

A Study on Effect of Column Discontinuity on Behavior of Structure

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Abstract— The behavior of a multi-storey framed building during strong earthquake motions depends on the distribution of stiffness, mass and strength in both the vertical and horizontal planes of the building. In multistoried framed buildings, damage from earthquake ground motion generally occur at locations of structural weaknesses present in the RC frames. This weaknesses may be created by discontinuities in stiffness, strength or mass between adjacent storeys. Such discontinuities between storeys are often associated with sudden variations in the frame geometry along the height. There are many examples of failure of buildings in past earthquakes due to such vertical discontinuities. A common type of vertical irregularity in building due to column discontinuity provided at specific levels of the structure. This building category is known as the vertically irregular structure. Many investigations have been performed to understand the behavior of irregular structures with column discontinuity. Here for analysis G+5, G+9, and G+13 storey building would be taken with column discontinuity at the various location of the building. Here in building column discontinuity is provided at bottom floor, first floor and middle floor. Non-linear static Pushover analysis is carried out and study the response of structure in terms of story displacement, story drift, and variation of base shear using a SAP2000v15.

Key words: Floating column, discontinuous column, pushover analysis, R.C. structure

I. INTRODUCTION

Many urban multistory buildings in India today have open ground and first storey as an unavoidable feature. This is primarily being adopted to accommodate parking or reception lobbies, conference hall in the first storey.

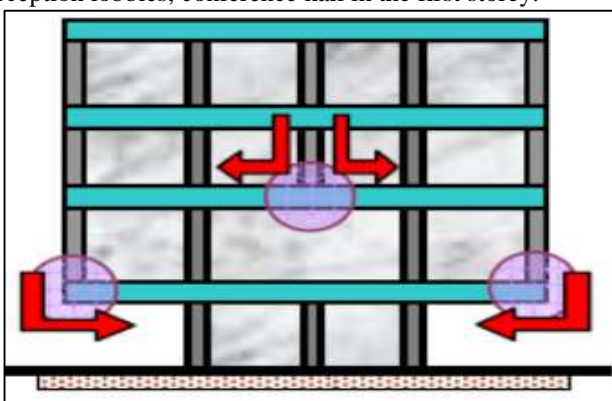


Fig. 1: Hanging or Floating Columns

Whereas the total seismic base shear as experienced by a building during an earthquake is dependent on

Its natural period, the seismic force distribution is dependent on the distribution of stiffness and mass along the height. Floating column are generally adopted at ground storey level or at just above the ground storey level. so maximum space is made available where parking is a major problem.

II. OBJECTIVE OF STUDY

Many models of reinforced concrete structures with and without column discontinuity for G+5, G+9, G+13 stories at various column discontinuity cases were considered and analyzed. Main objective of study as follow.

- 1) To calculate the design lateral force on regular and irregular buildings using non-linear static pushover analysis.
- 2) To calculate the variation of the base shear for regular and irregular building.
- 3) 3. Draw a push hour curve of frame having column discontinuity with different load cases
- 4) To determine the percentage variation of displacement of considered R.C. frame
- 5) To determine the percentage variation of structural drift of considered R.C. frame

III. METHODOLOGY

- 1) Carry out extensive literatures Review to establish the objectives of the research work.
- 2) Selection of types of structures models with different heights (up to G+5 to G+13), and different irregularity
- 3) Modelling of the selected structures.
- 4) Performing linear static and Non-linear static analysis on the selected building models and comparison of analysis results.

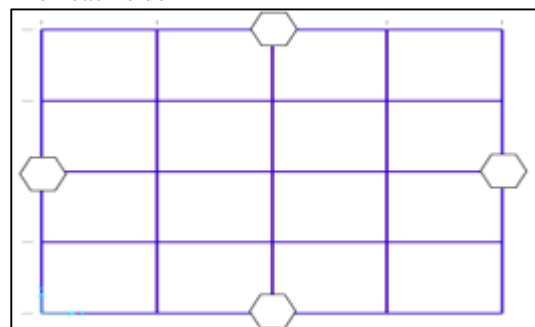
IV. PROBLEM STATEMENT

In present work in order to compare RC regular structure with RC structure with column discontinuity for G+5, G+9 and G+13 storey building having plan dimension at ground floor is 20m x 20m is modeled and analyzed in SAP2000v15 software.

Here for building with column discontinuity various position of column discontinuity taken in a regular model. For the column discontinuity remove the column at particular location.

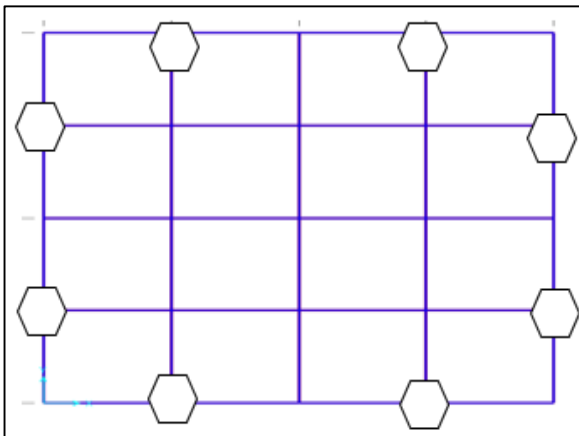
Here for analysis G+5, G+9, G+13 storey building would taken. Here for column discontinuity 3 cases would be taken.

Case 1: RC building with column discontinuity at middle column on each side



Case 2: RC building with column discontinuity provided at alternate column on Y-direction at side bay and middle column at first bay.

Case 3: RC building with column discontinuity provided at alternate column removed in each side of structure.



This three cases would be analysed at the bottom, first and the middle floor of structure. So here total 30. Model will be analyzed in this thesis work

V. GEOMETRICAL DATA

- Typical plan dimension : 20m x 20m
- Typical Storey Height : 3m
- Bottom Storey Height : 3m
- Height of structure : 18m, 30m, 42m
- Number of storey : G+5, G+9, G+13
- Thickness of slab : 150mm
- Thickness of all wall : 230mm
- Parapet wall height : 1m
- Type of structure : RC regular and RC structure with column discontinuity

Storey	Size of Column (mm)	Size of Beam
G+5	450 x 450	300 x 600
G+9	600 x 600	300 x 750
G+13	750 x 750	300 x 900

A. Loading Data:

- 1) Floor Finish: 1.5 kN/m²
- 2) Live Load : 2 kN/m²

Material	Modulus of Elasticity (E) Mpa	Poisson ratio	Coefficient of thermal expansion 1/C
Concrete M-25	25000	0.2	5.5×10^{-6}
Concrete M-30	27386.128	0.2	9.9×10^{-6}
Steel Fe-415	2×10^5	0.3	1.17×10^{-5}

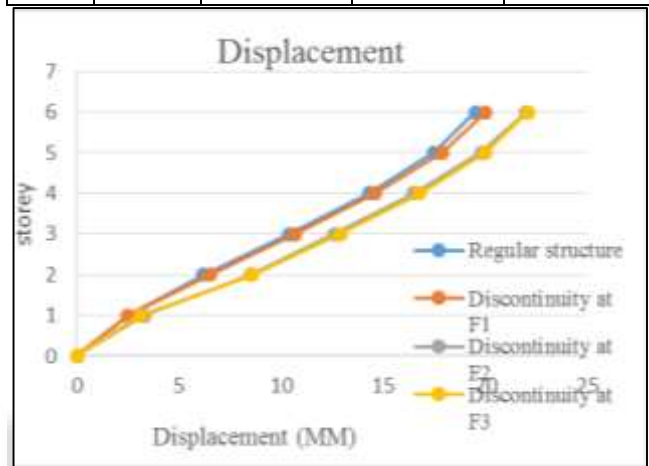
3) Earthquake Load In X Direction

- Zone factor : V
- Importance factor : 1
- Response reduction factor : 5
- Soil condition : Medium

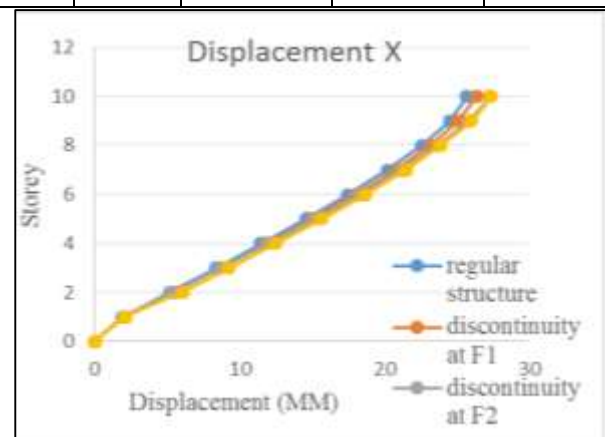
VI. RESULTS AND DISCUSSION

A. Storey Displacement:

Storey	Displacement (MM)			
	Regular structure	Discontinuity at F1	Discontinuity at F2	Discontinuity at F3
6	19.5	20	22	22.1
5	17.5	19.6	19.8	20
4	14.3	17.6	16.5	16.8
3	10.4	10.7	12.6	12.9
2	6.2	6.5	8.8	8.6
1	2.5	2.5	3.3	3.1
0	0	0	0	0

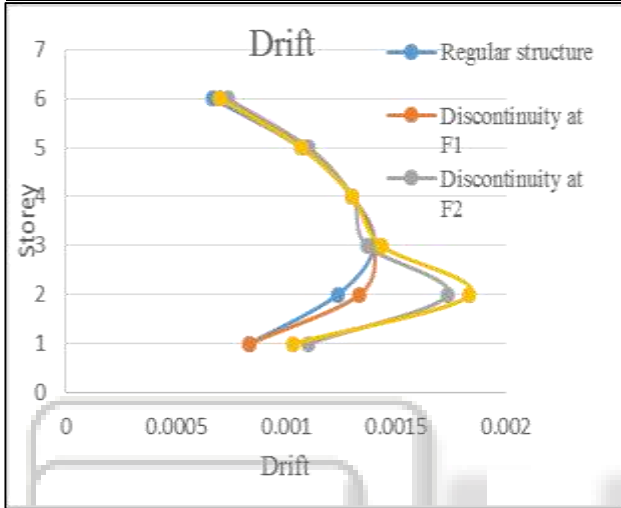


Storey	Displacement (MM)			
	Regular structure	Discontinuity at F1	Discontinuity at F2	Discontinuity at F3
10	25.7	26.4	27.3	27.4
9	24.5	25.1	25.8	26
8	22.6	23.2	23.7	23.9
7	20.2	20.8	21.2	21.5
6	17.5	18	18.3	18.7
5	14.6	15	15.3	15.7
4	11.5	11.9	12	12.5
3	8.4	8.7	8.7	9.3
2	5.2	5.2	5.4	6.1
1	2.1	2.1	1.9	2.1
0	0	0	0	0

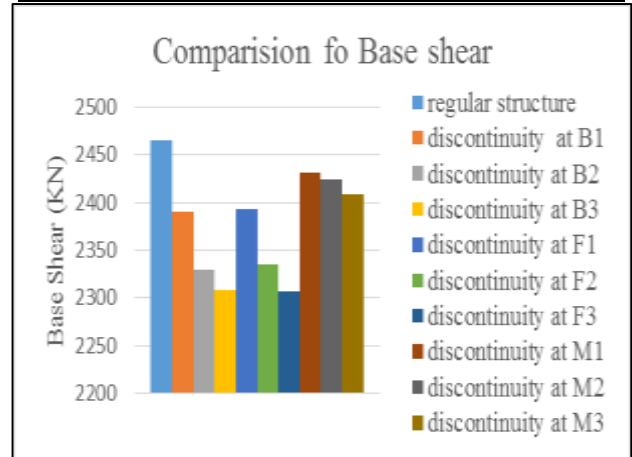


B. Storey Drift:

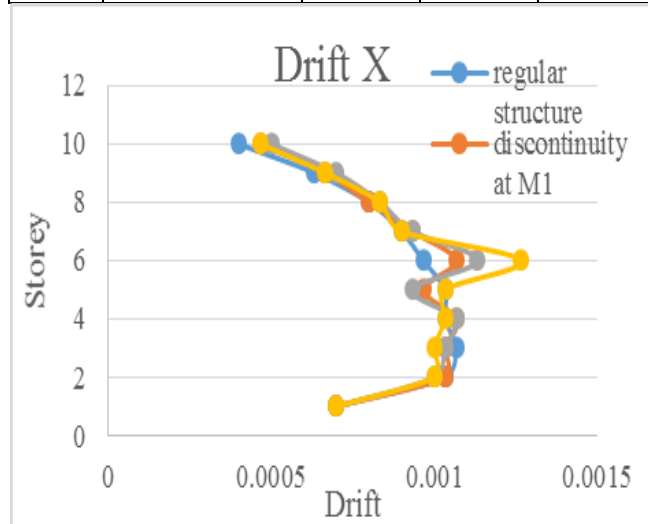
storey	Drift			
	Regular structure x 10 ⁻³	Drift at F1 x 10 ⁻³	Drift at F2 x 10 ⁻³	Drift at F3 x 10 ⁻³
6	0.000667	0.7	0.733	0.7
5	0.001067	1.1	1.733	1.066
4	0.0013	1.3	1.366	1.3
3	0.0014	1.4	1.3	1.43
2	0.001233	1.33	1.1	1.833
1	0.000833	0.833	0.733	1.033



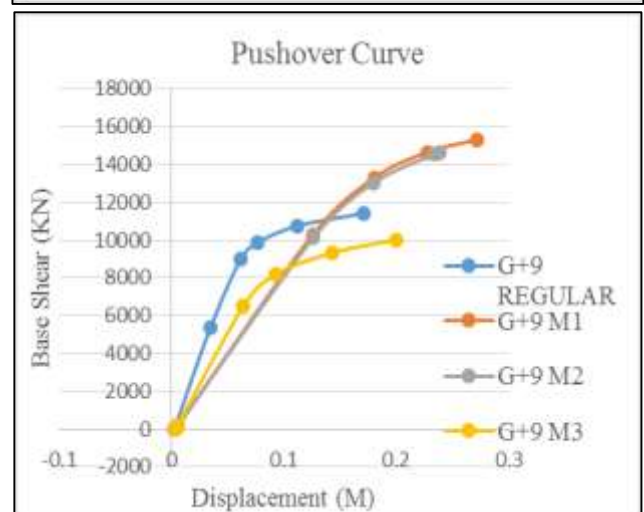
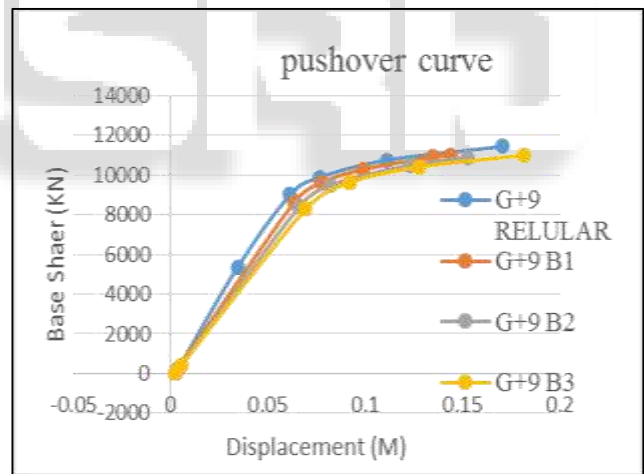
Type of structure	Base shear(KN)
Regular structure	2464.43
structure with Discontinuity at B1	2390.63
structure with Discontinuity at B2	2329.06
structure with Discontinuity at B3	2307.57
structure with Discontinuity at F1	2392.85
structure with Discontinuity at F2	2334.45
structure with Discontinuity at F3	2307.19
structure with Discontinuity at M1	2431.54
structure with Discontinuity at M2	2424.08
structure with Discontinuity at M3	2408.32



storey	Drift (MM)			
	Regular structure x 10 ⁻³	Drift at M1 x 10 ⁻³	Drift at M2 x 10 ⁻³	Drift at M3 x 10 ⁻³
10	0.4	0.466	0.5	0.466
9	0.6333	0.666	0.7	0.666
8	0.8	0.8	0.833	0.833
7	0.9	0.933	0.933	0.9
6	0.966	1.066	1.133	1.266
5	1.033	0.966	0.933	1.033
4	1.033	1.066	1.066	1.033
3	1.066	1.033	1.033	1
2	1.033	1.033	1	1
1	0.7	0.7	0.7	0.7



C. Pushover Curve:



VII. CONCLUSION

Based On Study of Effect of Column Discontinuity on Behavior of Structure Carried Out In This Project Following Conclusions Is Derived:

- 1) Storey Displacement Increase In A Structure As Number Of Column Discontinuity Increase.
- 2) When Column Discontinuity Provided At A First Floor We Got A Maximum Displacement.
- 3) Storey Drift Is Also Increase In Structure As Column Discontinuity Increase.
- 4) Storey Drift Is In Structure At Which Floor Column Discontinuity Provided
- 5) Base Shear Decrease In Structure As Column Discontinuity Is Increase
- 6) From Nonlinear Analysis It Is Concluded That Failure Hinge Will Generated At Position Of A Discontinuous Structural Member.

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