Assessment of Different Aspects of R.C Flat Slab With Drop Building Over R.C Flat Slab Without Drop Building

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Abstract- *Flat Slab is slab that run without beams it directly rest on column, because of that flat slab, large bending moment and punching shear near the columns. Due to this, stresses are developed leading to cracks in concrete which may be further responsible for the failure of slab. Therefore, to avoid this, flat slabs are usually provided with drop. Six models are prepared. First three models are of commercial building consisting of flat slab with drop with three different grades i.e. M40, M50, M60 and other three models are of commercial building consisting of slab without drop with three different grade i.e. M40, M50, M60. Firstly, the behavior of flat slab with drop and without drop buildings with different grades were studied and analyzed separately for seismic zones and then finally, a comparison between both structures was made. Analyses were carried out using Response Spectrum method with the help of ETAB.*

Keywords- Flat slab with drop, Flat Slab without Drop,Seismic performance, ETAB.

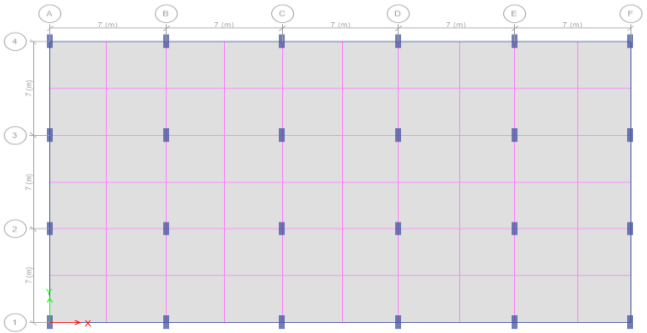
I. INTRODUCTION

In recent years, exploding population, largely urban, creates an increasing demand for tall buildings. The ever increasing population and growing economies in major cities of the world mean increasing urbanization globally and the continuing rise in population density in urban areas. Arable land areas are constantly being eaten away by urban spreading through suburban developments Multi-storied building can accommodate many more people on a smaller land than would be the case with low-rise building on the same land. Multi-storied buildings are essential part of functioning of modern cities. They represent economical as well as technological advancement of any nation or state. High rise building has huge scope in India because of huge population and expensive real estate. . They are most likely to fail due to punching shear which will occur due to the concentration of shear forces and the unbalanced bending and twisting moments. It has to be noted that the punching shear failure is rather more critical than the flexural failure. Such a concentration of shear force and moments leads to unsymmetrical stress distribution around the slab-column connections. The local and brittle nature of the punching shear failure is in the form of crushing of concrete in the column periphery before the steel reinforcement reaches the yield strain. The observed angle of failure surface is found to vary between 26° and 36°. Thus thepunching shear capacity of a slab (in absence of shear reinforcement) depends on the strength of concrete, the area of tension reinforcement, the depth of the slab and the column size. The sudden disaster effect of the punching shear is a critical problem for any designer. In a flat-plate structure (Figure 1), the floor load is transferred directly from the slab to the columns. As a result, high shear stresses and bending moments were concentrated at the slab-column connections, making the structure highly susceptible to punching failure around the slab-column connections

II. PROLEM STATMENT

The G+15 RC Flat slab without drop considered for analysis is as shown below. The parameters considered for analysis is same as shown above. This building is analysed for zones III. Weight of floor finish is taken as 2 KN/m2. The depth of foundation is taken as 3.0m. The plan dimensions are 35m x21m. The sizes of columns are as follows:

G – 15th story= 350mm x 1000mm



The G+15 RC Flat slab without drop with opening considered for analysis is as shown below. The parameters considered for analysis is same as shown above. This building is analyzed for zones III. Weight of floor finish is taken as 2 KN/m2. The depth of foundation is taken as 3.0m. The plan dimensions are 35m x21m. The sizes of columns are as follows:

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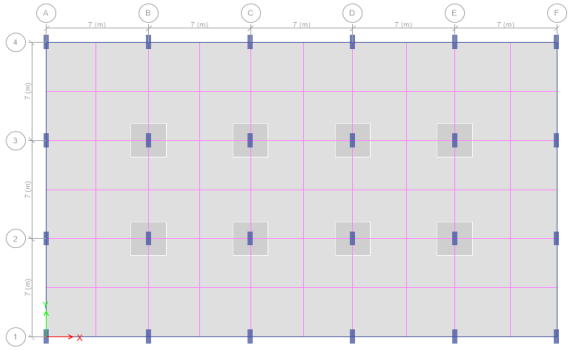


III. METHODOLOGY

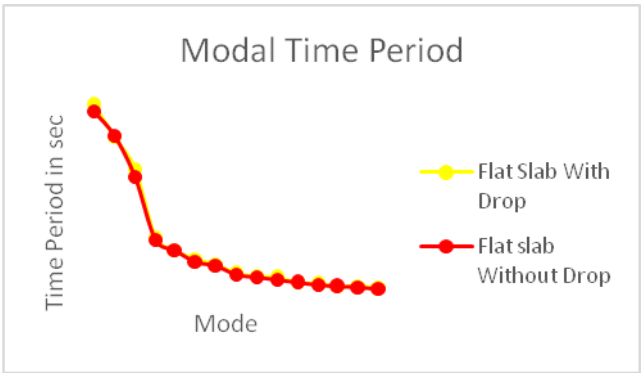
To Study the seismic behavior of flat slab building with and without drop, comparative analytical examination has been carried out between the flat slab with drop model and Flat slab without drop model using response spectrum method. ETAB software used for anlysis.

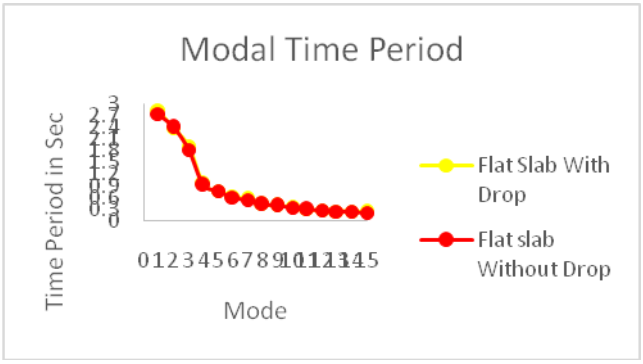
ONFIGRATION OF MODELLING

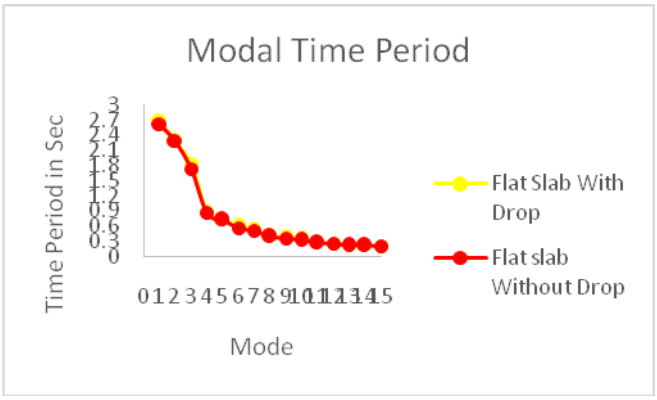
- Floor to floor height -3.0m
- Diaphragm – Rigid diaphragm
- Unit weight of RCC -25 KN/m2
- Unit weight of masonry -20 KN/m2
- Live load intensity on floor -4.0 KN/m2
- Live load intensity on roof -2.0 KN/m2
- Slab thickness = 200mm
- Drop thickness=250mm
- Size of beams = 350mm x 700mm
- Importance factor = 1.0
- Response reduction factor = 5
- Grade of concrete = M40, M50, M60
- Grade of steel = Fe415, Fe500.
- Damping- 5% (Clause 7.8.2.1– IS: 1893 (Part 1) -2002)
- Soil Type – I Medium soil (Clause 6.3.5.2 – Table 1- IS: 1893 (Part 1) -2002)
- Type of foundation – Raft foundation (Clause 6.3.5.2 – Table 1- IS: 1893 (Part 1) -2002.
- SBC of soil -150 KN/m2
- Dynamic analysis method – Response Spectrum analysis (as per Clause 7.8.4 of Indian seismic code IS:1893 (Part-1)-2002)

III. COMPARATIVE RESULTS OF FLAT SLAB WITHOUT DROP AND FLAT SLAB WITH DROP

A. Story Displacement:

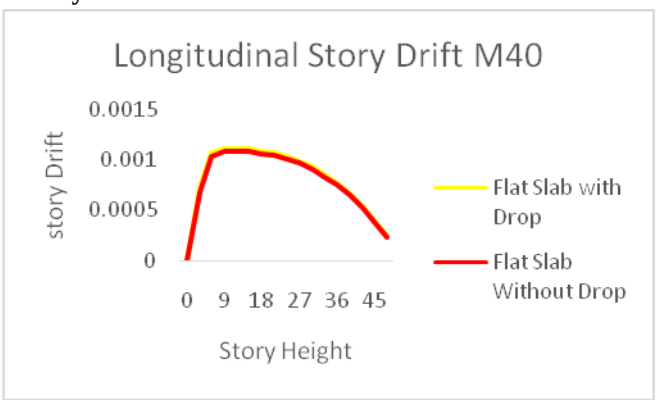


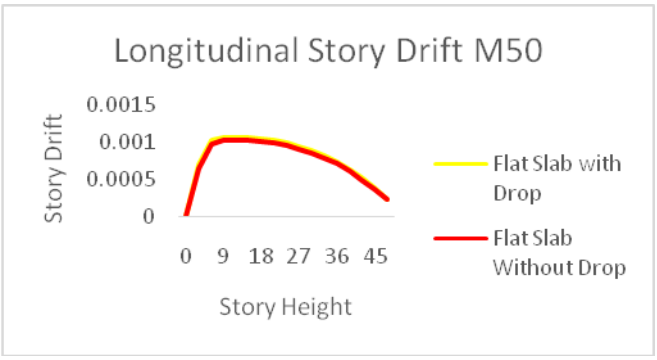


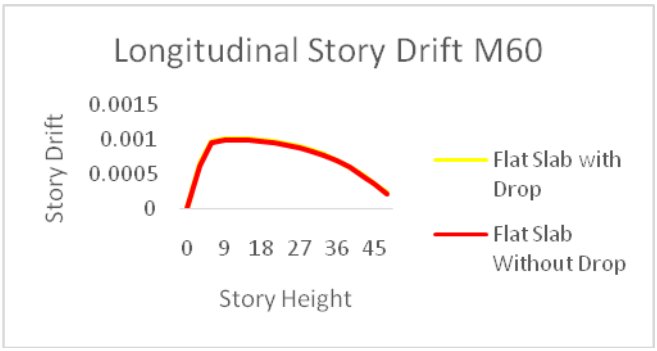


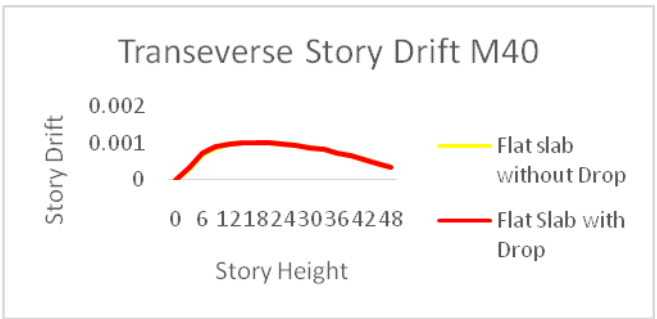
Time period is more in flat slab with drop this is because presence of drop where, in case of flat slab with no drop their stiffness is increases. This is because of stiffness reduction in the ground story of flat slab with no drop models whereas in case of flat slab with drop the drops are present throughout in all the stories thus increasing the stiffness and reducing the time period.

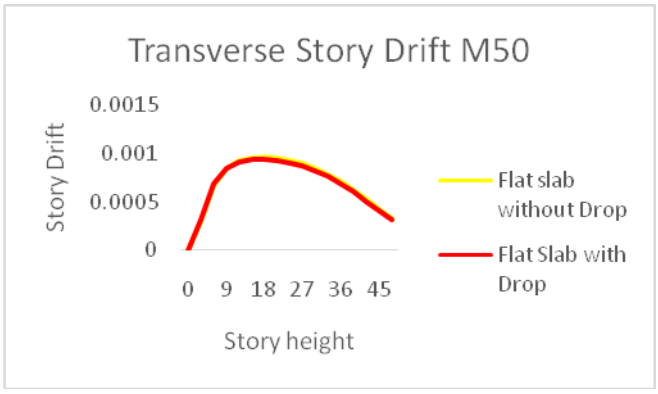
B. Story Drift

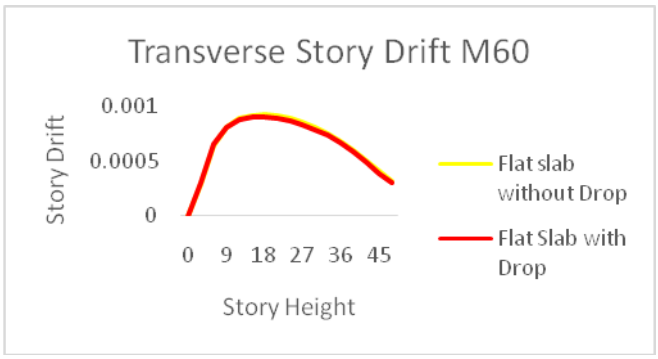






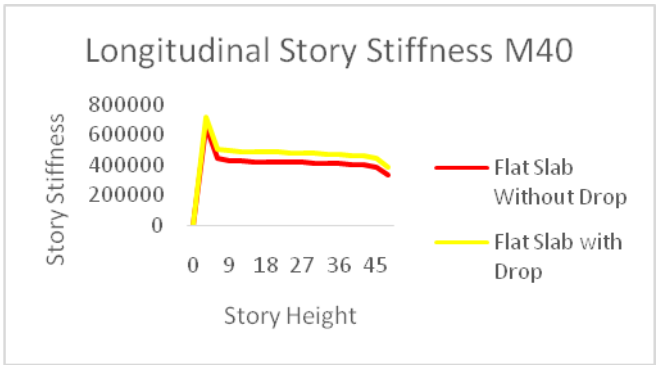


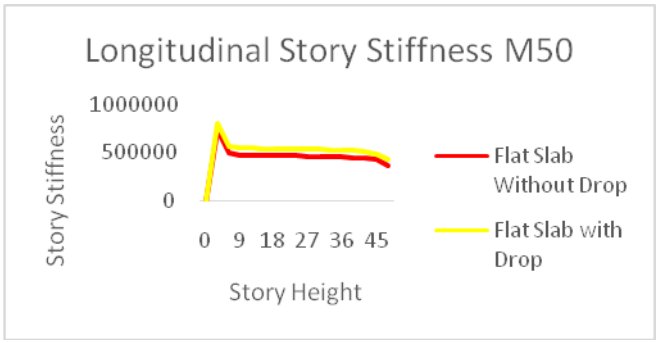


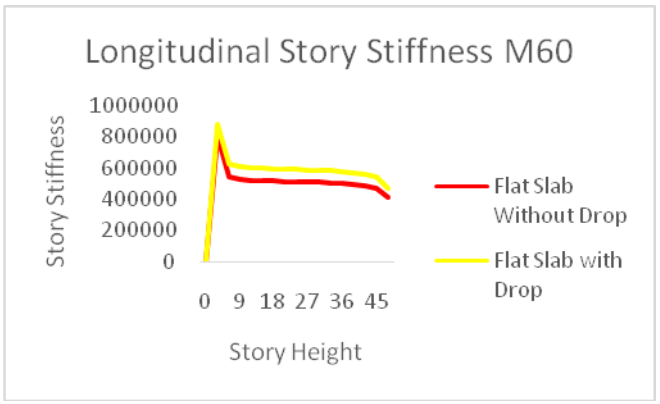


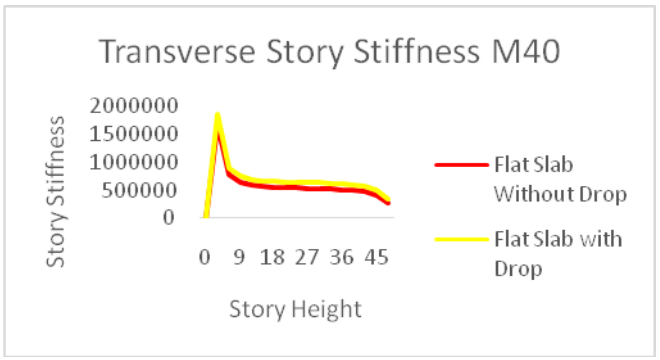
represents the comparative results of longitudinal and traverse story drifts for a RC Flat slab building with no drop and in the figures above, the story drifts of models. Flat slab with no drop of present study are compared to the story drifts of models flat slab with drop. study. It is seen that the trends of the story drifts of both the studies is nearly same.

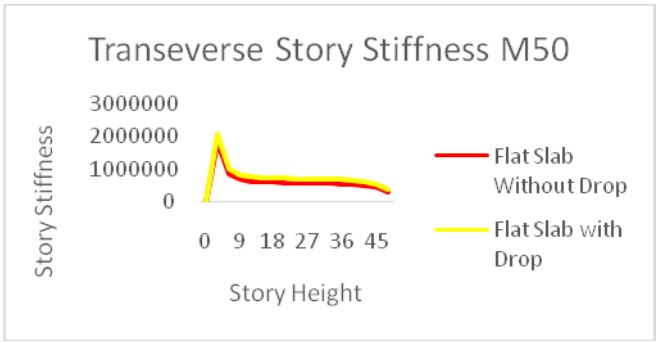
C. Story Stiffness

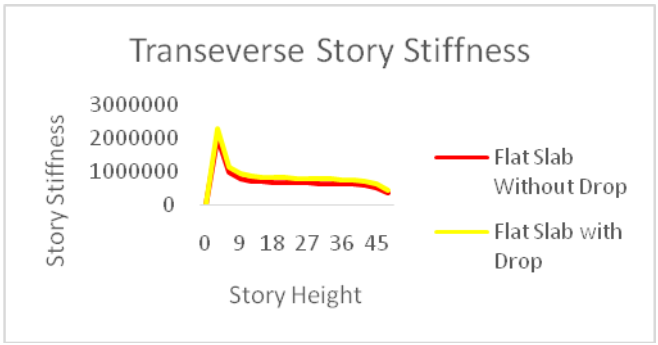






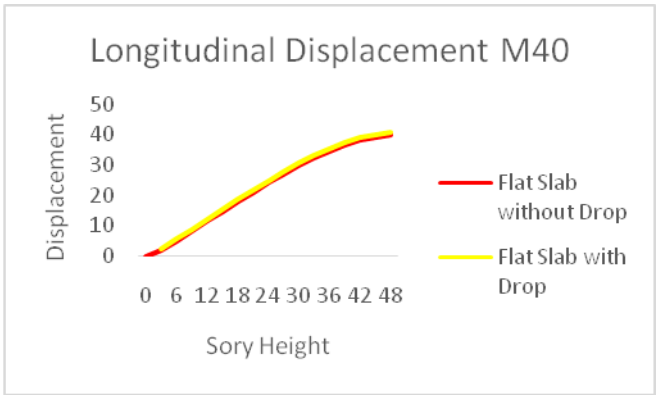


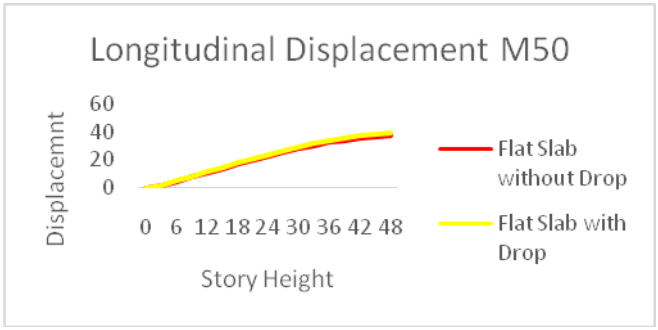


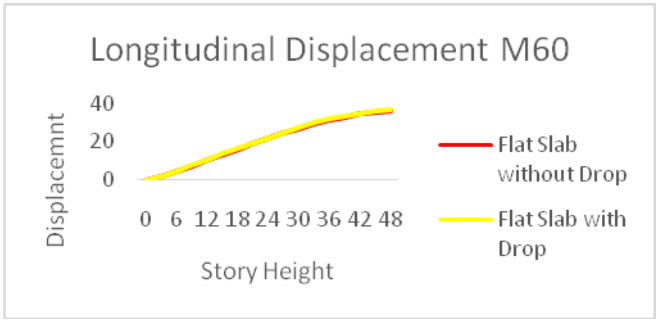


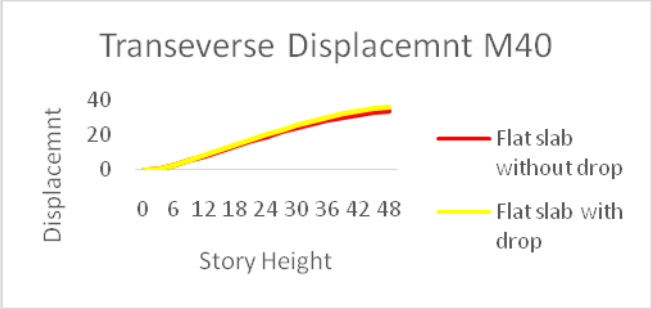
Story stiffness is defined as the rigidity of the object – the extent to which it resists deformation in response to the applied force. Story stiffness in flat slab with drop is 50% more when compared with flat slab with no drop.

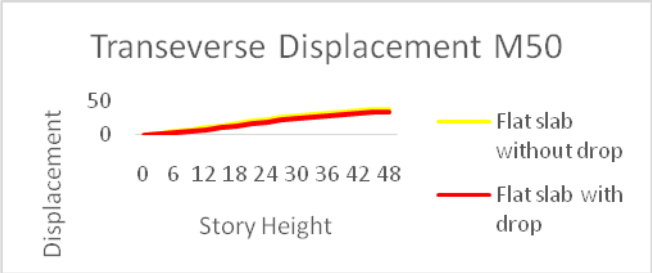
D. Story Displacement

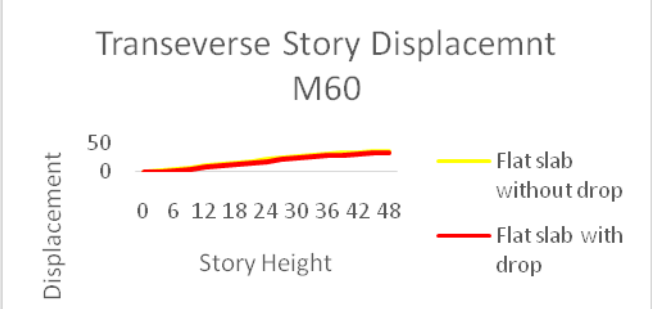






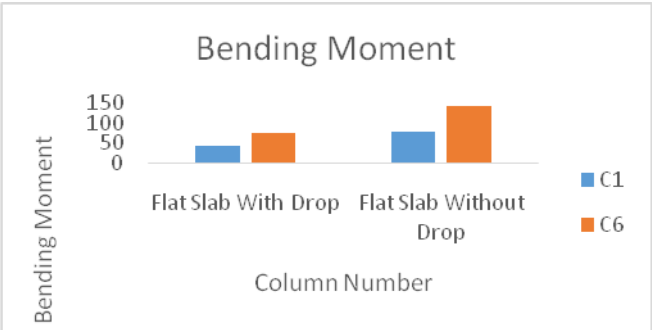


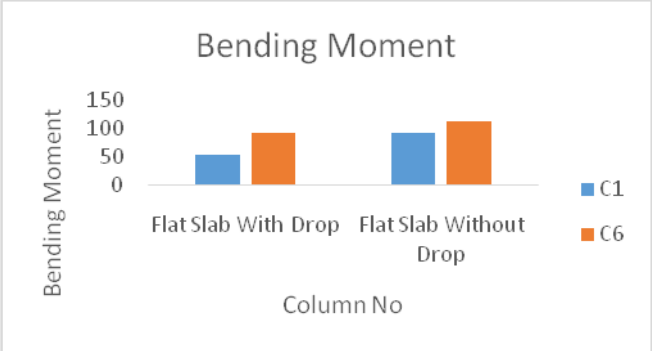




show the comparative graphs of results of lateral displacement in the transverse direction and Longitudinal direction for a building with flat slab with no drop and flat slab with drop. In figures of present study, it is seen that the trends of the lateral displacements obtained for both the studies is the not same in all the figures. There is more lateral displacement in flat slab with drop as compared with flat slab with no drop.

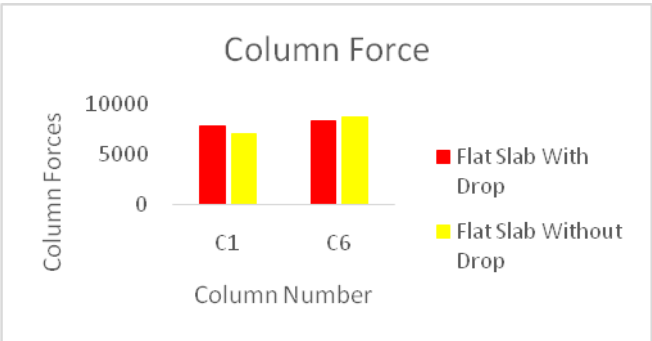
E. Bending Moment



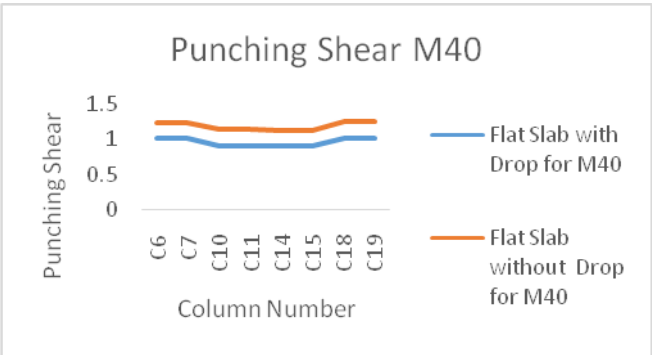


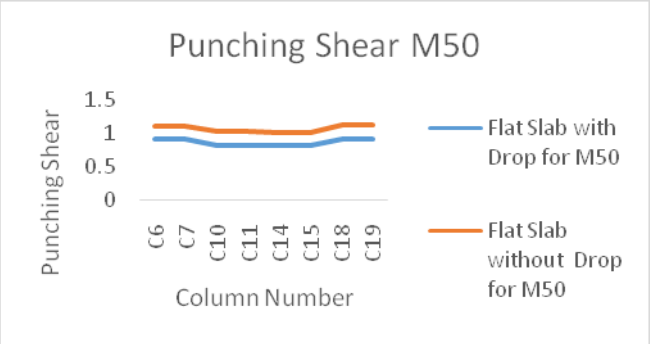
Bending moment is found to be minimum in flat slab with drop as compared to the other models. There is about 50% reduction in bending moment in flat slab with drop as compared to flat slab with no drop. Also the bending moment of external column is found to be less than that of internal column. Bending moment is higher in longitudinal direction as compared to transverse direction. As observed from the figure above, the bending moment decreases in flat slab with drop where drop is not provided when compared to model flat slab with no drop where drop is not provided at any floor. Hence providing drop reduces bending moment.

F. Column Forces



G. Punching Shear:





Punching shear capacity ratio is more in flat slab with no drop as compared with flat slab with drop. There is no punching shear capacity ratio in External column in both flat slab with drop and flat slab with no drop. The Shear stud requirement is more in Flat slab with no drop. As gradeincreases there is decrease in punching shear capacity ratio.

IV. CONCLUSION

1) The reduction in time period in Flat slab without drop, is 3% as compared with Flat Slab with Drop.
2) Story drift reduced to 2% in Flat slab without drop, in longer plane and increase in shorter plane with 5%. flat slab without drop as compared with flat slab with drop.
3) Story stiffness reduced to 14% in Flat slab without drop as compared with flat slab with drop.
4) Lateral Displacement reduced 3% in Flat Slab without drop in longer direction as compared with Flat slab with drop in longer direction. Lateral Displacement is minimum at plinth level and maximum at terrace level.
5) Lateral Displacement reduced is negligible in Flat Slab without drop in shorter direction as compared with Flat slab with drop in shorter direction.
6) Punching shear decreased to 18% in flat slab with drop as compared with flat slab without.
7) Reduction of column moments are 40% to 70% in flat slab without drop compared to flat slab with drop.
8) Column Forces are reduced to 9% in flat slab without drop as compared with flat slab with drop
9) From structural point of view for lateral loading Flat slab with drop is recommended as it increases punching shear resistance and prevent punching shear failure of slabs. A thicker section has better shear stress capacity; the vertical load will be transferred through shear from slab drop to column gradually.

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