IJMTARC – VOLUME – IX – ISSUE – 34, APR - JUN, 2021

ISSN: 2320-1363

ANALYSIS AND DESIGN OF (C+G+3) FLAT SLAB COMMERCIAL BUILDING USING ETABS

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Abstract :The main steps of any building construction and planning is drafting, analysing and designing the building. In the present days of improving science and technology, analysing and designing of a building has been made easy by using ETABS software. ETABS software helps civil engineers to make their work easy and decreases time necessary for planning.The project going to be done is design of a multi-storey building which is going to be used as a commercial. The building plan has been drafted using the AutoCAD software by the requirement and available area. The super structure i.e. the building frame has been analysed and designed using the ETABS software.In the present project C+G+3 building consider to analysis and design for gravity and lateral (wind and earth quake) loads as per Indian standards. By using the software building can be analysed and we can check for any failures in the analysis and redesign them, so that we can prevent failures after construction. By using the output building can be constructed according to the design.

Introduction to the project

Our main aim is to complete a Multi-storey building is to ensure that the structure is safe and economical against all possible loading conditions and to fulfil the function for which they have built. Safety requirements must be so that the structure is able to serve it purpose with the maintain cost. Detailed planning of the structure usually comes from several studies made by town planners, investors, users, architects and other engineers on that, and a structural engineer has the main influence on the overall structural design and an architect is involved in aesthetic details. For the Design of the structure, the deadload, live loads, seismic and wind load are considered. the analysis and design for the structure done by using a software package ETABS

In this project multi storied construction, we have adopted limit state method of analysis and design the structure. The design is in confirmation with IS456-2000.the analysis of Frame is worked out by using ETABS

Methods Of Analyzing Beams

Force method

Originally developed by James Clerk Maxwell in 1864, later developed by Otto Mohr and Heinrich Muller-Breslau, the force method was one of the first methods available for analysis of statically indeterminate structures. As compatibility is the basis for this method, it is sometimes also called as compatibility method or the method of consistent displacements. In this method,

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equations are formed that satisfy the compatibility and force-displacement requirements for the given structure in order to determine the redundant forces. Once these forces are determined, the remaining reactive forces on the given structure are found out by satisfying the equilibrium requirements.

Displacement method

The displacement method works the opposite way. In these methods, we first write load displacement relations for the members of the structure and then satisfy the equilibrium requirements for the same. In here, the unknowns in the equations are displacements. Unknown displacements are written in terms of the loads (i.e. forces) by using the load displacement relations and then these equations are solved to determine the displacements. As the displacements are determined, the loads are found out from the compatibility and load- displacement equations. Some classical techniques used to apply the displacement method are discussed.

Slope deflection method

This method was first devised by Heinrich Manderla and Otto Mohr to study the secondary stresses in trusses and was further developed by G. A. Maney extend its application to analyze indeterminate beams and framed structures. The basic assumption of this method is to consider the deformations caused only by bending moments. It's assumed that the effects of shear force or axial force deformations are negligible in indeterminate beams or frames.

The fundamental slope-deflection equation expresses the moment at the end of a member as the superposition of the end moments caused due to the external loads on the member, while the ends being assumed as restrained, and the end moments caused by the displacements and actual end rotations. A structure comprises of several members, slope deflection equations are applied to each of the member. Using appropriate equations of equilibrium for the joints along with the slope-deflection equations of each member we can obtain a set of simultaneous equations with unknowns as the displacements. Once we get the values of these unknowns i.e. thedisplacements we can easily determine the end moments using the slope-deflection equations.

Moment distribution method

This method of analyzing beams and multi-storied frames using moment distribution was introduced by Prof. Hardy Cross in 1930, and is also sometimes referred to as Hardy Cross method. One goes on carrying on the cycle to reach to a desired degree of accuracy in an iterative method. To startwith, this method, initially all the joints are temporarily restrained against rotation and fixed end moments for all the members are written down. Each joint is then released one by one in succession and the unbalanced moment is distributed to the ends of the members, meeting at the same joint, in the ratio of their distribution factors. These distributed moments are then carried over to the far ends of the joints again the joint is temporarily restrained before moving on to the next joint. Same set of operations are performed at each joint till all the joints are completed and the results obtained are up to desired accuracy. The method does not

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involve solving a number of simultaneous equations, which may get quite complicated while applying large structures, and is therefore preferred over the slope-deflection method

EARTHQUAKE LOADS

An earthquake (also known as a quake, tremor or temblor) is the result of a sudden release of energy in the Earth'scrust that creates seismic waves. The seismicity, seismic or seismic activity of an area refers to the frequency, type and size of earthquakes experienced over a period of time.

Earthquakes are measured using observations from seismometers. The moment magnitude is the most common scale on which earthquakes larger than approximately 5 are reported for the entire globe. The more numerous earthquakes smaller than magnitude 5 reported by national seismological observatories are measured mostly on the local magnitude scale, also referred to as the Richter scale. These two scales are numerically similar over their range of validity. Magnitude 3 or lower earthquakes are mostly almost imperceptible or weak and magnitudes 7 and over potentially cause serious damage over larger areas, depending on their depth. The largest earthquakes in historic times have been of magnitude slightly over 9, although there is no limit to the possible magnitude. The most recent large earthquake of magnitude 9.0 or larger was a 9.0 magnitude earthquake in Japan in 2011 (as of October 2012), and it was the largest Japanese earthquake since records began. Intensity of shaking is measured on the modified Mercalli scale. The shallower an earthquake, the more damage to structures it causes, all else being equal.

LATERAL LOAD RESISTING UNITS

In general a shear wall buildings, and for that matter any other structure, is designed to satisfy in basic structural and functioning requirements. The structural requirements are:

- Strength
- Stiffness
- Stability

The designed structure should be strong enough to withstand the entire lateral loads without excess deformations or deflections and should be under the largest stipulated loads.

The lateral deflection of the building under maximum load is to be controlled to a safe line. Committee 435 recommends a deflection limit of 1/500 of the height for tall buildings. Experience that buildings designed to satisfy this criterion ensure the comfort of the occupation and the stability of the structure as a whole. Three types of units are commonly used for resisting the lateral loads. These are:

- Frames
- Shear walls
- Tubes

Rigid frames have been used in the past for tall buildings and are still used up to certain heights. However, they are not so efficient for lateral loads and are being replaced by shear walls and tubes for taller buildings.

ETABS

In the last 30 years TABS and ETABS have set the international standards in structural analysis and design. They first took into consideration the characteristic properties of a building's mathematical model, thereby allowing the graphical creation of a

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building's model in the same sequence that will actually be constructed (slab by slab, floor by floor). Worldwide, ETABS is considered the most popular analysis and design software. The "Top Seismic Product of the 20th Century" (2006) and "Honour Award in Engineering Software" (2002) awards, establish it as the innovator in structural analysis and design and the reference point for the entire market. The latest version of ETABS continues in that tradition, incorporating structural element terminology that is used on a daily basis (Columns, Beams, Bracings, Shear Walls etc.), contrary to the common civil engineering programs that use terms such as nodes, members etc. Additionally, it offers many automatic functions for the formation, analysis and design of the structural system in an efficient, fast and easy way. The user can easily create a model, apply any kind of load to it and then take advantage of the superior capabilities of ETABS to perform a start or art analysis and design. ETABS is the solution, whether you are designing a simple 2D frame or performing a dynamic analysis of a complex high-rise that utilizes non-linear dampers for inter-story drift control.

AREAS OF APPLICATION

- Analysis and design of building structures with a structural system consisting of beams, slabs, columns, shear walls and bracings. Different materials can be assigned to the structural elements within the same model such as steel, RC, composite or any other user-defined material
- Easy and automatic generation of gravity and lateral loads (seismic and wind loads) when compared with other FE general analysis programs

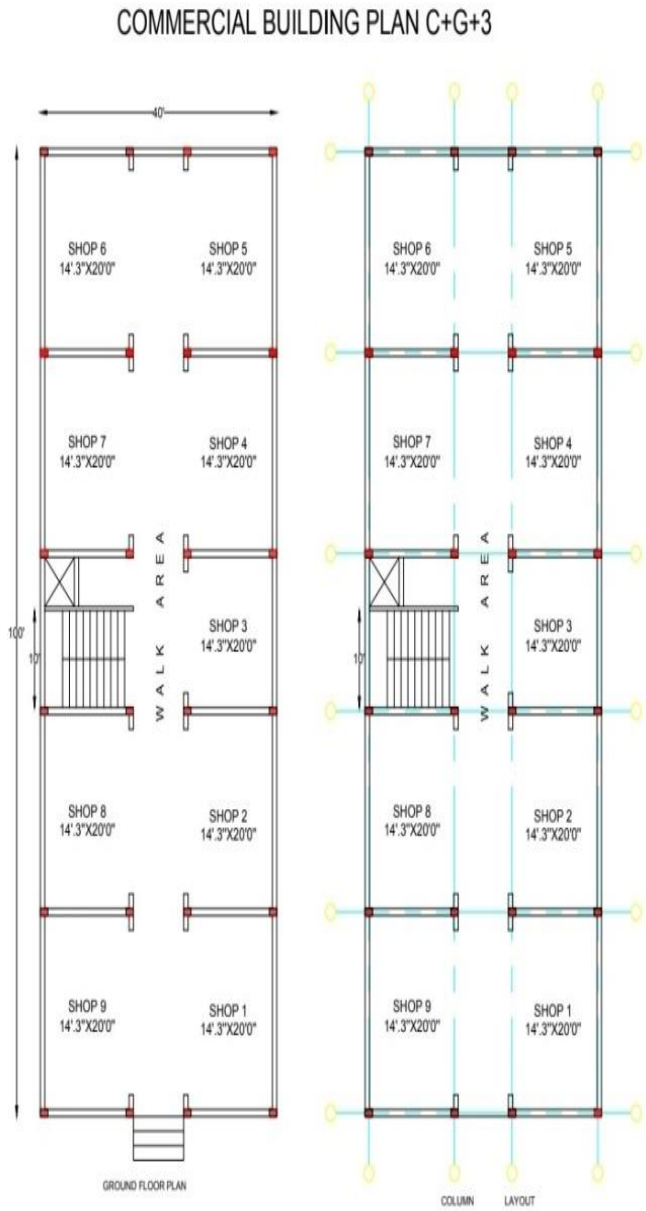

Fig: Plan of the structure

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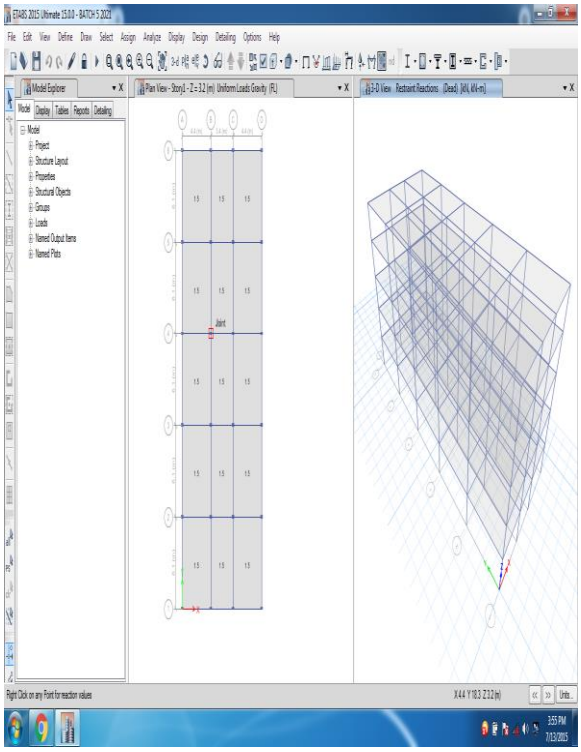

Fig: 3D view of the structure

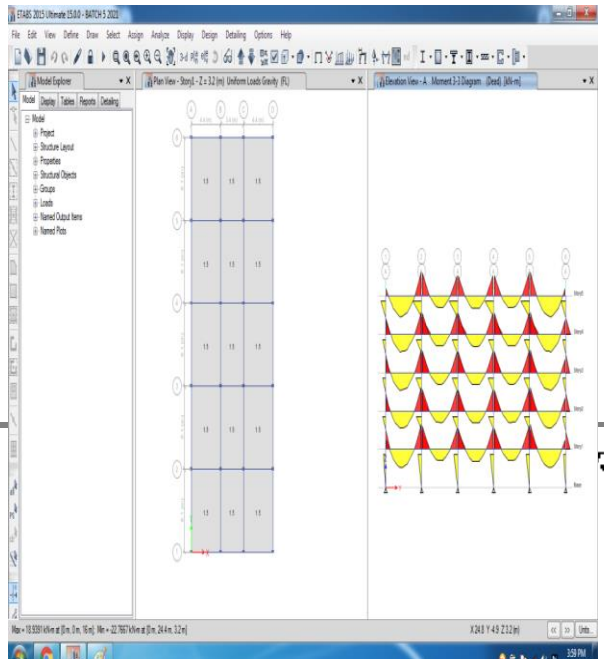

Fig: Bending moment Diagram

CONCLUSION

A C+G+3 commercial building has been analyzed on ETABS and using the analysis results the design has been carried out manually. Loads were applied on the ETABS design model as per IS 875 Part I and Part II. Recommendations from IS 456 were strictly followed for design of each RCC member.

Analysis of beams and columns can be performed using Softwares such as ETABS, the analysis results can be extracted in much less time compared to manual analysis. Details of each and every member can be obtained except footing and staircase using ETABS. All the List of failed beams and column can be obtained by the software. Accuracy is improved by using software.

BIBLIOGRAPHY

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We have used a number of books and code as a reference for carrying out this project work. Some of the books that we refer are mentioned below. **INDIAN STANDARD CODE**

- IS CODE 456-2000
- IS CODE 875-1987 PART I
- IS CODE 875-1987 PART II
- IS CODE 875-1987 PART III
- DESIGN AIDS TO IS -456-2000 (SP 16)
- ARRANGEMENT OF REINFORCEMENT USING SP 34

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