Effect of Floating Columns in Multi-Storey Building of Regular and Irregular Plan

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***Abstract*— Civil engineering is a professional engineering discipline that deals with the design, construction, and maintenance of the physical and naturally built environment, including works like roads, bridges, canals, dams, and buildings. Architectural innovations have lead to the inclusion of floating columns in many multi-storey buildings taking into consideration the maximum utilization of minimal area effectievely within the available bylaws. This project deals with the comparative study of analysis of multi-storied building with and without floating columns at different levels in regular and irregular plans, thereby aims at providing a safe location of floating column in a building of regular and irregular plans. The equivalent static analysis are carried out on the mathematical 3D model of G+14 building of regular and irregular plans using the software SAP2000 and the comparison of these models are done. This will help us to find the various analytical properties of the structure and also have a very systematic and economical design for the structure..**

Keywords—Floating Column, Regular plan , Irregular plan

I INTRODUCTION.

The floating column is used for the purpose of architectural view and site situations. The provision of floating columns can be stated as most of the buildings in India are covering the maximum possible area on a plot within the available bylaws. Since balconies are not counted in floor space index (FSI), buildings have balconies overhanging in the upper stories beyond the column foot print areas at the ground storey, overhangs from 1.2m to 1.5m in plan are usually provided on each side of the building. In such cases, floating columns are provided along the overhanging perimeter of the building. Most of the time, architect demands for aesthetic view of the building, in such cases also many of the columns are terminated at certain floors and floating columns are introduced.

The objective of the present work is to study the behavior of multistory buildings with and without floating columns at different levels of building. The building is modelled and analysed to find the behavior of buildings under different conditions. RC Frames of different stiffness on floor wise and height of building are considered. The base of the building frame is assumed to be fixed. The time history analysis of these RC Frames has been done using FEM Package SAP2000.

The structural analysis is based on engineering mechanics, mechanics of solids, laboratory research, model and prototype testing, experience and engineering judgment. The basic methods of structural analysis are flexibility and stiffness methods. The flexibility method is also called force method and compatibility method. The stiffness method is also called displacement method and equilibrium method.

In this project particular four construction practices often encountered: (i)Regular shape multi-storey building without floating column, (ii) Regular shape multi-storey building with floating column at 3 levels (iii) Irregular building without floating column (iv) Irregular building with floating column at 3 levels.

II. METHODS OF SEISMIC EVALUATION

The different analytical methods are categorized below as follows:

1. Linear static analysis or equivalent static Analysis
2. Linear dynamic analysis by response spectrum Method
3. Nonlinear static analysis

III SCOPE AND OBJECTIVE

The objective of the project are listed below.

1. Analytical investigation in ETABS on G+3 RC frame buildings with an aspect ratio of diaphragm 4:1 with sizes of openings(20%,40%,60% of the total diaphragm area) at different locations.
2. To investigate diaphragm openings influence with respect to size of openings at different locations on seismic response of building
3. To compare the different methods of analysis (Linear static, and non linear static analysis) on the building with diaphragm opening irregularity

IV.METHODOLOGY

a. A thorough literature review to understand the seismic evaluation of building structures and application by different linear and non linear analysis
b. A hypothetical G+14 Building is selected and floating columns are provided at different levels of regular and irregular building and is modelled in SAP2000.
d. Analyze the building using linear static and nonlinear static analysis methods.
e. Analyze the results and arrive at conclusions

V.STRUCTURAL MODELING OF BUILDING

In this project we are studying the effect of floating columns provided at different location on RC framed structure. The structure's plan size is 35m x 30m..The structure is modeled and analysed in SAP2000. The various details of the building are:
Storey height = 3.9 m
Beam dimension = 350 x 500
Column dimension = 650 x 650

TABLE I Properties of Materials Used

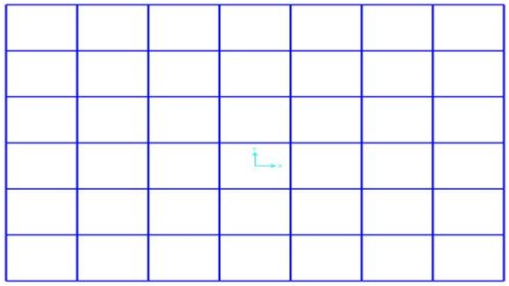

Fig 1Plan of Regular building

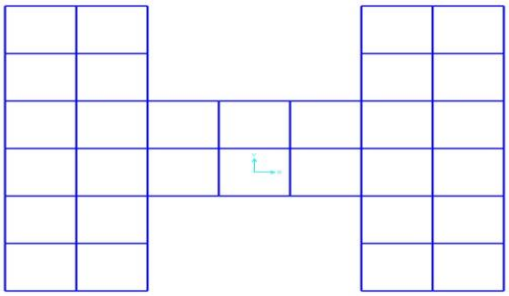

Fig 2 Plan of Irregular building

VI. FLOATING COLUMN LOCATIONS

Two cases each for regular building and irregular building are done. Building without floating column is compared with building with floating columns at different levels for both regular and irregular cases. Floating columns are provided at ground,fifth, and tenth floor and its behavior is checked with building without floating column.

VII. ANALYSIS OF HYPOTHETICAL BUILDING

A. LINEAR STATIC ANALYSIS

Linear Static analysis was performed on buildings with floating columns at different locations using SAP2000. The displacements of buildings were compared and plotted using graphs.

VIII RESULTS AND DISCUSSION

1.LINEAR STATIC ANALYSIS
Lateral Displacement

Concrete	M30
Steel	Fe 415

Lateral displacement for cases of floating columns provided at different levels of building with subcases of being provided by removing the outer and inner columns of the particular level.

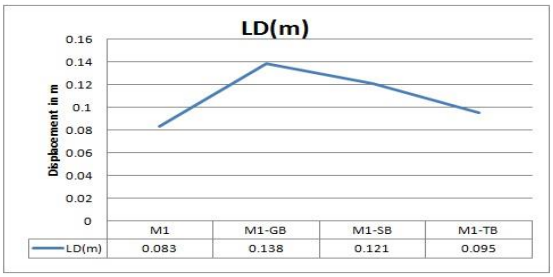

Fig 3 Lateral displacement for floating columns provided at outer regions for regular building

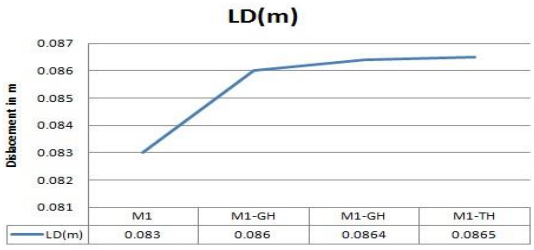

Fig 4 Lateral displacement for floating columns provided at inner regions for regular building

Lateral displacement for regular building are found for those without floating column and those with floating columns being provided at outer and inner regions of 3 different levels.

Fig 3 shows the lateral displacement of regular building with floating columns provided at outer regions of each level. It shows that for cases of provision of floating column at outer region it is least prone to displacements and thereby failure by providing it towards higher levels.

While fig 4 shows those for floating columns being provided at inner regions of the building. From this graph it is clear that floating columns are advisable to be provided at lower levels of building in case of floating columns are to be provided in the inner regions.

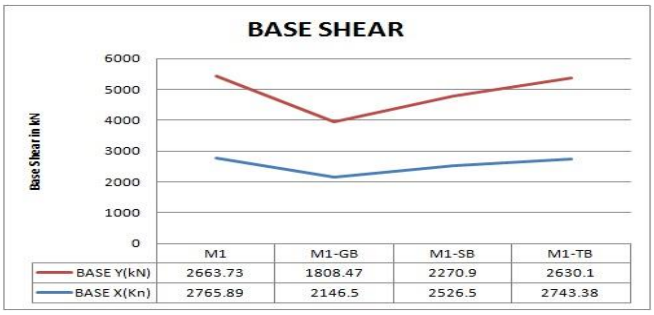

Fig 5 Base shear for floating columns provided at outer regions for regular building

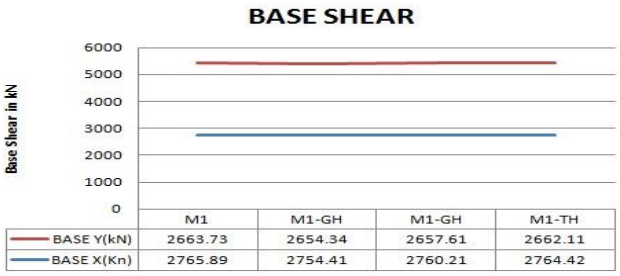

Fig 6 Base shear for floating columns provided at inner regions for regular building

Fig 5 shows the base shear of regular building with floating columns provided at outer regions of each level. It shows that for cases of provision of floating column at outer region the base shear is least for those at lower levels for both X and Y.

Base shear for regular building with floating columns at inner levels are shown in fig 6. It shows that base shear along X and Y are almost similar for all levels.

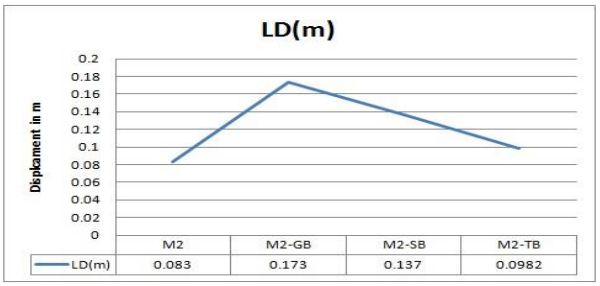

Fig 7 Lateral displacement for floating columns provided at outer regions for irregular building

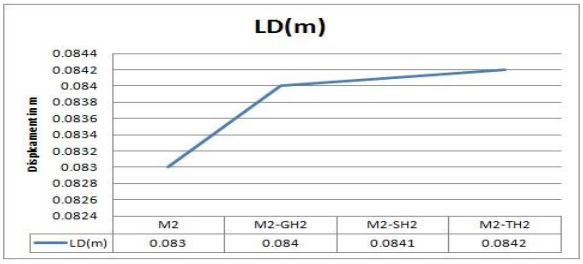

Fig 8 Lateral displacement for floating columns provided at inner regions for irregular building

Fig 7 shows the lateral displacement of irregular building with floating columns provided at outer regions of each level. It shows that for cases of provision of floating column at outer region higher floors is least prone to displacements and thereby failure .Fig 8 shows those for floating columns being provided at inner regions of the building. From this graph it is clear that floating columns are advisable to be provided at lower levels of building in case of floating columns are to be provided in the inner regions.

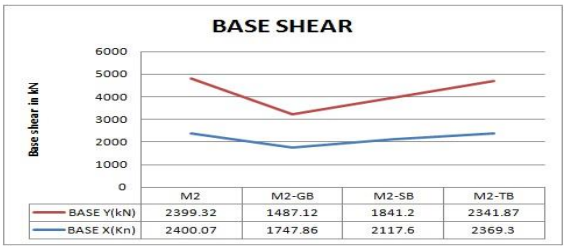

Fig 9 Base shear for floating columns provided at outer regions for irregular building

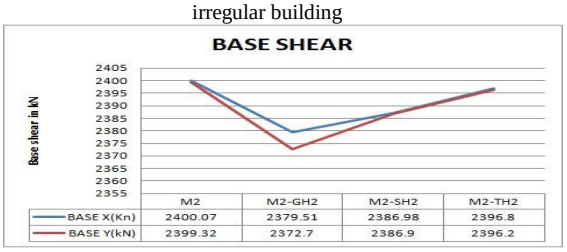

Fig 10 Base shear for floating columns provided at inner regions for irregular building

From fig 9 and 10 it is clear that the base shear of irregular building with floating columns provided at outer and inner regions of each level is least for those at lower levels for both X and Y.

VII CONCLUSION

A. Main Observations and Conclusions

The paper aims to find the effect of floating columns provided at different levels on seismic response of RC structures. Many researchers have put forward many approaches to observe seismic behavior of RCC framed buildings with irregularities considering various methods and these papers have been reviewed . Provision of floating columns are points of failure for a building. But in the present world of construction it has become a common practice to provide the same. The paper aims to fix the generalized position for floating columns where the building can withstand with least chance of failure for building.

Thus finally from linear analysis we can conclude that among the considered buildings with floating columns at different levels, it is safer to provide building with floating columns in the outer region at the higher levels and for those which require floating columns at the inner regions are to be provided along the bottom levels.

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