

# Optimum Position of Deep Beam Outrigger for Different Position of Shear Wall in High Rise Structure

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**Abstract**— In these paper, analysis has been done to determine optimum position of deep-beam outrigger at different position of shear wall for G+15 storey building by using STAAD-PRO V8i. Model with three different position of outrigger i.e.at 5th floor, 10th floor, and 15th floor separately with two different position of shear wall are analyzed by linear static analysis method for seismic zone III. As result coming out from above models shows the performance of the deep-beam outrigger at 10th floor with shear wall 2 position is better than other combination. So, additional combination of outrigger at 5th, 10th, 15th floor with shear wall 2 position is analyzed. Which shows minimum lateral displacement as compared to other combination.

**Key words:** Storey drift, Absolute displacement, Bending moment of column (My,Mz)

## I. INTRODUCTION

In these research paper optimum position of outrigger beam with significant position of shear wall in seismic zone III is determined by using STAAD-PRO V8i. For that purpose deep-beam outrigger section is used. Which is analyzed at three different position i.e. at 5th floor, 10th floor & 15th floor with two different shear wall position their result is compared with bare frame and also with each other. Shear wall positions are nomenclature as SW-1 and SW-2.

As the SW-2 with outrigger at 10th floor shows better performance additional combination of SW-2 with outrigger at 5th, 10th, 15th floor is analyzed. Seismic analysis is done as per IS 1893:2002.

## II. LINEAR STATIC METHOD

In linear static analysis strains, stresses, and reactions forces under the effect of applied loads are calculated.

Linear static analysis represents the most basic type of analysis. The term “linear” means that are computes response displacement or stress. It is linearly related to the applied force.

Term static means the forces that do not vary with the time, i.e. time variation is insignificant and can therefore be safely ignored.

## III. MODELLING

Different models of G+15 storey building, having plan length 25 m and width 25 m is analyzed with different combination of shear wall and outrigger beam.

General specification of the building discuss below

Height of the building: 49 m.

- Storey ht. 3 m.
- Beam size: 0.23 x 0.45 m.
- Column size: 0.85 x 0.85 m up to G-5 floor.  
0.65 x 0.65 m from floor 6-10.

0.55 x 0.55 m from floor 11-15.

– Grade of concrete used: M40.

– Grade of steel used: Fe415.

Description of model: Different combination of outrigger beam with shear wall is described below.

- Model 1: Outrigger at 5th floor with SW-1
- Model 2: Outrigger at 10th floor with SW-1
- Model 3: Outrigger at 15th floor with SW-1
- Model 4: Outrigger at 5th floor with SW-2
- Model 5: Outrigger at 10th floor with SW-2
- Model 6: Outrigger at 15th floor with SW-2
- Model 7: Outrigger at 5th, 10th, 15th floor with SW-2
- Model 8: Bare frame

Following figures shows the 3D view of models discuss above. Arrow shows the position of outrigger. Fig.1 to Fig.3 shows the SW-1 position and Fig.4 to Fig.6 shows SW-2 position. Fig.7 shows outrigger at 5th, 10th & 15th floor with SW-2 position. Fig.8 shows bare frame.

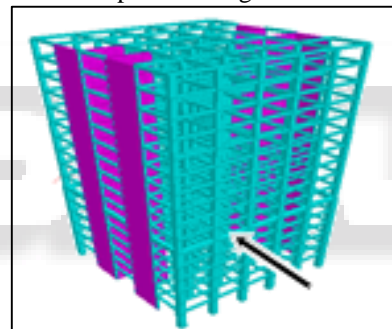


Fig. 1: 3D view of Model 1

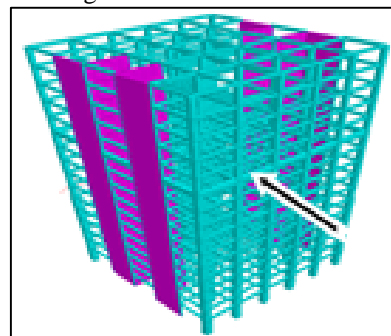


Fig. 2: 3D view of Model 2

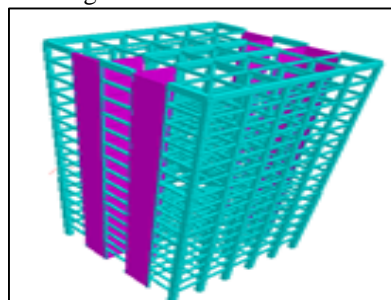


Fig. 3: 3D view of model 3

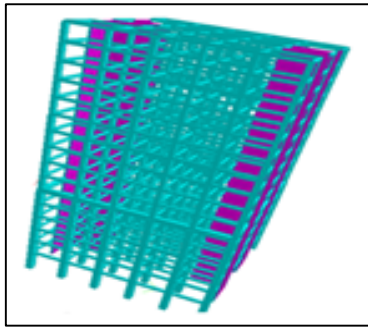


Fig. 4: 3D view of model 4

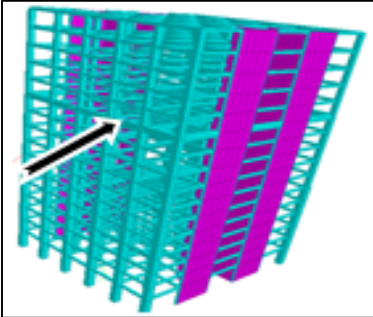


Fig. 5: 3D view of model 5

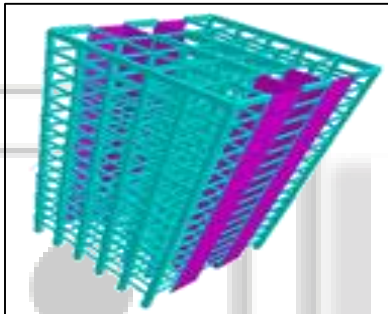


Fig. 6: 3D view of model 6

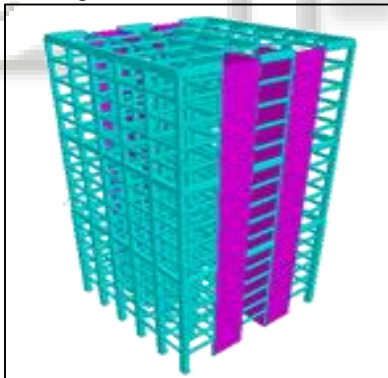


Fig. 7: 3D view of model 7

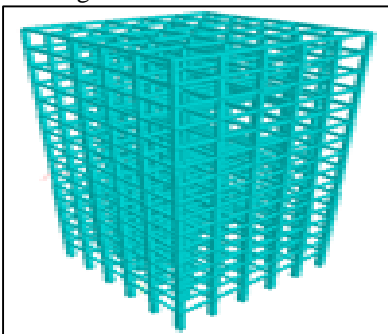


Fig. 8: 3D view of model 8

#### IV. RESULT AND GRAPH

From analyzing the models discuss above three parameters are compared i.e. storey drift, absolute displacement, bending moment of column. Results of the above parameters are shown in graphical form Storey drift graph: Following graph shows the comparison of storey drift between bare frame, model combined with different shear wall position with outrigger at 5<sup>th</sup>, 10<sup>th</sup> & 15<sup>th</sup> floor separately and Outrigger at 5<sup>th</sup>, 10<sup>th</sup> & 15<sup>th</sup> floor with SW-2 position.

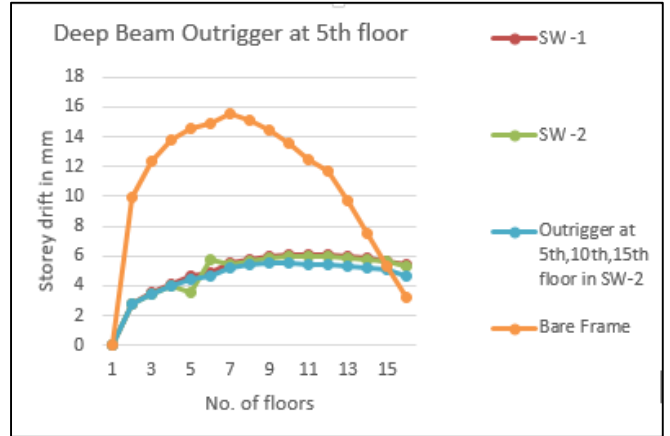


Fig. 9: Shows storey drift comparison between model 1, 4, 7, 8.

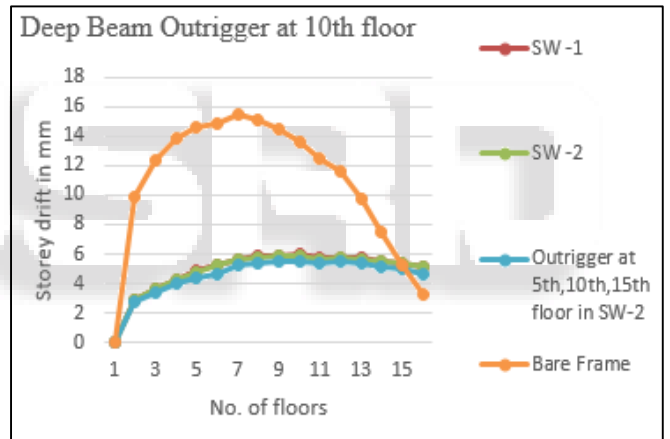


Fig. 10: Shows storey drift comparison between models 2, 5, 7, 8.

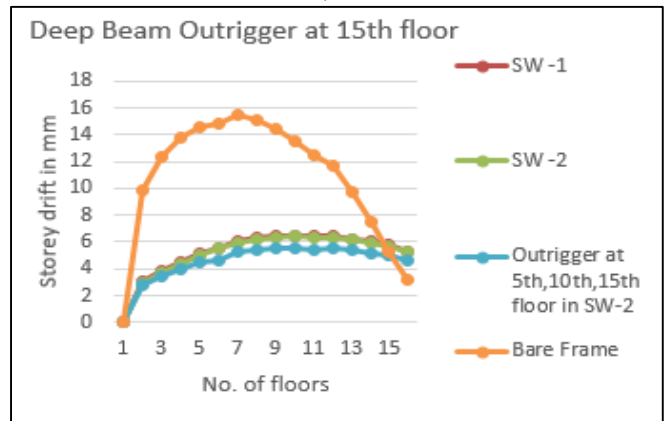


Fig. 11: Shows storey drift comparison between models 3, 6, 7, 8.

Absolute displacement graph: - Following graph shows the comparison of absolute displacement between bare frame, model combined with different shear wall

position with outrigger at 5<sup>th</sup>, 10<sup>th</sup> & 15<sup>th</sup> floor separately and Outrigger at 5<sup>th</sup>, 10<sup>th</sup> & 15<sup>th</sup> floor with SW-2 position.

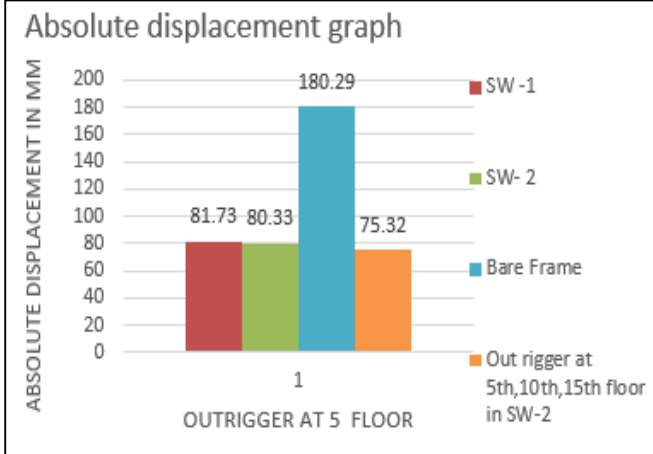


Fig. 12: Shows absolute displacement comparison between models 1, 4, 7, 8.

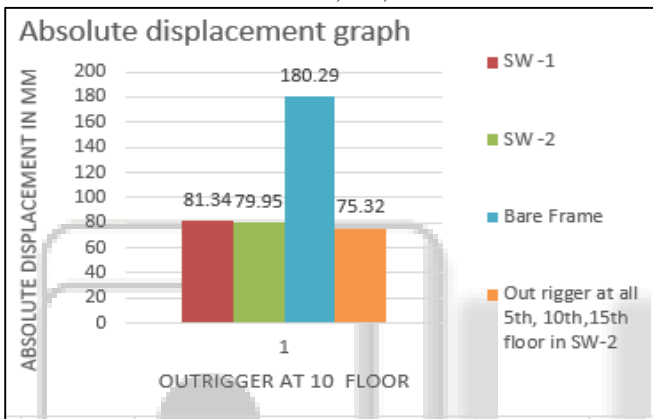


Fig. 13: Shows absolute displacement comparison between models 2, 5, 7, 8.

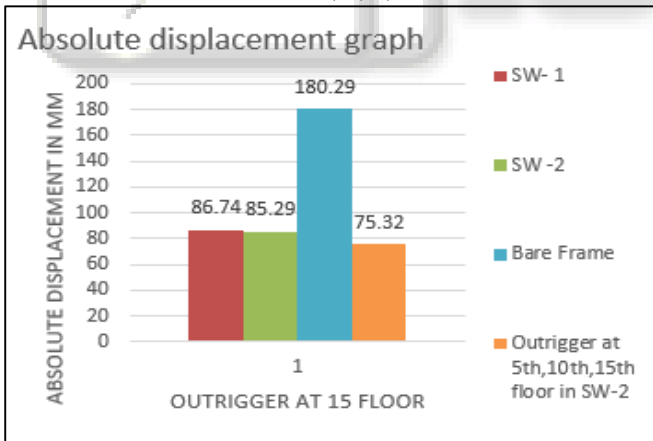


Fig. 14: Shows absolute displacement comparison between models 3, 6, 7, 8.

Bending moment of column (My):- Following graph shows the comparison of bending moment between bare frame, model combined with different shear wall position with outrigger at 5<sup>th</sup>, 10<sup>th</sup> & 15<sup>th</sup> floor separately and Outrigger at 5<sup>th</sup>, 10<sup>th</sup> & 15<sup>th</sup> floor with SW-2 position.

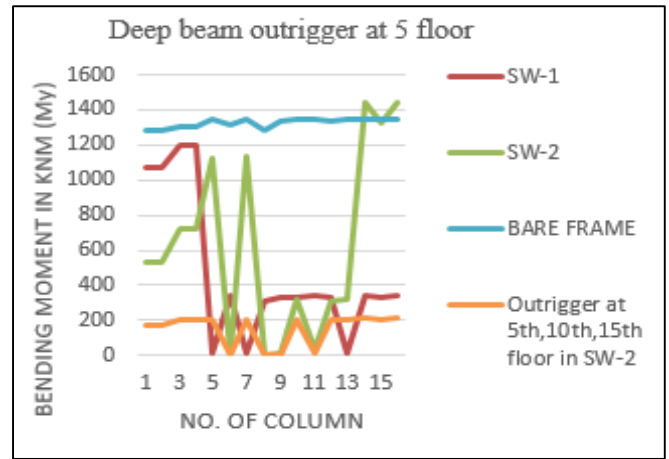


Fig. 15: Shows bending moment (My) comparison between models 1, 4, 7, 8.

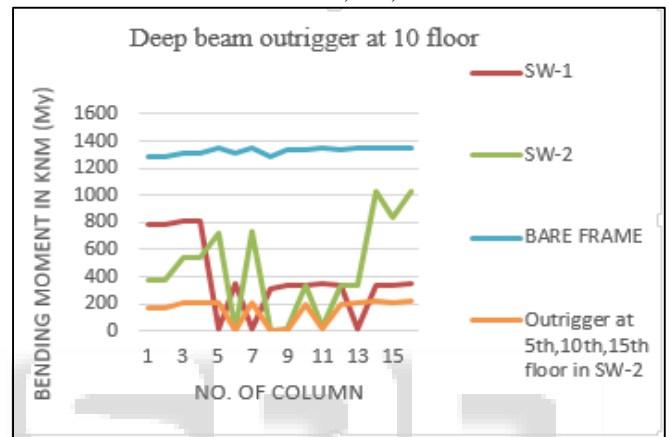


Fig. 16: Shows bending moment (My) comparison between models 2, 5, 7, 8.

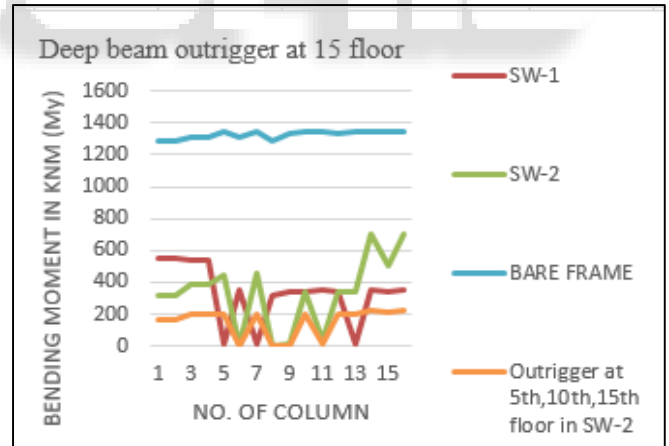


Fig. 17: Shows bending moment (My) comparison between models 3, 6, 7, 8.

Bending moment (Mz):- Following graph shows the comparison of bending moment between bare frame, model combined with different shear wall position with outrigger at 5<sup>th</sup>, 10<sup>th</sup> & 15<sup>th</sup> floor separately and Outrigger at 5<sup>th</sup>, 10<sup>th</sup> & 15<sup>th</sup> floor with SW-2 position.

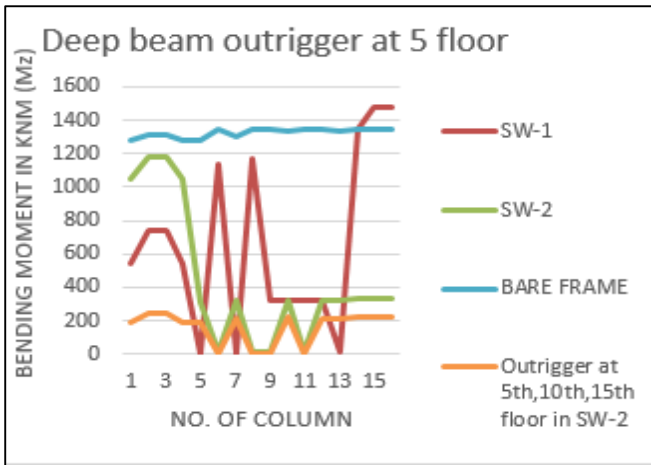


Fig. 18: Shows bending moment (Mz) comparison between models 1, 4, 7, 8.

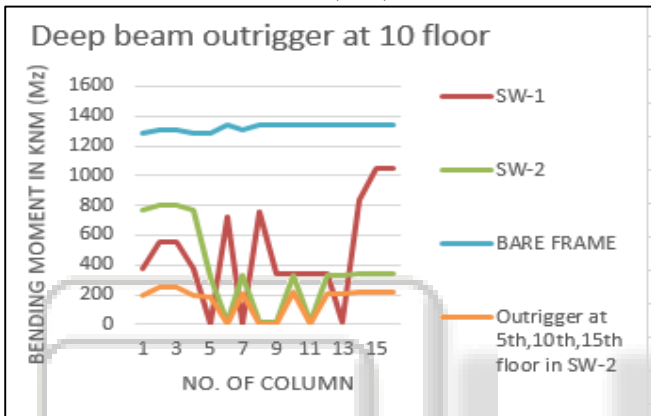


Fig. 19: Shows bending moment (Mz) comparison between models 2, 5, 7, 8.

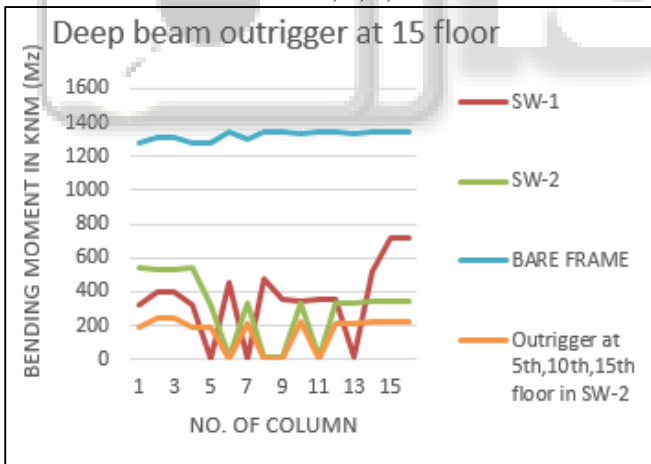


Fig. 20: Shows bending moment (Mz) comparison between models 3, 6, 7, 8.

#### V. CONCLUSIONS AND RECOMMENDATIONS

- Shear wall and outrigger beam have great effect to resist lateral displacement of building as compared to bare frame.
- Proper shear wall position and outrigger beam position resist lateral horizontal forces to great extent.
- SW-2 with outrigger at 10<sup>th</sup> floor gives better result as compared to other.
- Additional combination of SW-2 with outrigger at 5<sup>th</sup>, 10<sup>th</sup> & 15<sup>th</sup> floor is analyzed.

- Result obtained from the analysis of all models are tabulated below. Table shows maximum value of parameter discuss below

Model no.	Storey drift (mm)	Absolute displacement (mm)	Bending moment (kN.m.)	
			My	Mz
1	6.13	81.73	1200.44	1482.48
2	5.95	81.34	811.95	1051.96
3	6.50	86.74	554.63	719.15
4	6.02	80.33	1440.81	1185.58
5	5.84	79.95	1024.48	802.52
6	6.39	85.29	703.65	542.34
7	5.57	75.32	219.78	248.65
8	15.51	180.29	1345.74	1345.69

Table 1: From the above table it is concluded that model 7 shows better performance in all manner.

- Hence, Outrigger position at 5<sup>th</sup>, 10<sup>th</sup> & 15<sup>th</sup> floor with SW-2 position is better as compared to other.

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