STUDY ON OPTIMUM LOCATION OF SHEAR WALL IN TALL BUILDINGS AGAINST WIND LOAD

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Abstract - *In this paper work an attempt have been made to study the optimum location of shear wall against wind load in tall buildings. A comparison is made between 4 structural models one without any shear wall, and other three with shear wall at core, corner and at periphery. Each building is modeled with 12 stories, with same plan area, and height of each storey is 3.6m. Analysis is done for Imposed loads, Dead loads and wind load as per IS 875 Part 3. Combinations of loads are driven as per the appropriate Indian Standard codes. Results are tabulated and plotted for time period, frequency, storey drift ratio, displacement, and base shear for different models. The results were discussed by comparing the above three structures with conventional structure to obtain the optimum location of shear wall which is best suitable for the wind resistance.*

Key Words: *Tall building, Shear wall, Wind load, Time period, Frequency, Displacement, Storey shear, Storey drift ratio.*

1. INTRODUCTION

Now a day's poor building plan led to building collapse and many other serious problems. The planned building design should withstand the wind or movement of air. In order to overcome the wind blow we have to construct a plan so that height, flexibility and weight of a building should tolerate the wind.

If wind flows surrounding the building it may produce high suction pressures and leading edges are mainly affectedd. Hence in those areas were strongly attached to the structure and the roof needs to be strongly held down. It depends on the roof, if the roofs flatter then higher the suction force. So stay confirm that the holdings down straps are 100% fixed securely into the structure. In Present days, it is very important to introduce the shear walls in tall structures to reduce the wind response. In absence of shear walls in tall structures might cause Sevier damages to the structural elements when expose to wind. So introducing shear wall in optimum location will help to reduce the wind response of tall building like Storey displacement, storey drift, time period and frequency.

In Present study,

1. The buildings with shear walls at core, corners, and peripheryy. Each structure is modeled for 12 stories.
2. Each model has the same plan area.
3. Analysis is done for Imposed loads, Dead loads and wind load as per IS 875 Part 3. Combinations of loads are driven as per the appropriate Indian Standard codes.
4. Results are tabulated and plotted for time period, frequency, storey drift ratio, displacement, and base shear for different models.
5. The results were discussed by comparing the above three structures with conventional structure to obtain the optimum location of shear wall which is best suitable for the wind resistance.

2. GEOMETRICAL CONFIGURATIONS

BUILDING CONFIGURTION

No, of stories	12
Height of each storey	3.6m
Shear wall thickness	200mm
Depth of slab	175mm
Grade of steel	Fe 500
Grade concrete for For beam/slab For column/wall	M25 M40
Column size	400mmX1000mm
Beam size	200mmX600mm
Area of building	42mX24m

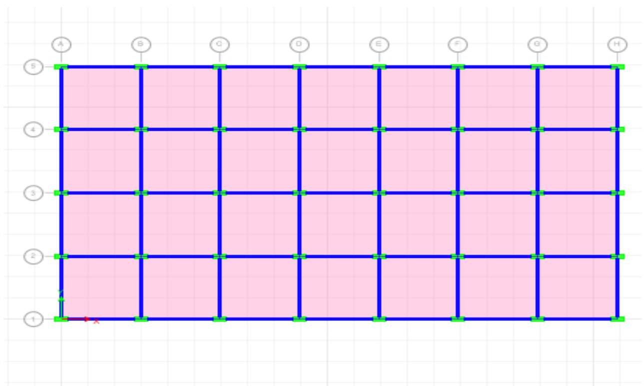


Fig 2.1 Plan of building

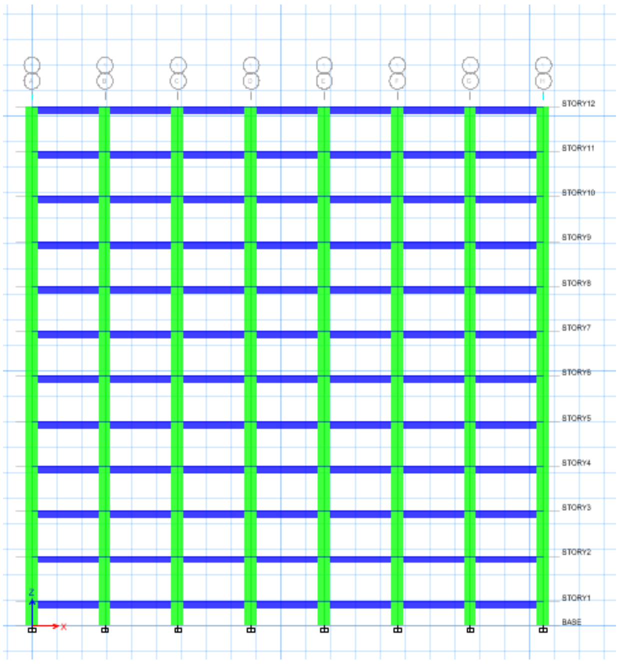


Fig 2.2 Elevation of building

3. LOAD CONSIDERATION

a) Dead Load: Self weight of all the structural elements.

b) Live Load: 4.0KN/m² the floor and 1.5 KN/m²

c) Wind Load: Wind load in terms of wind pressure depend on the Basic wind speed. basic wind speed (V_b=33.0m/sec.)

d) floor finish : 2 KN/m²

Load combinations: The load combinations is obtained from IS 875 – PART 3

DLFWX =1.5 (DL+LL+FF+WX)
DLFWY =1.5(DL+LL+FF+WY)

4. E-TAB MODELS

The analysis is carried out for shear wall model using ETABS and the parameters considered for studies are maximum storey Displacement, Time period , Storey shear and Storey drift .

Model 1 - Conventional frame structure without any shear wall.

Model 2- Having line shape shear wall at the periphery.

Model 3- Having box shape shear wall at the core.

Model 4 - Having L shape shear wall at the corner.

MODEL 1

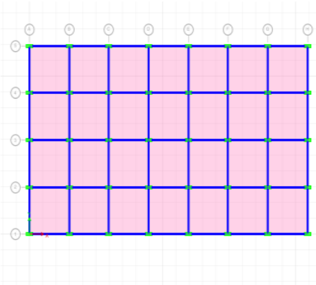


Fig 4.1 Plan

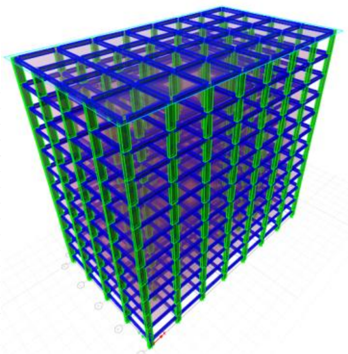


Fig 4.2 3D VIEW

MODEL 2

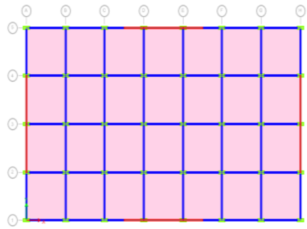


Fig 4.3 Plan

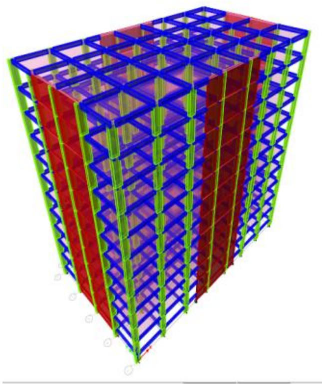


Fig 4.4 3D VIEW

MODEL 3

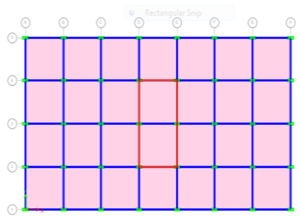


Fig 4.5 Plan

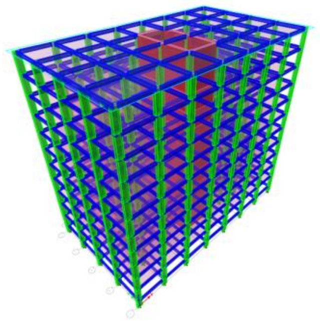


Fig 4.6 3D VIEW

MODEL 4

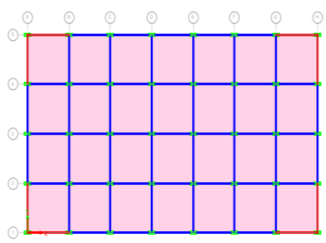


Fig 4.7 Plan

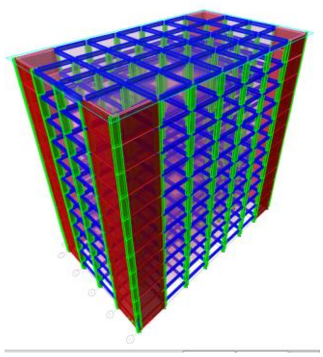


Fig 4.8 3D VIEW

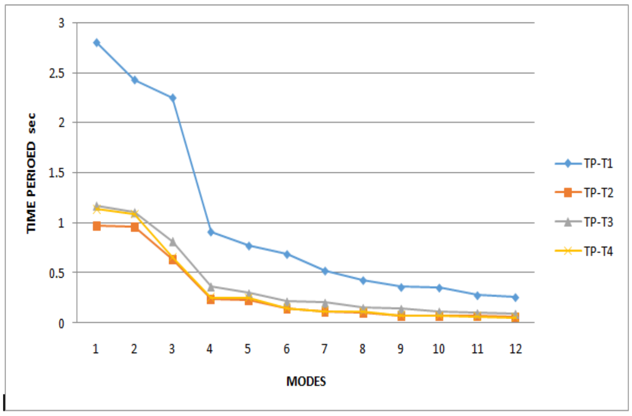
6. ANALYSIS

Static wind analysis is carried out for all four models with different shear wall location and the parameters such as time period, storey shear, displacement, storey drift ratio are studied.

7. RESULTS AND DISCUSSION

1. TIME PERIOD:

As we know that time period depends on mass and flexibility, so in this case the mass is same throughout the height of the building in all model, but as we have introduced shear walll in different locations which will result in variation of flexibility. So, this variation of flexibility is maximum in type 1 model, hence the time period is more in type1 model and the flexibility in type 2 model less, hence time period is less type2 model.



Graph 1: Time period vs modes

From the above graph it is observed that

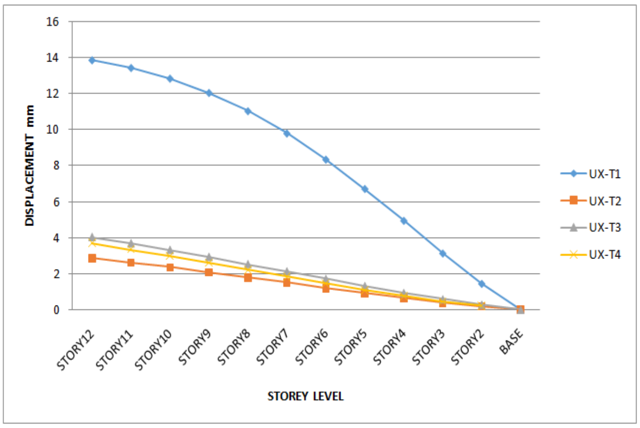
1) The maximum time period is present in mode 1 for all 4 models.

2) among all four maximums the maximum is 2.799702 sec of type 1 model and minimum is 0.971227 sec of type 2 model

2. DISPLACEMENT:

Displacement is an essential parameter used for assessing the stiffness of lateral force resisting systems of tall buildings and lateral stability. Lateral displacement is caused during wind, which reduces stability and durability of tall buildings. Due to displacement of the building the occupants feel uncomfortable.

WIND IN X DIRECTION



Graph 2: Displacement vs Storey level

From above graph one can see that,

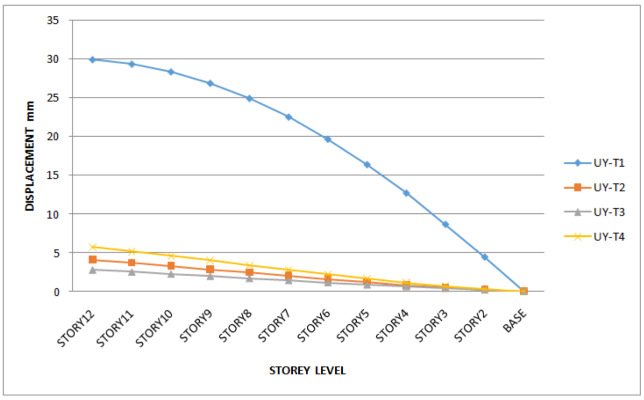
1) The storey with highest displacement is considered for comparison, which is the 12th storey of building.

2) The models which have shear walls and the one model which don't have shear wall has huge difference.

3) The maximum displacement is present in type 1 model that is 13.8465 mm and minimum in type 2 model that is 2.8752 mm.

4) Type 2 model has lower displacement hence this is preferred in x direction.

WIND IN Y DIRECTION



Graph 3: Displacement vs Storey level

From above graph one can see that,.

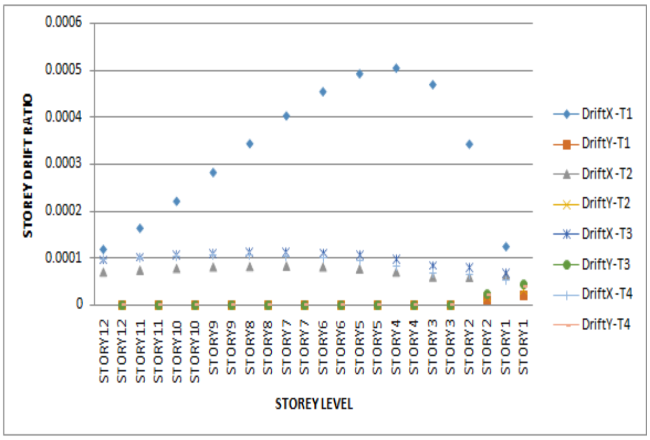
1) The maximum displacement is present in type 1 model that is 29. 9105mm and minimum in type 3 model that is 2.8309 mm.

2) Type 3 model has lower displacement hence this is preferred in y direction.

3. STOREY DRIFT RATIO

It is defined as the displacement of building in relative to the other level building below or above the considered one. Due to different response quantities, the building may collapse. For example -at local levels such as curvatures, strains in building, rotations and interior story drifts at global levels of building etc .

WIND IN X-DIRECTION



Graph 4: Storey drift ratio vs Storey level

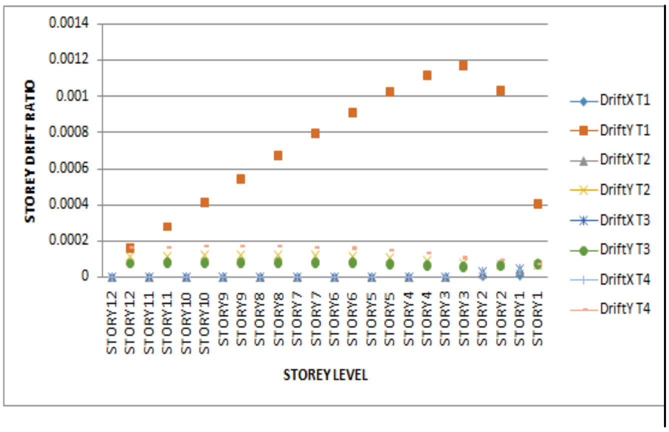
Discussion:

1) The pattern of the drift over the height of the building is maximum at middle storey's, minimum at bottom storey's and medium at top storey's.

2) Storey drift is maximum at type 1 model and is minimum in type 2 model.

3) The minimum storey drift ratio is preferred so type 2 model is preferred in x direction.

WIND IN Y DIRECTION



Graph 5 : Storey drift ratio vs Storey level

Discussion:

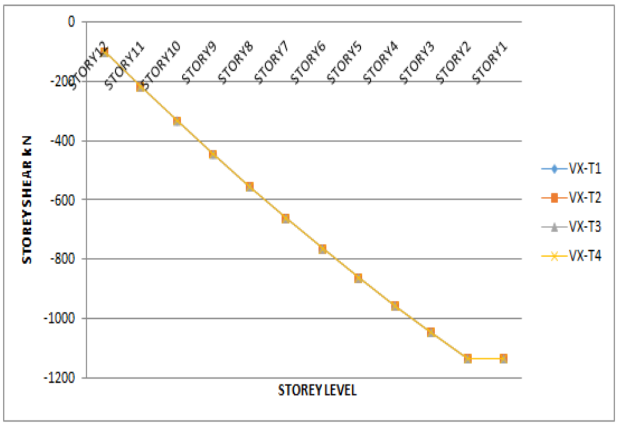
1) Storey drift is maximum at type 1 model and is minimum in type 3 model.

2) The minimum storey drift ratio is preferred so type 3 model is preferred in Y direction.

4. STOREY SHEAR

It is the sum of design lateral forces at all levels above the storey under consideration. As the area of building is same in all the models the storey shear due to wind load will be same. The storey shear due to wind load will vary only when there is a variation in the building. The maximum storey shear at the bottom of the building and the minimum is at the top of the building.

WIND IN X DIRECTION

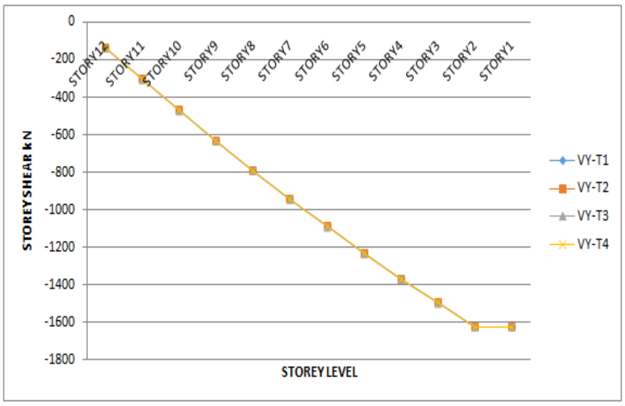


Graph 6: Storey shear vs Storey level

Discussion:

1. There is no variation of storey shear in all 4 models its almost same.

WIND IN Y DIRECTON



Graph 7: Storey shear vs Storey level

8. CONCLUSION

Presence of shear wall can affect the wind responses in tall or high rise buildings. Shear wall will add strength and stiffness for the building if it is in correct or optimum location, otherwise it will be only dead weight. For final conclusion overall results of all four parameters are compared for wind in x and y directions.

1. It is seen that the wind response in x direction is reduced in the Building with shear walls located at periphery of the building.

2. And in y direction the Building with shear walls located at core has shown the reduction in wind response

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