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ANALYSIS OF A MULTISTORIED COMMERCIAL CUM RESIDENTIAL BUILDING USING ETABS

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Abstract – *Structural Analysis is the method to ensure the safety of the structure. This project "Analysis of A Commercial Cum Residential Building using ETABS" deals with the analysis and design of a multi-storied commercial cum residential building(B+G+3) using the software ETABS (Extended Three Dimensional Analysis Of Building Systems). This software enables to check the stability of structure under gravity loading, shear forces and seismic loads. The proposed site is in Pathanamthitta with a plot area of 25 cents. The dead load and live loads are applied and the design for beams, columns, slab is obtained. In this project we are considering seismic load as the lateral load. In this project, limit state method is adopted for analysis. In this work, an attempt is made according to Building Bye Laws and design of building is done as per IS: 456-2000, SP-16 and SP-34 specifications.*

***Key Words*: Structural analysis, ETABS, Seismic load, Codes used**

1. INTRODUCTION

A building is a structure with columns, beams, slab, roof and walls standing more or less permanently in one place. A building should be capable to resist all the applied loads without failure during its intended life for that structural analysis have to be done. The process of collecting information and evaluating the conditions of the site for the purpose of designing and constructing the foundation for a structure is called the geotechnical site investigation. Structural engineers are facing the challenges of striving for most efficient and economical design with accuracy in solution while ensuring that the final design of a building and the building must be serviceable for its intended function over its design life time. Nowadays, various software packages are available in market for analyzing and designing practically all types of structures.

High rise buildings are in high demand because of the world population boom and development of technology during past decades. Various structural forms and construction materials were developed along with a diverse assemblage of structural and non-structural components. The real performance of the high rise structures depends greatly on the integrated interaction of structure and non structural components. This makes the behavior of muilti-storeyed structures complicated.

In current design practice, the lateral load resisting system of a high rise building is considered vital to the whole structure.

For the design of the structure, the dead load, live and seismic loads are considered. The analysis and design of the structure is done by using software called as ETABS. In this project, limit state method is adopted for analysis. The design is in confirmation with IS 456-2000. The results of analysis are used to ensure the fitness of structure for use.

1.1 OBJECTIVE

- The project concerned with the analysis & design of a commercial cum residential building (B+G+3) consisting of parking facilities, commercial area and apartments.
- The proposed site was in Pathanamthitta with a plot area of 25 Cents.
- The design was done in accordance with the provisions of IS Codes.
- The main objective of this project was to design and analyze a building using ETABS.
- The objective of structural design is to design a structure that's stable against overturning, sliding and buckling.

2. DESIGN PHILOSOPHY

Limit State Method

It is based on the concept as to achieve an acceptable probability that the structure will not become unserviceable in its life time. Hence this method is based on the philosophy that the structure should be able to withstand safely the working load throughout its life span and also satisfy the serviceability requirement. In the design the following limit states are examined;

- Limit State of Collapse

It corresponds to the maximum load carrying capacities and its violation implies failure but do not mean complete collapse. This limit state has close similarity to: flexure, compression, shear, and torsion.

- Limit State of Serviceability

It corresponds to the development of excessive deformation. This state corresponds to: deflection, cracking & vibration.

3. STRUCTURAL DETAILS

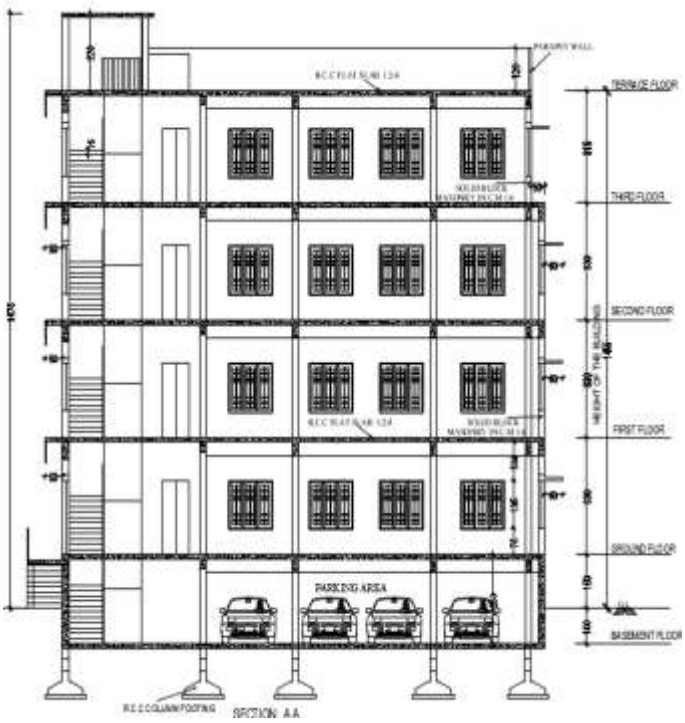

Fig -1: Elevation view

Table -1: Structural details

Floor	Purpose	Facilities
Basement area	Parking	Lift, main staircase, electrical room
Ground floor	Commercial	main staircase, commercial space, fire staircase and lift
First floor	Commercial	main staircase, commercial space, fire staircase and lift.
Second floor	Commercial	main staircase, commercial space, fire staircase and lift.
Third floor	Residential	two apartments, main staircase, lift and fire staircase
Terrace area	Open space	Stair cabin, lift operator room

4. METHDOLOGY

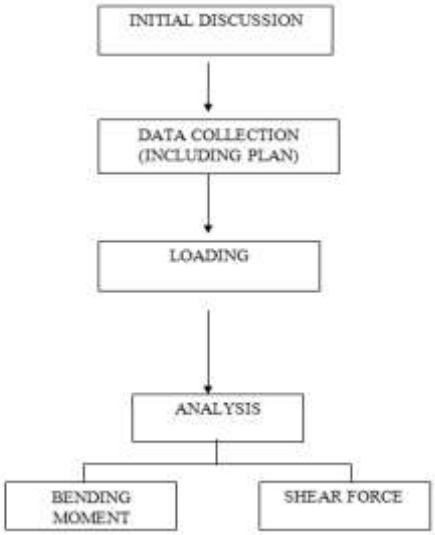

Fig -2: Flow chart

5. PROCEDURE IN ETABS

Step 1: Select standard codes and country codes.

Step 2: Generation of grid lines and structures.
At first open ETAB, select new model. A grid system will appear on the screen in which we enter the dimension values.

Step 3: Define property.
First define the material property from menu material properties. Then define each components of the structure such as columns, beams, slab, wall, footings. In defining section, add all the data regarding the components size, shape, reinforcement details cover etc.

Table-2: Beam details

Beam No	**Size(mm)**
B1	200x400
B2	200x300
B3	200X500

Table-3: Column details

Column No	Size(mm)
C1	200X400
C2	300X400
C3	300X300
C4	300X500
C5	200X300

Step 4: Assigning property
After defining, assign each section along with the material property.

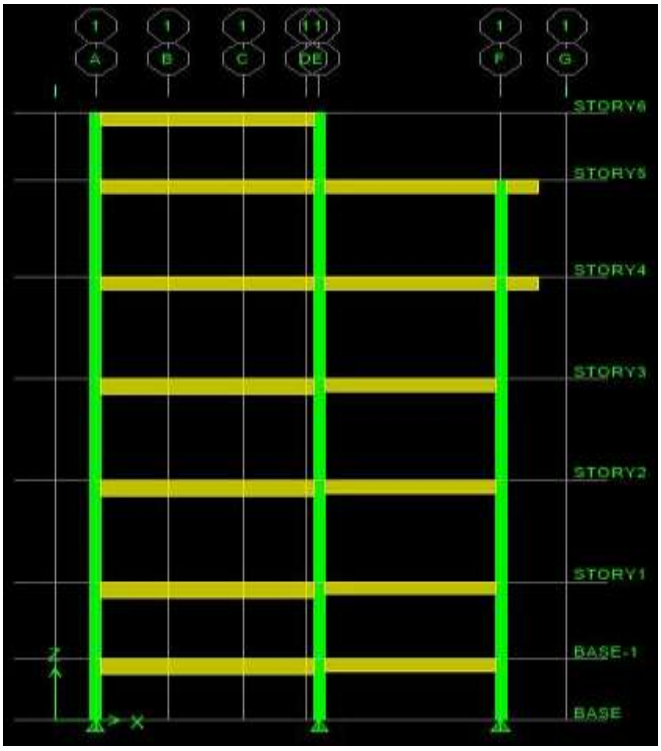

Fig -3: Property assigning

Step 5: Define loads
Load combinations are initially introduced into the ETAB consisting of dead, live, seismic and super imposed load.

Step 6: Assigning load combination
Live load of 4kN to 5kN is generally assigned and dead load constitutes of floor finish is considered. Since the height of building is 15m, according to provision of code wind load can be neglected. As per IS 1893:2002 earthquake response reduction factor is considered on both X and Y direction.

Step 7: Analysis
After completion of all the above steps then have to analyse the structure and check for errors.

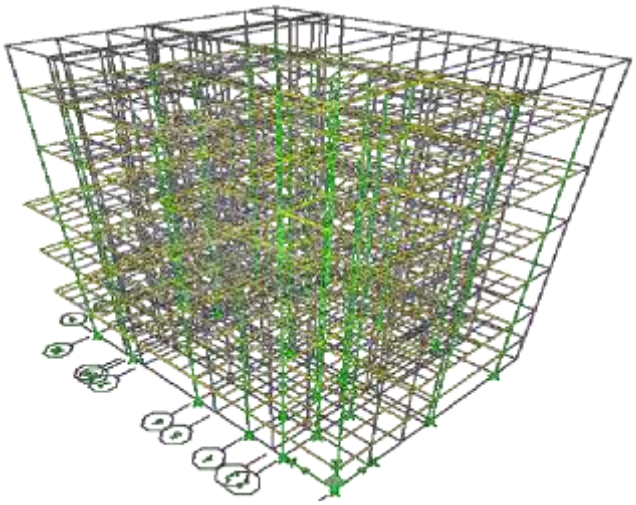

Fig -4: Deformed structure

Step 8: Design
After analysing the structure the designing of the concrete structure have to be done as per IS 456:2000.

6. SEISMIC ANALYSIS

Seismic analysis is a part of structural analysis. It is the calculation of the response of a building structure to earthquakes. Here dynamic analysis is done in this structure. In this Dynamic analysis is performed by Response Spectrum Method.

Table 4 Data's for Seismic Analysis

Fundamental Time Period	0.577 second
Zone Factor	0.16
Importance Factor	1.0
Response Reduction Factor	5
Type Of Soil	III
Location	Pathanamthitta

Table -5: Maximum Storey Drift and Storey Shear

Storey	Storey Height	Max Storey Drift
Base	0	0.0000097
Storey 1	2.5	0.0017627
Storey2	3.3	0.0013425
Storey 3	3.3	0.0013377
Storey 4	3.3	0.00111687
Storey 5	3.15	0.0008982
Storey 6	2.2	0.000536

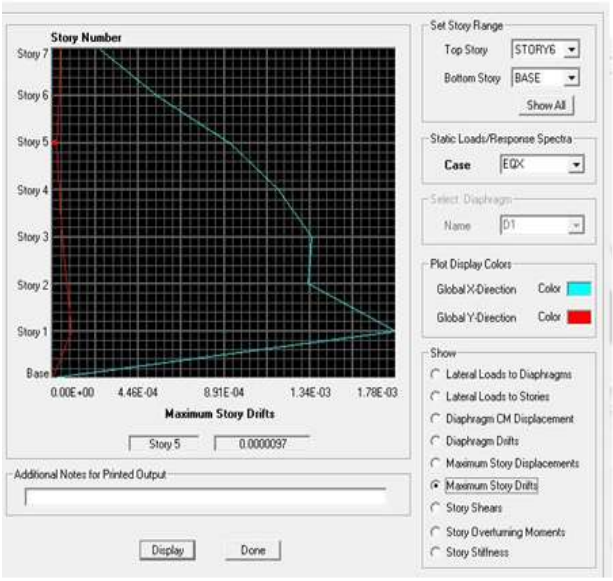

Fig -5: Maximum Story Drift

From IS 1893: 2002(part1), clause 7.11, the storey drift in any storey due to the minimum specified design lateral force, with partial load factor of 1.0, shall not exceed 0.004 times the storey height. From the above data, it is clear that, story drift is within the allowable limit; hence the structure is safe against the seismic forces.

7. RESULT ANALYSIS

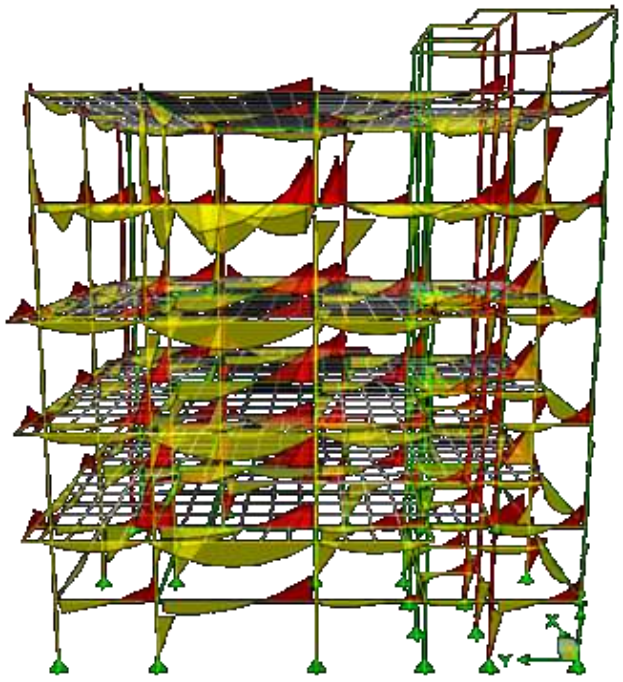

Fig -6: Bending Moment and Shear Force Diagram

ETAB provide a powerful graphics along with modeling, analytical, and design procedures, integrated using a common database. From the shear or spandrel force diagram, the amount of deflection occurring at each span of beam can be known. For beam having unsafe design strength with greater moment, overwriting can be done.

8. CONCLUSION

The analysis of commercial cum residential building was done using ETABS. A stable, economic & aesthetic structure was designed. Use of software proved to be more efficient in case of time consumption and accuracy. Details of each and every member can be obtained using ETABS. The structural components of this building are found to be safe in shear and flexure. Seismic analysis is done with response spectrum. Beam are designed for Flexure, ETABS gives SFD and BMD for individual member and whole structure. It suggests the adequacy of the section as a singly reinforced section, doubly reinforced section. The analysis of structure was successful using ETABS software.

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c) SP: 16 Design Aids for Reinforced Concrete.