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Study of Floating Column in Multistory Building Subjected to Seismic Load using Pushover Analysis

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Abstract: ***Now a day's constructions with irregularity in structure are a common feature. The irregularities such as plan, vertical and floating columns at various level and locations are introduced to achieve the architectural and functional requirements, but these features are undesirable in high seismic regional. Study of floating columns in multistory building subjected to seismic load using pushover analysis. Floating columns are provided in different positions of building such as at interior of building, corner of building and outer edges of building are analysis by non linear static method of analysis. In this first type of model is internal floating column here floating columns are provided in interior of building in every story, second type of model is providing floating column in corner of the building in each story level and third type of model is floating columns are provided in outer edge of the column in each story level. In these all models we can provide floating column in any one story level in building. The analysis is carried out by non linear static method of analysis (pushover analysis) in software ETABS2015 and comparisons are made between No floating column building and different locations of floating column building.***
Keywords: Pushover analysis, No Floating Column (NFC), Internal Floating Column (IFC), Corner Floating Column (CFC), Outer Floating Column (OFC).

I. INTRODUCTION

During earthquakes structure becomes critical; it is depend on overall configurations and geometry along with the path of the seismic forces carried to the ground. Now a day's asymmetry, floating column building with irregular type of construction has become a very common feature in all over world. Irregularities in buildings refer to non uniform response of a structural building due to non uniform distribution of building properties. A building with vertical irregularity and plan irregularity demonstrated larger vulnerability in the past earthquakes. In most of the situations buildings become vertical irregular due to some architectural and functional reasons and this type of irregularity causes sudden damage of structure. The seismic activity by no means is uniform throughout the belt. The intensity of the earthquakes is various at different points. Earthquakes are happened by the sudden release of energy within limited are of the rocks of the Earth. The energy can be released due gravity, elastic strain, chemical reactions, or even the motion of large bodies of all these the release of elastic strain is the most important cause for earthquake, because this form of energy is that can be stored in required quantity in the Earth to produce major disturbances. Earthquakes associated with this type of energy release is known tectonic earthquakes.

A. Floating Column

Generally column is a vertical compression member which rests on foundation. But when it comes to a concept of floating column also called hanging column, it is also a vertical element which rests on a beam instead of foundation. In this concept column can be taken from any story level because it is resting on beam. Normally columns start from the foundation below earth and it transfers the load to the ground from slabs and beams. This means that the supporting beam act as a foundation for the column. That beam is called as a transfer beam, in this case transfer beam transfers load up to foundation. Hence very much care should be taken while design detailing of transfer beam under high seismicity zones area. In modern architectural multi-storey buildings construction, for any purpose, open storey has become a common feature. So that more open space is available in ground floor and any other floor, which can be used for assembly hall or parking purpose. The closely spaced columns at ground storey level may interrupt our functional requirements. Hence to avoid this problem, concept of floating columns is come into existence. The aesthetic appearance of the structures can be enhanced by introducing floating column in the construction of building

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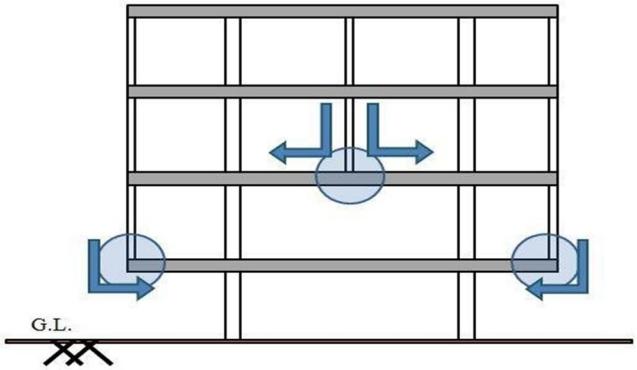

Fig. 1: Load path in floating column building

B. Pushover Analysis

Pushover analysis is defined as a mathematical model-wearing analysis that incorporates the normal load deformation, individual component characteristics and building elements directly. The non-linear static seismic analysis procedure, commonly known as pushover analysis, is a technique in which a computer model of a structure is subjected to a predetermined lateral load pattern that represents approximately the relative inertia forces generated at substantial mass locations. The intensity of the load is increased, i.e. the structure is 'pushed', and the crack sequence, yielding, plastic hinge formations, and the load at which the different structural components fail is recorded as function of the increasing lateral load. This increased process continues up to a predetermined displacement limit. Federal Emergency Management Agency (FEMA) and Applied Technical Council (ATC) are two agencies which formulated and suggested the non-linear static analysis. This included documents FEMA-356, FEMA-273 and ATC-40. The analysis includes applying horizontal loads or lateral loads, in a unknown pattern to the structure incrementally, that is structure get pushed and plotting the total applied shear force and associated lateral displacement at each increment up to the collapse condition. Fig.2 shows the pushover curve, the variation in the curve as follows. Collapse Prevention, Life Safety, Immediate Occupancy.

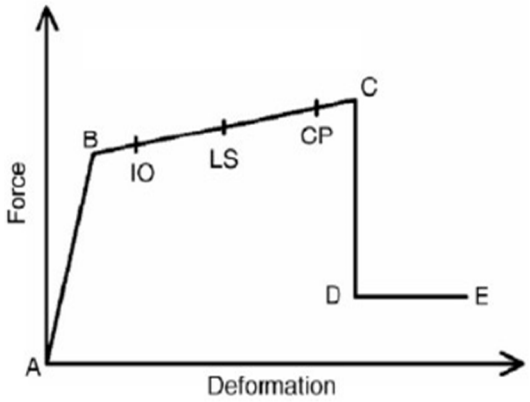

Fig 2: Force-Deformation for pushover analysis

II. MODELING DETAILS

A. General Considerations

The software used in this research is ETABS-2015 and the method of seismic analysis used is Non-linear Static Analysis also known as Pushover Analysis. The models used for present study include buildings with no floating column and with floating column. In floating column model there are three types such as Internal Floating Column (IFC), Corner Floating Column (CFC) and Outer Floating Column (OFC). After analysis compare floating column model with no floating column model. The shapes of the models considered are square shape. Models consist of 5 bays both X and Y direction each bays consist of (5*5) m. models consists 7 stories (G+5) we consider below plinth as a one story height 1.5m, ground floor height 3.5m and typical story height 3.2m. Consider isolated type of building, code book used for the load calculation is IS 875 (Part-2) 2002 for live load calculation and IS 456-2000 for design purpose and FEMA, ACT-40 for pushover analysis.

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Table 1: Parameter consider for the present study

Type of building	Residential cum public
No of Story's	7
Typical story height	3.2m
Seismic zone	V
Material Properties	
Grade of concrete	25
Grade of steel	HYSD500
Density of concrete	25kN/m^3
Member properties	
Slab thickness	0.15m
Beam size	0.23X0.45m
Transfer beam	0.23X0.60m
Column size	0.23X0.60m
Load Intensities	
Floor Finish	1.5 kN/m^2
Floor	4 kN/m^2
Roof	2 kN/m^2
Wall load	12 kN/m

B. Models of Building

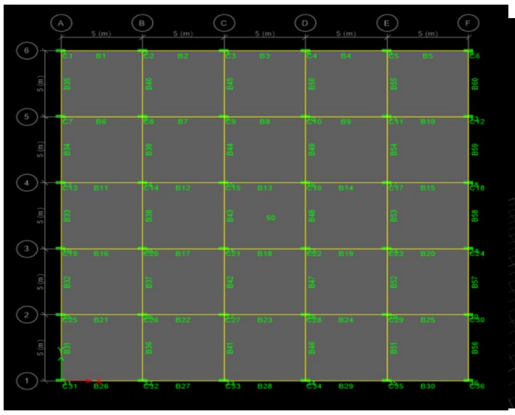

Fig 3: Plan of No Floating Column Model

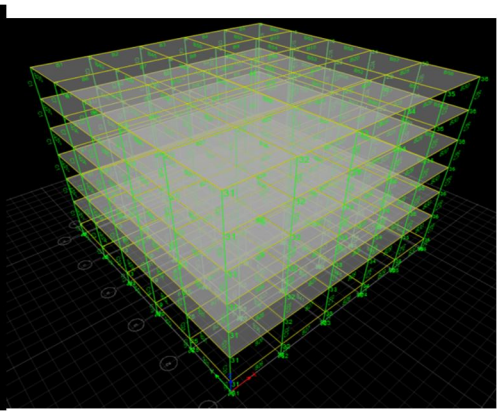

Fig 4: 3D Model

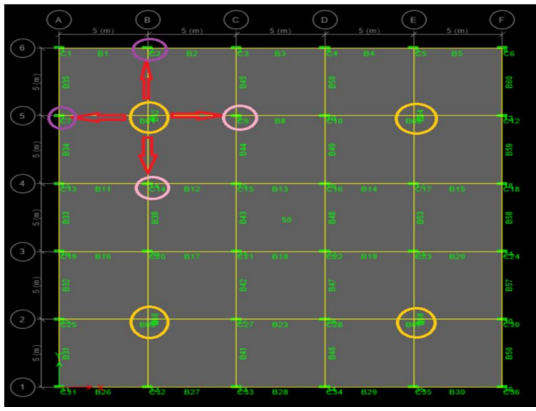

Fig 5: Plan of Internal Floating Column (IFC) C8

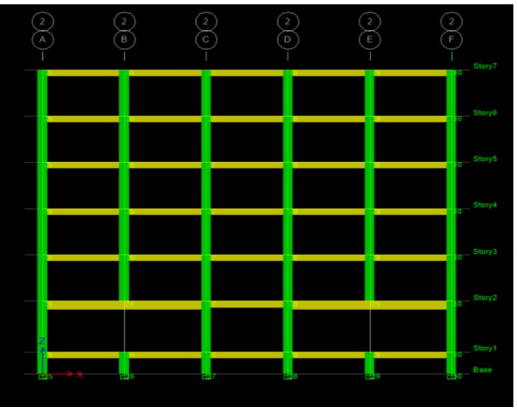

Fig 6: Elevation of IFC Story-1

Above fig 5 shows the mark of floating column, load distribution of floating column and adjacent critical column such as C2 and C9.

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III. RESULTS AND DISCUSSIONS

Seismic analysis is carried as per IS 1893(Part 1): 2002 guidelines. Nonlinear static analysis (pushover analysis) is adopted and analysis is carried out using ETABS 2015 software package. The typical No floating column (NFC), interior floating column (IFC), corner floating column (CFC) and outer floating column (OFC) buildings are considered in this project the all models are symmetrical structure so that the behavior of the structural elements is same which is located in similar place in the building. Here we eliminate the column in different position of floor but the all that floating columns are similar to each other so the behavior of the structure is same so that any one of column results is enough for know the response of the structure.

Table 2: Bending Moment of Column C2 and C9 due to IFC of C8

Model type	Storys	Bending moment kN-m							
		C2				C9			
		Push X		Push Y		Push X		Push Y	
		Along X	Along Y	Along X	Along Y	Along X	Along Y	Along X	Along Y
NFC	7	10.68	0.00	0.00	1.90	14.48	0.00	0.00	0.69
	6	46.97	0.00	0.00	8.34	51.50	0.00	0.00	13.37
	5	80.22	0.00	0.00	18.3	88.83	0.00	0.00	27.52
	4	109.98	0.00	0.00	27.53	124.26	0.00	0.00	41.45
	3	136.70	0.00	0.00	33.85	163.85	0.00	0.00	57.39
	2	169.90	0.00	0.00	48.81	189.32	0.00	0.00	64.19
	1	208.84	0.00	0.00	50.76	316.65	0.00	0.00	94.76
IFC-1	7	9.69	0.00	0.00	2.6	15.08	0.00	0.00	0.80
	6	43.66	0.00	0.00	8.9	48.71	0.00	0.00	14.84
	5	73.94	0.00	0.00	19.49	82.59	0.00	0.00	30.52
	4	100.29	0.00	0.00	29.09	112.17	0.00	0.00	46.06
	3	108.52	0.00	0.00	45.75	192.36	0.00	0.00	61.50
	2	195.50	0.00	0.00	74.9	235.8	0.00	0.00	89.20
	1	208.72	0.00	0.00	52.8	192.15	0.00	0.00	100.94
IFC-2	7	10.72	0.00	0.00	2.34	14.73	0.00	0.00	0.77
	6	46.78	0.00	0.00	8.80	51.60	0.00	0.00	14.42
	5	79.31	0.00	0.00	18.86	86.68	0.00	0.00	29.67
	4	100.72	0.00	0.00	33.44	133.33	0.00	0.00	43.07
	3	153.11	0.00	0.00	47.44	190.07	0.00	0.00	72.76
	2	169.95	0.00	0.00	53.76	220.88	0.00	0.00	88.02
	1	217.71	0.00	0.00	62.87	332.10	0.00	0.00	101.89

1) *Bending Moment:* the above fig 5 shows the load distribution of column C8. Load of this column is distributed to that near columns such as C2, C7, C9 and C14. These are the critical column due to this Floating column of C8. Here behaviour of column C2, C7 and C9, C14 columns are same due to symmetry of the structure so that we need to find behaviour of column C2 and C9 is enough for analyse the structure.

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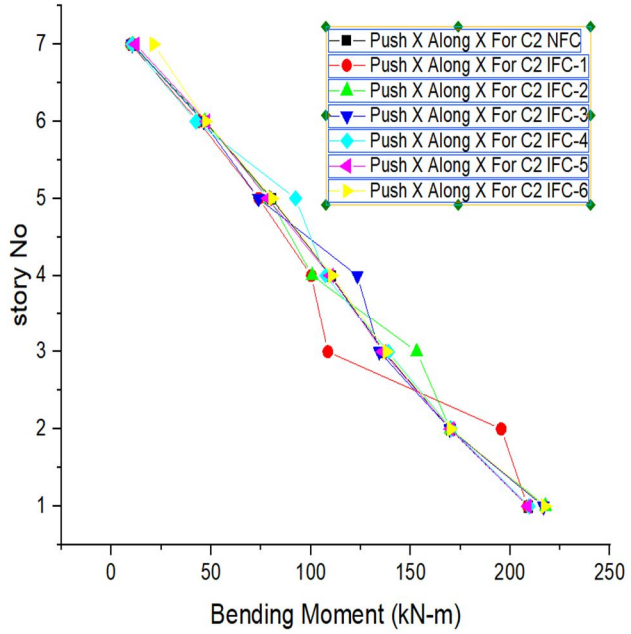

Fig 7: Variation of BM for IFC C2 in various stories.

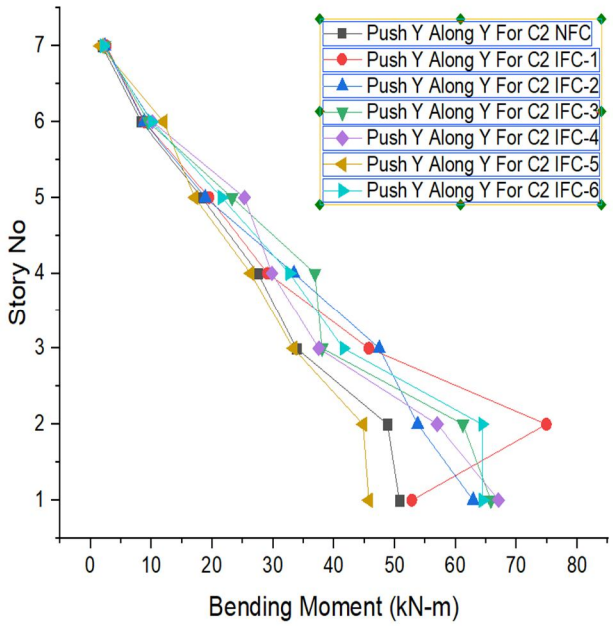

Fig 8: Variation of BM for IFC C2 in various stories.

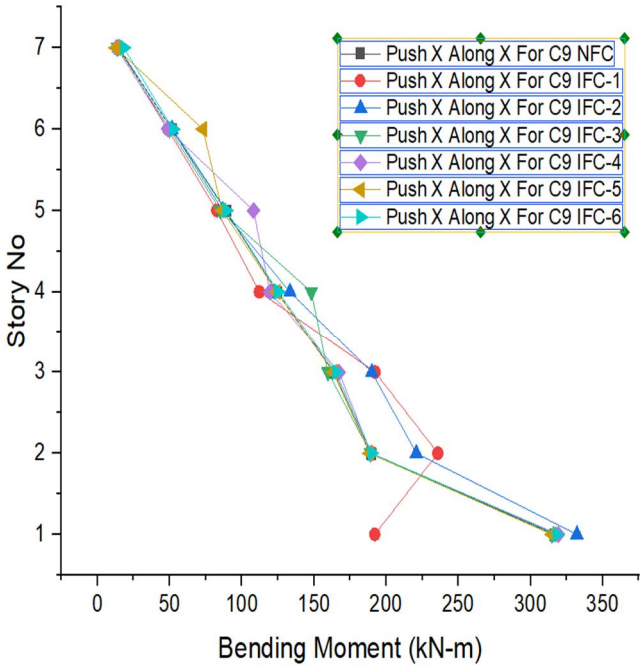

Fig 9: Variation of BM for IFC C9 in various stories.

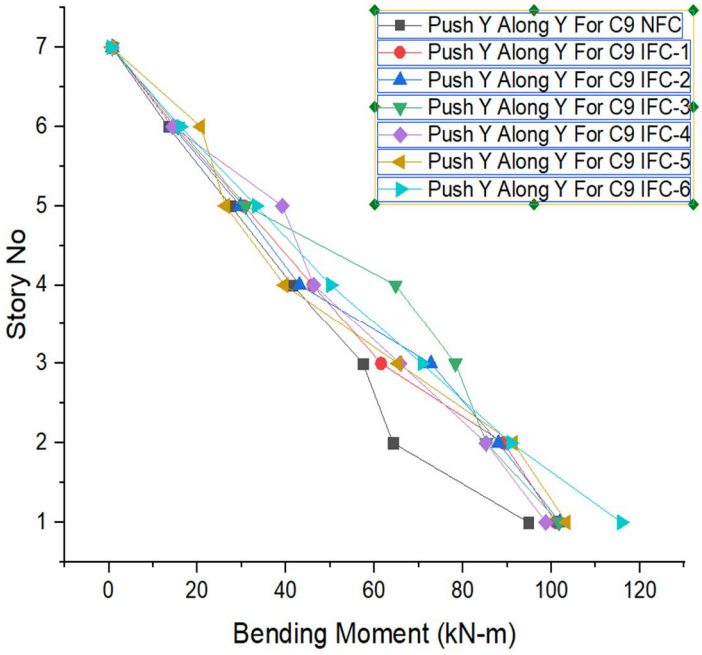

Fig 10: Variation of BM for IFC C9 in various stories.

2) *Summary:* From Fig.7 to Fig.10 shows the variation of bending moment at different storey for no floating column model and internal floating column buildings due to the application of push X force in X- direction and push Y force in Y- direction of column C2 and C9 due to internal floating column C8. From the results it clearly shows that the bending moment value is more in near floating column because floating column load is distributed to near columns so that columns becomes critical. Also the bending moment values for all types of structure subjected to Push X load case is more than the same due to Push Y load case. This is because of orientation of longer side of column in X direction is more than Y direction.

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Table 3: Lateral Displacement of Column C2 and C9 Due To IFC of C8

Model type	Storys	Lateral displacement in mm							
		C2				C9			
		Push X		Push Y		Push X		Push Y	
		Along X	Along Y	Along X	Along Y	Along X	Along Y	Along X	Along Y
NFC	7	66.07	0.00	0.00	42.80	66.06	0.00	0.00	42.80
	6	65.11	0.00	0.00	42.52	65.12	0.00	0.00	42.53
	5	62.10	0.00	0.00	40.30	62.02	0.00	0.00	40.30
	4	55.24	0.00	0.00	35.33	55.85	0.00	0.00	35.93
	3	45.96	0.00	0.00	29.40	45.95	0.00	0.00	29.40
	2	31.79	0.00	0.00	20.42	31.82	0.00	0.00	20.43
	1	8.29	0.00	0.00	3.21	4.73	0.00	0.00	3.19
	Base	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IFC-1	7	67.28	0.00	0.00	58.99	67.29	0.00	0.00	58.99
	6	65.39	0.00	0.00	58.68	66.40	0.00	0.00	58.68
	5	63.52	0.00	0.00	56.21	63.53	0.00	0.00	56.21
	4	56.87	0.00	0.00	51.36	56.89	0.00	0.00	51.36
	3	45.08	0.00	0.00	44.13	46.06	0.00	0.00	44.13
	2	32.27	0.00	0.00	34.45	32.39	0.00	0.00	34.45
	1	7.29	0.00	0.00	4.23	3.55	0.00	0.00	5.42
	Base	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IFC-2	7	69.91	0.00	0.00	50.54	69.91	0.00	0.00	50.54
	6	68.95	0.00	0.00	50.24	68.97	0.00	0.00	50.24
	5	65.87	0.00	0.00	47.84	65.88	0.00	0.00	47.85
	4	59.82	0.00	0.00	43.14	59.81	0.00	0.00	43.15
	3	50.40	0.00	0.00	36.24	50.42	0.00	0.00	36.24
	2	35.05	0.00	0.00	25.36	35.07	0.00	0.00	25.37
	1	9.30	0.00	0.00	3.99	5.19	0.00	0.00	3.69
	Base	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

A. Lateral Displacement

The above fig 5 shows the load distribution of column C8 load of this column is distributed to that near column such as C2, C7, C9 and C14. These are the critical column due to this Floating column of C8 Here behaviour of column C2, C7 and C9, C14 columns are same due to symmetry of the structure so that we need to find behaviour of column C2 and C9 is enough for analyse the structure.

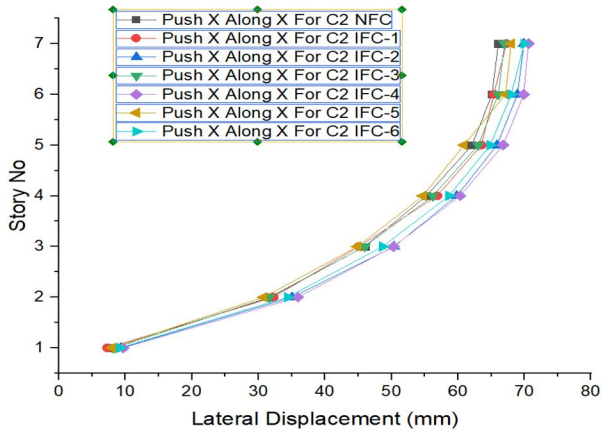

Fig 11: Lateral Displacement for IFC C2 in various stories

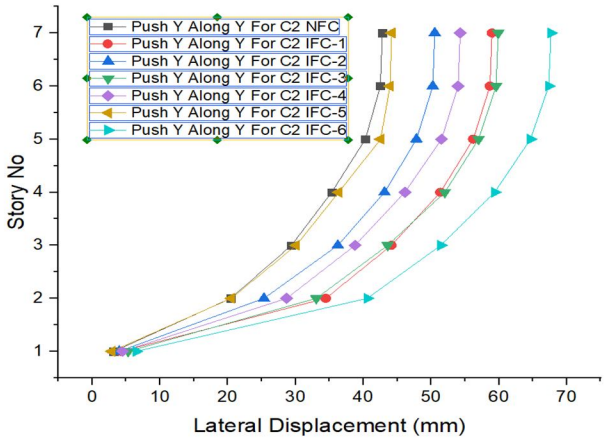

Fig 12: Lateral Displacement for IFC C2 in various stories

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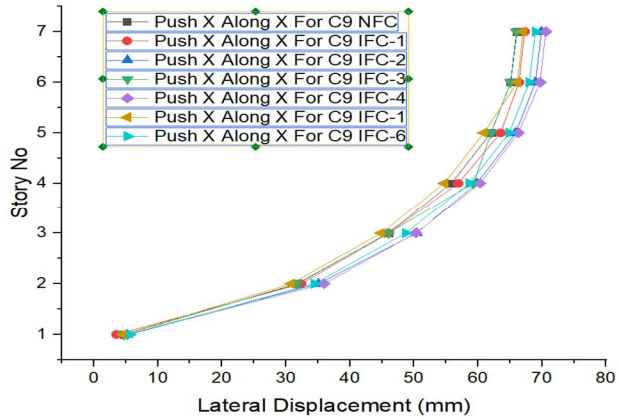

Fig 13: Lateral Displacement for IFC C9 in various stories

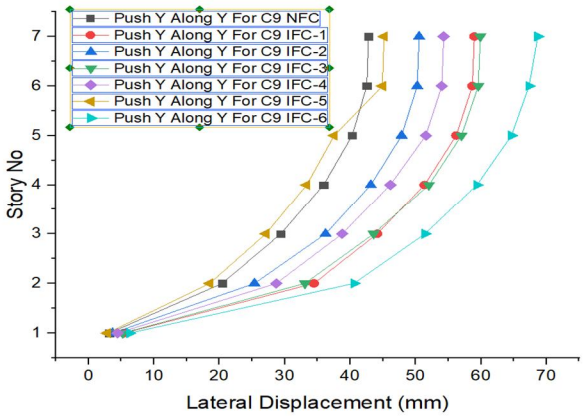

Fig 14: Lateral Displacement for IFC C9 in various stories

1) *Summary:* From Fig 10 to Fig 14 shows the variation of lateral displacement at different storey for a No floating column and internal floating column buildings due to the application of push X force in X- direction and push Y force in Y- direction of column C2 and C9 due to internal floating column C8. From the results it clearly shows that the lateral displacement value is more near top storey and goes on decreases towards the bottom storey and zero at the base. This is due to the increase in flexibility towards the top storey. Lateral displacement value is more in floating column model compared with No floating column model. Also the lateral displacement values for all types of structure subjected to Push X load case is lesser than the same due to Push Y load case. This is because of orientation of longer side of column in X direction is more than Y direction.

IV. CONCLUSIONS

It is observed that introduction of floating column increases the criticality of the structure. It observed that bending moment of adjacent column is more due to providing floating column in building. Providing floating columns in lower stories is very critical compared to the floating column provided in upper stories, because it is very difficult for nears columns take the load of floating column from the top stories. In INTERNAL FLOATING COLUMN models due to C8 IFC the C9 interior side column is more critical than C2 exterior side column. In every floating column models due to floating columns the interior side near column is very critical compared to the exterior side adjacent columns. Lateral displacement of floating column models is more compared to the model of No floating column. The maximum lateral displacement developed due to floating columns provided in middle stories compared to lower and upper stories.

REFERENCES

[1] A.P.Mundada, and S.G.Sawdarkar,(2014), “Comparative Seismic Analysis of Multistory Building with and without Floating Column”, International Journal of Current Engineering and Technology, Volume 04, No.5, E-ISSN 2277-4106,P-ISSN237-5161,pp.3395-3400
[2] Bhavya B.S and JishaP,(2016), “Seismic evaluation of RC unsymmetrical building with floating columns and soft storey considering different configuration”, International Journal of Innovative Research in Science, Engineering andTechnology,Vol.5,pp.15456-15465.
[3] Hardik Bhensdadia, Siddharth Shah, (2015), “pushover analysis of rc frame structure with floating column and soft story in different earthquake zones”, IJRET: International Journal of Research in Engineering and Technology, eISSN: 2319-1163 | pISSN: 2321-7308.
[4] IshaRohilla, S.M.Gupta, Babitasaini,(2015), “Seismic Response of multi-storey irregular building with floating column”, International Journal of Research in Engineering and Technology, Volume 04, Issue03.
[5] Pratyushmalaviya and Saurav,(2014), “Comparative study of effect of floating column on the cost analysis of a structure Designed on STAAD Pro V8i”,International Journal of Scientific and Engineering Research, Vol.05,Issue5,ISSN2299-5518,pp.22-34
[6] Pankaj Agarwal ,Shrinkhande Manish (2009) , “ Eathquake resistant design of structure “ PHI learning private limited , NewDelhi.
[7] Stella Evangeline, D.Satish, (2016), “push over analysis for rc building with and without floating columns” International Journal of Advancements in Research & Technology, Volume 4, Issue 11, November -2015 ISSN 2278-7763.
[8] Prof. SaritaSingla, Er. AshlieRahaman, (2015), “Effect of Floating Columns on Seismic Response of Multi-storied RC framed Buildings”,International Journal of Engineering Research and Technology, ISSN:2278-0181,Volume 04, Issue 06, pp.1131-1136.
[9] Umesh P. Patil and Shivanand S Hallur,(2015), “Seismic analysis of G+5 Framed structure with and without Floating column using ETABS-2013 software”, International Research Journal of Engineering and Technology, Volume 02, Issue04.
[10] IS:456(2000),Indian Standard Code of Practice for Plain and Reinforced Concrete, Bureau of Indian Standards, NewDelhi, India.
[11] IS:1893-Part I (2002), Criteria for Earthquake Resistent Design of Structures, Bureau of Indian Standards, NewDelhi, India.
[12] IS: 875-1987 – Code of practice for Design Loads other than Earthquake for Building and Structures, Part 1: Dead loads, Part – 2: Imposed loads, Part – 5: Special loads and load combinations, Bureau of Indian Standards, New Delhi.

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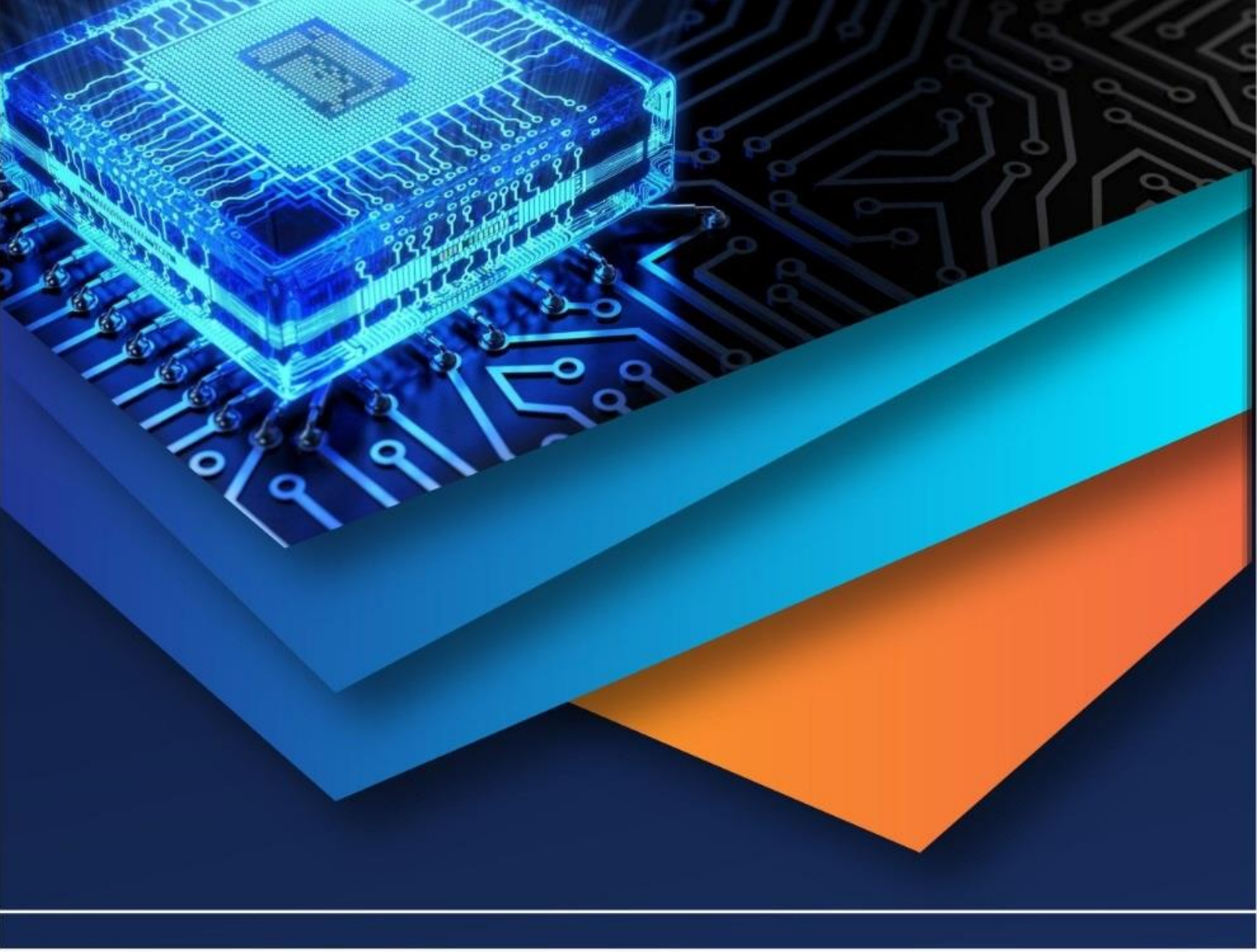

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