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Comparative Seismic Study of Floating Column & Lateral Resisting System on RC Frame Building

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ABSTRACT

Floating column structure are typical features in the modern multi-storey constructions in urban India. Such features are highly undesirable in buildings built in seismically active areas like bhuj. The earthquake forces that are developed at different floor levels in building need to carried down along the shortest path, but due to floating column there is discontinuity in the load transfer path which results in poor performance of building.

The main intension of this study to show the effects of floating column in RC building affected with seismic forces. For this purpose static linear and push over analysis is adopted. The parameters which are considered point displacement, storey drift, storey shear, base shear, performance level, hinge status and pushover curve. To achieve this objective, three models are considered with G+ 10 storeys by using ETAB2016 analysis software.

Keywords— RC Structure; Floating Column; Static linear analysis; Pushover analysis.

I. INTRODUCTION

In present construction of multi-storied buildings areproviding an open space for first storey. This is basically being utilized to stopping or gathering entry ways in the main storey. The seismic force depends on the distribution of stiffness and mass along the height of the structure.

A column is structural vertical element starting from foundation level to the roof level and transferring the loads from slab and beams to the footing. The term floating section is likewise a vertical component which (because of compositional configuration/site circumstance) at its lower level (end level) lies on a beam which is horizontal structural element. The beams which are present at floating column floor level transfer the load to the respective column present below it. There are various activities in which floating columns are used, particularly over the ground floor, where transfer girder are utilized, so more open space is accessible in the ground floor. These open spaces mightbe required for get together lobby or stopping reason. The transfer girder which is present below the floating column are designed and detailed, particularly in Seismic zones. The load which comes from the column is concentrated on the beam as far as analysis is concerned, the column is often assumed pinned at the base. Therefore it is taken as pinned load on which beamit is resting. STAAD Pro, ETABS and SAP2000 can be utilized to do the investigation of this kind of structure.

Ⅱ. OBJECTIVES

- To study the elastic behaviour, plastic (inelastic) behaviour and change of state from elastic to plastic state behaviour of the RC framed SMRF building model under consideration.
- To perform non-linear static displacement controlled analysis and obtain load-displacement curve (pushover curve) for the building models under consideration.
- To study the performance response of the RC framed SMRF building models situated in seismic zone Ⅴ, on hard soil(Type-Ⅰ) using linear static and non-linear static displacement controlled analysis by considering the effect of floating columns.
- To attain and compare various results such as story shear, story drifts, story displacement with and without considering the idea of floating columns for the considered building models under consideration using both linear and non-linear static displacement controlled analysis under gravity and lateral loads as per IS 1893:2002(part-1) using FEM based analytical software ETABS-16 version.
- To find the overall capacity of the building having floating columns at various story floors for the model under gravity and lateral loads in EQX and PUSHX directions as per IS 1893:2002(part-1)
- To attain the inelastic formation of hinges and their status for the RC framed SMRF building model under consideration.

III. METHODOLOGY

MODEL CONSIDERED

Types of building models considered in study:
MODEL-1: G+10 Story bare frame
MODEL-2: G+10 Story building with floating column.
MODEL-3: G+10 story building with bracing to floating column.

TABLE1: Building parameters

Parameters	Model-1	Model-2	Model-3
Soil type	Hard(type- Ⅰ)	Hard (type- Ⅰ)	Hard (type- Ⅰ)
Seismic zone	V	V	V
Response reduction factor	5	5	5
Importance factor	1	1	1
Height of building	33.2m	33.2m	33.2m
Building floor height	3m	3m	3m
Basement height	3.2m	3.2m	3.2m
Slab thickness	150mm	150mm	150mm
Floating column	-	present	present with bracing
Live load	4kN/m²	4kN/m²	4kN/m²
Floor finish	1kN/m²	1kN/m²	1kN/m²
Terrace load	2kN/m²	2kN/m²	2kN/m²
Spacing of column	6m	6m	6m
Column size	450x600mm	450x600mm	450x600mm
Beam size	350x600mm	350x600mm	350x600mm
Material property	M25,fe415	M25,fe415	M25,fe415

MODEL ELEVATION:

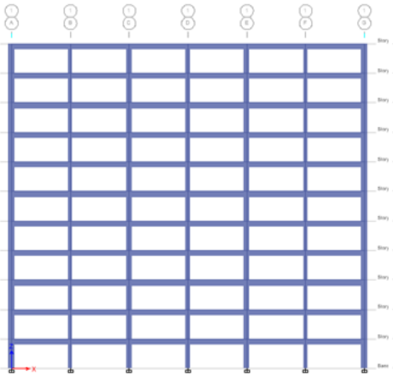

FIG1: BARE FRAME

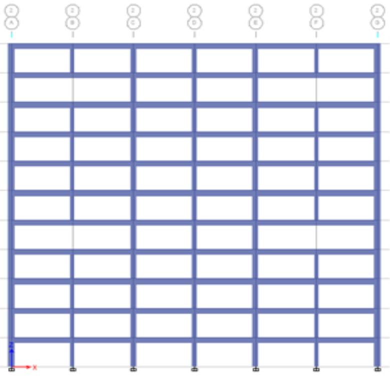

FIG2: FLOATING COLUMN

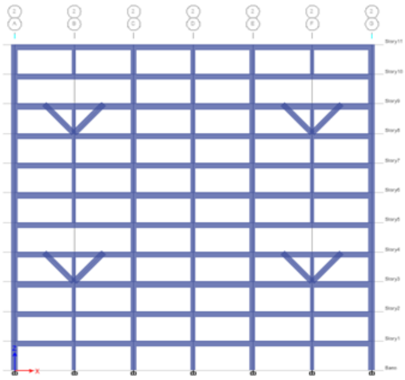

FIG3: FLOATING COULMN WITH BRACING

IV. RESULTS

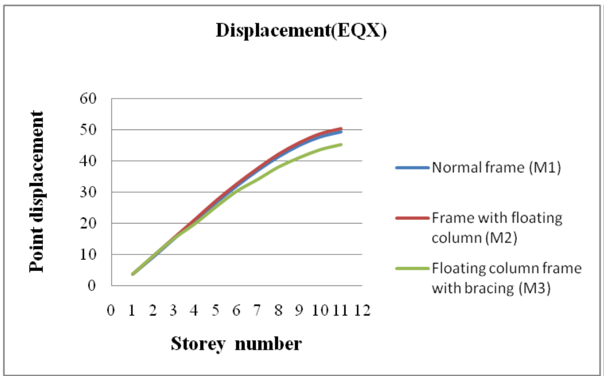

FIG4: DISPLACEMENT (EQX)

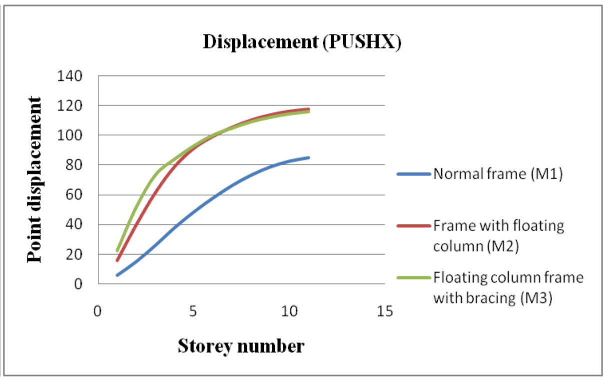

FIG5: DISPLACEMET(PUSHX)

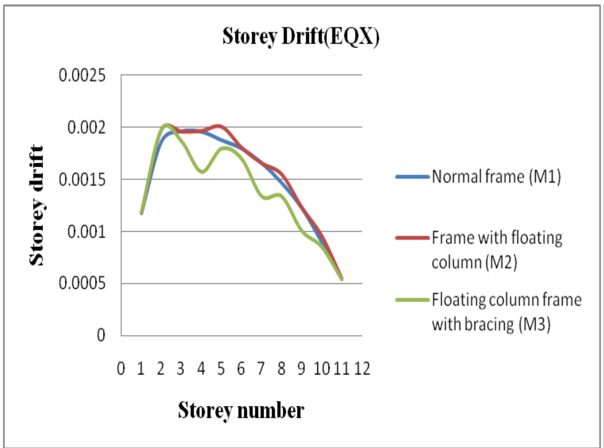

FIG6:STOREY DRIFT(EQX)

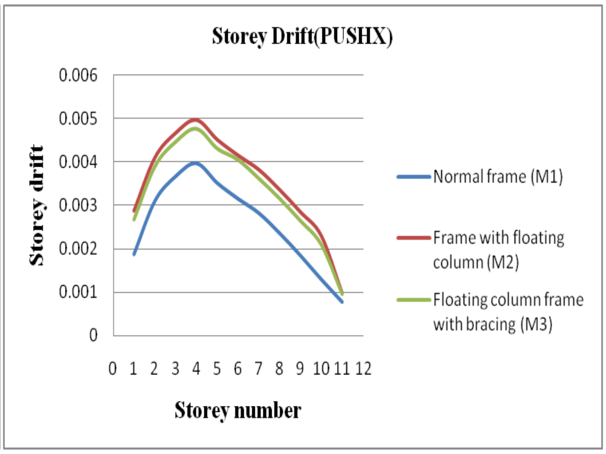

FIG7:STOREY DRIFT(PUSHX)

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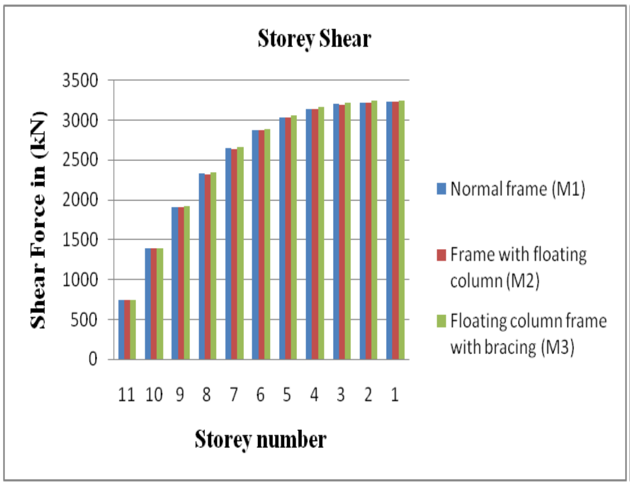

FIG8: STOREY SHEAR (EQX)

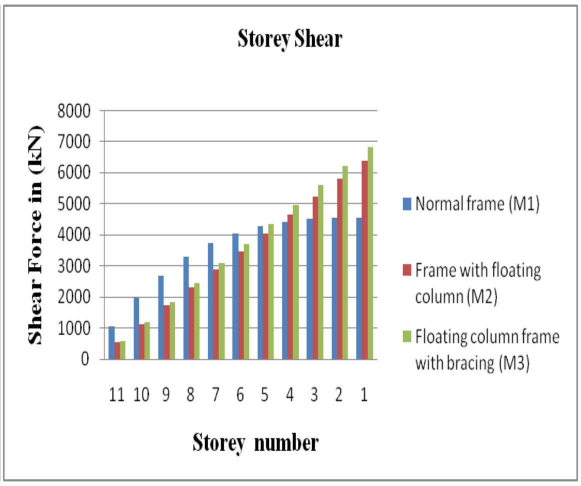

FIG9: STOREY SHEAR (PUSHX)

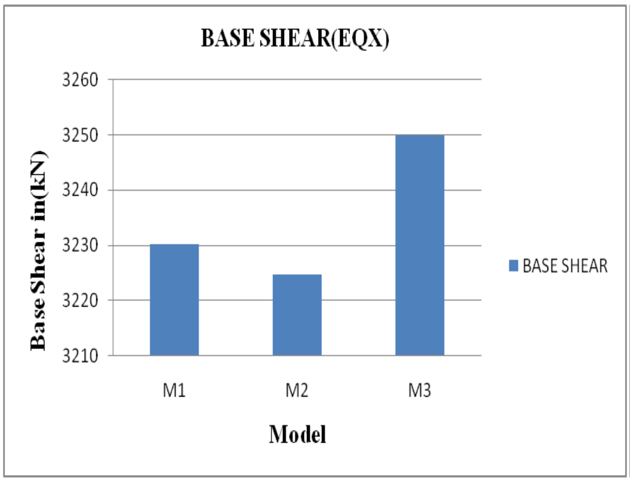

FIG10: BASE SHEAR(EQX)

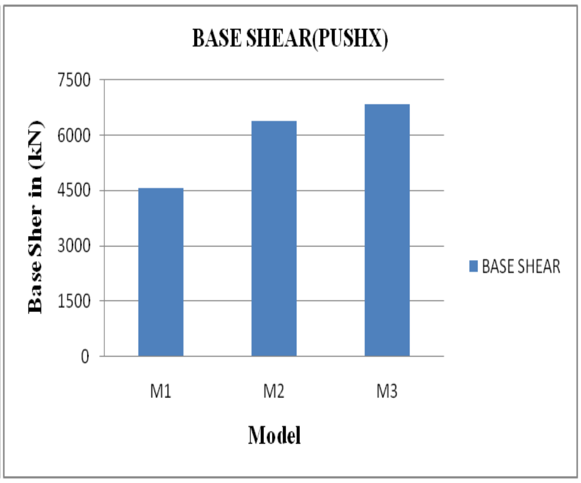

FIG11: BASE SHEAR (PUSHX)

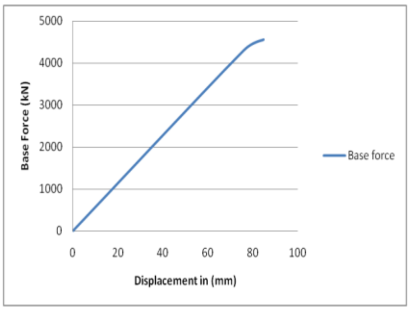

FIG12:PUSH OVER CURVE(M1)

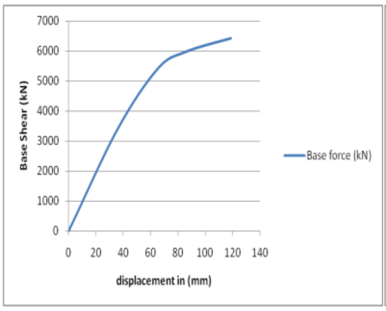

FIG13:PUSH OVER CURVE(M2)

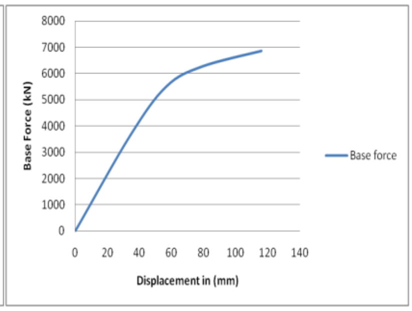

FIG14:PUSH OVER CURVE(M3)

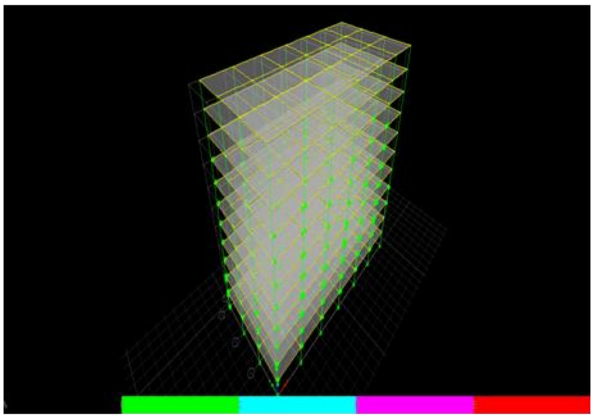

FIG15:HINGE STATUS (M1)

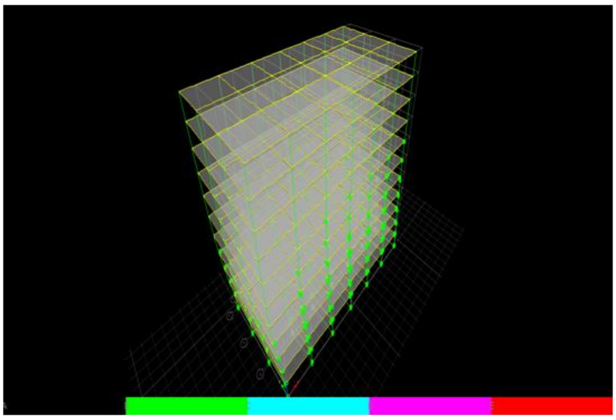

FIG16:HINGE STATUS (M2)

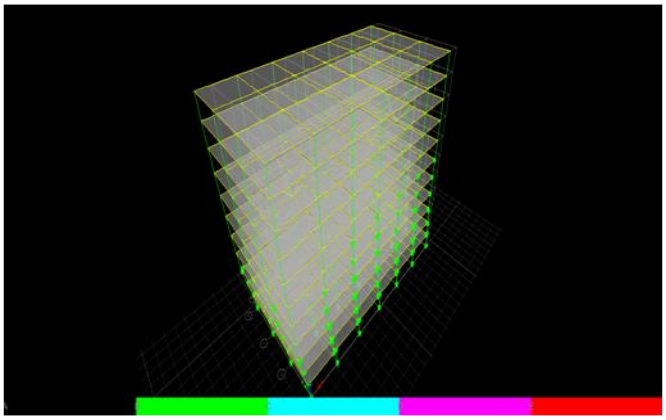

FIG17:HINGE STATUS (M3)

PERFORMANCE LEVEL:

TABLE2: PERFORMANCE LEVEL (M1)

Step	A-B	B-C	C-D	D-E	>E	A-IO	IO-LS	LS-CP	>CP	Total
0	1606	0	0	0	0	1576	0	0	0	1576
1	1605	1	0	0	0	1576	0	0	0	1576
2	1377	229	0	0	0	1576	0	0	0	1576
3	1327	279	0	0	0	1576	0	0	0	1576
4	1327	279	0	0	0	1576	0	0	0	1576

TABLE3: PERFORMANCE LEVEL (M2)

Step	A-B	B-C	C-D	D-E	>E	A-IO	IO-LS	LS-CP	>CP	Total
0	1590	0	0	0	0	1590	0	0	0	1590
1	1589	1	0	0	0	1590	0	0	0	1590
2	1419	171	0	0	0	1590	0	0	0	1590
3	1325	265	0	0	0	1588	0	0	2	1590
4	1252	338	0	0	0	1575	12	0	3	1590
5	1251	339	0	0	0	1575	12	0	3	1590

TABLE4: PERFORMANCE LEVEL (M3)

Step	A-B	B-C	C-D	D-E	>E	A-IO	IO-LS	LS-CP	>CP	Total
0	1590	0	0	0	0	1590	0	0	0	1590
1	1588	2	0	0	0	1590	0	0	0	1590
2	1456	134	0	0	0	1589	0	0	1	1590
3	1357	233	0	0	0	1588	0	0	2	1590
4	1308	282	0	0	0	1556	26	0	8	1590
5	1307	283	0	0	0	1555	27	0	8	1590
6	1307	283	0	0	0	1555	27	0	8	1590
7	1307	283	0	0	0	1555	27	0	8	1590

V. CONCLUSIONS

From the distinctive result obtained, and tabulated in the chapter 5, following conclusions are drawn.

- The storey shear obtained for nonlinear analysis seems to be 42% greater when compared to linear equivalent static analysis, as the storeyheight increases storey shear decreases.
- The storey displacement obtained from equivalent analysis is 62% less than nonlinear static analysis.
- The story drift obtained from non linear static analysis is seen to be about 54% higher than the drift obtained for linear equivalent static analysis.
- From the results obtained on story shear, story drift, it is perceived that the increase of weight or mass of building the respective results decreases w.r.t the total building height, but corresponding story displacement increases.
- The building performance level for all the building models are examined and the performance level for all models lies within life safety i.e.[IO-LS].
- Model M2 seems to form more number of hinges (1590) as per non-linear static analysis. It shows the building would not breakdown suddenly; instead prior intimation is prearranged by forming non-linear plastic hinges.

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