Linear and Non-Linear Analysis on RCC Building Having Different Shapes of Projection

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Abstract: The behavior of a building during earthquake depends critically on the geometry of the structure. Structures with large hanging or projection parts are very vulnerable to seismic effects. In practical problem the prediction of such effects is difficult to represent because of the various parameters involved, which can affect the behavior of a structure individually or as a whole. From literature study author attempts to create a similar virtual environment with the help of ETABS software & verify the effects of different forces on three different projection type models keeping the projection area on each floor same but distribution & geometric orientation of projection different. They have worked on Square symmetric projection building, but to be in realistic condition we will work on unsymmetrical building in plan and do non-linear analysis for two different storey height.

Index Terms **– Projections in building, H-Shapes, +-Shapes, H+-Shapes, Asymmetrical Shapes, Time History, Etabs 2016.**

I. INTRODUCTION

In our country many urban multi story buildings first storey will be open as an unavoidable future. This is being adopted for accommodate majorly vehicle parking, reception lobbies, or halls etc. in the first storey. The behavior of a building during earthquakes depends critically on its overall shape, size and geometry, in addition to how the earthquake forces are carried to the ground. Buildings with vertical setbacks like the hotel buildings with a few storey wider than the rest cause a sudden jump in earthquake forces at the level of discontinuity. Buildings that have fewer columns or walls in a particular storey or with unusually tall storey tend to damage or collapse which is initiated in that storey.

Columns which are directly rested on slabs or cantilever beams to fulfill architectural purpose is known as Projection. Projection creating additional space with unique view characteristic. By providing projection, each floor can be varied and designed for multipurpose use.

Non-linear analysis is required for complex or unsymmetrical structures. Very tall structures or structures built with non-linear materials & geometry may also require non-linear analysis

II. OBJECTIVES

- To check response of projection effects in structure in Different Shapes (H, H+, +, + Asymmetry)
- To evaluate the response under soil conditions (Maximum Story Displacement, Base Shear and Drift)
- To evaluate the response under linear & non-linear loading

III. LITERATURE REVIEW

[7]Suvradeep Saha investigated that Maximum Storey drift is 2%, 17 with respect to H type in plus and H+ type respectively and Story Stiffness is Maximum in H+ shape.

[4]Kirankumar Gaddad, Vinayak Vijapur investigated that Displacement is increased 6% in floating column at base. Displacement is decreased 45% with shear wall at corner.

[5]Meghana B.S., T.H. Sadashiva Murthy, investigated that Floating column have more displacement and Internal floating column have more displacement then outer floating column.

[6]Sabari S, Mr. Praveen J.V. investigated that Storey drift decrease up to 14%.

IV. METHODOLOGY

In the present work the analysis of following structures with different type of shapes are been carried out:

a) H Shape

b) H+ Shape

c) + Shape

d) + Asymmetric

The plan areas of the all three structures are different for the analysis; also, the beam and column dimensions also vary with different storey height. The materials such as Poisson ratio, Density of RCC, Density of Masonry, Young's modulus, compressive strength of steel and concrete etc. are kept constant in all buildings. The steps are followed for the analysis purpose, the below are the steps which carry out the whole analysis and description of the procedure:

Time History Analysis

a) Regular Building without projection

i) 5 Storey Building

ii) 10 Storey Building

iii) 15 Storey Building

b) Building with projection (H, H+, +, + Asymmetric)

i) 5 Storey Building

ii) 10 Storey Building

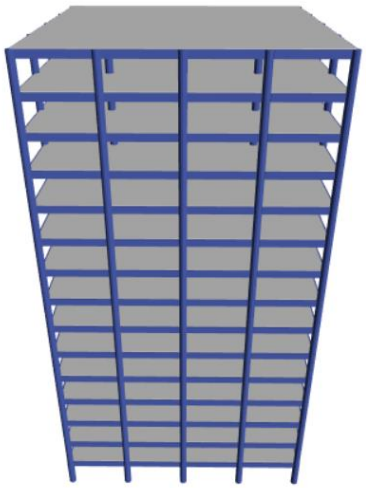
iii) 15 Storey Building

Comparison of the parameters considered in the study of regular as well as the irregular type structures.

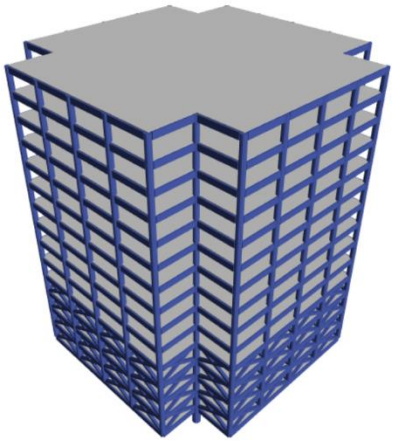
- The non-linear analysis is carried out for soil condition I and II.
- The non-linear analysis is carried out for different seismic zones (IV and V).
- The result parameter includes the Base Shear, Displacement, Drift and Time Period which are to be compared.

Structure and Section details:

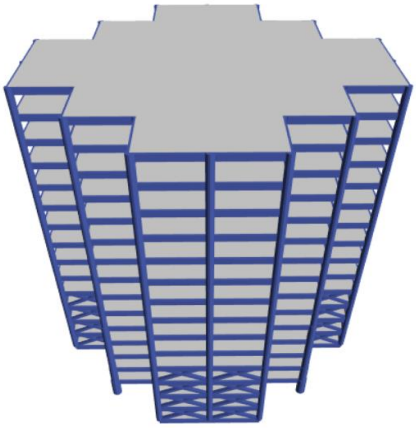
PARAMETERS	REGULAR SHAPE	MODEL-1, H SHAPE	MODEL-2 + SHAPE	MODEL-3 H+ SHAPE	MODEL-4 ASYMMETRIC SHAPE
Plan dimension	36mx36m	36mx36m	36mx36m	36mx36m	42mx30m
Projection dimension	-	6mx6m	12mx6m	**H** 6m x 6m + 12m x 6m	**As shown in fig** 3.2.1
Number of arms in x-axis	4	4	4	4	**7**
Number of arms in y-axis	4	4	4	4	6
Height of the floor	3m	3m	3m	3m	3m
Grade of concrete	M35	M35	M35	M35	M35
Grade of steel	Fe500	Fe500	Fe500	Fe500	Fe500
Column 1	475 mm dia 550 mm dia 650 mm dia	775 mm dia 925 mm dia 950 mm dia 1025 mm dia 1050 mm dia	775 mm dia 925 mm dia 950 mm dia 1075 mm dia 1025 mm dia	750 mm dia 775 mm dia 925 mm dia 1000 mm dia 1025 mm dia 1175 mm dia	775 mm dia 950 mm dia
Slab thickness	140 mm	140 mm	140 mm	140 mm	140 mm
Live load	3 kN/m^2	3 kN/m^2	3 kN/m^2	3 kN/m^2	3 kN/m^2
Floor finish	1.5 kN/m^2	1.5 kN/m^2	1.5 kN/m^2	1.5 kN/m^2	1.5 kN/m^2
Importance Factor, I	1	1	1	1	1
Response Reduction Factor, R	5	5	5	5	5



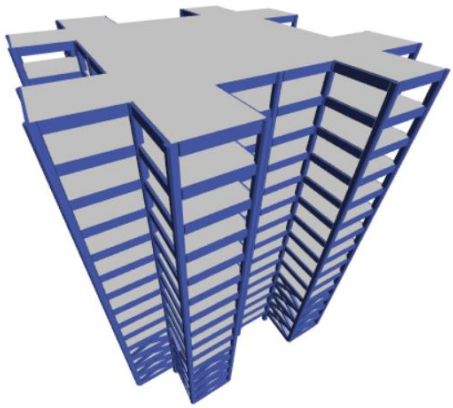
REGULOR SQUARE SHAPE BUILDING



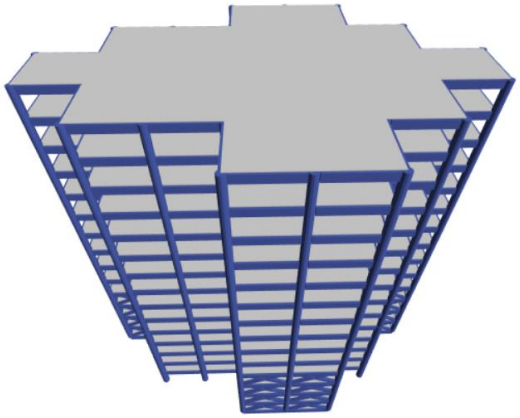
H+ SHAPE BUILDING



+ SHAPE BUILDING



H SHAPE BUILDING

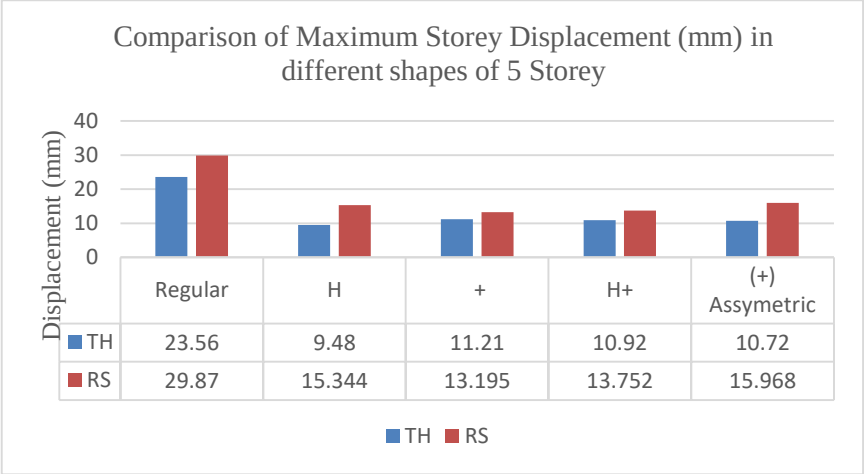


ASSYMMETRIC SHAPE BUILDING

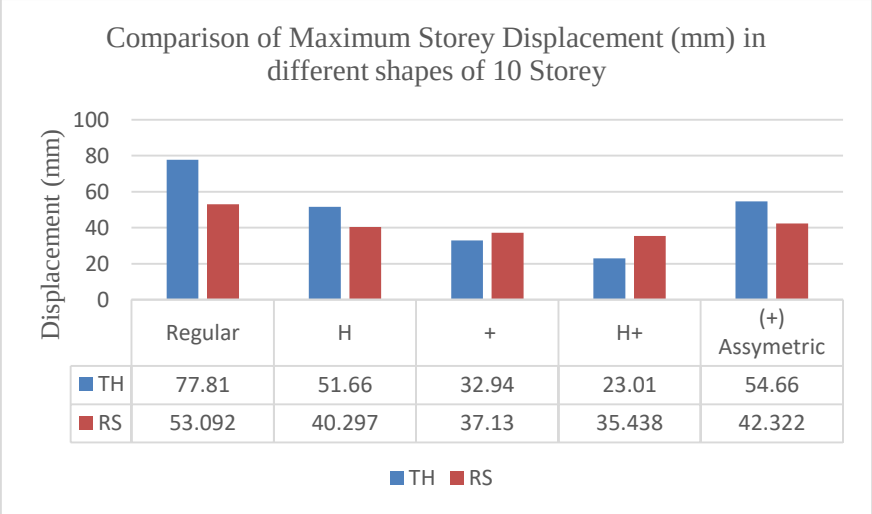
V. RESULTS

The analysis results of multi storey building with Conventional, Flat and Grid slab subjected to seismic forces in Zone IV and V are as below of with and without shear wall having rectangular and C-shape structure.

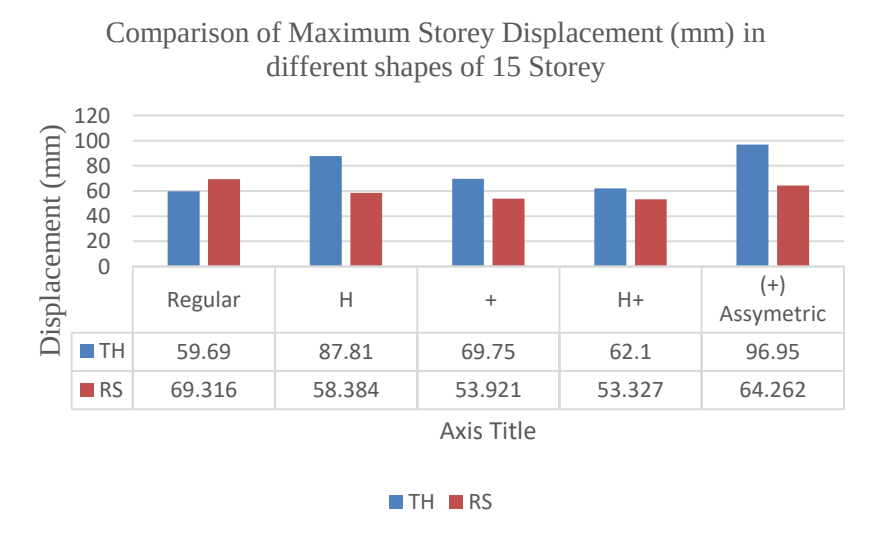
- **Maximum Storey Displacement**



Maximum Storey Displacement of 5 Storey

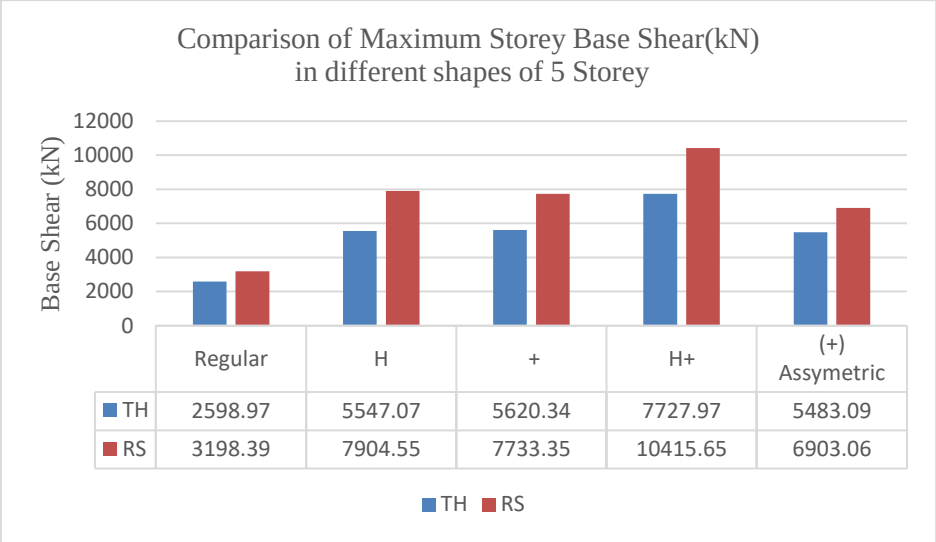


Maximum Storey Displacement of 10 Storey

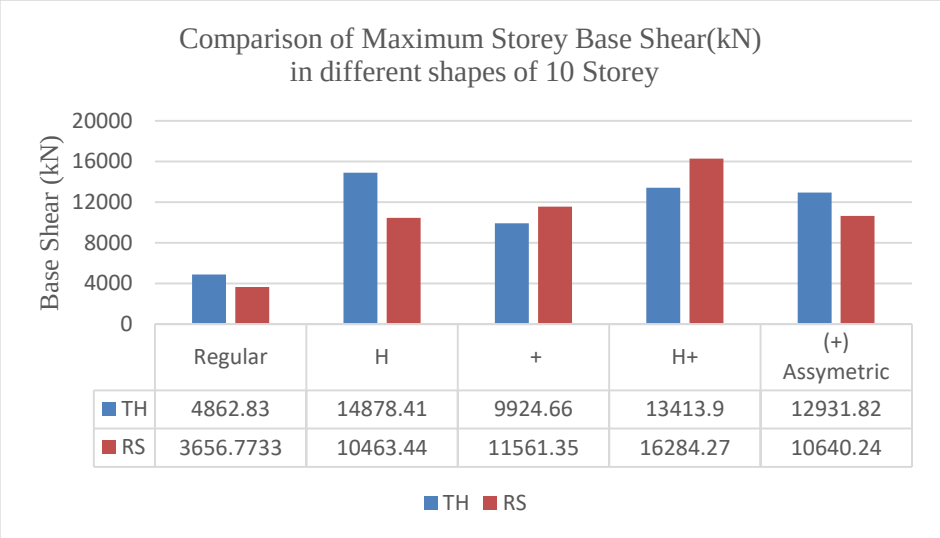


Maximum Storey Displacement of 15 Storey

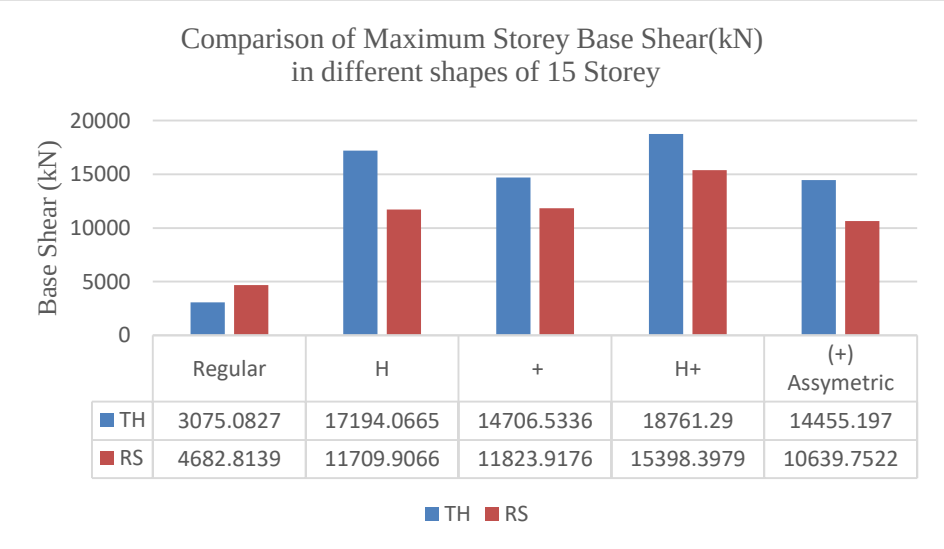
- **Base Shear**



Maximum Storey Base Shear of 5 Storey

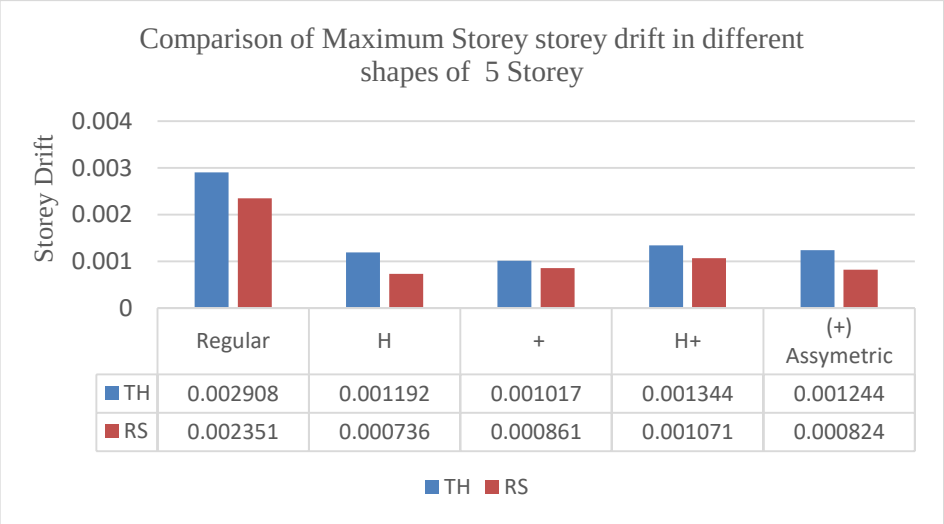


Maximum Storey Base Shear of 10 Storey

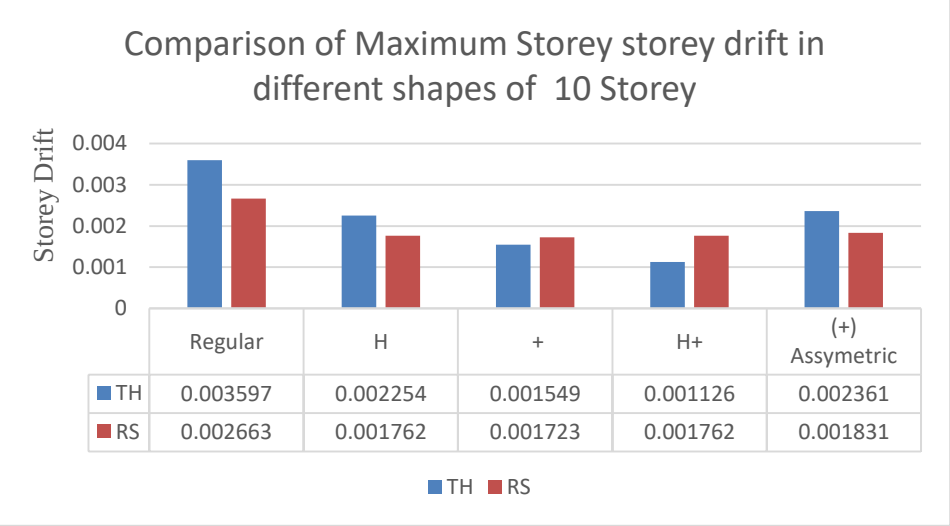


Maximum Storey Base Shear of 15 Storey

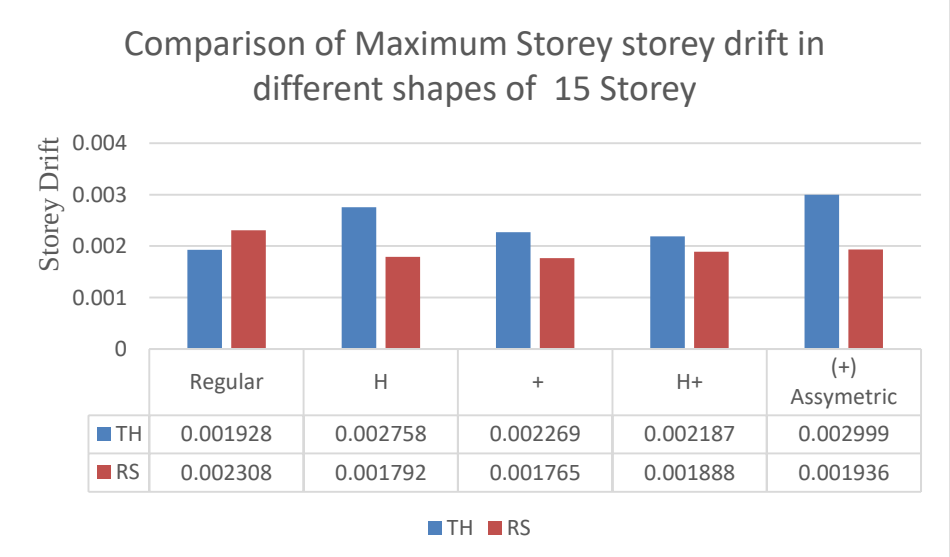
- **Maximum storey Drift**



Maximum Storey Drift of 5 Storey



Maximum Storey Drift of 10 Storey



Maximum Storey Drift of 15 Storey

I. CONCLUSION

- It is found that result of displacement is 26.78%. 61.86%, 17.71%, 25.93%, 48.96%, for 5 storey will be higher in case of RS than TH in Regular, H Shape, + Shape, H+ Shape, + asymmetric building respectively.
- It is found that result of displacement is 31.77%. 22.00%, 22.57%, for 10 storey will be lower in case of RS than TH in Regular, H Shape, + asymmetric building respectively.
- It is found that result of displacement is 12.72%, 54.01%, for 10 storey will be higher in case of RS than TH in Regular, H Shape, + asymmetric building respectively.
- It is found that result of displacement is 33.51%. 22.69%, 14.13%,33.72%, for 15 storey will be lower in case of RS than TH in H Shape, + shape, H+ shape, + asymmetric building respectively.
- It is found that result of displacement for 15 storey will be 16.23% higher in case of RS than TH in Regular building building
- It is found that result of base shear is 23.05%. 42.50%, 37.60%,34.78%,25.90% for 5 storey will be lower in case of RS than TH in Regular, H Shape, + shape, H+ shape, + asymmetric building respectively.
- It is found that result of base shear is 24.80%. 29.67%, 17.72%, for 10 storey will be lower in case of RS than TH in Regular, H Shape, + asymmetric building respectively.
- It is found that result of base shear is 16.46%. 21.40%, for 10 storey will be higher in case of RS than TH in + shape, H+ shape.
- It is found that result of base shear is 31.90%. 19.60%, 17.92%,26.39% for 15 storey will be lower in case of RS than TH in H Shape, + shape, H+ shape, + asymmetric building respectively.
- It is found that result of base shear for 15 storey will be 52.28% higher in case of RS than TH in Regular building
- It is found that result of storey drift is 19.15%. 38.26%, 15.32%,20.31%,33.76% for 5 storey will be lower in case of RS than TH in Regular, H Shape, + shape, H+ shape, + asymmetric building respectively.
- It is found that result of storey drift is 25.97%. 21.83%, 22.45%, for 10 storey will be lower in case of RS than TH in Regular, H Shape, + asymmetric building respectively.
- It is found that result of storey drift is 11.23%. 56.48%, for 10 storey will be higher in case of RS than TH in + shape, H+ shape.
- It is found that result of storey drift is 35.03%. 22.21%, 13.67%,35.45% for 15 storey will be lower in case of RS than TH in H Shape, + shape, H+ shape, + asymmetric building respectively.
- It is found that result of storey drift for 15 storey will be 19.71% higher in case of RS than TH in Regular building

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