

# Seismic Effect on Staircase in Performance of RC Frame Building

Sneh B. Patel<sup>1</sup>, Arjun M. Butala<sup>2</sup>

<sup>1</sup>Post Graduate, CED, U.V. Patel College of Engineering, Ganpat University, Mehsana, Gujarat, India

<sup>2</sup>Asst. Prof, CED, U.V. Patel College of Engineering, Ganpat University, Mehsana, Gujarat, India

\*\*\*

**Abstract** - In this paper, analyzing the effect on different staircase location during earthquake have been studied. In design of building, the staircase is generally not analyzed & considered secondary structural member in the RC frame building. Staircase is one of the main parts of the building. So, not considering in analysis & design it causes vulnerable damage in the structure. Here comparing the staircase model in different location to check how seismic effect affects the building when staircase is placed in different location and more staircase is present in the building.

**Key Words:** Stair case, Story Drift, Base Shear, Earthquake, Location

## 1. INTRODUCTION

Earthquake is an impulsive event and acts quite differently. The force generated by seismic action of earthquake is different than other types of loads, such as, gravity, Dead load, Live load and wind load. It strikes the weakest spot in the whole structural frame building.

Ignorance in structural design and poor quality & maintenance of construction result many weaknesses & faults in the structure member and structural building also, thus cause vulnerable damage to life and structural property of building.

In RC frame structural buildings, the primary structural system to resist lateral & gravity load are beams and columns. Besides, primary frame structural system, some structural member also contributes to lateral load resistance. These elements fall in the category of secondary systems. Secondary system can be structural secondary like staircase, structural partition etc and non-structural secondary like storage tanks, machinery etc. A special case of structural secondary members which are normally designed for non-seismic force; are concrete staircase.

In the present study, the effects of staircase on the seismic performance of the RC frame structural buildings of different plans have been studied in this paper with different structural seismic parameter e.g. Story drift & Base Shear.

## 2. GEOMETRY & PARAMETER

**Table -1:** Geometry Parameter

Total Height of Building	20m
Column Size	450mmX450mm
Beam Size	230mmX450mm
Slab Thickness	150mm
Staircase Slab Thickness	200mm
Story Length in X & Y Direction	20m
Each Story Height	3m
Total Building height	19.5 m
Time Period in X & Y-Direction	0.3823 Sec.
Live load on Slab	2 kN/m <sup>2</sup>
Live load on Stair case	3 kN/m <sup>2</sup>
Floor Finish on slab	1.25 kN/m <sup>2</sup>
Floor finish on Stair case	2.25 kN/m <sup>2</sup>
Self-Weight	Auto Calculate by Software (Etabs)
Seismic Zone	IV
Soil type	Medium

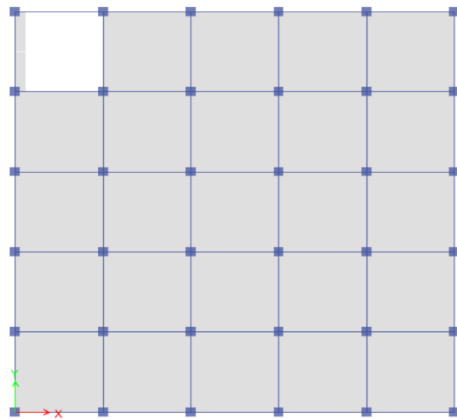


Fig -1: Building with staircase at one corner location.

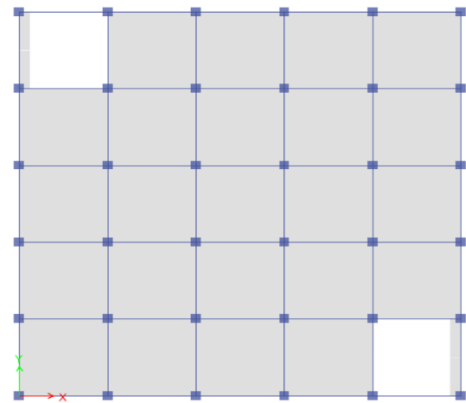


Fig-4: Building with 2-staircase at opposite direction location.

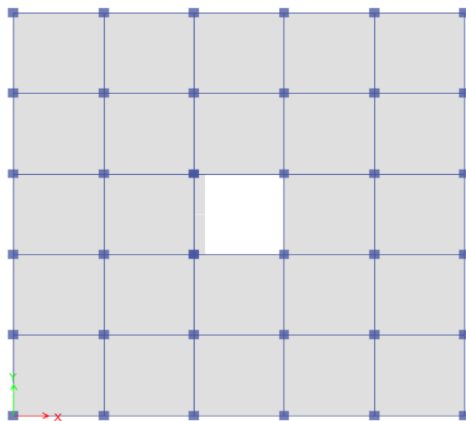


Fig -2: Building with staircase at center location.

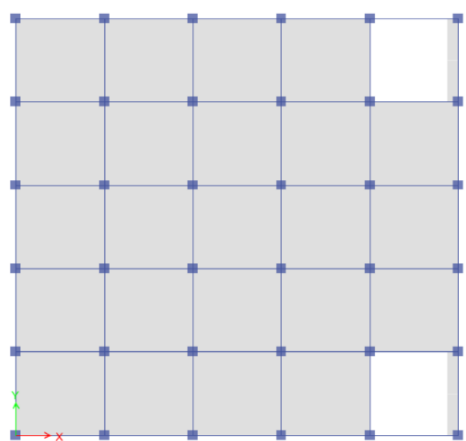


Fig-3: Building with 2-staircase at alternate corner location.

## 2. RESULT

In this paper 4 type of model with different stair case location is considered for seismic performance of building. To check seismic performance of building with different staircase location Story drift & Base Shear parameter consider Preliminary basis.

### 2.1 STORY DRIFT

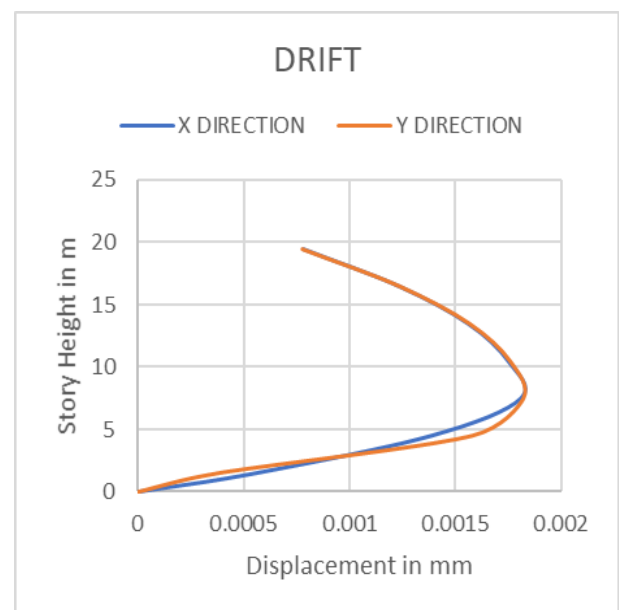
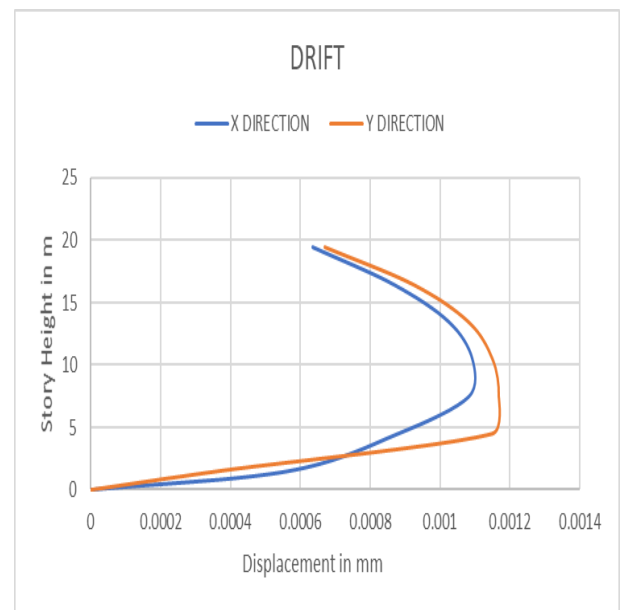


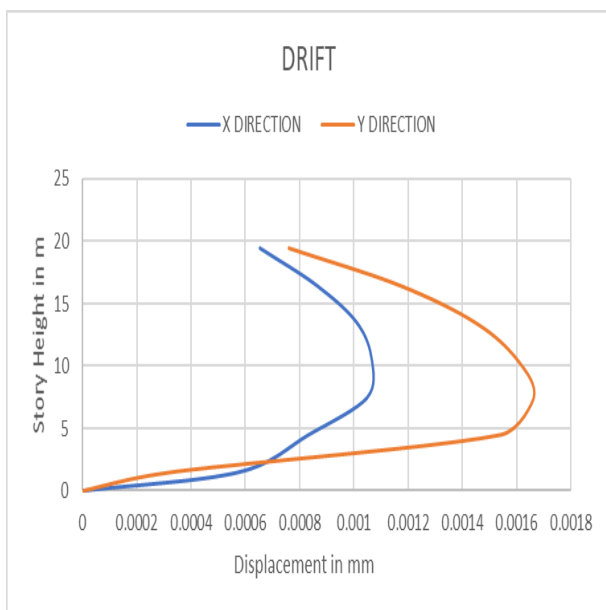
Chart -1: Story Drift of Building with staircase at one corner location.



**Chart -2:** Story Drift of Building with staircase at center location.

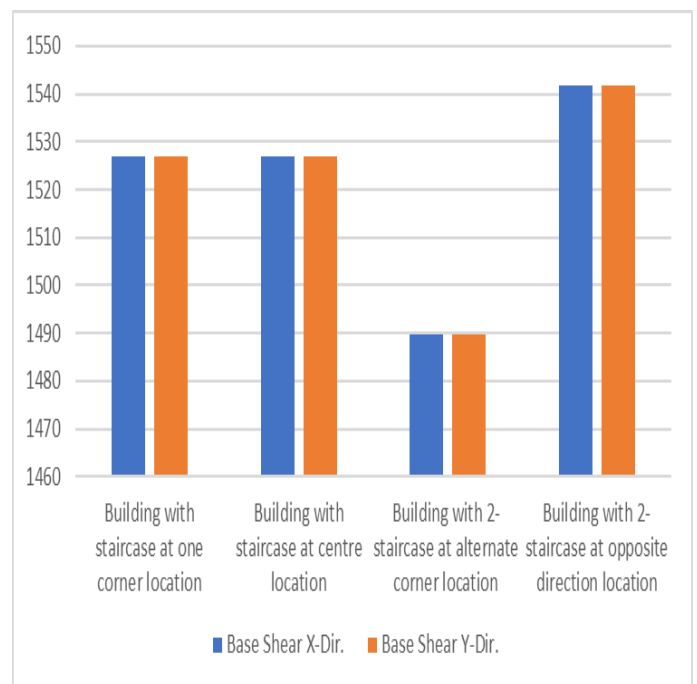


**Chart-4** Building with 2-staircase at opposite direction location



**Chart-3** Story Drift Building with 2-staircase at alternate corner location

### 2.1 BASE SHEAR



**Chart-5:** Fig. Base shear of Building in X-Dir. & Y-Dir.

### 3. CONCLUSIONS

From the result made by the study of G+5 Building, following conclusions have been made.

1. Having staircase in the building tremendously increase stiffness in the building.
2. Story displacement value is low in two staircase model comparing with one staircase model.
3. In tall building drift control by improve shear capacity.
4. Staircase cause change in column force, that affected by the position of the staircase.
5. In all model story drift remain same for both direction X-Direction & Y-Direction except staircase at alternate corner location Model.
6. Building with staircase at one corner location & Building with staircase at centre location model have nearly same Base shear.
7. Building with 2-staircase at alternate corner location have least base Shear & Building with 2-staircase at opposite direction location model have maximum base shear.

### REFERENCES

1. "Seismic Performance of Stairs in the Existing Reinforced Concrete Building", the 14<sup>th</sup> World Conference on Earthquake Engineering October 12-17, 2008, Beijing, China.
2. "Seismic Analysis of High-Rise R.C Frame Structure with Staircase at Different Location", the International Journal of Engineering and Science (IJES).
3. "Analysis and Design of Staircases against seismic loadings ", 4th ECCOMAS Thematic Conference on Computational Methods in Structural Dynamics and Earthquake Engineering.
4. "Effects of Staircase on the Seismic Performance of RCC Frame buildings", International Journal of Advance Engineering and Research Development.
5. "Effects of Staircase on the seismic Performance of RCC Frame building", International Journal of Engineering Science and Technology (IJEST).