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Analysis and Design of G+3 School Building Structure Using Etabs Software

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A B S T R A C T

This is a final year civil project report on ANALYSIS AND DESIGN OF SCHOOL BUILDING USING ETABS. The present project deals with the analysis of a multi storied School building of G+3 floors. This project is mostly based on software and it is essential to know the details about these software's. The software's used in this project are ETABS & Auto cad.

The principle objective of this project is to analysis and design of school building using etabs. The design involves load calculations manually and analyzing the whole structure by ETABS. The design methods used in ETABS analysis are Limit State Design conforming to Indian Standard Code of Practice. ETABS features a state-of-the-art user interface, visualization tools, powerful analysis and design engines with advanced finite element and dynamic analysis capabilities. From model generation, analysis and design to visualization and result verification.

Keywords: creation, dynamic, e-tabs, displacements, encompass.

INTRODUCTION

1.1 GENERAL ASPECTS:

The main idea of every Structural Engineer is to improve his concept of analysis and design so that an economical structure is obtained consistent with safety and serviceability. Through laboratory research, field tests and computer simulations, several new concepts of analysis and designs have been identified.

A Structure must be designed on the basis of strength, serviceability and durability. Strength is assessed by plastic hinge theory. Serviceability requires that excessive deflection, cracking and local failures be avoided at service loads. Durability requirements are concerned with the determinations and decay of materials with age and environmental impact. The newly emerging Limit State Methods of Designs are oriented towards the simultaneous satisfaction of all these requirements. The limit state design now seeks to account for the various aspects in an orderly manner.

The limit state design adopts characteristic values for strength of steel and concrete. The term "Characteristic Strength" means that value of strength of material below which not more than 5% of the test results expected to fall. Further in a Structural Design, the Dead Load, Live Load, Wind Load, Creep, Temperature etc…are also taken into account. The term "Characteristic Load" means that the value of which has got a 95% probability of not being exceeded during the lifetime of the structure.

The characteristic value allows for inherent variations in the loads and material strength. There are additional factors such as overloads, under strength of materials unknown in analysis and design and loss of life due to failure of structural elements, which are to be considered in ensuring adequate safety of the structure. These are actually considered together in a single safety of the structure. For the limit state method, determination of these factors have been separated and designed as partial safety factors. The recommended value of partial safety factor for concrete is 1.5.

1.2 METHODS OF DESIGNING STRUCTURE:

There are three Methods or Philosophies for the design of Reinforced Concrete, Pre-Stressed Concrete as well as Steel Structures, namely:

Working stress method.

Ultimate load method.

Limit state method.

1.2.1 WORKING STRESS METHOD:

In this method it is assumed that concrete is elastic and both steel and concrete act together elastically and the relationship between loads and stress is linear right up to the failure of the structure.

The basis of the method is that the permissible stresses for concrete and steel are not exceeded anywhere in the structure when it is subjected to worst combination of working loads. The sections are designed in accordance with the elastic theory of bending, assuming that both materials obey the Hooke's law. The permissible stresses are prescribed to provide suitable factors of safety to allow for uncertainties in the estimation of working loads and variation in properties of materials.

IS: 456-2000 uses a factor of safety equal to 3 on the 28 days cube strength to obtain the permissible compressive stresses in bending concrete and equal to 1.78 on the yield strength of steel intention to obtain the permissible tensile stress in bending reinforcement.

The main draw backs of the working stress method are as follows:

Concrete is not elastic. The inelastic behavior of concrete starts right from very low stresses. A triangular stress diagram cannot describe the actual stress distribution in a concrete section.

Since factor of safety is on the stresses under working loads, there is no way to account for different degrees of uncertainty associated with different types of loads with elastic theory it is impossible to determine the actual factor of safety with respect to lo**2.3 LOADS ON MAIN BEAM FROM SECONDARY BEAM**

The load from secondary beam is transformed to the main beam as concentrated load.

2.4 LOADS ON FOOTING

The SBC of soil at the building site is 200 KN/m2 .The sum of column load and 10% of the column load gives the load on footings.

2.5 LOAD COMBINATIONS

Load combinations as per IS 875 Part 5 are taken into consideration.

A judicious combination of the loads (specified in IS 875 Parts 1 to 4 of this standard and earthquake), keeping in view the probability of:

a) Their acting together, and

b) Their disposition in relation to other loads and severity of stresses or

c) Deformations caused by combinations of the various loads are necessary to ensure the required safety and economy in the design of a structure.

Load Combinations - The various loads should, therefore, be combined in accordance with the stipulations in the relevant design codes. In the absence of such recommendations, the following loading combinations, whichever combination produces the most unfavourable effect in the building, foundation or structural member concerned may be adopted (as a general guidance).

It should also be recognized in load combinations that the simultaneous occurrence of maximum values of wind, earthquake, imposed and snow loads is not likely: -

1) 1.5 (DL)

2) 1.5 (DL + LL)

3) 1.2(DL+LL±WL)

Where,

DL = Dead Load

LL = Live Load

WL = Wind Load

The negative sign in the above load combinations shows the directions opposite to the defined case.

METHODOLOGY

3.1 GENERAL:

In this chapter, the analysis of typical frames has been carried out. The analysis and the results obtained for all frames have been shown in detail. Bending Moment and Shear Force Diagrams are also shown.

3.2 STRUCTURAL ANALYSIS AND ITS OBJECTIVES:

The phases of the design effort which involves the computation of forces (External Reactions, Shear, Moment, and Internal Shears) and Displacements (Deflections and Rotations) developed in the structure analysis, which forms a major quantitative part of design process.

3.3 METHOD OF INDETERMINATE ANALYSIS:

There are basically two fundamental methods of indeterminate analysis

The Force Method or Flexibility Method

Displacement Method or Stiffness Method

In the Force Method, the unknown are in the form of forces (External Reactions or Moments) where as in the Displacement method, certain displacements (Linear and Angular) are taken as the unknowns. However, the method employed in the analysis of the hyper static structure as specified in introduction are listed below:

Method of Consistent Deformation

Strain Energy Method

Moment Distribution Method

Kani's Method

Column Analogy Method

Matrix Method

Finite Element Method

Experimental Method (Model Method)

ANALYSIS OF FRAMES USING ETABS -SOFTWARE

All the frames in our project are analyzed using ETABS software package. The bending moment diagrams of all the frames of the building are shown in this report.

3.5 LOAD TRANSFERRED FROM SLAB TO BEAM:

According to IS:456-2000, the total loads that act on the supporting beams for two way slabs may be considered as the load within the respective area of the slab bounded by the intersection of 45° line from the corners with the median line of the panel parallel to the long side as shown in fig 3.1. As is known from yield line theory of slabs this is a good approximation if all the sides are similarly supported either continuous or discontinuous.

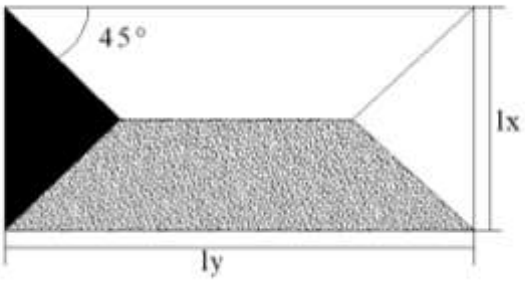

Fig: 3.1 Shows Two Way Slab Load Distribution

Beams AB and CD have the Triangular Loading.

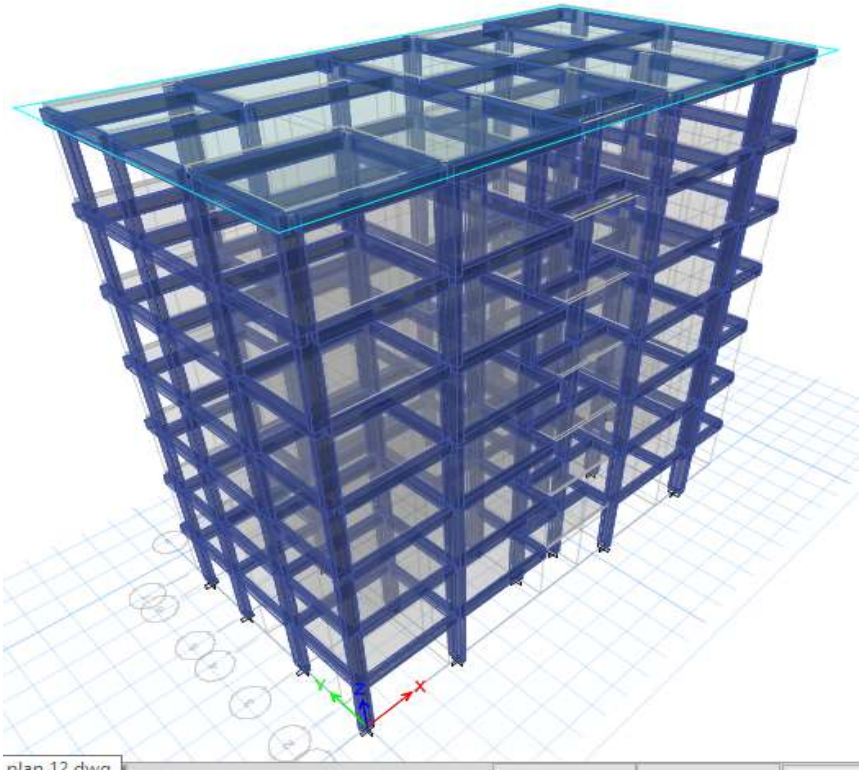

Fig 7.3: 3-D view of the structure

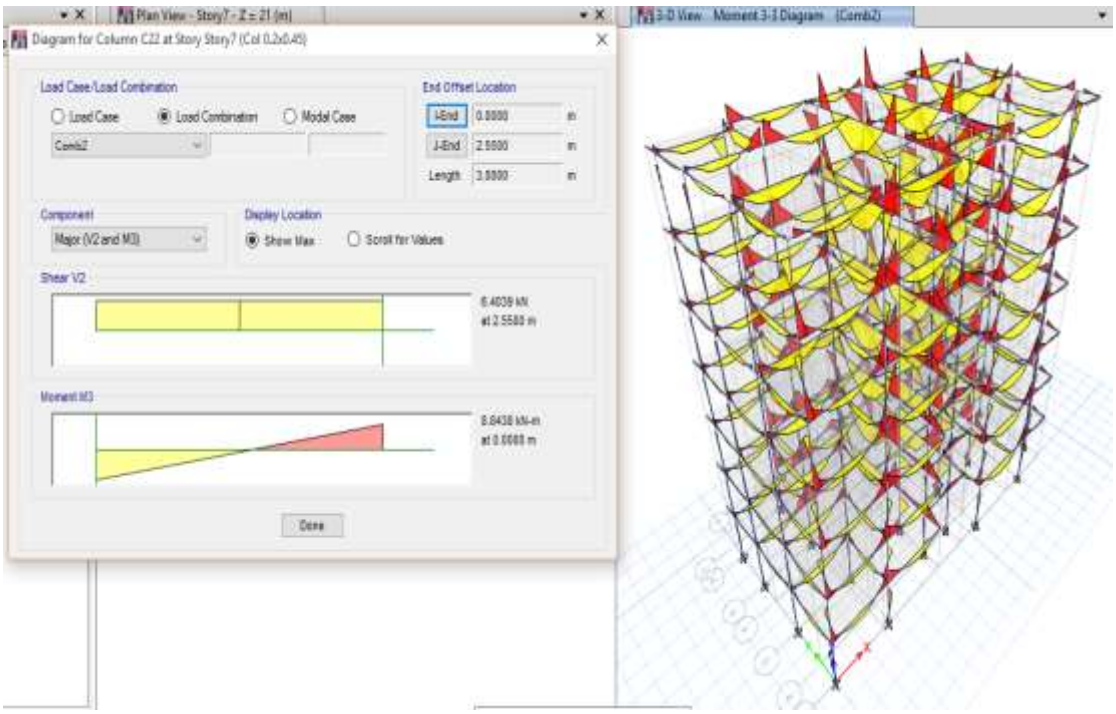

Fig 7.4: graph for shear force and bending moment for a column

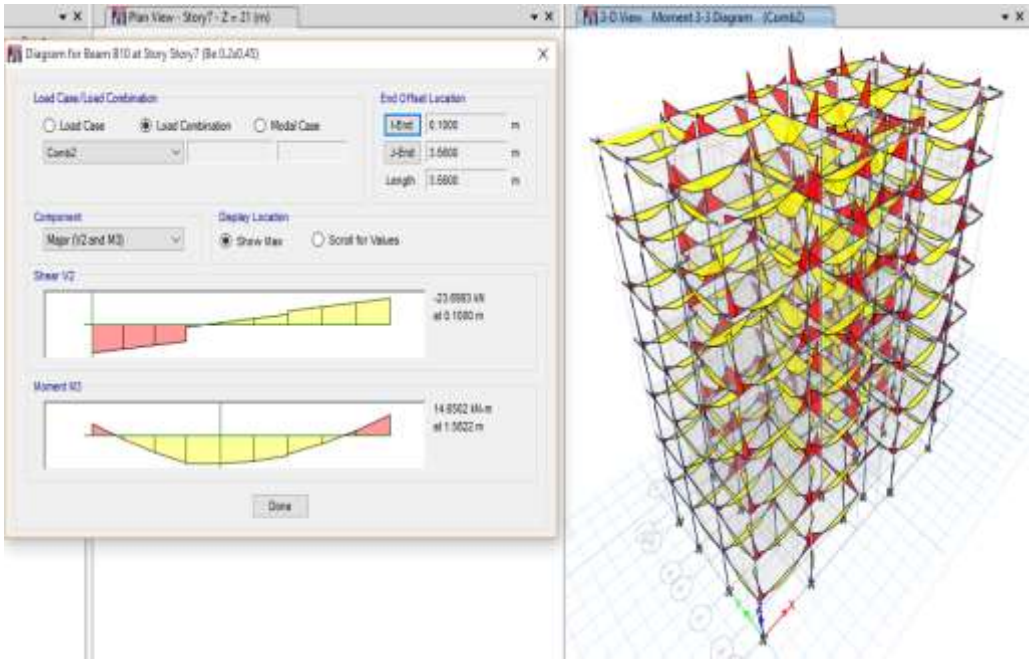

Fig 7.5: graph for shear force and bending moment for a Beam

CONCLUSION

1. This project is mainly concentrated with the analysis and design of multi-storied residential building with all possible cases of the loadings using ETABS Meeting the design challenges are described in conceptual way.
2. We may also check the deflection of various members under the given loading combinations.
3. Further in case of rectification it is simple to change the values at the place where error occurred and the obtained results are generated in the output.
4. Very less space is required for the storage of the data.

ETABS is an advanced software which provides us a fast, efficient, easy to use and accurate platform for analyzing and designing structures

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