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Convincement Based Seismic Design of Open Ground Storey Framed Building

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Abstract - *In this paper we study about the seismic analysis of the open ground storey with three different models and that model is done with help of Etabs software which is product of the CSI Company. In first model provided with 250mm thin wall at every position except at ground storey without opening in wall. In second model provided 250mm thin wall at only outer side and 125mm at inner side of the building which is partition wall and also provided opening in second model at outer side In thirds model provided 250mm thin wall at every position with opening in the wall. In this paper we did comparative study of three model with respect to base shear, storey drift, storey displacement and as well as time periods. Using IS Code 1893 part 1 2016 and all model exists in the zone IV and 2nd type of soil is taken. Considering the special moment resisting frame (SMRF) and importance factor is taken 1.2. After comparative study we gave the conclusion that which model is giving the better performance as compared as other two structures.*

Key Words: Etabs, Time history, Open ground storey, load bearing wall, partition wall, opening, Seismic Analysis.

1. INTRODUCTION

Open ground storey is a type of structure in which the ground storey is fully kept open means there is no wall is build at the ground storey and this structure is increasingly used day by day in the urban area. The main purpose of providing the open ground storey to providing the parking area in the ground storey. An open ground storey structure, having only vertical member of the structure (column) in the ground storey of the structure and both partition walls(wall without load bearing) and columns in the upper storey, have two distinct characteristics, namely:
(1) It is relatively flexible in the ground storey, i.e., the relative horizontal displacement it undergoes in the ground storey is much larger than what each of the storey above it does. This flexible ground storey is also known as soft storey.
(2) It is relatively weak in ground storey, i.e., the total horizontal earthquake force it can carry in the ground storey is significantly smaller than what each of the storey above it can carry. Thus, the open ground storey may also be a weak storey. Often, open ground storey buildings are called soft storey buildings, even though their ground storey may be soft and weak. Generally, the soft or weak storey usually exists at the ground storey level, but it could be at any other storey level too.
When seismic force acting on the structure then structure acts as the Inverted pendulum which showing in the given below figure.

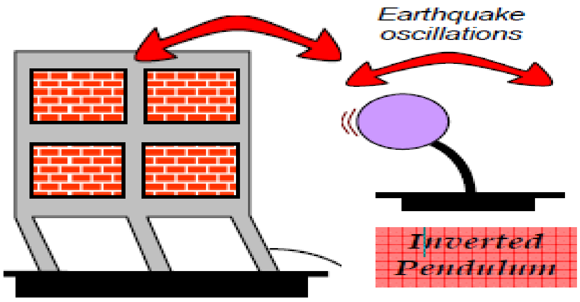

Fig-1: Open Ground Storey Building During the Earthquake.

2. MODELLING

Mainly provided three models for comparative study of the seismic analysis of the open ground storey building, which data are given below:-

2.1. Open Ground Storey building with load bearing wall (Model1).

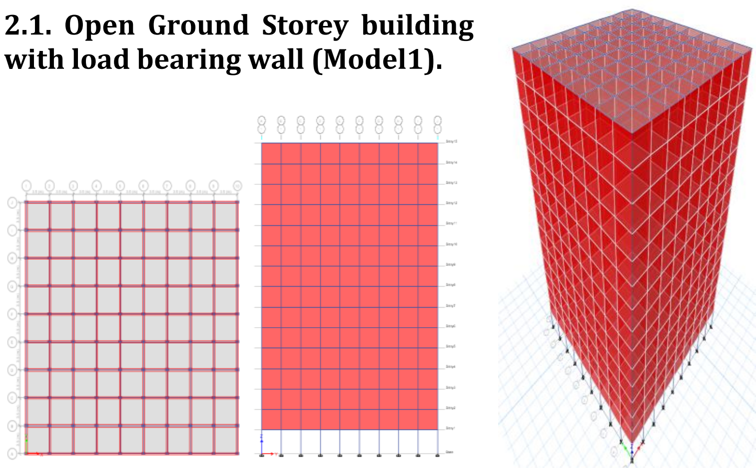

Fig-2.1: Plan, Elevation and 3D view.

2.2. The figure of open ground storey building with load bearing wall with opening at outer wall (Model2), Open Ground Storey Building with load bearing wall only at outer side with opening and partition wall at inner side (Model3)

Mode2 and Model3 are looking same in given below figure but different is that in model2 is fully load bearing wall and provided opening at the outer side. In model3, at outer side provided load bearing wall with opening and inside the wall is partition wall without opening.

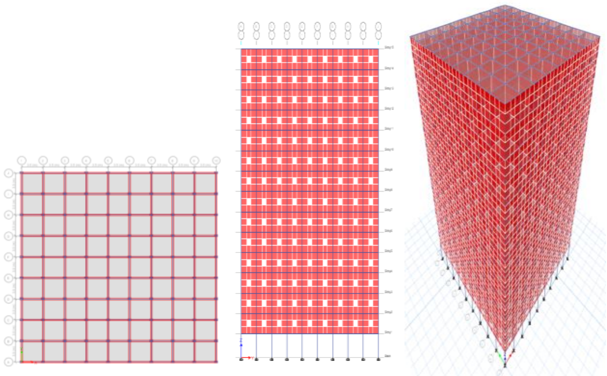

Fig-2.2: Plan, Elevation and 3D View.

Section Parameter of above three models is given below:-

Table-2.2: Section Parameter

S.No	Parameter	Detailed Value
1.	Concrete	M25
2.	Rebar	HYSD500, Fe250
3.	Slab thickness	150 mm
4.	Thickness of load bearing wall	250 mm
5.	Thickness of partition wall	No
6.	Opening in wall	No
7.	Beam size	300x400 mm
8.	Column size	400x600 mm
9.	Zone	IV
10.	Type of frame	Special Moment Resisting Frame
11	Soil type	II
12	Importance factor	1.2

The following type of the load considering on the above model is given below:-

Table-2.3: Load Type

S.No	Load Name	Values
1.	Dead Load	Auto defined
2.	Live load at slab	3KN/m2
3.	Roof load	1.5KN/m2
4.	Floor finishing load	1KN/m2
5.	Parapet wall	7.5KN/m
6.	EX	IS 1893 Part 1 2016
7.	EY	IS 1893 Part 1 2016
8.	Wall load	15KN/m (Auto)

3. METHODOLOGY.

This chapter is including the method of the analysis of the open ground storey building due to various load type, load combination.

3.1. Linear Time History Analysis

It calculates the solution to the dynamic equilibrium equation for the structural behavior (displacement, member force etc.) at an arbitrary time using the dynamic properties of the structure and applied loading when a dynamic load is applied. The Modal superposition method and direct method are used for linear time history analysis. The data of the time history is taken from the file of the Etabs.

3.2. Load Combination:-

According to the IS CODE 1893 part1 2016, we use the mainly 13 load combination which is given below:-

A.1..5(DL+LL)
B.1.2(DL+LL+EX)
C.1.2(DL+LL-EX)
D.1.2(DL+LL+EY)
E.1.2(DL+LL-EY)
F.1.5(DL+EX)
G.1.5(DL-EX)
H.1.5(DL+EY)
I.1.5(DL-EY)
J.0.9DL+1.5EX
K.0.9DL-1.5EX
L.0.9DL+1.5EY
M.0.9DL-1.5EY

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4. RESULTS and CALCULATION.

In the result and calculation chapter we study about the result which came out after the analysis of the above three model:-

4.1. Base Shear

The following table is given for the base shear for above three models:-

Table-4.1: Base Shear

Storey	Elevation	Model1	Model2	Model3
Story15	45.5	2798.9721	2776.0808	2277.37
Story14	42.5	3886.5419	3847.2384	2977.0381
Story13	39.5	3357.2191	3323.2685	2571.5841
Story12	36.5	2866.6272	2837.6379	2195.7974
Story11	33.5	2414.7663	2390.3465	1849.6781
Story10	30.5	2001.6363	1981.3943	1533.2262
Story9	27.5	1627.2373	1610.7815	1246.4416
Story8	24.5	1291.5691	1278.5079	989.3244
Story7	21.5	994.632	984.5735	761.8745
Story6	18.5	736.4257	728.9785	564.0921
Story5	15.5	516.9504	511.7226	395.977
Story4	12.5	336.206	332.8061	257.5293
Story3	9.5	194.1926	192.2288	148.7489
Story2	6.5	90.9101	89.9908	69.6359
Story1	3.5	19.2031	19.0721	16.1211
Base	0	0	0	0

4.2. Storey Overturning Moment (SOM)

The storey overturning moment of the open ground storey building of above three models is given below in the form of table as well as graph:-

Table-4.2: Storey Overturning Moment

Storey	Eleva-tion	SOM MODEL1	SOM MODEL2	SOM MODEL3
Story15	45.5	0.1347	-0.1217	-0.1478
Story14	42.5	2.0864	-2.0837	-2.4846
Story13	39.5	6.7778	-6.798	-7.9162
Story12	36.5	14.1877	-14.2432	-16.4182
Story11	33.5	24.2944	-24.3976	-27.9665
Story10	30.5	37.0768	-37.2398	-42.5366
Story9	27.5	52.5131	-52.7482	-60.1043
Story8	24.5	70.5822	-70.9012	-80.6454
Story7	21.5	91.2623	-91.6774	-104.1354
Story6	18.5	114.5322	-115.055	-130.5501
Story5	15.5	140.3704	-141.0127	-159.8649
Story4	12.5	168.7552	-169.5287	-192.0557
Story3	9.5	199.6654	-200.5815	-227.098
Story2	6.5	233.0794	-234.1495	-264.9673
Story1	3.5	268.9162	-270.1657	-305.6026
Base	0	312.6353	-314.0954	-355.3461

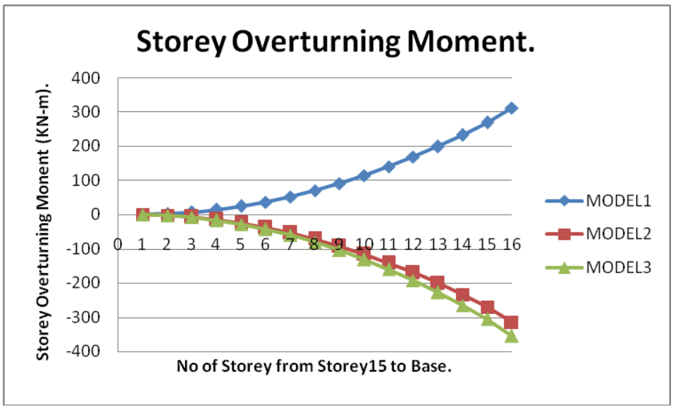

Chart-4.2: Storey Overturning Moment

4.3. Time Period

The following table and line graph is given below for the different three models, which represent the time period from mode1 to mode12

Table-4.3: Time Period

MODE	MODEL1 (TIME (SEC))	MODEL2 (TIME (SEC))	MODEL3 (TIME(SEC))
MODE1	0.715	0.712	0.628
MODE2	0.524	0.519	0.47
MODE3	0.505	0.503	0.444
MODE4	0.118	0.117	0.105
MODE5	0.114	0.113	0.101
MODE6	0.078	0.078	0.069
MODE7	0.034	0.034	0.041
MODE8	0.033	0.033	0.039
MODE9	0.022	0.022	0.027
MODE10	0.022	0.022	0.027
MODE11	0.019	0.019	0.019
MODE12	0.019	0.019	0.019

Chart-4.3: Mode of Time Period

4.4. Storey Stiffness

The following line graph as well as table given below for the storey stiffness for different model. The value of the storey stiffness due seismic force in y direction is negligible so we not take value due to EY.

Table-4.4: Storey Stiffness

STOREY	DUE TO EX/ EY	STOREY STIFFNESS (KN/M2)MODEL1	STOREY STIFFNESS (KN/M2)MODEL2	STOREY STIFFNESS (KN/M2)MODEL3
Story 15	EX	21219585.72	21232356.63	22212424.67
Story 14	EX	50654989.91	50637321.72	51207814.84
Story 13	EX	76049177.64	75997158.58	76199081.45
Story 12	EX	97714357.33	97632407.34	97515707.15
Story 11	EX	115953319	115849764	115462199
Story 10	EX	131072152	130952769	130342417
Story 9	EX	143372135	143245374	142451239
Story 8	EX	153151969	153023314	152091387
Story 7	EX	160708091	160580276	159554337
Story 6	EX	166334854	166212597	165128232
Story 5	EX	170319500	170196298	169130855
Story 4	EX	172958988	172881231	171807298
Story 3	EX	174546381	174285723	173396833
Story 2	EX	174948053	174634769	173342801
Story 1	EX	4573775.238	4572892.392	4571308.677

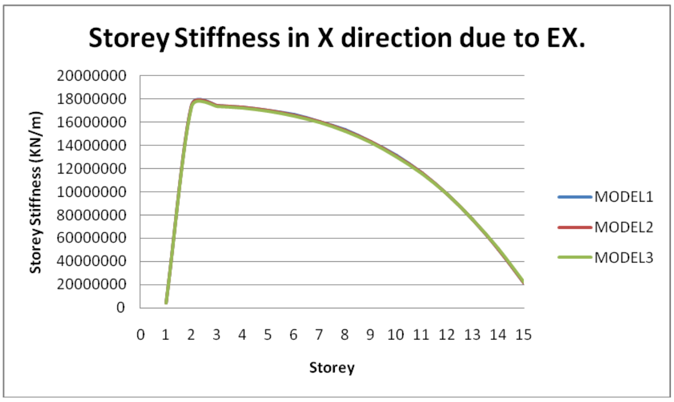

Chart-4.4: Storey Stiffness

3. CONCLUSIONS

The seismic analysis of the open ground storey building in three different conditions. In which first model is with load bearing wall at every position. In the second model providing the opening at the outer wall which is load bearing wall. In the third model outer wall is load bearing wall and inner wall is without opening. After analysis above three models we find some conclusion which is given below:-

1. The mode of the time period for the models3 is better as compared to the other models. In model3, mode of time period decrease about 11% as compared to model2 and about 9.95% decrease as compared to model1. We found that to reduce the mode of time period is depend upon the type of wall and opening.
2. After analysis we found that in model1 has large storey stiffness as compared model2 and model3 from storey12 to storey1. But at storey13 and above we found the model3 have more storey stiffness as compared to the model1 and modol2.
3. In the storey overturning moment we found the model3 have more storey overturning moment at the base of the building in negative direction which is more about 12% as compared to model1. From this result we found that if we increasing the dimension of the opening then it will increase the storey overturning moment at the base so we try to keeping dimension as much as we can reduce.

REFERENCES

[1] IS 1893 Part 1 (2016) Indian Standard Criteria for Earthquake Resistant Design of Structures, *Bureau of Indian Standards*, New Delhi.

[2] Jagadish, R.; H. Achyutha and P. S. Rao (1987) Behaviour of infilled frames with stiffened openings- an experimental study. *Proceedings of International Conference on Modern Techniques in Construction*.

[3] Kanitkar, R. and V. Kanitkar (2004) Seismic performance of conventional multi-storey buildings with open ground storey floors for vehicular parking.

[4] Karisiddappa, (1986) Effect of position of openings on the behavior of infilled frames.

[5] Murty, C. V. R. and S. K. Jain (2000) Beneficial influence of masonry infill walls on seismic performance of RC frame buildings.

[6] Panagiotakos, T. B. and Fardis, M. N. (2001) Deformation of reinforced concrete members at yielding and ultimate

[7] S. B. Smith and C. Carter, (1969) A Method of Analysis for Infilled Frames

[8] Subramanian, N. (2004) Discussion on seismic performance of conventional multi-storey building with open ground floors for vehicular parking by Kanitkar and Kanitkar.

[9]P. Sarkar, A. M. Prasad, D. Menon, "Vertical geometric irregularity in stepped building frames," Engineering Structures, vol. 32, pp. 2175 – 2182, 2010.

[10]. A. Wibowo, J. L. Wilson, N. TK Lam and E. F Gad, "Collapse modelling analysis of a precast soft storey building in Australia," Engineering Structures, vol. 32, pp. 1925 – 1936. 2010.

[11]. C.J. Athanassiadou, (2008). "Seismic performance of R/C plane frames irregular in elevation", Engineering Structures, vol. 30, pp. 1250–1261, 2008.

[12]. H. S. Lee and D.W. Ko "Seismic response characteristics of high-rise RC wall buildings having different irregularities in lower stories," Engineering Structures, vol. 29, pp. 3149–3167, 2007.

[13]. M. Yoshimura, "Nonlinear Analysis of a Reinforced Concrete Building with a Soft First Story Collapsed by the 1995 Hyogoken-Nanbu Earthquake," Cement and Concrete Composites, vol. 19, pp. 213-221, 1997.