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# "EFFECT OF DIFFERENT SHAPED SHEAR WALL ON STOREY DRIFT AND DISPLACEMENT OF A MULTISTOREYED BUILDING UNDER SEISMIC LOADING"

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## ABSTRACT

Shear wall systems are one of the most commonly used lateral load resisting systems in high-rise buildings. It is very necessary to determine effective, efficient and ideal location of shear wall. In this paper focuses to see the effect of shear wall location in multi-storied building. In this we place shear wall at different locations of building for critical parameters like storey displacement and storey drift for lateral loading. The analysis has been carried out using the software ETABS 9.6.0 and for analysis we use IS 1893:2002 equivalent static method is used here.

**Keywords:** Storey drift, storey displacement, shear wall and base shear.

## I. INTRODUCTION

Shear wall is defined as the structural vertical member that is able to resist the combination of shear, moment and axial load induced by lateral load and gravity load transfer to the wall from other structural member. Shear wall can be used simultaneously for resisting large horizontal loads and to support gravity loads which reduces lateral sway action that do not cause damage on structure, this is due to stiffness and strength of shear wall. Shear walls of different cross sections with varying shapes like rectangular, T, L, box shaped etc. Shear walls are placed symmetrically in structure to reduce the ill effects of twisting.

## II. METHODOLOGY

As per the Indian Standard code for Earthquake IS: 1893-2002, seismic analysis can be performed by the following methods

1. Equivalent Static Analysis (Linear Static)

2. Response Spectrum Analysis (Linear Dynamic)

3. Pushover Analysis (Nonlinear Static)

4.Time History Analysis (Nonlinear Dynamic)

Here we use the first method i.e. equivalent static method. This method well worked for low to medium rise buildings without coupled lateral-torsional modes in which only the first mode in each direction is significance.

**Software implementation**

ETABS has feature known as similar storey, can perform various seismic coefficients, automates templates for typical structures, provide object based modelling.

Step-1 Design of R.C.C framed structure

Step-2 Design of shear wall

Step-3 Placing the shear wall at different locations of building under lateral loading.

Step-4 finding the efficient location of shear wall under lateral loading on the basis of seismic parameters like storey displacement and base shear.

**Storey displacement**

It is the total displacement of ith storey with respect to ground. In our project we taken the top storey displacements for all the models.

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**Storey drift**

It is the ratio of difference of two consecutive floor to height of that floor.

**Base shear**

It is an estimate of the maximum expected lateral force that will occur due to seismic ground motion.

## III. MODELING AND ANALYSIS

As per IS:13920 minimum thickness of shear wall is 150 mm, here we taken 300 mm as shear wall thickness for the models.

As dead load and wall load are permanent loads on building so we take self-weight multiplier as one for those cases.

Loads

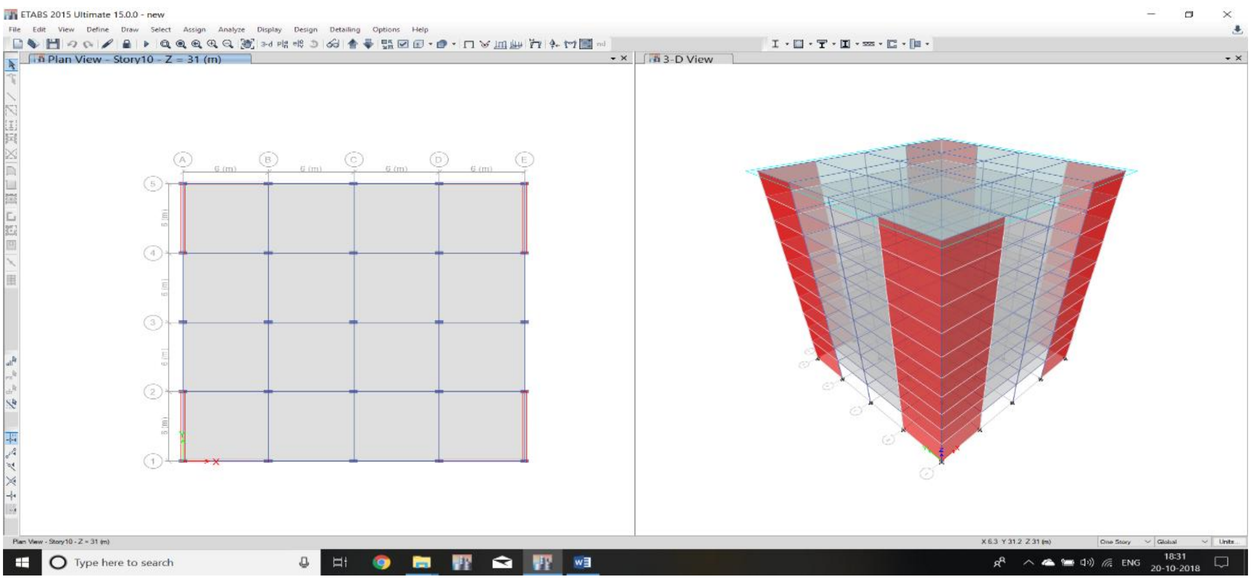
| Load | Type | Self Weight Multiplier | Auto Lateral Load |
|---|---|---|---|
| Dead | Dead | 1 | |
| Dead | Dead | 1 | |
| Live | Live | 0 | |
| wall | Super Dead | 1 | |
| eq x | Seismic | 0 | IS1893 2002 |
| eq y | Seismic | 0 | IS1893 2002 |
| wind x | Wind | 0 | Indian IS875:1987 |
| wind y | Wind | 0 | Indian IS875:1987 |

According to IS 1893:2002 (PART-1), clause 7.11.1.The maximum permissible storey drift should not exceed $0.004h^1$, where $h^1$ is storey height. Here 0.004x3= 0.012. In our project storey drifts of all the models lies within the limit.

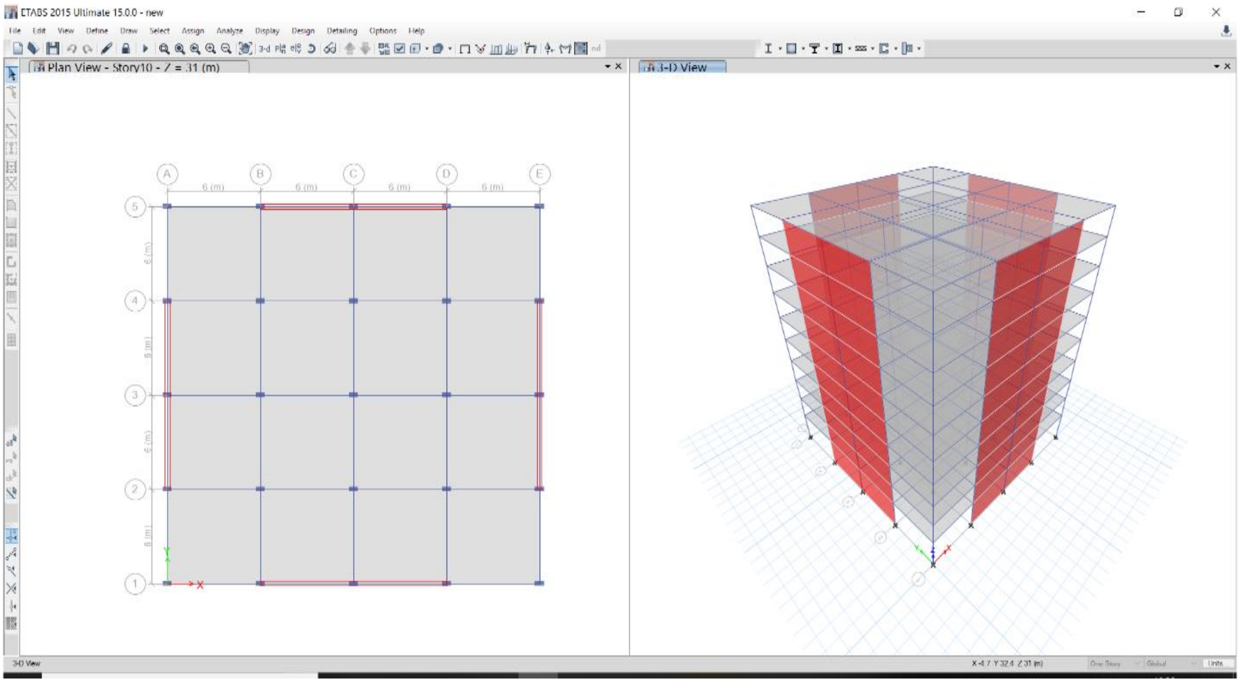
According to IS 1893:2002 (PART-4), clause 18.7 the maximum lateral displacement of the top of structure shall not exceed the equation, $D_{max}$ = 0.003h = 0.003x31= 0.093m= 93mm, where h is height of structure above base. Here all the model storey displacement are within the limit.

**Plan and 3-D views of models**

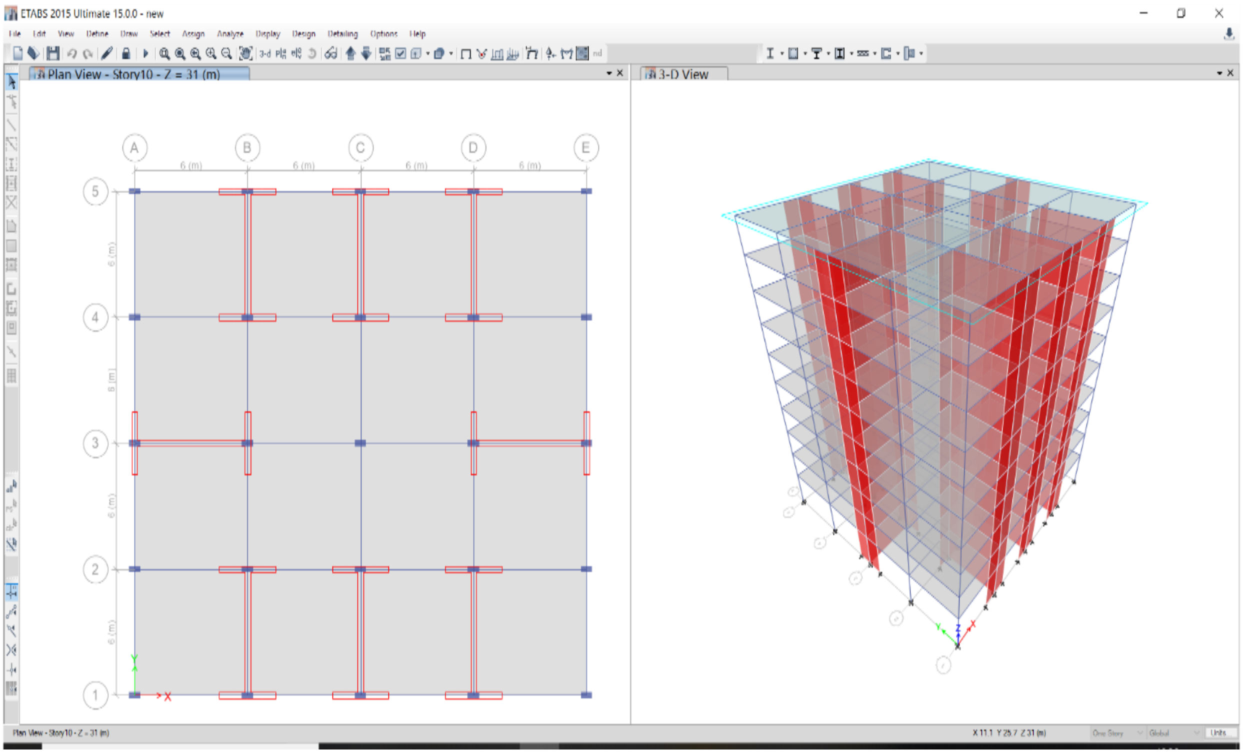
**Model-1 (**L shape at four corners )



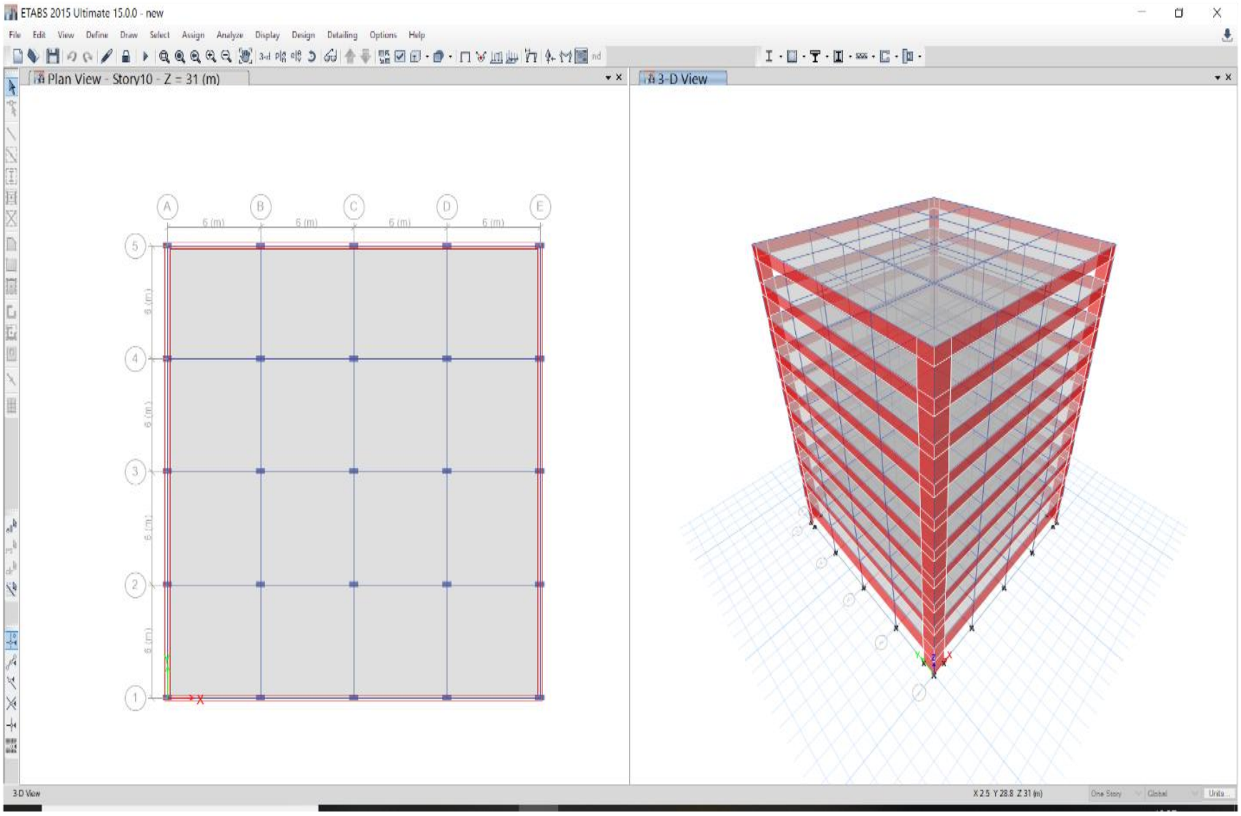
**Model-2 ( straight walled shear wall at center)**



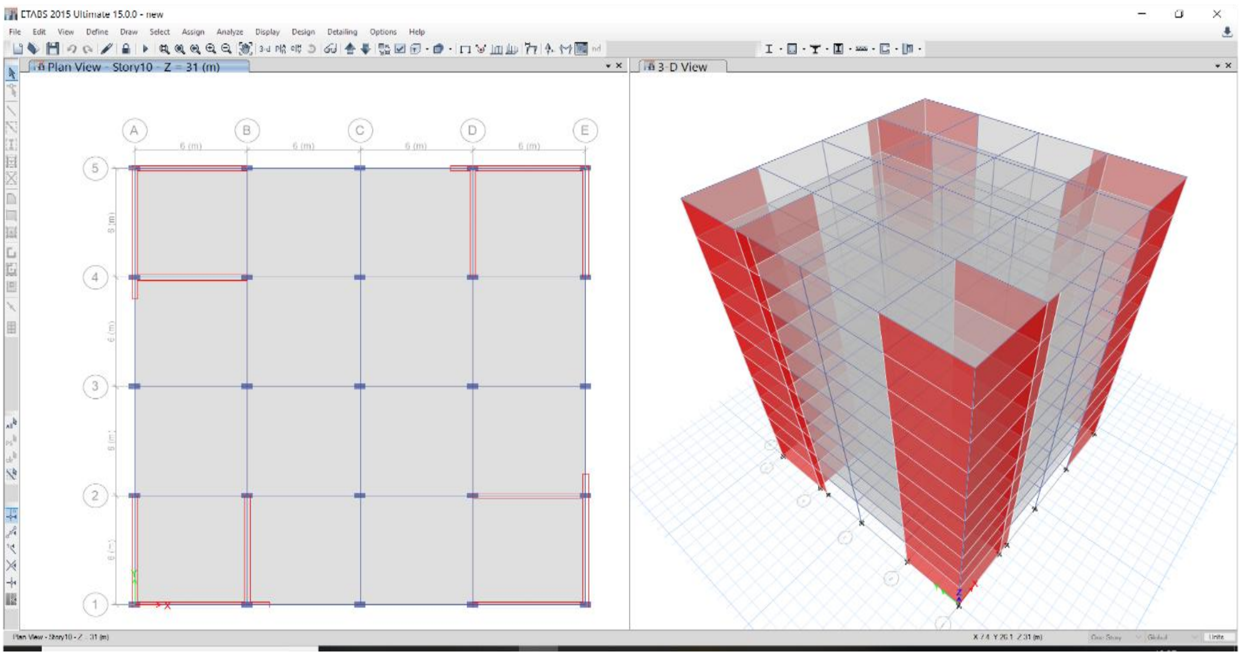

**Model-3 ( I shape)**



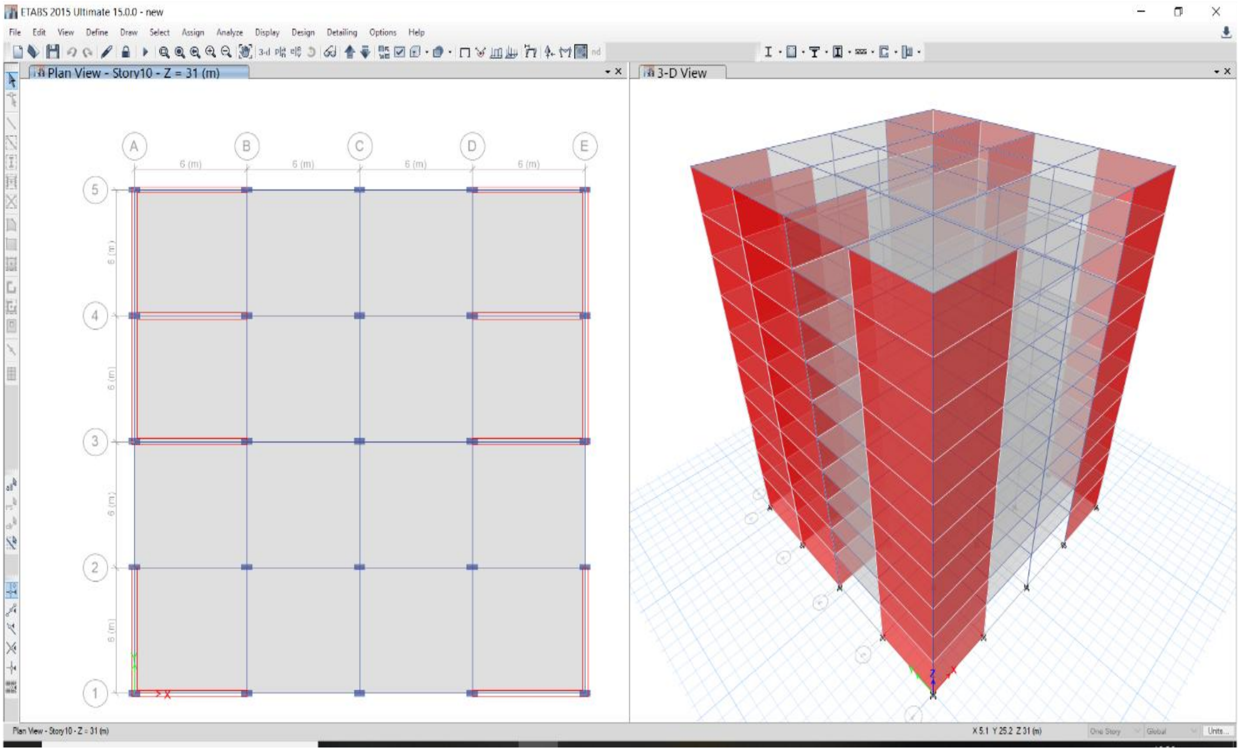
**Model-4 (straight wall with openings)**



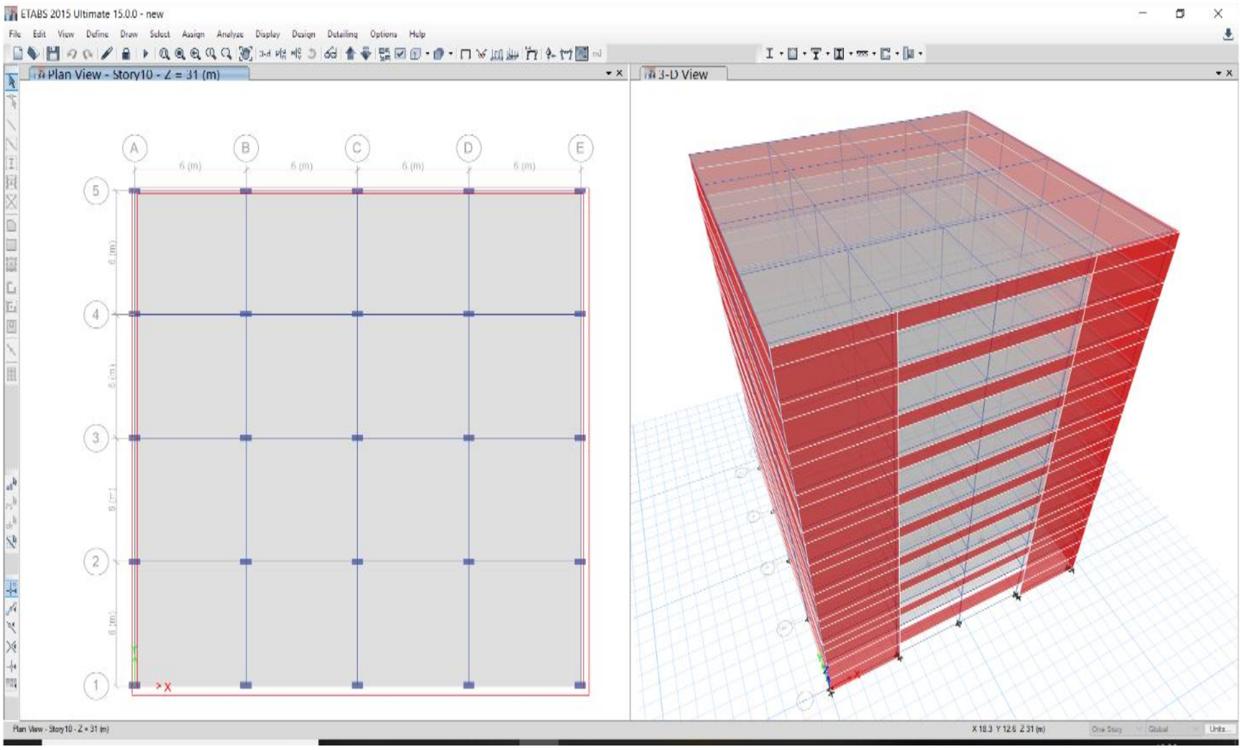

**Model-5 ( F shape at four corners)**



**Model-6 (combination of E and L shape)**




**Model-7 (single cell)**



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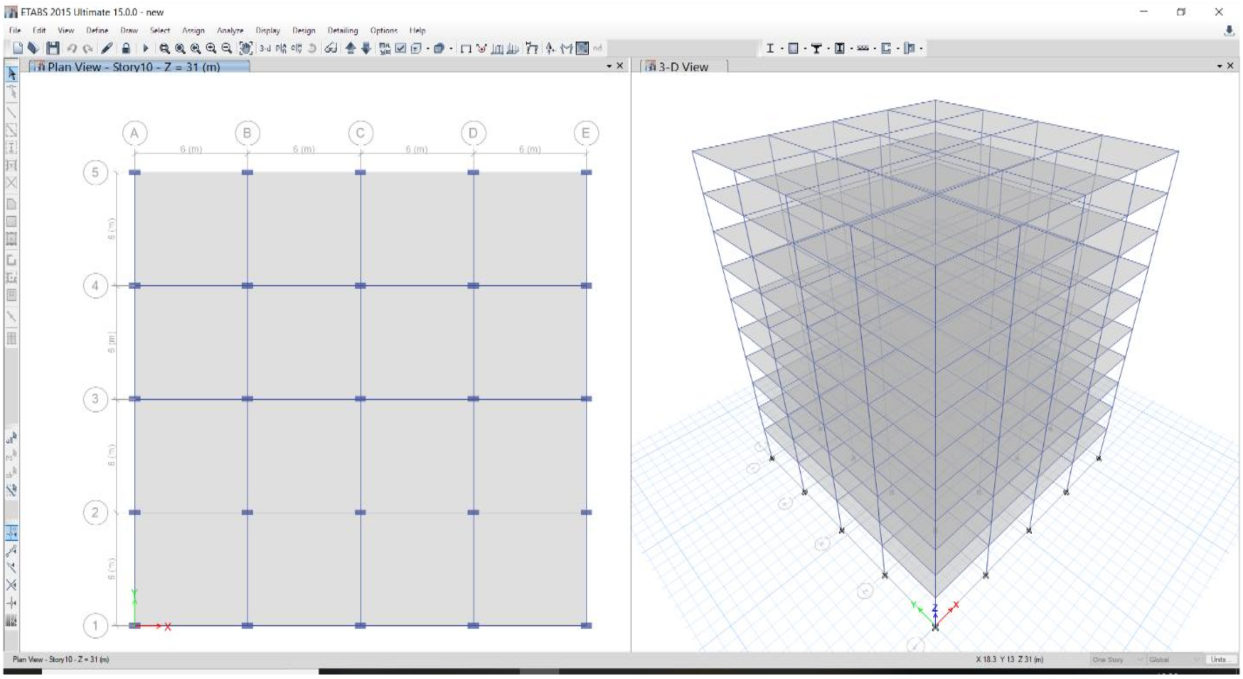
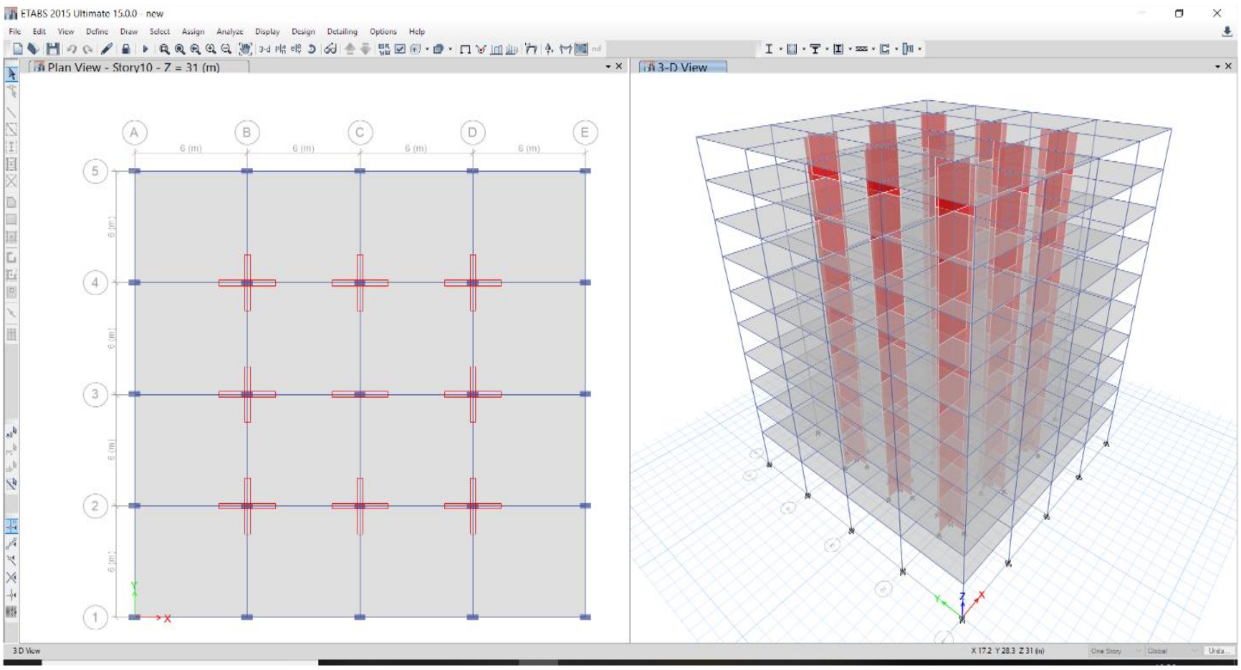
**Model-8 (without shear wall)**




**Model-9 (plus shape at four slab meeting joint)**



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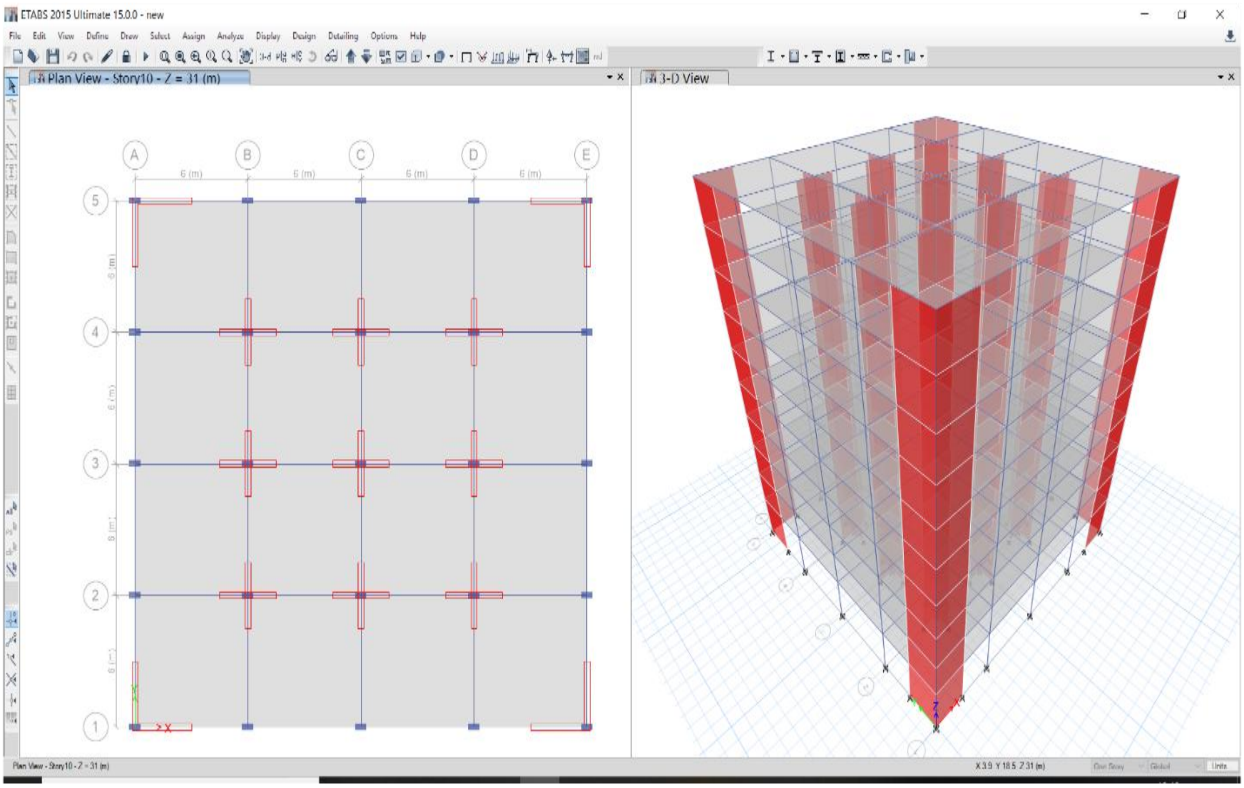
**Model-10 (plus shape at four slab meeting joint and L shape at four corners)**



## IV. RESULTS AND DISCUSSION

| MODEL | BASE SHEAR RESISTANCE in MN | STOREY DRIFT | STOREY DISPLACEMENT (mm) | % INCREASE IN BASE SHEAR RESISTANCE | % REDUCTION IN STOREY DRIFT | % REDUCTION IN STOREY DISPLACEMENT |
|---|---|---|---|---|---|---|
| M-1 | 205.995 | 0.000348 | 16.6 | 11.35 | 10.53 | 67.93 |
| M-2 | 205.995 | 0.000346 | 13.5 | 11.35 | 11.05 | 72.94 |
| M-3 | 227.032 | 0.000251 | 10.3 | 22.08 | 33.16 | 79.35 |
| M-4 | 203.213 | 0.000333 | 16.3 | 9.86 | 14.39 | 67.33 |
| M-5 | 218.617 | 0.000378 | 13.7 | 18.19 | 2.83 | 72.54 |
| M-6 | 221.773 | 0.000362 | 12.3 | 19.9 | 6.94 | 75.35 |
| M-7 | 224.165 | 0.000311 | 7 | 21.19 | 20.05 | 85.97 |
| M-8 | 184.958 | 0.000389 | 49.9 | - | - | - |
| M-9 | 207.310 | 0.000262 | 13.5 | 12.08 | 32 | 72.94 |
| M-10 | 219.143 | 0.000245 | 11.1 | 18.48 | 37.01 | 77.75 |

Here all the results are obtained by taking the Model-8 as reference or standard Building because it is the primary multistorey without shear wall.

## V. CONCLUSION

- 85.97% of storey displacement is reduced for Model-7 with single cell shear wall followed by M-3 I shape with 79.35% and M-10 with 77.75% when compared to M-8 model structure without shear wall. So single cell shear wall is effective in resisting displacement in lateral loads.
- Model-3 has 22.08% more base shear, followed by M-7 and M-10 with 21.19% and 18.48% respectively when compared to base shear for the Model-8 structure without shear wall. Model-3 is preferred than other models in base shear criteria.
- Storey drift decreases for all the model structures above when compared to structure without shear wall. For M-10 storey drift is more decreased by 37.01%.

- Taking displacement as our primary criteria followed by base shear and storey drift we conclude that M-7 single cell shear wall is preferred as effective in shear wall location followed by Model-3 with I shape shear walls at different loctions.

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