ANALYSIS AND DESIGN OF MULTI-STOREY BUILDING WITH GRID SLAB USING ETABS

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ABSTRACT: Grid floor systems consist of beams spaced at regular intervals in perpendicular directions, monolithic with slab. They are generally employed for architectural reasons for large rooms such as auditoriums, vestibules, theatre halls, show rooms of shops where column free space is often the main requirement.

In present study, "Analysis and Design of multi-storey building with grid slab using ETABS" is carried out and parameters like quantity of concrete, quantity of steel, bending moment, shear force and displacement of grid slab is considered .In the present study, G+6 Building is considered and analysis and design is done for both Gravity and lateral (earth quake and wind) loads. The analysis and design of slab system is done as per IS 456-2000 and IS 1983-2002.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. Instead of rectangular beam grid considered here a diagonal. And this is compared with the flat slab.

I. INTRODUCTION

Building construction is the engineering deals with the construction of building such as residential houses. In a simple building can be define as an enclose space by walls with roof, food, cloth and the basic needs of human beings. In the early ancient times humans lived in caves, over trees or under trees, to protect themselves from wild animals, rain, sun, etc. as the times passed as humans being started living in huts made of timber branches. The shelters of those old have been developed nowadays into beautiful houses. Rich people live in sophisticated condition houses. 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.

STRUCTURE GRID:

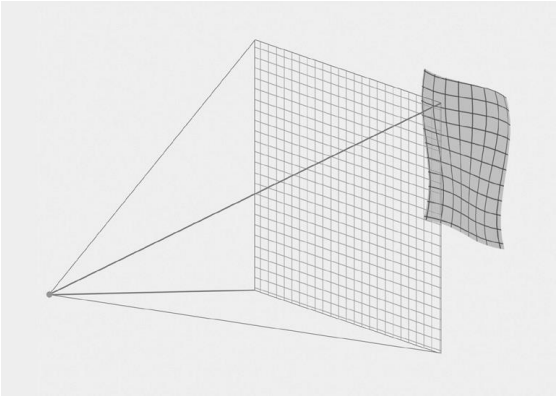
The plank and beam system described above is the simplest system for creating flat, horizontal surfaces. However, greater efficiency can be achieved by designing the flooring as one integral slab and spanning the flooring in two directions supported by a rectilinear grid of beams known as structural grid.

SKEWED GRIDS:

When the overall shape of a structural grid does not approximate a square, structural and economic efficiency can sometimes be gained by employing a skewed grid.

CURVED SURFACE GRIDS :

The skewed grid can be warped to form a curved surface grid and spans large distances in an efficient manner. The structural concept of the arch is combined with the characteristics of skewed grids to increase efficiency.



DIAGONAL GRID :

A Diagonal grid is a framework of diagonally intersecting metal, concrete or wooden beams that is used in the construction of building and roofs.

II. OBJECTIVES

•To Plan Multi-storey Building Using AUTOCADD

• To analyses and design a multi-storey building with Grid Slab using ETABS

III. ANALYSINGG OF BUILDING AND MODELLING IN ETABS

A G+6 STOREY BUILDING WITH PLAN OF 40×40 M each storey height of 3m was analysed in ETABS .The structure is divided into frame and shell elements. Grid lines are made for the x,y,z coordinates ,x-direction is 8m and Y-direction 8m.

1.Preparing grid for layout

2.Assigning member properties of beams, columns and slab and wall panels.

3.Preparing load cases lie Dead, Live ,Earthquake and wind loads.

4.Make load combinations and modal mass of the structure.

5.Run analysis.

6.Note doun the results

The materials used for the analysis are M-30 grade reinforced concrete for beams and column and slab and Fe-500 grade for the entire structure.

The model details are given below :

- Number of stories = G+6
- Plan dimension =40×40m
- No .of .bays in X- directions=6
- No..of. bays in Y-Directions=6
- Height of each storey =3m
- Slab depth =100mm
- Size of Column =300×450 mm
  =300×600mm
  Size of the beam =300×450mm

Loading condition

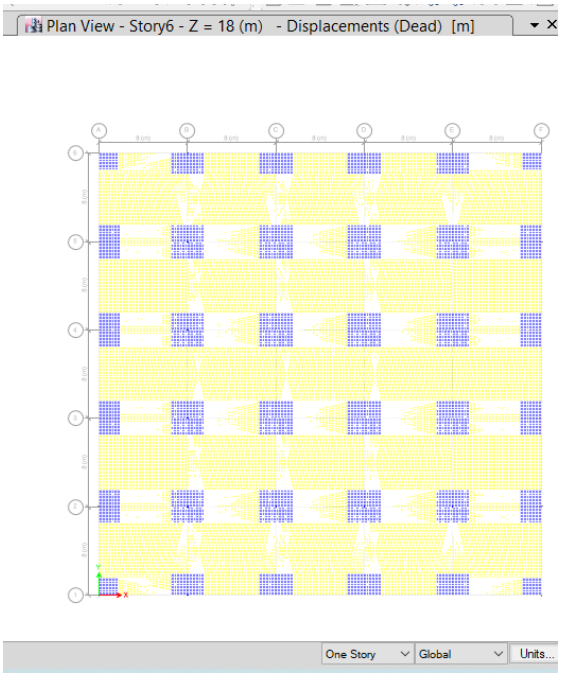
The loads considered during design and analysis of multistory building is as follows

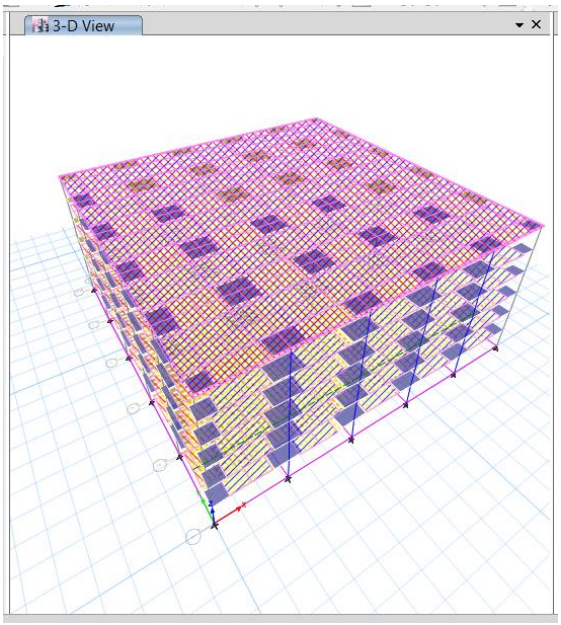
1.Dead load: It is taken as according to IS -875(PART 1):1987

(A)Dead load = Density of concrete ×Slab Thickness =25KN/m×.100 m=2.5KN/m^2

(B) Masonary load n plate =1KN/m

(C)Floor finishing =1.5kn/m^2





2.Live load : Its calculated as per IS-875 (PART 2):1987

Live load on floors =2KN/m^2

Total weight of slab =7.65KN/m^2

3.Earthhquake load :It is calculated as per IS-1893 (Part1):2002

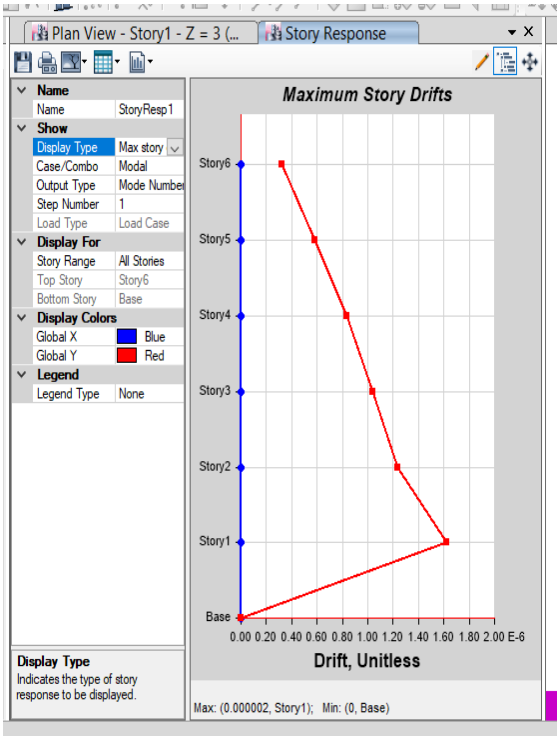
Seismic Definition

Earthquake zone =III (Z=0.16)

Response reduction factor =5 Importance Factor=1.5(very Important Buildings)

Rocks and soil Site Factor=1 Damping=5%(0.0 5).

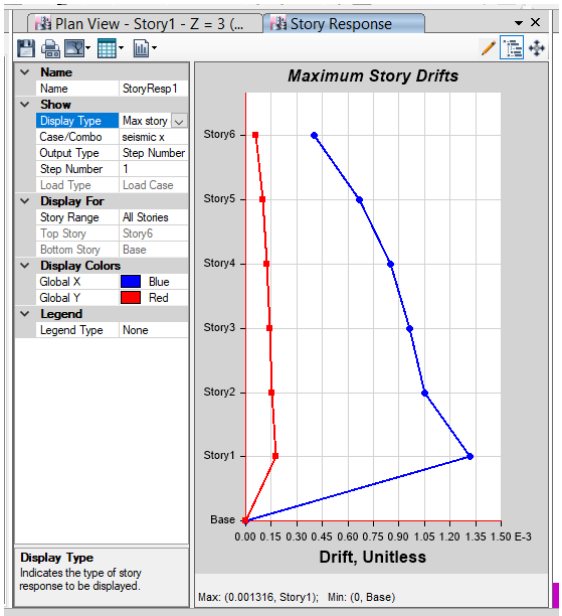
Soil type :Medium soil



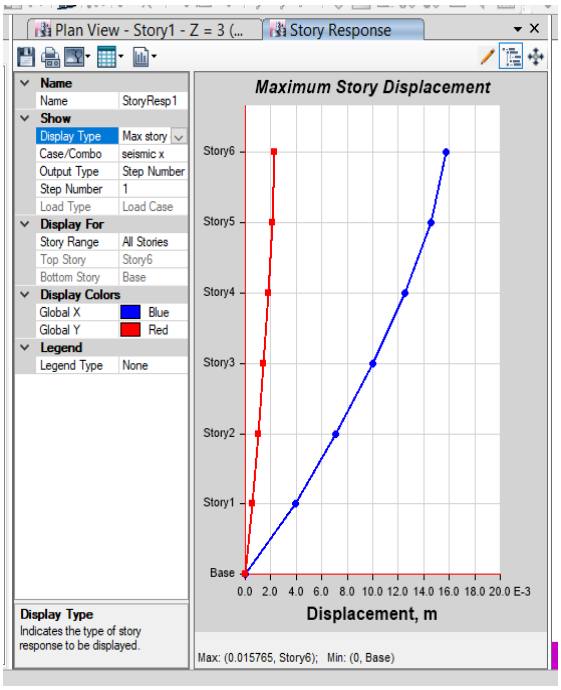
MAXIMUM STOREY DRIFTS

The following are the graphs derived from waffle slab analysis Maximum storey Displacements : storey drift is the difference of displacements between two consecutive stories divided by the height of the storey. Storey displacements is the absolute value of displacement of the storey under action of the lateral forces.

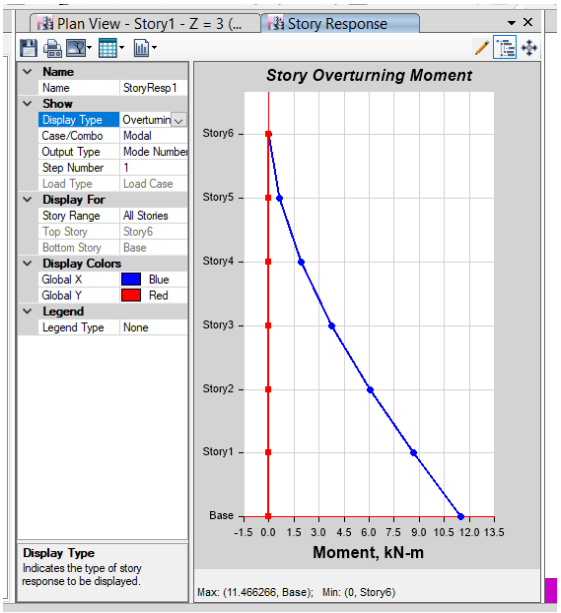
1) Storey shear :It is the lateral force acting on a storey due to the force such as seismic and wind force .It is calculated for each storey, changes from minimum at the top to maximum at the bottom of the building.
2) Storey stiffness:Stiffness is the extent to which an object resists deformation in response to an applied force .The complementary concept is flexibility or pliability: the more flexible an object is ,the less stiff it is



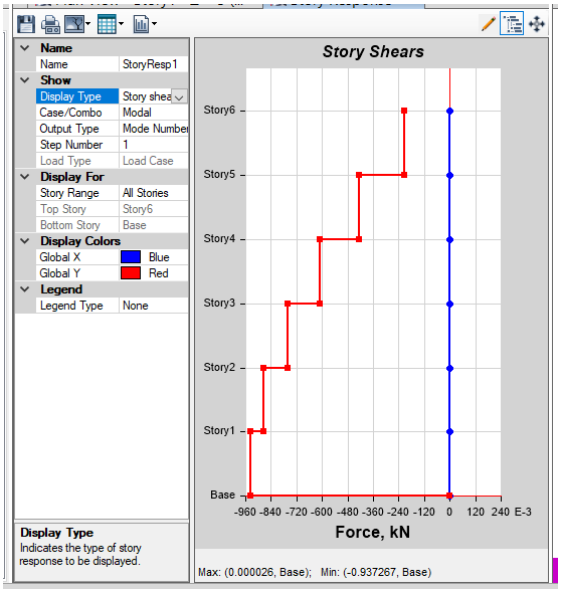
MAXIMUM STOREY DRIFTS (SEISMIC)



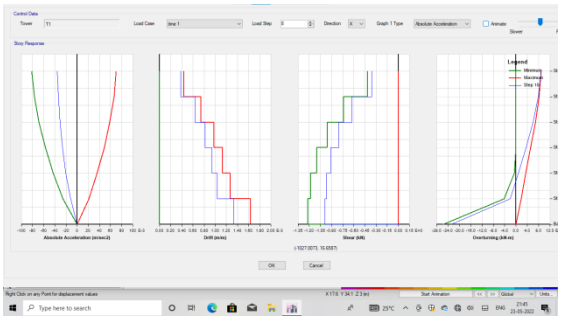
MAXIMUM STOREY DISPLACEMENT



STOREY OVERTURNING MOMENT



STOREY SHEAR



CONTROL DATA

V.CONCLUSSIONS

1.The quantity of concrete required for grid slab multistory building is maximum and for other slab is less

2.Its is also seen that the quantity of concrete is increase with increase span /grid size of the structure for the same slab system. The quantity of concrete is least for smaller span of the structure and it is most for larger span of the structure.

3.The center to center spacing between ribs is found to be (6.57% -14.76%)of the span length to get the optimum total cost of waffle slab with solid heads, while it

should be(8.22%-16.23%)of the span length for optimum design of waffle.

4.The increasing in the ratio of concrete cost relative to the steel cost causes a decreasing in the ribs spacing and the cross-section area of the ribs. While the increasing in the steel unit cost relative unit cost causes an increasing in the cross sectional area of the ribs.

5.Maximum axial force in the structure is 32031.56I KN

6.Maximum tensile force is 10586.5KN

7.Maximum diaphragm drift force is 0.008400

8.Design of R.C.C Slab 100mm thickness.

9. Storey drift values of different types of buildings are within the permissible limits as per IS-1893-2002 code provision.

VI.REFERENCE

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. IS: 456-2000. 'Indian Standard Code of Practice for Design of reinforced concrete", Bureau of Indian Standard, New Delhi

3. Design of Reinforced concrete structures by S. Ramamrutham and R. Narayanan, 17 th edition Dhanpat Rai Publishing Company.

4. User manual for E tabs.

5. A Sathawane R.S Deotale 'Analysis and design of flat and grid slab and their comparison, international journal of engineering Research and their applications volume 1. Issue.3.PP 837-848.

6. Baishali Das Static and dynamic analysis of grid beams, project report of Bachelor of technology, Deportment of civil engineering ,National institute of technology Rourkila 21010.

7. N. krishnaraju, Advanced reinforced concrete design (IS 456-2000)(CBS publications and distributors, CBS plaza, New Delhi)

8. Ibrahim vepari, Dr.H.S Patrl, study on economical aspects of long span slabs, 13-14 may 2000.

9. Charles, E. Reynolds and James C. Steedman Reinforced concrete design handbook (E&FM span Taylor and Francis cgroup 1988).

10. P. F. Schwetz, F. P. S. L. Gastal, L. C. P. Silva F, Numerical and Experimental Study of a Real Scale Waffle Slab, IBRACON Structures and Materials Journal • 2009 • vol. 2, No.4, p. 380 - 403 • ISSN 1983-4195

11. S. Timoshenko and S. Woinowsky-Krieger Theory of plates and shell (McGraw-Hill Book Company)

12. S. Timoshenko and J. N. Goodier Theory of Elasticity (McGraw-Hill Book Company, 1951).

13. Charles E Reynolds and James C. Steedman, Reinforced Concrete Designer's Handbook (E and F N Spon Taylor and Francis Group, 1988) [8] IS: 456, "Code of practice for plain and R.C. Structures", (Bureau of Indian Standards, New Delhi. 2000).

14. I.S.875 Part-I, Part-II (Bureau of Indian Standards, New Delhi,1987).

15. John J Panak and Hudson Matlock, A Discrete Element Method of Analysis for Orthogonal Slab and Grid Bridge Floor System, (Research No 56-25, Development Methods for Computer Simulation of Beam Columns And Grid Beam And Slab System Research Project 3-5-63-56, Center for Highway Research, The University of Texas At Austin 1972).

16. Baishali Das Static And Dynamic Analysis Of Grid Beams, Project report for Bachelor of Technology, Department of civil engineering, National Institute of technology, Rourkela 2010.