International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 1689-1698 www.ijaem.net ISSN: 2395-5252

Comparative Analysis and Design of Flat and Grid Slab System with Conventional Slab System by using Etabs software

Vicky Kamthe
V M Institute of Engineering & Technology, Nagpur,Maharashtra

Submitted: 15-05-2022 Revised: 20-05-2022 Accepted: 25-05-2022

ABSTRACT
In the present day, Structural Engineering is a branch of Civil Engineering in which the look at is done to recognize how the structure behave while building is constructed at real environment and to perceive the numerous forces like axial force and shear force, maximum storey displacement, storey stiffness, lateral loads and storey drifts for grid slab and flat slab with conventional system.When the analysis come to complicated structure or multistory structure the guide calculation will be hard to carry out and subsequently there is diverse software available to carry out those calculations, this software program are STAAD Pro V8i, ANSYS, ETAB, Safe and so forth. In this examine, slab machine layout and evaluation for G+10 building for seismic zone III and having medium soil situation by the usage of ETABS.Four and those slab gadget analyzed for one of a kind plan location or grid length/ spacing of the column. The evaluation and layout of slab system is finished as per IS 456-2000 and IS 1893-2002. In the present work the comparison of Conventional building and Flat slab without Drop in different zones, using ETABS software. Therefore, the characteristics of a seismic behavior of Grid slab,Flat slab and Conventional RC frame building measures for guiding the concept and design of these structures and for improving the performance of buildings during seismic loading.

Keywords: Storey displacement, storey stiffness, Grid slab, flat slab, Etabs.

I. INTRODUCTION

In Urban areas due to scarcity of space vertical construction has developed such as low-rise, medium and tall buildings. These various types of buildings utilizesframe structures as Conventional RC frame structure and Flat slab frame structure. Conventional RC frame structure possess Conventional slab used for the construction that accomplishes a system where a slab is supported by beams and columns. It called be as Beam –Slab Load Transfer method, a formula that is common practice all over the world .The another form of frame structure called Flat Slab, where slab directly rests on column. This is also called as Beamless Slab as there would be no beams in this frame structure.

The flat slab arrangement of structure is one in which the beam is used in the conventional procedures of construction through away with the directly rests on column as well as the load from the slabs is directly conveyed to the columns and then to the footing. Drops or columns are generally provided using column heads or capitals. Flat slabs are being used chiefly in office buildings due to reduced formwork cost, fast excavation, and easy establishment. Grid floor systems comprising of beams move apart at regular intervals in perpendicular directions, monolithic with slab.Grid Slab Interconnected grid systems are being commonly used or supporting building floors bridge decks and overhead water tanks slabs. A grid is a planar structural system composed of continuous members that either intersect or cross each other. Grids are used to cover large column free areas and have been constructed in number of areas in India and abroad. Is subjected to loads applied normally to its plane, the structure is referred as Grid. It is composed of continuous member that either intersect or cross each other. Grids in addition to their aesthetically pleasing appearance provide a number of advantages over the other types of roofing systems.

1.1 GRID SLAB

Grid floor systems is a conventional method of construction in which beams are spaced at regular intervals in perpendicular directions and monolithic with slab. They are generally employed for architectural reasons for large rooms such as

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 1689-1698 www.ijaem.net ISSN: 2395-5252

auditoriums, vestibules, theatre halls, show rooms of shops where column free space is required. Often the main requirement. The rectangular or square void formed in the ceiling is advantageously utilized for concealed architectural lighting. The sizes of the beams running in perpendicular directions are generally kept the same. The grid slab system is used in the areas where less number of column are provided, i.e. it is basically used in the areas which has huge spaces. This type of slab is used in airports, parking garages, commercial and industrial buildings, residencies and other structures requiring extra stability.

1.2 FLAT SLAB

The term flat slab means a reinforced concrete slab with or without drops, supported generally without beams, by columns with or without flared heads. Flat slabs are beam less structures which are very usable in these days, in flat slab structure we are only adding panels on the top of the columns and increasing the thickness of the slab, structures with flat slabs are more usable because of decreasing floor to floor height of the structure, low amount is required to be constructed and for other reasons as architectural requirements.

Types of Flat slab system:

1) Flat slab without drop panel
2) Flat slab with drop panel
3) Flat slab with periphery beam with drop panel
4) Flat slab with periphery beam without drop panel

1.3 CONVENTIONAL SLAB SYSTEM

The slab which is rested on Beams and columns is called a conventional slab. In this kind, the thickness of the slab is small whereas the depth of the beam is large and load is transferred to beams and then to columns. It requires more formwork when compared with the flat slab. In the conventional type of slab there is no need for providing column caps.

A conventional slab is classified as either:

1) **One-way slab**: Supported by beams on two opposite sides, carrying the load along one direction.
2) **Two-way slab**: Supported by beams on all four sides, carrying the load along both directions.

II. LITERATURE REVIEW

2.1 Amit A. Sathwane studied that the among flat slab, flat slab with drop and grid slab which is economical for the nexus point opposite to vidhan bhavan and beside NMC office. The analysis of flat slab, flat slab without drop and grid slab done both manually by IS 456-2000 and by STAAD PRO V8i. It is found in the study that flat slab with drop is economical then rest of other considered slab for the nexus point. It is also revealed in the study that concrete required for grid slab is more than the flat slab with and without drop and steel required for the flat slab without drop is more than the flat slab with drop and grid slab.

2.2 D. Ramya et all,. (October 2015)analyzed the multi-story (G+10) building by both STAAD PRO V8i and ETABS software. In the study comparison between these two software is done to find out which give economy of multi storied (G+10) building. It is show that in the study STAAD PRO is much simple to work with as compare to ETABS software. It is also show that quantity of steel given by the ETABS is 9.25% less than by STAAD Pro when analyzed G+10 multistory building. The quantity of concrete show by both the software's is found same for multistory building. In the study it is revealed that the most economical section given by ETABS.

2.3 Mohana, et.al (2015) "Comparative Study of Flat Slab and Conventional Slab Structure Using ETABS for Different Earthquake Zones of India", analyzed a G+5 commercial multistoried building having flat slab and conventional slab for the parameters like base shear, story drift, axialforce, and displacement. The performance and behavior of both the structures in all seismic zones of India has been studied. The story shear of flat slab is 5% more than conventional slab structure, the axial forces on flat slab building is nearly 6% more than conventional building, the difference in story displacement of flat and conventional building are approximately 4mm in each floor. The work provides reasonable information about the suitability of flat slab for various seismic zones without compromising the performance over the conventional slab structures.

2.4 S. D. Bothara et.al studies discuss the comparative study of the earthquake on flat slab & Grid floor system. Grid slab consisting of beam spaced at regular intervals in perpendicular directions, monolithic with slab, whereas Flat slab does not consist of beams. A comparative study gives how flat slab is more feasible than Grid slab.

2.5 M. A. Eebrikhas focused on the comparison of Flat-slab RC buildings conventional RC slab building seismic conditions. The study showed that the structural effectiveness of flat-slab construction is hindered during earthquakes. This results showed fragility analysis could not be undertaken under seismic conditions though Flat slab is used the structural system. This study focuses slabs on the derivation of fragility curves and comparison made with those in literature for a moment –resisting curves that conclude that flat slab shows similarity to that in literaturefor small-medium height buildings and varies as height increases.

2.6 K.S.Sable [2012]analyzed seismic behavior of building for different heights to see what changes are going to occur if the height of conventional building and flat slab building changes. It was concluded that story drift in buildings with flat slab construction is significantly more as compared to conventional R.C.C building. As a result of this, additional moments are developed. Therefore, the columns of such buildings should be designed by considering additional moment caused by the drift.

III. METHODOLOGY

A RCC structure is primarily composed of beams, columns, slabs and foundation and this whole system behave as a one unit and transfer load finally to the footing. Normally the flow of load in the building is from slab to beam, beam to column and finally to footing. In the current study we have taken different type of floors for different grid size and for this purpose we have utilized the ETABS software. The different types of floors taken are conventional slab, flat slab, and grid slab having same elevation.

1) The representation of maximum response of idealized single degree freedom system having certain period and damping, during earthquake ground motions.
2) The Buildings are assumed to be in Zone-III.
3) Analysis of Floors using ETABS 2016.
4) The buildings are being designed as per IS 456:2000 & IS 1893:2016.

1.4 DESCRIPTION OF PROJECT WORK

In present work in order to determine dynamic response of flat slab without drop and conventional reinforced concrete framed structure for different height in seismic zone III, it will be modeled and analyzed in ETABS software. Linear dynamic response spectrum analysis will be performed on the structure.

A) Building configuration, loading data and earthquake data

TABLE 1.DESIGN DATA OF BUILDING

Sr.No.	Specifications	Different types of slab system		
		Conventi-onal Slab	Flat Slab	Grid Slab
1	Plan Dimension	30 X 30	30 X 30	30 X 30
2	Length of Grid in x-direction	5 m	5m	5m
3	Length of Grid in z-direction	6m	6m	6m
4	Floor to Floor height	3m	3m	3m
5	No. of Stories	10	10	10
6	Plinth Level	1.5	1.5	1.5
7	Slab Thickness	150mm	150mm	150mm
8	Size of Beam	300 x 500	300 x 500	300 x 500
9	Size of Column	450x600	450x600	450x600
10	Grade of Concrete	M45	M45	M45
11	Grade of Steel	Fe415	Fe415	Fe415

TABLE 2. EARTHQUAKE DATA OF BUILDING

Live Load	a) On Roof = 1.5 b) On Floor= 3
Floor Finish	**1.5**kN/m^2
Earthquake data	Zone III (Type II medium soil) Importance factor = 1.2 Response reduction factor = 5

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 1689-1698 www.ijaem.net ISSN: 2395-5252

	Seismic Zone Factor, Z = 0.16

3.2 ETABS MODELS

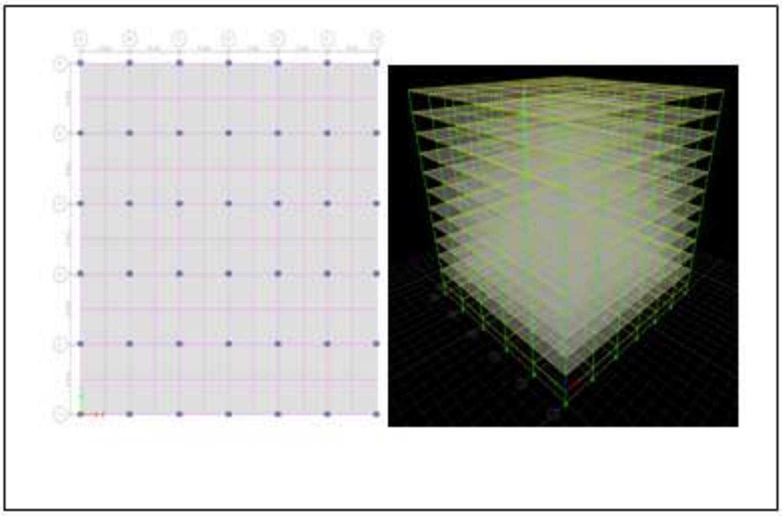
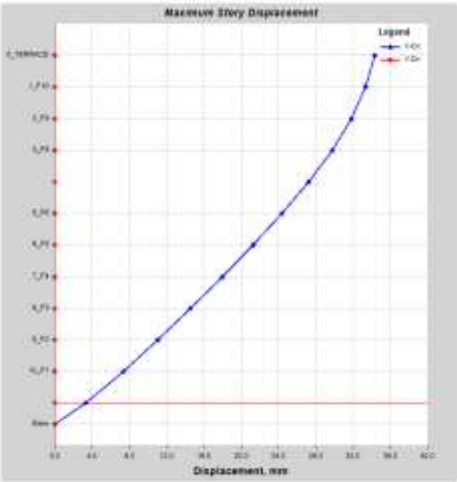


Fig 1 –G+10 MODEL STRUCTURE AFTER ANALYSIS IN ETABS

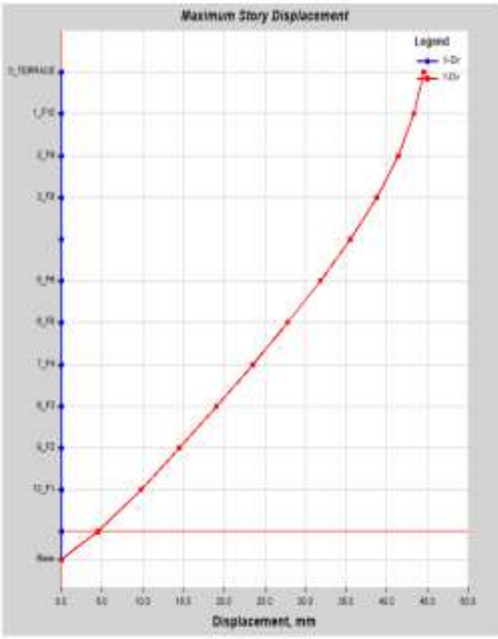
IV. RESULTS AND ANALYSIS

4.1 Graphical Representation of G+10 Multistorey Building in Grid Slab System

Maximum story Displacement at X Due to load EQx

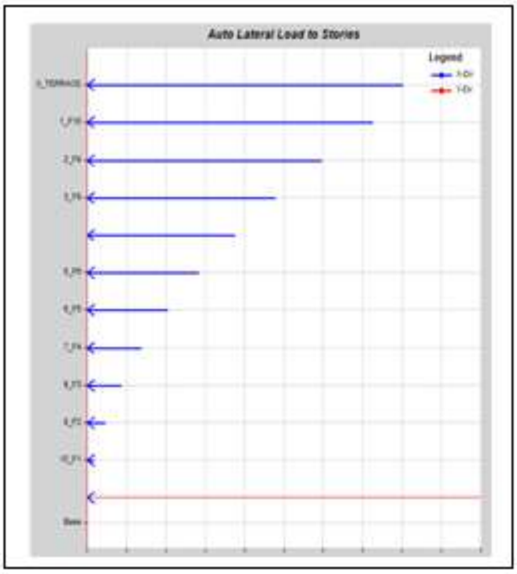


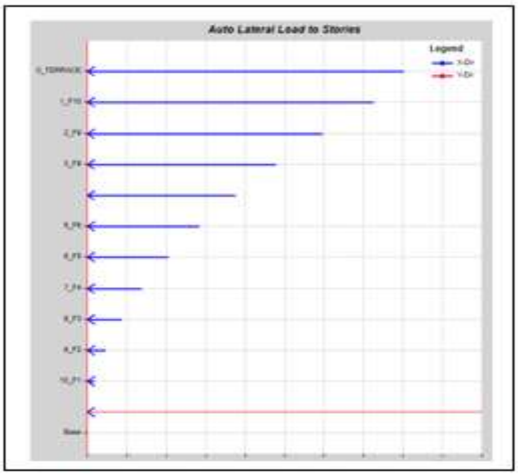
Maximum story Displacement at Y Due toload EQy



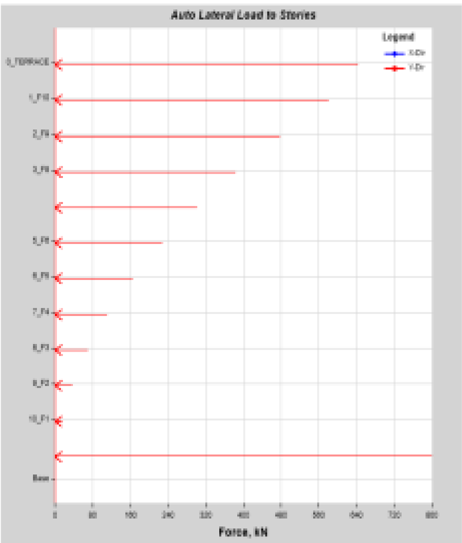
Lateral Loads at X due to EQx

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 1689-1698 www.ijaem.net ISSN: 2395-5252

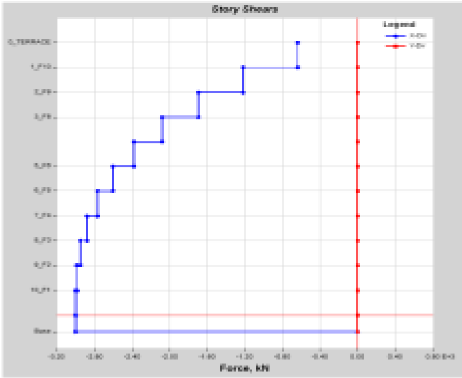




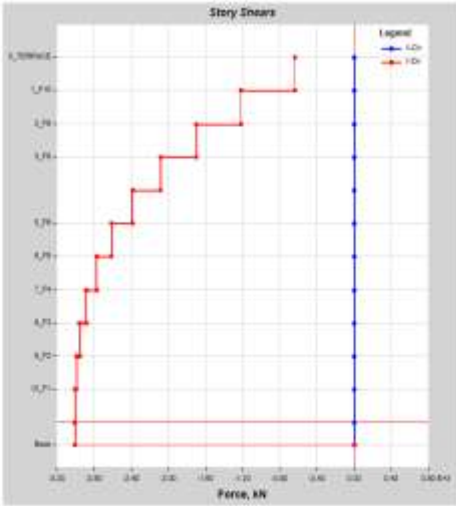
Lateral Loads at Y due to load EQy



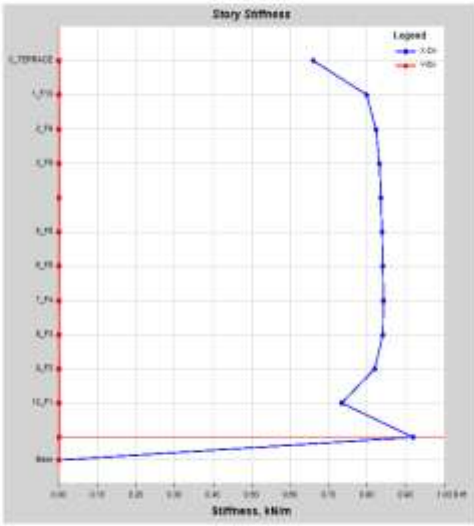
Story Shear at X Due to load EQx



Story Shear at Y Due to load EQy

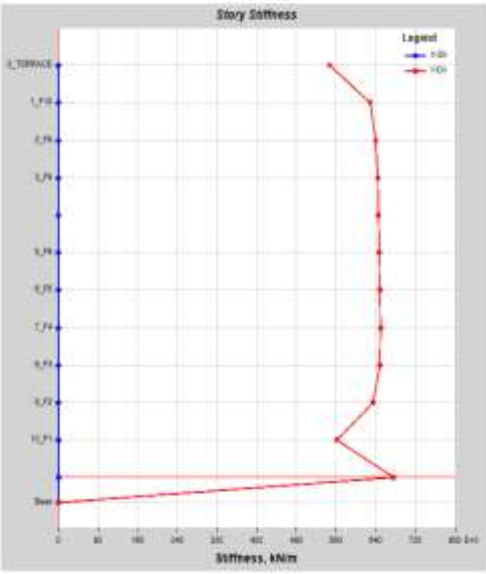


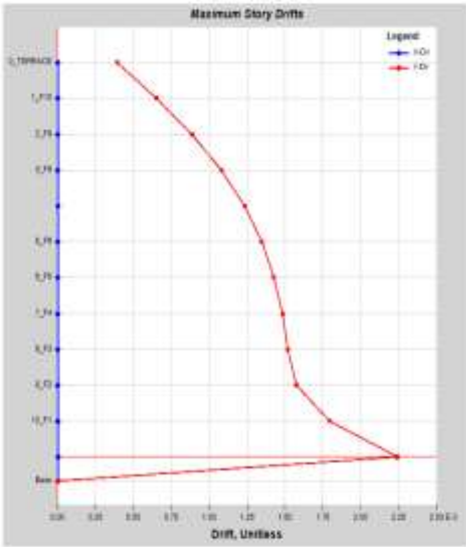
Storey Stifffness at X due to load EQx



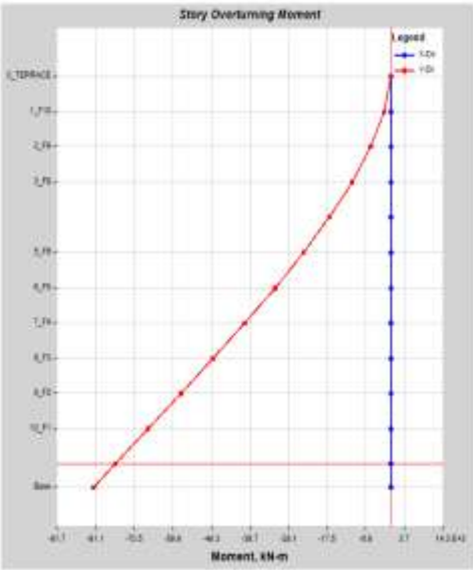
International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 1689-1698 www.ijaem.net ISSN: 2395-5252

Story Stiffness at Y Due to load EQy

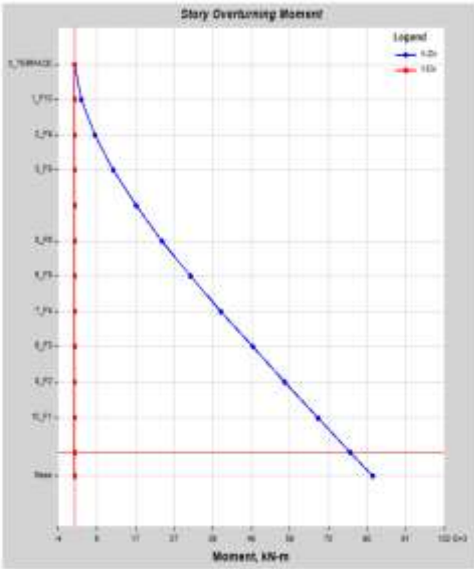




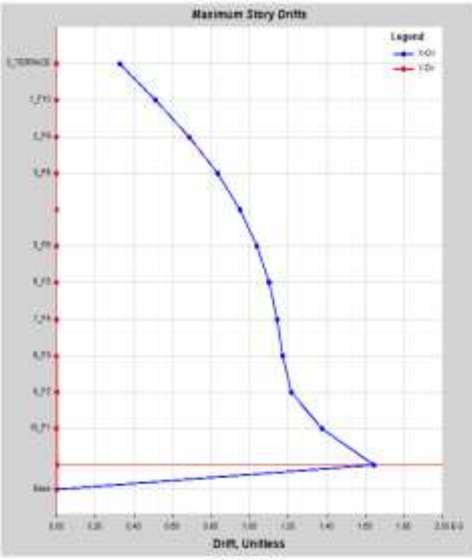
Story Drifts at Y Due to load EQy



Story Moments at X Due to load EQx



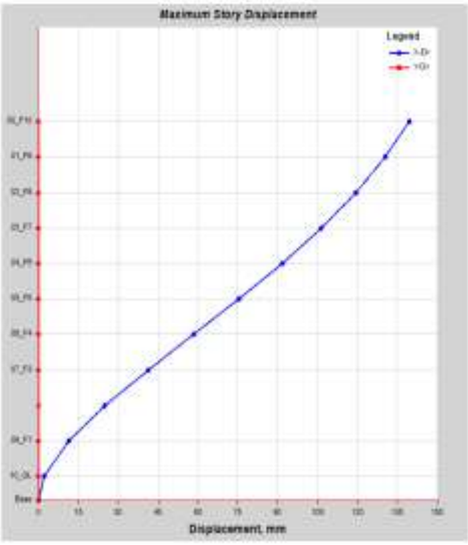
Story Moments at Y Due to load EQy



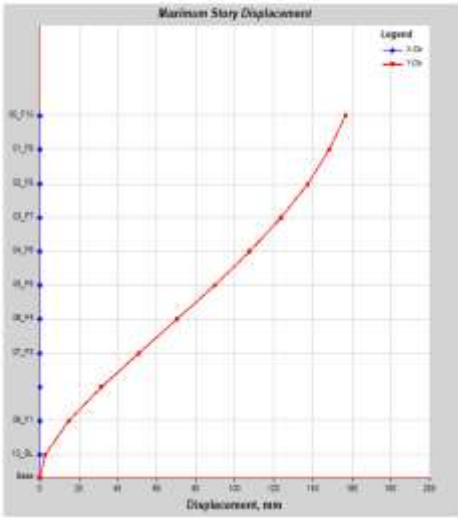
Story Drifts at X Due to load EQx

4.2 Graphical Representation of G+10 Multistorey Building in Flat Slab System

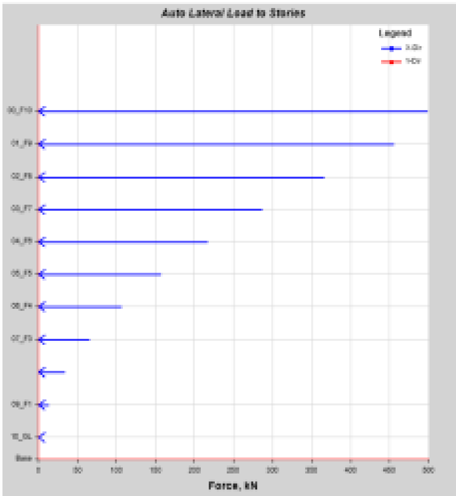
Maximum story Displacement at X Due to load EQx



Maximum story Displacement at Y Due to load EQy

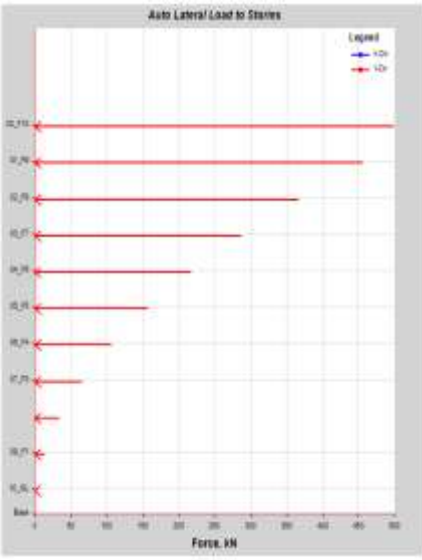


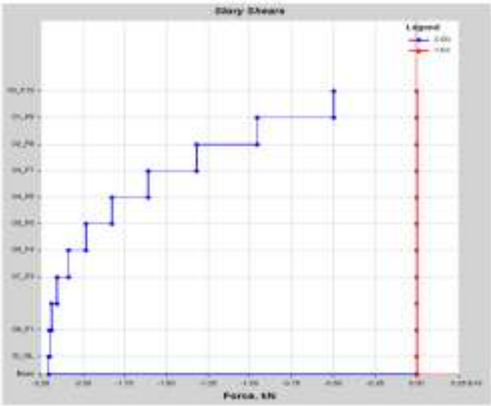
Lateral Loads at X due to load EQx



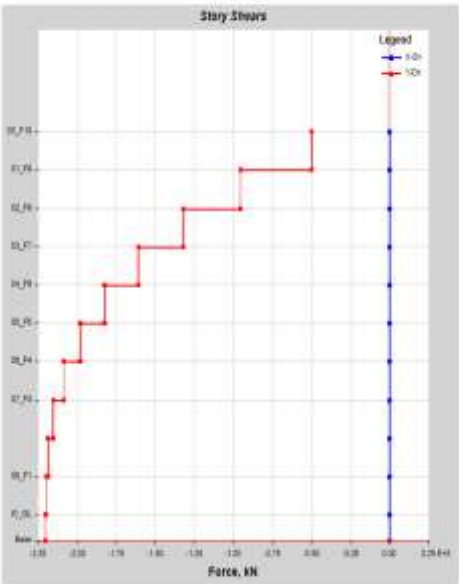
Lateral Loads at Y due to load EQy

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 1689-1698 www.ijaem.net ISSN: 2395-5252

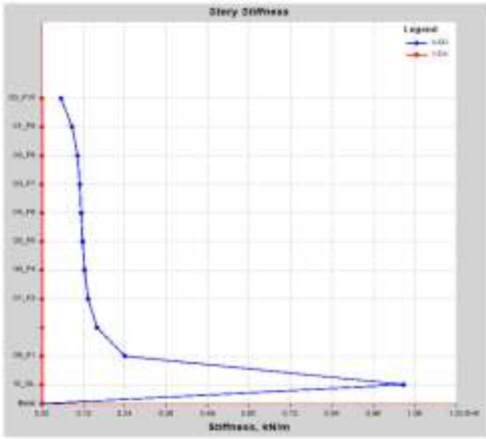




Story Shear at X Due to load EQx

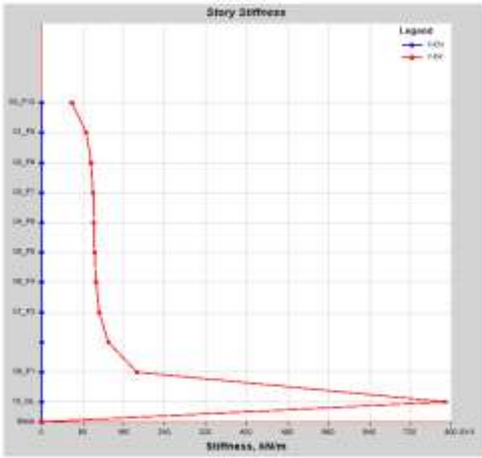


Story Shear at Y Due to load EQy

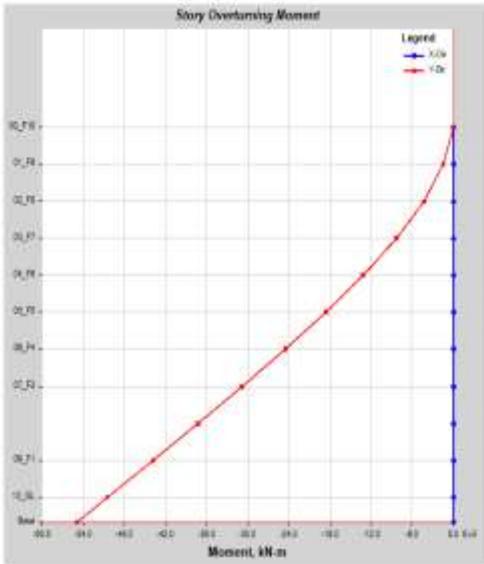


Story Drifts at X Due to load EQx

Story Stiffness at X Due to load EQx

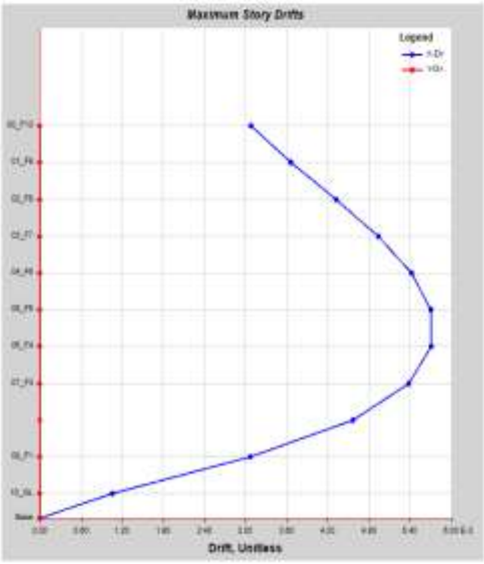


Story Stiffness at Y Due to load EQy

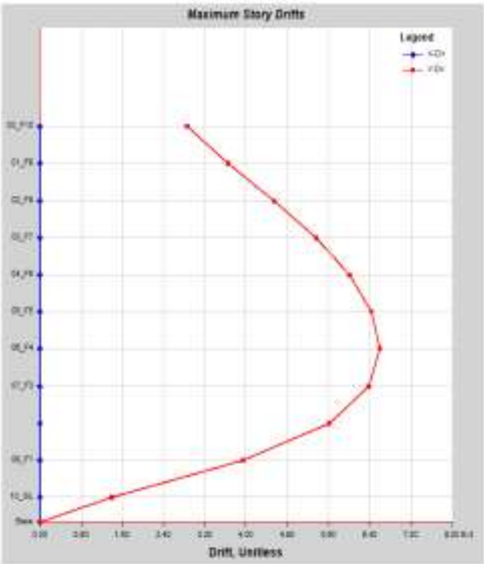


Story Moments at X Due to load EQx

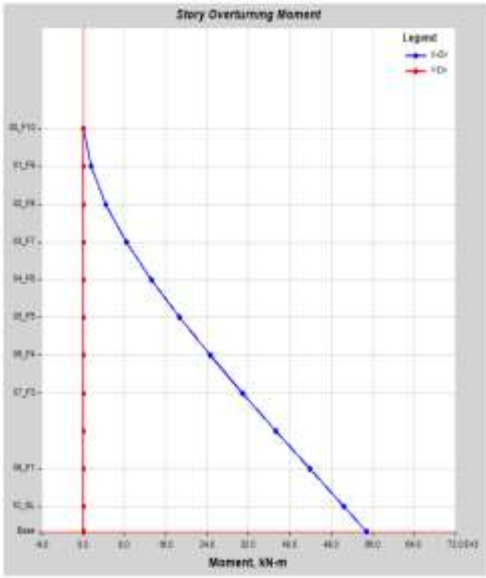
International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 1689-1698 www.ijaem.net ISSN: 2395-5252



Story Drifts at Y Due to load EQy



Story Moments at Y Due to load EQy



V. CONCLUSION

1.Storey displacement is high at top storey and least at the base of the structures. As the height of the building increases the value of displacement also increases.

2. Flat slab is provided with drop and column head to reduce large shear force and negative bending moment.

3.For Grid slab and irregular building systems the values of drift in both X and Y direction are less for building using Grid slab system than building with Flat slab system. As per displacement point of viewGrid slab will have less displacement than Flat slab systems.

4.ETABS is very essential tool to analyze the structure, and very fast and accurate results can be obtained .

SCOPE OF THE WORK

1. Comparisons of flat plate (without drop) and flat slab (with drop) can be studied for all seismic zones

2. Comparisons of pretension and post tensioned flat slab with or without drops.

3. Cost comparisons of various types of slabs available.

REFERENCES

[1]. IS: 875-1987. 'Indian Standard Code of Practice for Design Loads (other than Earthquakes) for Buildings and Structures,

(2nd revision).' Bureau of Indian Standard, New Delhi.
[2]. K.N. Mate, Volume 4 Issue 6, June 2015 Study of Flat Slab, International journal of science and research (IJSR), pp.1106-1110.IS1893-2002Indian standards code of practice for criteria of Earthquake resistance design of structures.
[3]. Navyashree K. Sahana. Use of flat slab in high seismic zone volume 3 issued on 08/august 2014.
[4]. Professor KavanM.R ,Mohana HS Comparative study of flat slab ad conventional slab for earthquake using ETABS in all zones in INDIA volume2issue 03:june 2015
[5]. M. Walker , a study on Earthquakes-that gives earthquake and its effect.
[6]. R. Clough,, and J. Penzien, Dynamics of Structures, McGraw-Hill, New York.
[7]. 1993 Structural Engineers Association of California, Recommended Lateral Force Requirements and Commentary, Structural Engineers Association of California, Sacramento, 1996 .
[8]. Earthquake Resistant Design of Structures (English) 1st Edition by Manish Shrikhande and Pankaj Agarwal.
[9]. Bhavikatti S.S, "Advance R.C.C. Design" , New Age International (p) Limited, Publishers, New Delhi, India.
[10]. www.wikipedia.org