STUDY ON EFFECT OF OPEN GROUND STOREY ON SEISMIC PERFORMANCE OF HIGH RISE BUILDING

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***Abstract*— This study on effect of open ground storey on seismic performance of high rise building current era Parking space for residential apartments in populated cities is a matter of major concern. Hence the trend has been to utilize the ground storey of the building itself for parking. "Open Ground Story" (OGS) buildings are those types of buildings in which the ground storey is free of any infill masonry walls. These types of buildings are very common in India for parking provisions.**

In the present study, a typical ten-storied OGS framed building is considered and the building considered is located in Seismic Zone-IV & V. The design forces for the ground storey columns are evaluated based on various codes such as Indian, Euro, Fema. Various OGS frames are analysis nonlinear behavior of building structures with soft stories by utilizing nonlinear static pushover studied using the EATBS_9.6.0

***Index Terms*—soft storey, pushover analysis, infill wall, seismic performance**

I. INTRODUCTION

NEED OF SPACE BECAME VERY IMPORTANT IN URBAN AREAS DUE TO INCREASE IN POPULATION ESPECIALLY IN DEVELOPING COUNTRIES LIKE INDIA. NEED OF PARKING SPACE TAKES IMPORTANT VITAL ROLE WHILE PLANNING A BUILDING. TO PROVIDE ADEQUATE PARKING SPACES, GROUND STOREY OF THE BUILDING IS UTILIZED.

THESE TYPES OF BUILDINGS HAVING NO INFILLED WALLS IN GROUND STORY, BUT IN-FILLED IN ALL UPPER STORIES, ARE CALLED OPEN GROUND STOREY (OGS) BUILDINGS. THE MAJORITY OF APARTMENTS ARE OF THIS TYPE AND THE INFILL WALLS USED ARE OF MAINLY BRICK MASONRY.

II. Objectives and Scope of works

- The main objective of current work is to study the effect of multiplication factor given in IS 1893:2002 for soft storey building, other objectives are stated below.
- Determination of the nonlinear behavior of building structures with soft stories by utilizing nonlinear static pushover for various deformation levels.
- To study the effect of infill strength and stiffness in the seismic analysis of Open ground storey buildings.
- To evaluate the multiplication factor for different height of Open ground storey buildings.
- To check the applicability of provisions those are defined in various earthquake codes for soft storey irregularity
- The scope of present study is to study the effect of infill wall on behavior of Structure.
- To study the modeling techniques of brick infill in ETABS software.
- Pushover analysis has been carried out to predict the effect and behavior of infill wall on building using ETABS software.
- After that evaluate the multiplication factor for different buildings and compare same with the multiplication factor mentioned in code IS 1893:2002.

III. LITERATURE REVIEW

Saurabh Singh, Saleem Akhtar and Geeta Batham[1]: Open First storey buildings are considered as vertically irregular buildings as per IS 1893: 2002 that requires dynamic analysis considering strength and stiffness of the infill walls. the MF based on linear and non linear analysis is in the range 1.106-1.1084 for a four storied OFS building, 1.806-1.858 for seven storeyed OFS building and 1.959-2.193 for ten storied OFS building. The MF increases with the height of the building.

P.B.Lamb, Dr R.S. Londhe[2]: parametric study is performed on multistoried building with soft first story, located in seismic zone IV; The study is carried out on a building with the help of different mathematical models considering various methods for improving the seismic performance of the building with soft first storey.

Nevzat Kirac et al[3] "Following factors or parameters affect the weak-story irregularity formation in structures, Height of the weak-story, Existence of mezzanine floor. Rigidity, stiffness distribution of columns in soft story, cantilever projection existence in weak-story, Infill wall material properties, Soil class and properties, Height of the weak-story, Rigidity and stiffness distribution of columns in soft story, cantilever projection existence in soft story, Infill wall material properties, Soil class and properties.

Dr. Saraswati Setia and Vineet Sharma[4] With urbanization and increasing unbalance of required space to availability, it is becoming imperative to provide open ground storey in commercial and residential buildings. These provisions reduce the stiffness of the lateral load resisting system and a progressive collapse becomes unavoidable in a severe earthquake for such buildings due to soft storey. Soft storey behavior exhibit higher stresses at the columns and the columns fail, as the plastic hinges are not form on predetermined positions. Thus, the vulnerability of soft storey effect has caused structural engineers to rethink the design of a soft storey building in areas of high seismicity. Parametric studies on displacement, inter storey drift and storey shear have been carrying out using equivalent static analysis to investigate the influence of these parameter on the behavior of buildings with soft storey.
Diana Samoila[5] The analytical modeling of the infills implies the determination of their geometrical and mechanical characteristics. The paper presents three one- bay, one- story frames, for which the diagonal strut width and the strength to different failure types are determined. The effects of the masonry infill panels upon the seismic behavior of the frames structures was rendered by the capacity curves obtained from the pushover analysis carried out on a series of concrete frames with different number of stories.
Rahiman G. Khan, Prof. M. R. Vyawahare [6] Open first storey is a typical feature. These have been verifying numbers of experiences of strong past earthquakes. We are concentrating on finding the best place for soft stories in high rise buildings. With the availability of fast computers, so-called performance based seismic engineering (PBSE), where inelastic structural analysis is combined with seismic hazard assessment to calculate expected seismic performance of a structure, has become increasingly feasible. With the help of this tool, structural engineers too, although on a computer and not in a lab, can observe expected performance of any structure under large forces and modify design accordingly. PBSE usually involves nonlinear static analysis.

IV. Material Properties

1	Storey	G + 5 storey
2	Size of column	C1-675mm X 300mm
3	Size of beam	C2-675mm X 230mm
4	Slab	128 mm
5	Type of building	230mm X 500mm
6	Live load	2.0 kn/m2 at typical floor
7	Floor finish	1.0kn/m2
8	Earthquake load	As per IS – 1893 : 2002
9	Type of soil	Type II, Medium
10	Storey height	3.0 m
11	Walls	230mm & 120mm Thick masonry wall
12	Seismic zone	Zone IV
13	Soil type	Medium
14	Frame	Special moment resisting frame
15	Over all dimension	17.0 m X 15.0 m

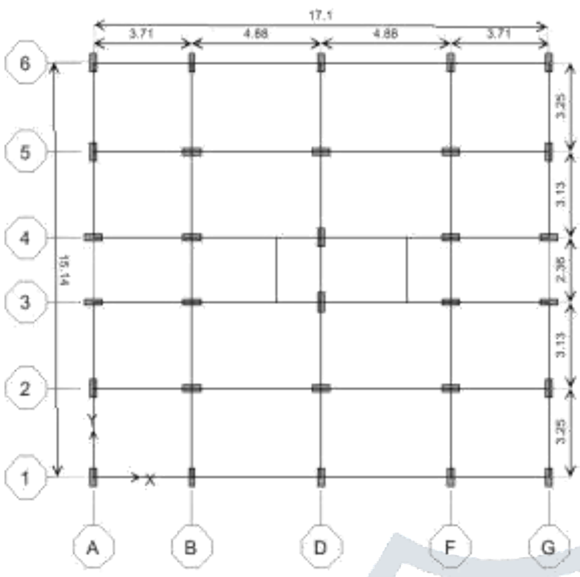


Figure-1 plan of building

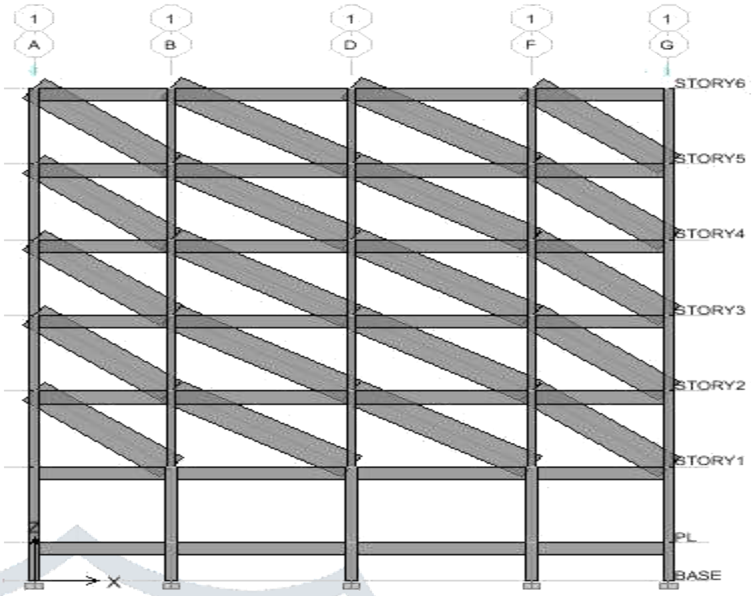


Figure-2 Elevation of building model

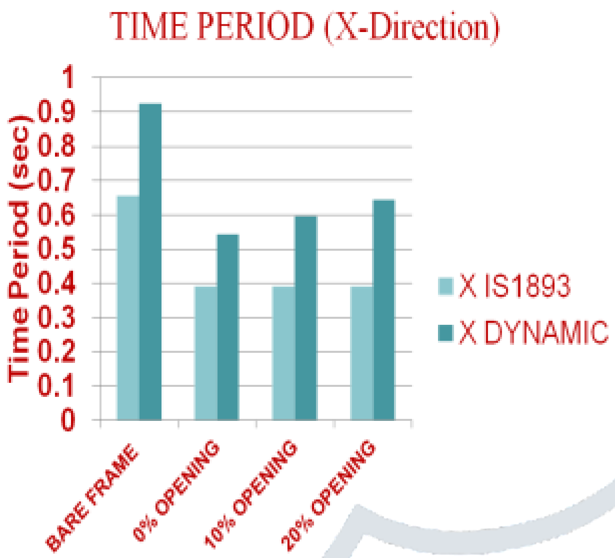
V. PARAMETRICAL COMPARISON

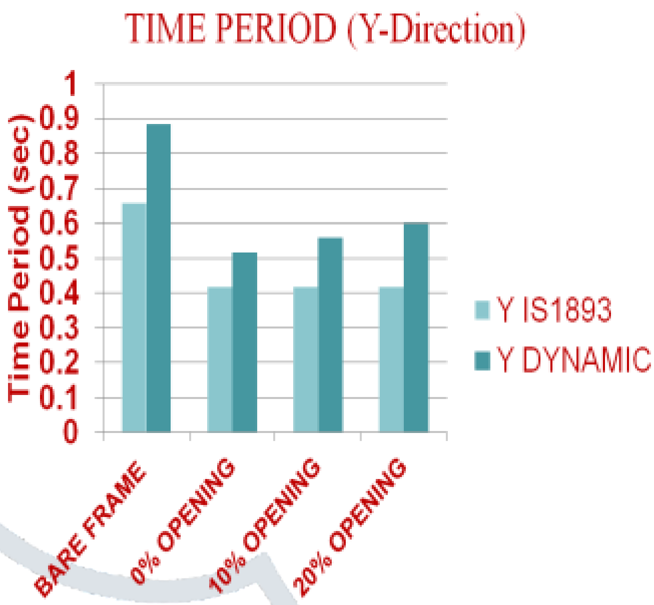
Static nonlinear pushover analysis of all above building models has been carried out using ETABS and Results obtained will be compared in form of following parameters,

- Time period
- Storey Displacement
- Storey Drift
- Storey Shear

1) TIME PERIOD

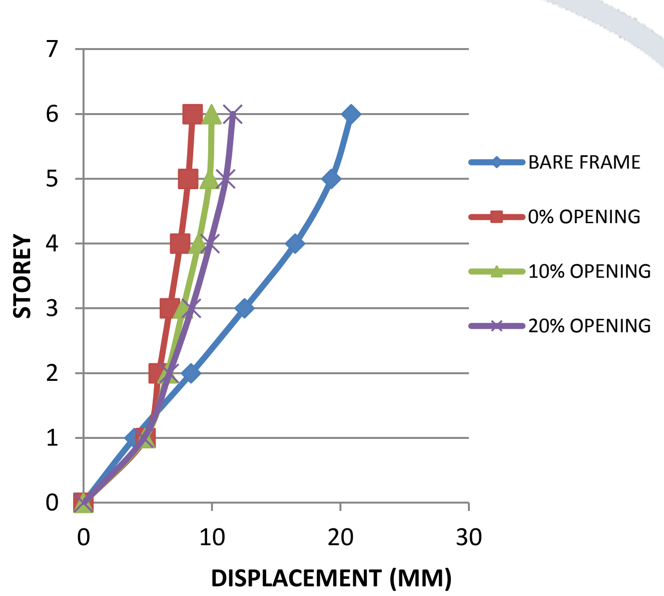
TIME PERIOD				
FRAME TYPE	IS1893		DYNAMIC	
	X	Y	X	Y
BARE FRAME	0.6554	0.6554	0.9223	0.8851
0% OPENING	0.3918	0.4169	0.5430	0.5159
10% OPENING	0.3918	0.4169	0.5965	0.5581
20% OPENING	0.3918	0.4169	0.6443	0.5998

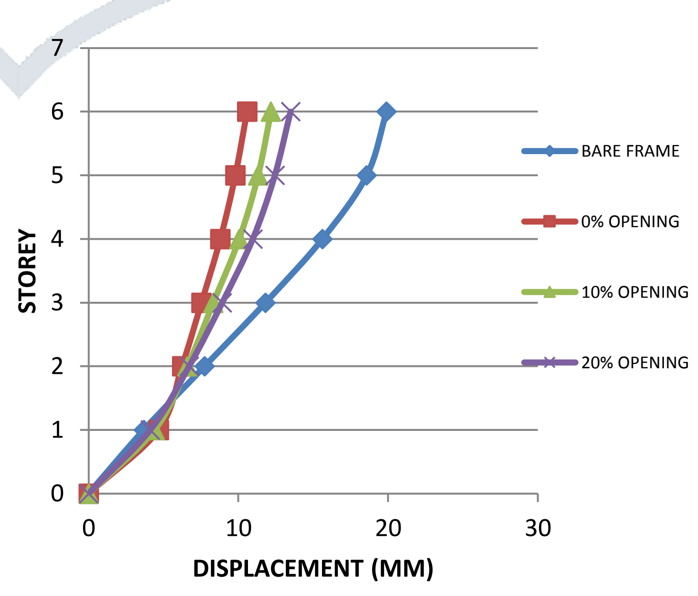




2) **STOREY DISPLACEMENT**

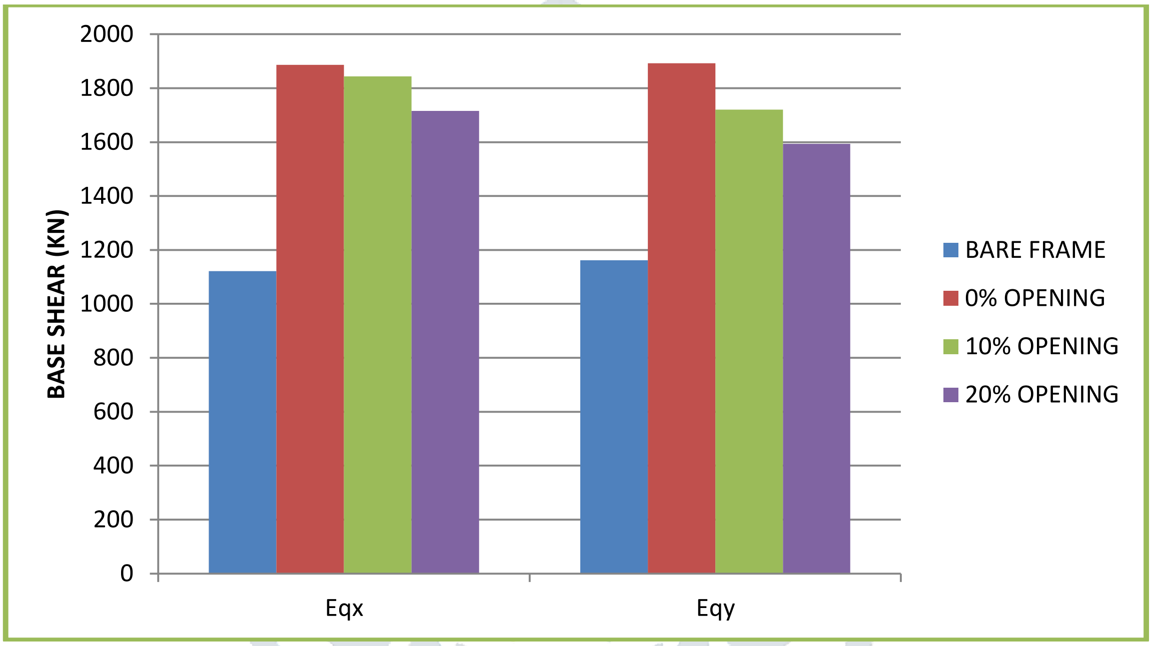
STORY	BARE FRAME		0% OPENING		10% OPENING		20% OPENING	
	X	Y	X	Y	X	Y	X	Y
6	20.86	19.89	8.49	10.58	9.97	12.18	11.62	13.49
5	19.31	18.57	8.15	9.8	9.81	11.32	11.06	12.44
4	16.49	15.61	7.52	8.8	8.94	10.06	9.84	10.97
3	12.54	11.81	6.72	7.54	7.75	8.33	8.41	8.93
2	8.38	7.75	5.86	6.24	6.53	6.6	6.68	6.72
1	3.95	3.69	4.82	4.68	4.77	4.42	4.68	4.12
0	0	0	0	0	0	0	0	0





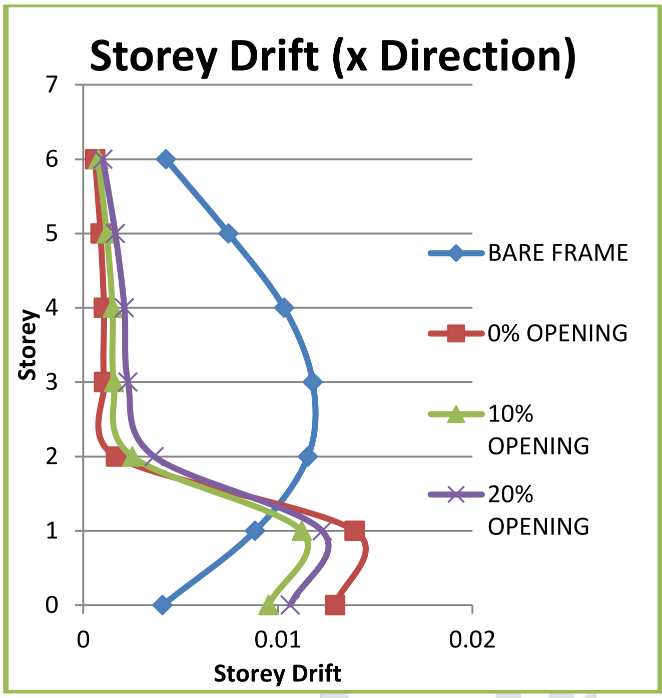
3) BASE SHEAR

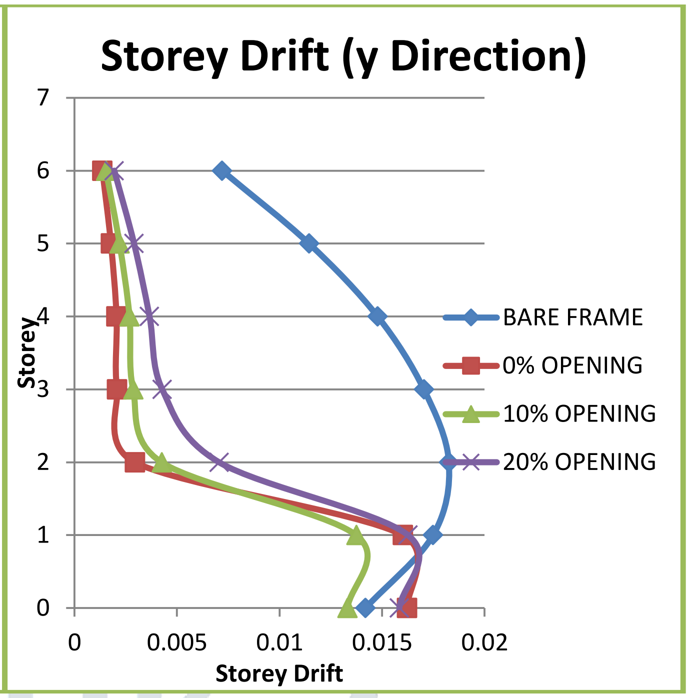
STORY SHEAR STATIC		
	Eqx	Eqy
BARE FRAME	1120.89	1161.749
0% OPENING	1886.91	1892.043
10% OPENING	1844.29	1720.8
20% OPENING	1715.93	1593.28



4) STOREY DRIFT

STORY	BARE FRAME		0% OPENING		10% OPENING		20% OPENING	
	X	Y	X	Y	X	Y	X	Y
6	0.004243	0.007199	0.000598	0.001363	0.000764	0.001543	0.001002	0.001937
5	0.007459	0.011437	0.000877	0.001778	0.001204	0.002204	0.001637	0.002901
4	0.010313	0.014786	0.001055	0.002052	0.001504	0.002691	0.002106	0.003656
3	0.011787	0.017042	0.001067	0.002076	0.001575	0.002868	0.002289	0.004277
2	0.011541	0.018262	0.00168	0.002948	0.002513	0.004255	0.003638	0.007055
1	0.008825	0.017488	0.013946	0.016017	0.011222	0.013748	0.012272	0.016269
BASE	0.004067	0.014186	0.012938	0.016221	0.009521	0.013317	0.010635	0.015841





VI. Conclusion

- Higher time period observed in bare frame cases and as the opening percentage increases time period increases that is due to reduction in stiffness
- As the infill percentage increases base shear reduces and lower base shear obtained in bare frame
- Global stiffness indicate that's bare frame has lower stiffness than infill
- Storey drift is drastically changes at ground storey, due to effect of soft story
- Magnification factor obtained from pushover analysis is varying from 1.82 for 20% opening to 1.95 for full infill frame

VII. References

[1]. ATC-40, Applied Technology Council, Seismic Evaluation and Retrofit of Concrete Buildings, Volume 1, 1996.
[2]. ETABS User's Manual, "Integrated Building Design Software, Computer and Structure Inc. Berkeley, USA
[3]. FEMA 356, Federal Emergency Management Agency, Pre standard And Commentary for the Seismic Rehabilitation of Buildings, November 2000.
[4]. FEMA 273, Federal Emergency Management Agency, NEHRP Guidelines for the Seismic Rehabilitation Of Buildings, October 1997.
[5]. IS: 1893 (Part 1):2002, Criteria For Earthquake Resistant Design Of Structures, June 2002.
[6]. IS: 456:2000, Plain And Reinforced Concrete Code of Practice, July 2000.
[7]. Kaushik, H.B., Rai, D.C., and Jain, S.K. (2006). A Rational Approach to Analytical Modeling of Masonry Infills in Reinforced Concrete frame Buildings; The 14th World Conference on Earthquake Engineering October 12-17, 2008, Beijing.