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Analysis and Design of Flat Slab with and without Shear Wall of Multi-Storied Building Frames

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Abstract:

In this research G+9 and G+19 Storey models, are selected. For stabilization of the variable parameters, shear wall are provided at corners, center and along the periphery. To study the effect of varying thickness and different location of shear wall on flat slab multi-storey building, static analysis (Equivalent Static Analysis) in software STAAD Pro is carried out for zone IV and V. The seismic parametric studies comprise of drift reduction factor and contribution factor.

Keywords: Drift reduction factor, Contribution factor, Equivalent Static Analysis, Shear Wall

I. INTRODUCTION

The shear wall is a structural element used to resist the earthquake forces or the forces parallel to the plane of wall. Generally, it is provided in tall buildings to avoid total collapse of the structure under seismic loads. We can control the side bending of structure, by providing shear wall. The shear wall will devour shear forces and prevents the location-position of construction from changing and consequently destruction. But one thing must be given importance that the shear wall arrangement must be supremely accurate, if not the resultant will give a negative effect instead. The shear wall comprises of braced panels (shear panels) to counter lateral load effects acting on a structure. Seismic loads and wind is amongst the most common loads that shear wall designed to carry. When shear wall is build, it is constructed in line form of heavily braced and reinforced panels. This is why they are also known as braced wall lines in some region. The wall perfectly connects two exterior walls and braces other shear walls in the structure. Bracing is achieved with heavy timbers and metal brackets or support beams that keep the wall steady and strong. The shear walls are now a vital part of mid and high rise buildings. A building to be an earthquake resistant design, these walls are positioned in the building plans which reduces lateral displacements under seismic loads. Thus shear wall frame structures are attained.

II. OBJECTIVE OF STUDY

- Static analysis of flat slab multi-storey building with or without shear wall using staad pro and determine the lateral displacement, storey drift or sway, drift reduction factor and contribution of shear wall.
- Study of performance of building with varying height and thickness of shear walls.
- Analysis of behavior of structure for different location of shear wall.
- Analysis of performance of dual structural configuration using bare frame or flat slab system and shear wall system with emphasis to the interaction of flat slab and shear wall.
- Study of the optimal height of shear wall for multi-storey building keeping other parameters as same.

III. METHDOLOGY & MODELLING

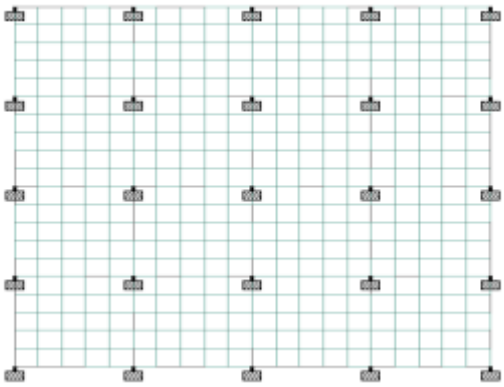
Description of structure

Three dimensional models of shear wall frame with flat slab and bare frame models are used for analysis of structure. The typical plan size for both G+9 and G+19 storey buildings are 20m X 20m. The height of each storey is 3 meters for all the models. Thickness of slabs used is of 175mm but according to the case considered thickness of shear wall used are 150mm, 200mm, 250mm. All the structural models were analyzed using Equivalent Static Method. The analyses of structures for severe zones i.e. zone IV and zone V under seismic loadings are done by using structural analysis software STAAD PRO.

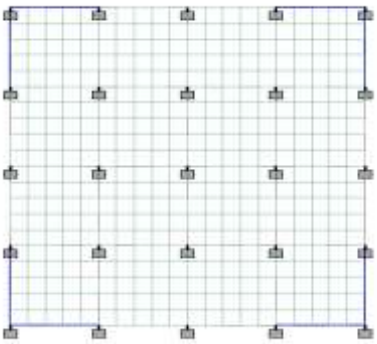
Modeling Approach

Equivalent Static Method is used to analyze various models by using staad pro software. Different models are prepared for different cases to analyze the G+9 and G+ 19 structures without shear wall and with RC shear wall. The various positions of shear wall are used to study the effect of changing shear wall position. Introduction of shear wall in the structural system provides stability against lateral loads i.e. wind, seismic and blast. The performance and behavior of ten and twenty storey buildings on the parametric studies of lateral displacement, storey drift and sway, drift reduction factor and contribution factors carried out for all the models. The modeling approach includes types of cases considered for analysis of structure, the development and analysis of models and details of models. Then linear static analysis has been carried out for Zone IV and V for structural analysis.

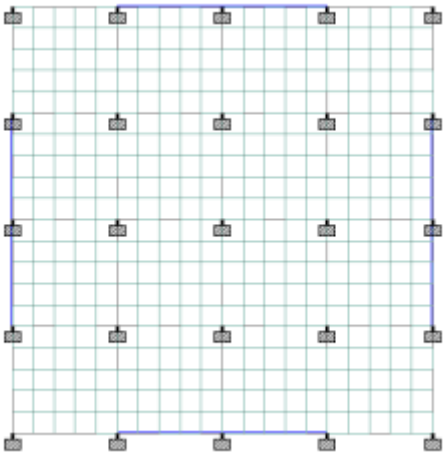
Plan of the Models



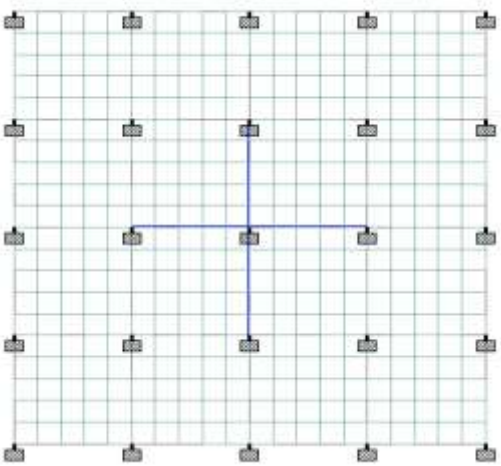
Plan 3.1- Shear Wall is not provided



Plan 3.2- Shear Wall at corners



Plan 3.3- Shear Wall along periphery



Plan 3.4- Shear Wall at center

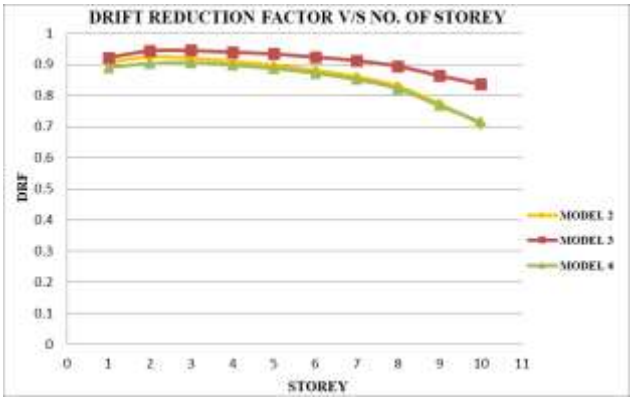
IV. Result & Discussion

The equivalent static analysis is performed on curtailed or part, stepped and full height shear wall for different location and position of shear wall having different building heights are assessed for building areas through various cases for two earthquake zones i.e. Zone IV and V.

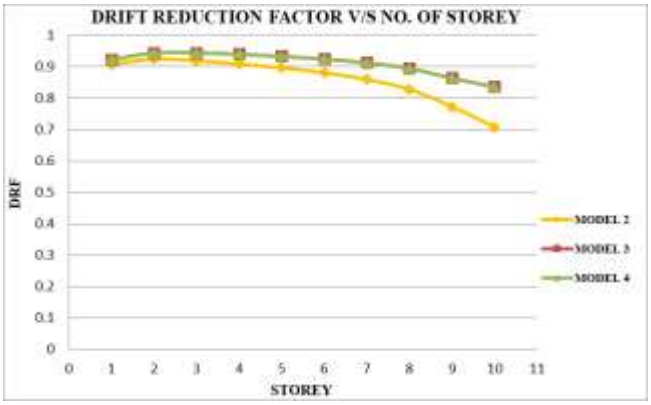
5.1GRAPHS FOR DRIFT REDUCTION FACTOR

5.1.1 Comparison of drift reduction factor for different models of ten storey building.

Graph 5.4.1.1 Static analysis for zone IV.

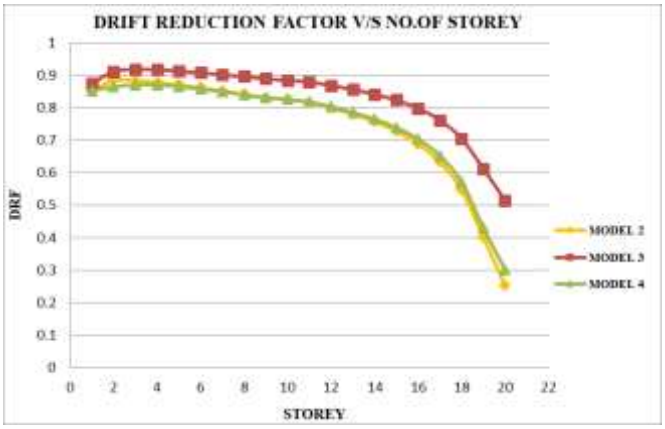


Graph 5.1.1.2 Static analysis for zone V.

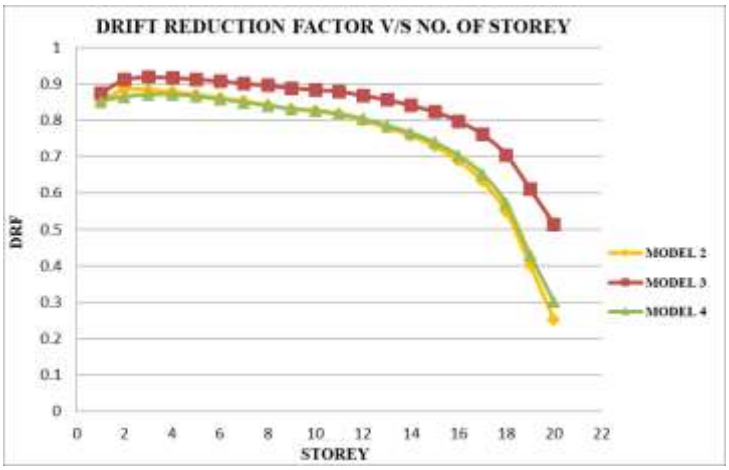


5.1.2 Comparison of drift reduction factor for different models of twenty storey building (full shear wall).

Graph 5.1.2.1 Static analysis for zone IV.



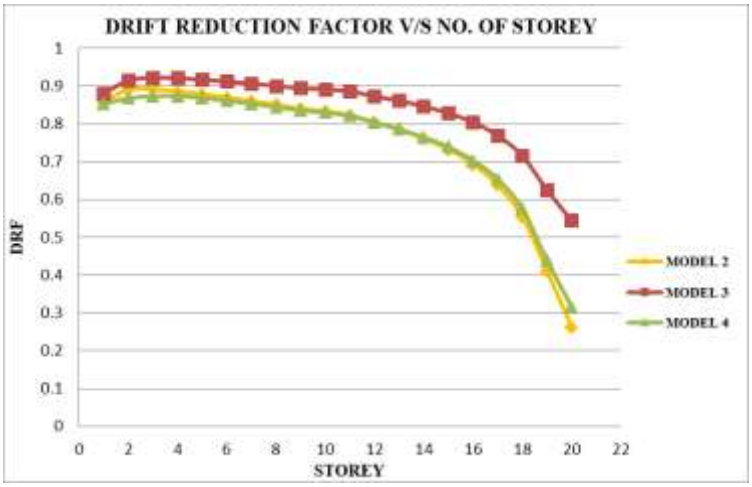
Graph 5.1.2.2 Static analysis for zone V.



5.1.3 Comparison of drift reduction factor for different models of twenty storey building (stepped shear wall).

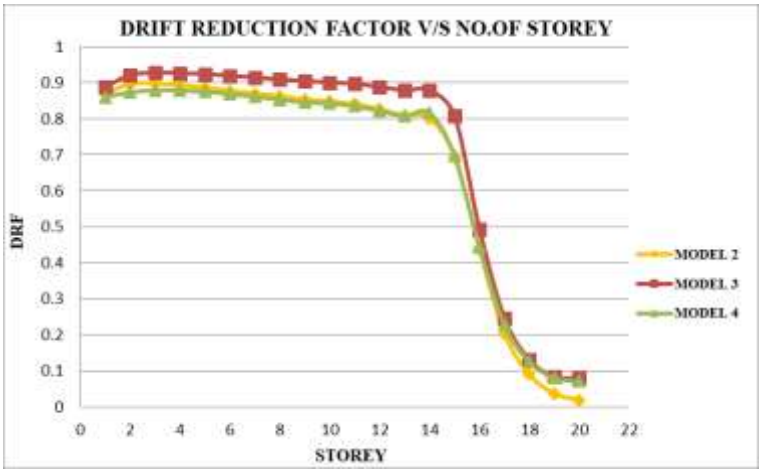
Graph 5.1.3.1 Static analysis for zone IV.

Graph 5.1.3.2 Static analysis for zone V.

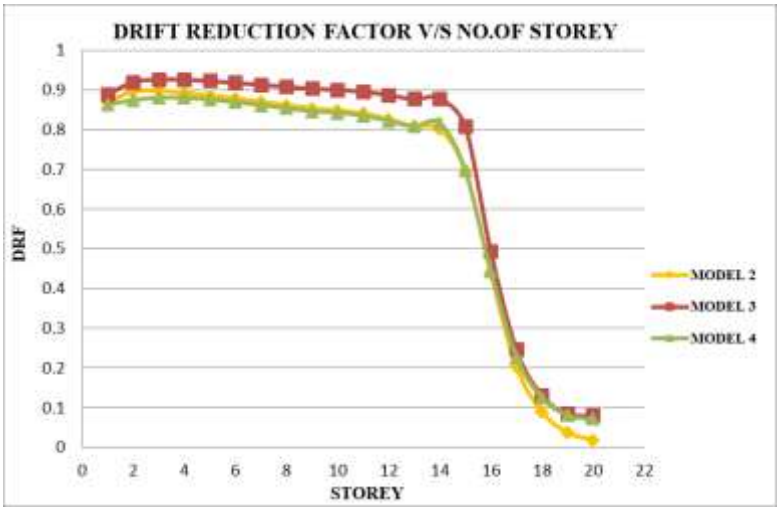


5.1.4 Comparison of drift reduction factor for different models of twenty storey building (curtailed or part shear wall).

Graph 5.1.4.1 Static analysis for zone IV.



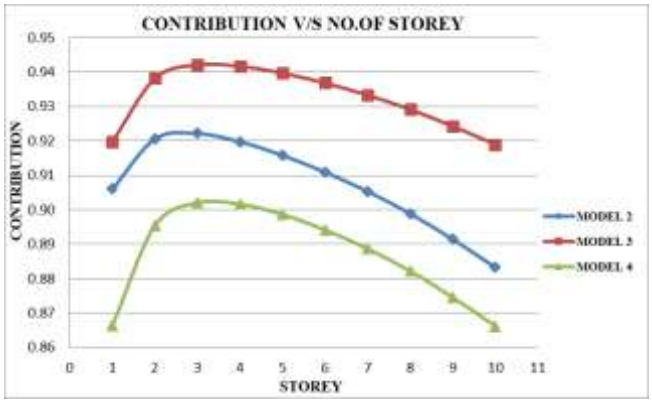
Graph 5.1.4.2 Static analysis for zone V.



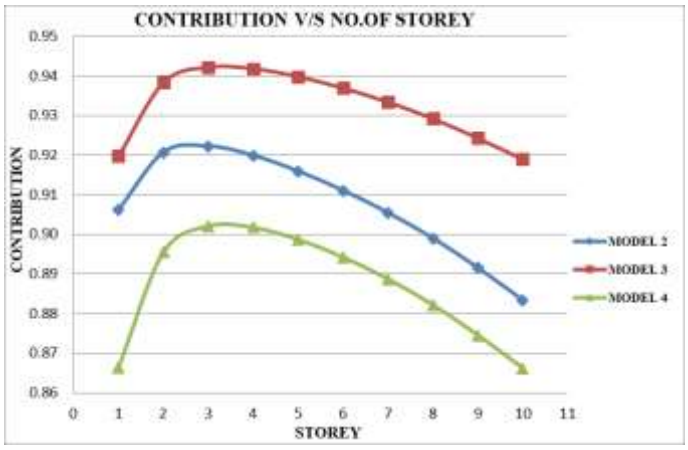
5.2 Graphs for Contribution Factor

5.2.1 Comparison of contribution factor for different models of ten storey building.

Graph 5.2.1.1 Static analysis for zone IV.

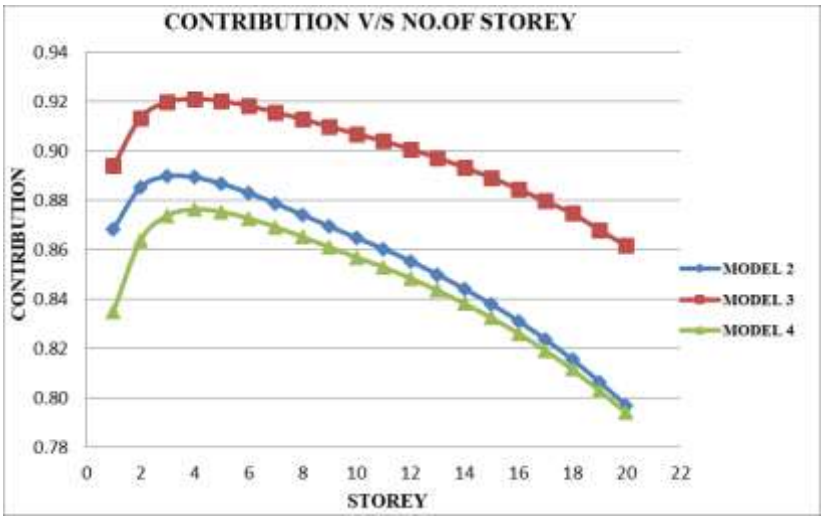


Graph 5.2.1.2 Static analysis for zone V.

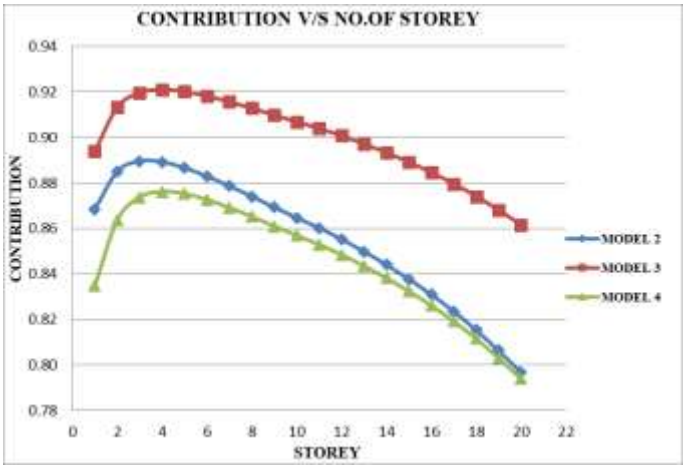


5.2.2 Comparison of contribution factor for different models of twenty storey building (full shear wall).

Graph 5.2.2.1 Static analysis for zone IV.

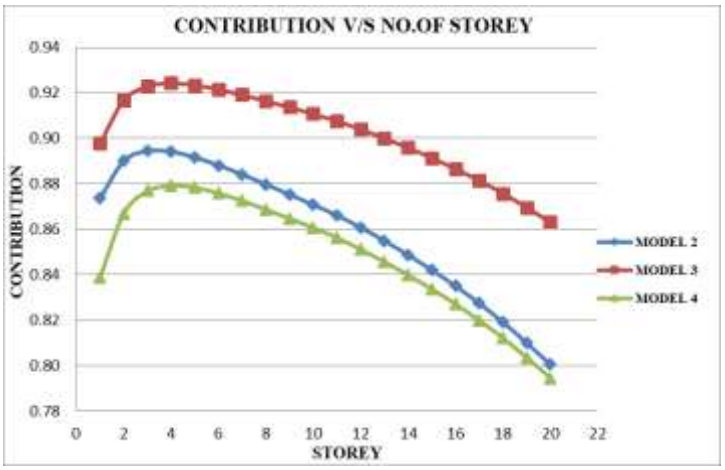


Graph 5.2.2.2 Static analysis for zone V.

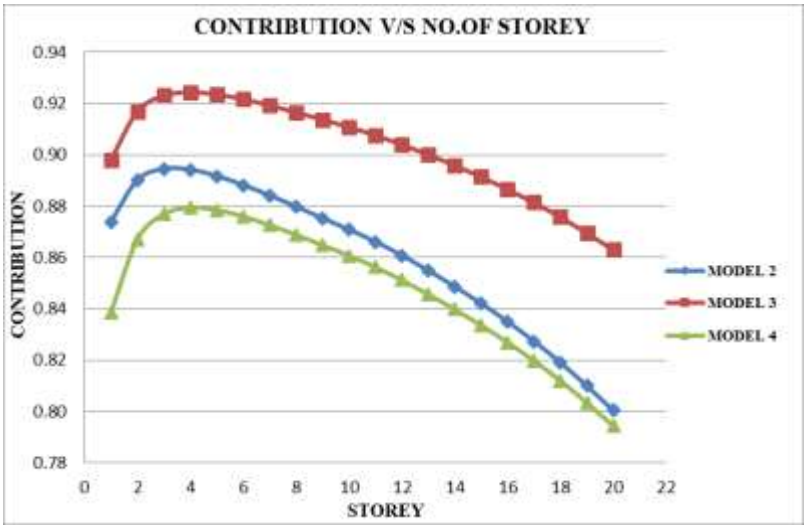


5.2.3Comparison of contribution factor for different models of twenty storey building (stepped shear wall).

Graph 5.2.3.1 Static analysis for zone IV.

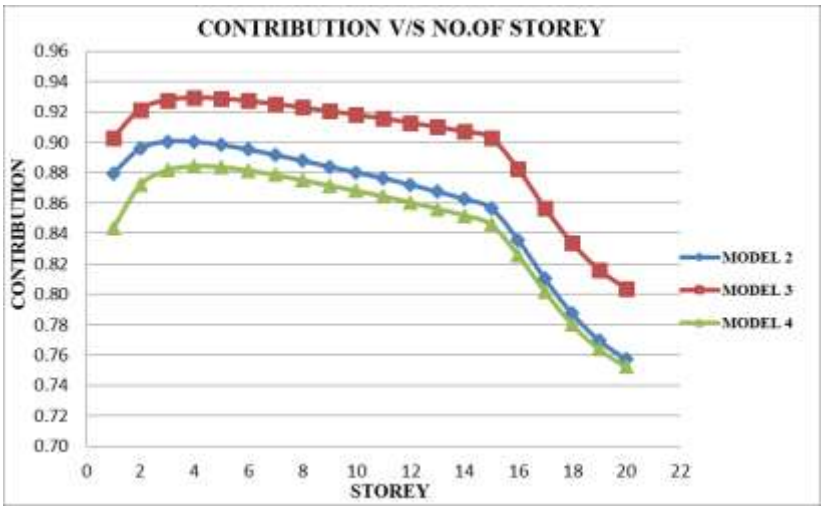


Graph 5.2.3.2 Static analysis for zone V.

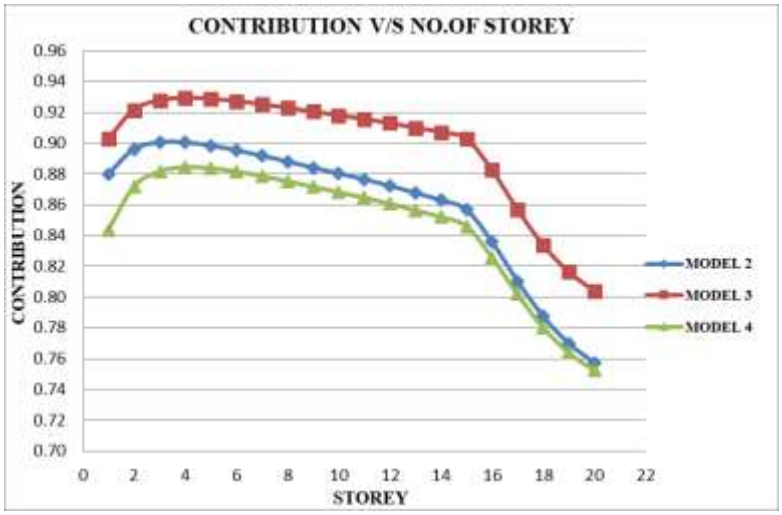


5.2.4 Comparison of contribution factor for different models of twenty storey building (curtailed or part shear wall).

Graph 5.2.4.1 Static analysis for zone IV.



Graph 5.2.4.2 Static analysis for zone V.



V. Conclusion

1. The analysis results for drift reduction factor are represented in above graphs. It can be observed from the graphs that in G+9 building having shear wall, reduction in drift varies from 0.70 to 0.92 for both zone IV and zone V. In case of G+19 buildings, drift reduction factor varies gradually upto fifteenth storey from 0.86 to 0.76. beyond that it reduces to 0.35 in case of full height and stepped shear wall and 0.05 in case of part or curtailed shear wall. Larger value of drift reduction factor indicates the larger participation of shear wall in controlling drift.

2. From the above result graphs it can be observed that contribution factor is almost same in all the cases irrespective of building height, type and location of shear walls. All the graphs have almost same pattern for all the cases. Larger value of contribution factor indicates the larger participation of shear wall in controlling lateral displacement.

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