                    | 0.00138                                 |
| 16    | 0.00078                    | 0.00132                                 |
| 17    | 0.00074                    | 0.00125                                 |
| 18    | 0.00070                    | 0.0011                                  |
| 19    | 0.000468                   | 0.0010                                  |
| 20    | 0.00058                    | 0.00097                                 |
| 21    | 0.00054                    | 0.00086                                 |
| 22    | 0.00045                    | 0.00074                                 |
| 23    | 0.00037                    | 0.00062                                 |
| 24    | 0.0003                     | 0.000502                                |
| 25    | 0.000231                   | 0.000405                                |

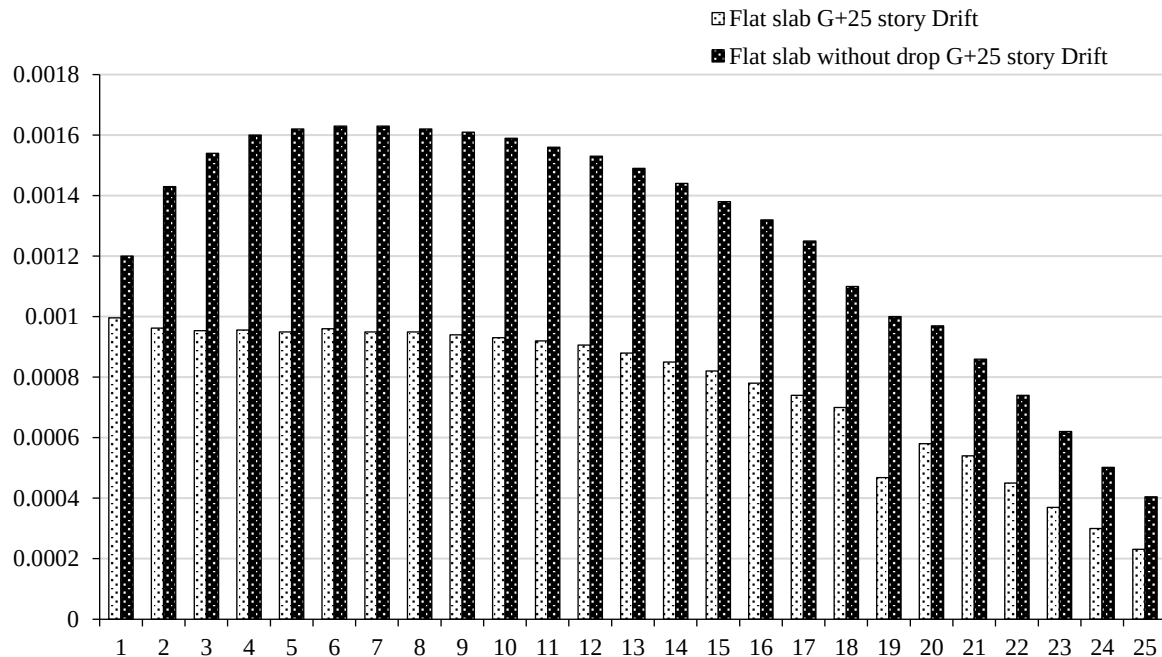


**Figure 10.** Drift Details for G+25 storey.

#### Base Shear Details (for G+15 stories)

The table shows the Base Shear values for G+15 story building for Flat slab and flat slab without drop. The Base Shear values are in mm. Each story shows its own Base Shear values respectively Table 7 and Figure 11.

#### Base Shear Details (for G+20 stories)

The table shows the Base Shear values for G+20 story building for Flat slab and flat slab without drop. The Base Shear values are in mm. Each story shows its own Base Shear values respectively Table 8 and Figure 12.

**Table 7.** Base shear details for seismic condition for G+15 story.

| Story | Flat slab G+15 story Base shear (kn) | Flat slab without drop G+15 story Base shear (kn) |
|-------|--------------------------------------|---------------------------------------------------|
| 1     | 2537.24                              | 1761.15                                           |
| 2     | 2528.54                              | 1744.04                                           |
| 3     | 2511.68                              | 1723.87                                           |
| 4     | 2482.50                              | 1692.85                                           |
| 5     | 2437.63                              | 1658.25                                           |
| 6     | 2374.14                              | 1648.66                                           |
| 7     | 2288.38                              | 1588.97                                           |
| 8     | 2177.02                              | 1511.47                                           |
| 9     | 2036.76                              | 1413.82                                           |
| 10    | 1864.14                              | 1293.71                                           |
| 11    | 1655.94                              | 1148.80                                           |
| 12    | 1408.77                              | 976.79                                            |
| 13    | 1119.31                              | 775.30                                            |
| 14    | 784.22                               | 542.11                                            |
| 15    | 400.14                               | 274.80                                            |

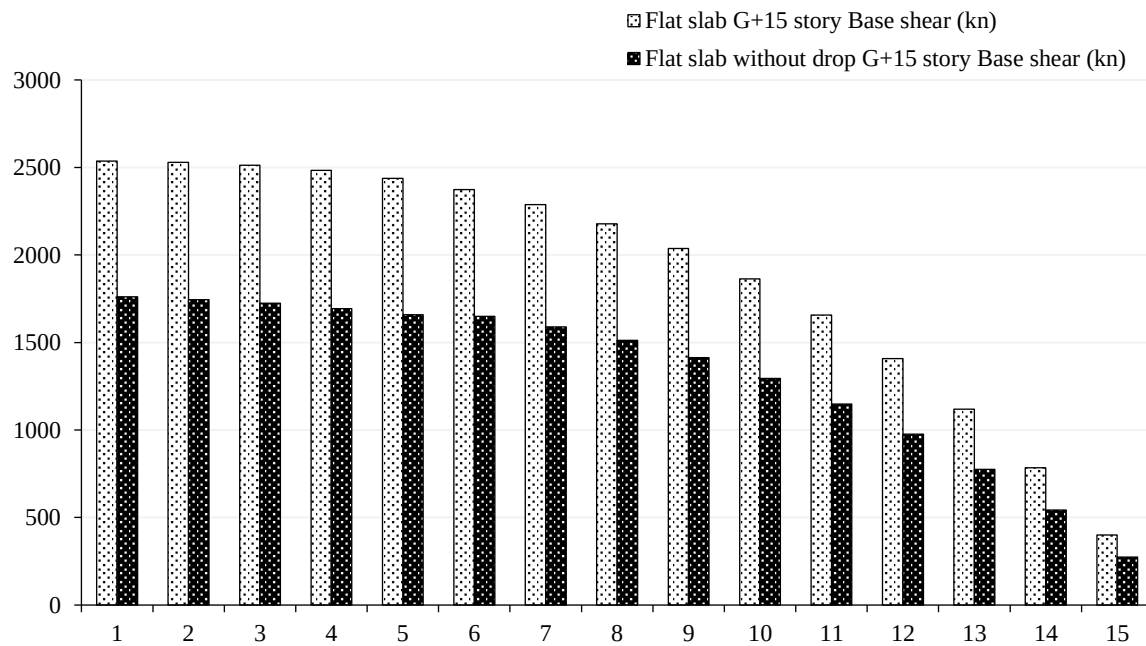


**Figure 11.** Base Shear Details for G+15 storey.

**Table 8.** Base shear details for seismic condition for G+20 story.

| Story | Flat slab G+20 story Displacement (mm) | Flat slab without drop g+20 story Displacement (mm) |
|-------|----------------------------------------|-----------------------------------------------------|
| G     | 2547.57                                | 1747.18                                             |
| 1     | 2543.93                                | 1744.72                                             |
| 2     | 2536.30                                | 1739.49                                             |
| 3     | 2502.50                                | 1730.42                                             |
| 4     | 2473.66                                | 1716.47                                             |
| 5     | 2374.14                                | 1696.61                                             |
| 6     | 2434.61                                | 1669.71                                             |
| 7     | 2383.90                                | 1634.93                                             |
| 8     | 2320.00                                | 1591.04                                             |
| 9     | 2241.41                                | 1537.04                                             |
| 10    | 2146.59                                | 1471.90                                             |
| 11    | 1902.22                                | 1394.57                                             |
| 12    | 1749.61                                | 1304.01                                             |
| 13    | 1574                                   | 1199.17                                             |
| 14    | 1375.97                                | 1079.00                                             |
| 15    | 1151.61                                | 942.47                                              |
| 16    | 900.61                                 | 788.52                                              |
| 17    | 621.61                                 | 616.12                                              |
| 18    | 312.37                                 | 424.21                                              |
| 19    | 312.37                                 | 211.76                                              |
| 20    | 2547.57                                | 1747.18                                             |

#### Base Shear Details (for G+25 stories)

The table shows the Base Shear values for G+25 story building for Flat slab and flat slab without drop. The Base Shear values are in mm. each story shows its own Base Shear values respectively Table 9 and Figure 13.

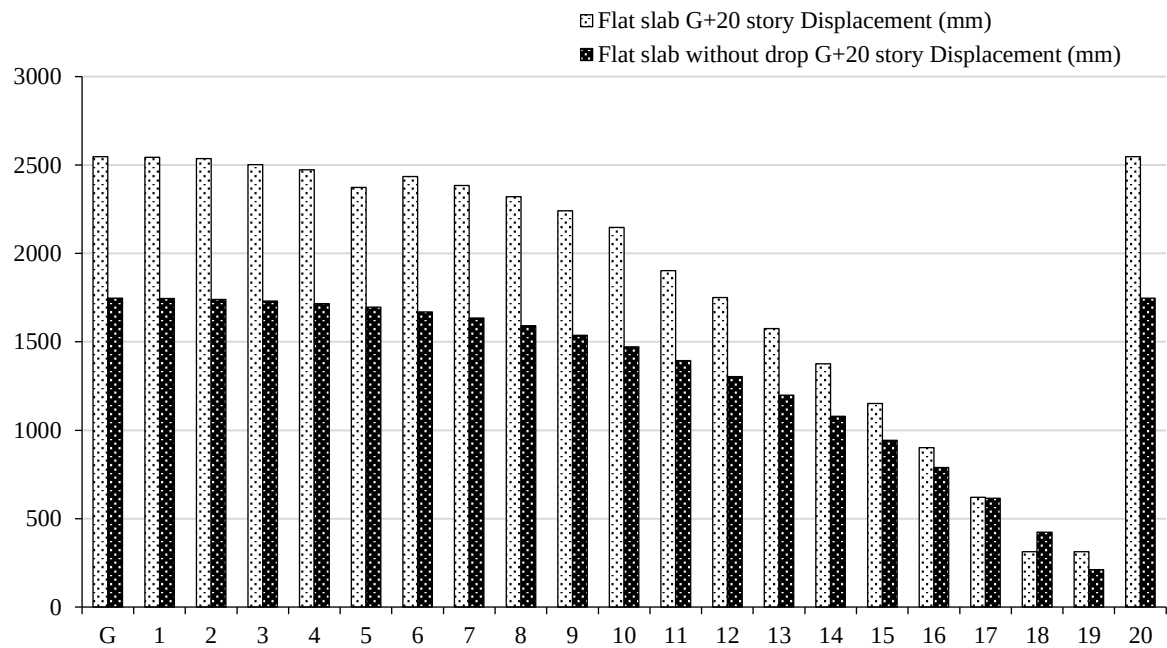


**Figure 12.** Base Shear Details for G+20 storey.

**Table 9.** Base Shear Details for Seismic Condition for G+25 story.

| Story | Flat slab G+25 story Base shear (kn) | Flat slab without drop G+25 story Base shear (kn) |
|-------|--------------------------------------|---------------------------------------------------|
| 1     | 2542.88                              | 2092.84                                           |
| 2     | 2540.96                              | 2091.27                                           |
| 3     | 2536.86                              | 2087.91                                           |
| 4     | 2529.76                              | 2082.10                                           |
| 5     | 2518.85                              | 2060.43                                           |
| 6     | 2503.40                              | 2060.43                                           |
| 7     | 2482.54                              | 2043.24                                           |
| 8     | 2455.45                              | 2020.92                                           |
| 9     | 2421.32                              | 1992.79                                           |
| 10    | 2379.34                              | 1958.19                                           |
| 11    | 2328.70                              | 1916.45                                           |
| 12    | 2268.58                              | 1866.90                                           |
| 13    | 2198.17                              | 1808.87                                           |
| 14    | 2116.65                              | 1741.69                                           |
| 15    | 2023.23                              | 1664.69                                           |
| 16    | 1917.07                              | 1577.22                                           |
| 17    | 1797.08                              | 1478.56                                           |
| 18    | 1663.34                              | 1368.08                                           |
| 19    | 1514.13                              | 1245.11                                           |
| 20    | 1348.95                              | 1108.98                                           |
| 21    | 1166.98                              | 959.00                                            |
| 22    | 967.42                               | 794.53                                            |
| 23    | 749.43                               | 614.87                                            |
| 24    | 512.23                               | 419.38                                            |
| 25    | 254.99                               | 207.37                                            |

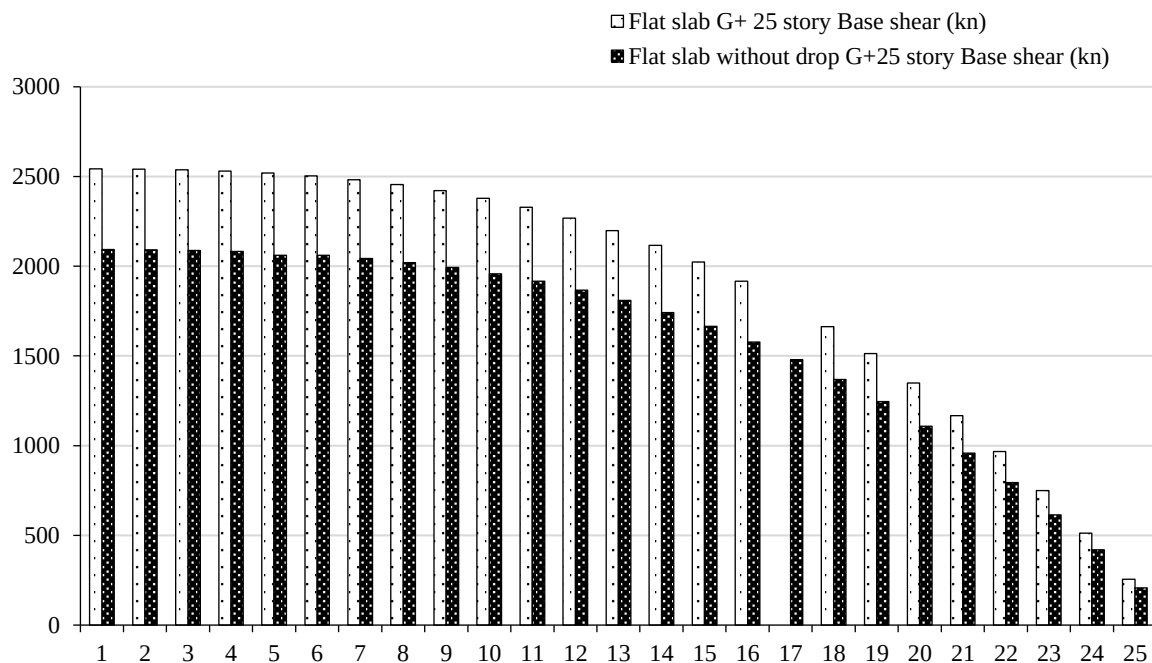


**Figure 13.** Base shear details for G+25 storey.

## CONCLUSION

### Base shear

The base shear values are higher in G+25 storey building due to its mass, as the base shear is depends on mass and stiffness of the building there for base shear in high rise building is more. Also the base shear values are increasing as we increase in convensional frame building and less in case of flat slab without drop due to the mass of drop is reduces.

### Displacement

The Displacement values are higher as 40% m in G+25 storey building for convensional frame building when compared with the flat slab and flat slab without drop frame. Similarly the displacement values are increasing in G+15 and G+20 storeys building respectively.

### Drift

Drift is more in case of flat slab without drop frame building and less in case of convensional frame building as shown in Table.

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