

Design And Analysis of Commercial G+5 Under Wind Load Analysis using E.Tab

MOHD MUDDASSIR AHMED¹, MOHD ABDUL IMRAN², MOHD JALEES AHMED³, MOHD ABDUL ADIL⁴,
AKBAR HUSSAIN⁵, SYED SABEEL PASHA⁶

Dept of Civil Engineering, SVITS, Mahbubnagar, Telangana, India.

Abstract: Structural Analysis is a branch which involves in the determination of behaviour of structures in order to predict the responses of different structural components due to effect of loads. Each and every structure will be subjected to either one or the groups of loads, the various kinds of loads normally considered are dead load, live load, earth quake load and wind load. ETABS (Extended Three Dimensional Analysis of Building System) is a software which is incorporated with all the major analysis engines that is static, dynamic, Linear and non-linear, etc. and especially this Software is used to analyze and design the buildings. Our project “Analysis and Design of Commercial building using ETABS software” is an attempt to analyze and design a commercial building using ETABS. A G+5 storey building is considered for this study. Analysis is carried out by static method and design is done as per IS 456:2000 guidelines. Also an attempt has been made to design the structural elements manually. Drawing and detailing are done using Auto CAD as per SP 34.

Keywords: ETABS, Graphics Environment, Auto CAD.

I. INTRODUCTION

In this Commercial building we are doing G+5 office building. . A five stored office building having a regular layout and which can be divided in to a number of similar vertical plane frames has been considered in this project to illustrate the analysis and design of a rigid jointed plane frame. Structural planning, Estimation of load, Analysis of structure, Member design, Drawing Detailing & Preparation of schedules.

Structural planning: They are Form of the structure, Material of the structure, Structural system, Layout of components, Method of analysis, Philosophy of structural design.

Estimation of loads: In Estimation of loads we are taking dead loads, live loads according to code IS: 875.

Analysis the structure: To Analysis the structure we are using moment distribution method.

Member design: They are Slabs, Beams, Column, and Footings. The multistoried structure, with the increase in height, the effect of horizontal loads requires consideration. Therefore such structures are provided with rigid frames having rigid joints. In a rigid frame forces get distributed between the component members due to rigidity of connection and hence analysis of the structure as a whole becomes necessary. Therefore, a five storied office building having a regular layout and which can be divided in to a number of similar

vertical plane frames has been considered in this project to illustrate the analysis and design of a rigid jointed plane frame.

The analysis of one intermediate floor frame has been illustrated giving detailed calculations for all the substitute frames floor frame, bay frame, beam-column systems used in the analysis. The results obtained by the methods have been compared to examine the relative merits and demerits of each in regards to simplicity and degree of accuracy. Analyses of top storey frame and bottom storey frame have been done. Frame package prepared by the authors for personal computer. Design of members of only one frame that is analyses has been presented. The purpose of this project is to illustrate the design of building.

II. LITERATURE REVIEWS

Method of analysis of statically indeterminate portal frame.

- Method of Flexibility Coefficients.
- Slope Displacement Methods (Iterative Methods)
- Moment Distribution Method.
- Kani’s Method (Approximate Method).
- Cantilever Method.
- Portal Method.
- Matrix Method.
- STADDPro.
- ETABS

A. Force methods

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, 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.

B. Displacement methods

The displacement method works the opposite way. In these methods, we first write load displacement relations for the

MOHD MUDDASSIR AHMED, MOHD ABDUL IMRAN, MOHD JALEES AHMED, MOHD ABDUL ADIL, AKBAR HUSSAIN, SYED SABEL PASHA 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.

C. 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. the displacements we can easily determine the end moments using the slope-deflection equations.

D. 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. It is an iterative method in which one goes on carrying on the cycle to reach to a desired degree of accuracy. To start off with 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 joints till all the joints are completed and the results obtained are up to desired accuracy. The method does not 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.

E. Kani's method

This method was first developed by "Prof. Gasper Kani" of Germany in the year "1947". The method is named after him. This is an indirect extension of slope deflection method. This is

an efficient method due to simplicity of moment distribution. The method offers an iterative scheme for applying slope deflection method of structural analysis. Whereas the moment distribution method reduces the number of linear simultaneous equations and such equations needed are equal to the number of translator displacements, the number of equations needed is zero in case of the Kani's method. This method may be considered as a further simplification of moment distribution method wherein the problems involving sway were attempted in a tabular form thrice (for double story frames) and two shear coefficients had to be determined which when inserted in end moments gave us the final end moments. All this effort can be cut short very considerably by using this method.

- Frame analysis is carried out by solving the slope-deflection equations by successive approximations. Useful in case of side sway as well.
- Operation is simple, as it is carried out in a specific direction. If some error is committed, it will be eliminated in subsequent cycles if the restraining moments and distribution factors have been determined correctly.

This chapter reviews about some of the fundamental concepts of structural design and present them in a manner relevant to the design of light frame residential structures. The concepts from the basis for understanding the design procedures and overall design approach addressed in the remaining chapter of the guide. With this conceptual background, it is hoped that the designer will gain a greater appreciation for creative and efficient design of home, particularly the many assumptions that must be made. The world is leading Structural Analysis and Design package for Structural Engineers.

- Starting the Program.
- Creating a New Structure.
- Creating Joints and Members.
- Switching On Node and Beam Labels.
- Specifying Member Properties.
- Specifying Material Constants.
- Specifying Member Offsets.
- Printing Member Information.
- Specifying Supports.
- Specifying Loads.
- Specifying the Analysis type.
- Specifying Post-Analysis Print Commands.
- Specifying Steel Design Parameters.
- Performing Analysis and Design.

III. ETABS OVERVIEW

Concurrent Engineering based user environment for model development, analysis, design, visualization and verification.

- Pull down menus, floating toolbars, and tool tip help.
- Flexible Zoom and multiple views.
- Isometric and perspective views 3D shapes.

Design And Analysis of Commercial G+5 Under Wind Load Analysis using E.Tab

- Built-in Command File Editor.
- Simple Command Language.
- Graphics / Text input generation.
- State-of-the-art Graphical Pre and Post Processor.
- Rectangular / Cylindrical Coordinate systems.
- Joint, Member / element, Mesh Generation with flexible user-controlled numbering.
- Efficient algorithm minimizes disk space requirements.
- FPS, Metric or SI units.
- Presentation quality printer plots of Geometry and Results as part of run output.

IV. GRAPHICS ENVIRONMENT:

A. Model Generation

- Interactive Menu-driven Model Generation with simultaneous 3D display.
- 2D and 3D Graphic Generation using rectangular or polar coordinate system.
- Segments of repetitive geometry may be used to generate complex structural models.
- Generate Copy, Repeat, Mirror, Pivot, etc., or quick and easy geometry generation.
- Quick / easy mesh generation.
- Comprehensive graphics editing.
- Graphical Specification and Display of Properties, Loadings, Supports, Orientations.
- Import Auto CADD XF files.
- Access to Text Editor.

B. Model Verification

- 2D/3D drawings on screen as well as on plotter / printer.
- Full 3D shapes for Frames, Elements.
- Sectional views or views with listed members only.
- Isometric or any rotations for full 3D viewing.
- Display of properties, Loadings, Supports, Orientations, Joint/ Member numbering, Dimensions, Hidden line removed, etc.
- Plot manipulation according to the size, rotation, viewing origin and distance.

C. Analysis & Design

- Static Analysis
- 2D/3D analysis based on state-of-the-art Matrix method to handle extremely large job.
- Beam, Truss, Tapered Beam, Shell / Plate Bending / Plane Stress.
- Full / partial Moment Releases.
- Member Offset Specification.
- Fixed, Pinned and Spring Supports with Releases. Also inclined Supports.
- Automatic Spring Support Generator.
- Linear, P-Delta Analysis, Non-Linear Analysis with automatic load and stiffness correction.
- Multiple Analyses with in same run.
- Active/Inactive Members for Load- Dependent structures.

- Tension-only members and compression – only members, Multi – linear spring supports.
- CIMSTEEL Interface.

D. Dynamic/Seismic Analysis

- Mass modeling, Extraction of Frequency and Mode shapes.
- Combination of Dynamic forces with Static loading for subsequent designs.

E. Secondary Analysis

- Forces and Displacements at sections between nodes.
- Maximum and minimum force Envelopes.

F. Load Types And Load Generation:

- Loading for Joints, Members/ Elements including Concentrated, Uniform, Linear, Trapezoidal, Temperature, Strain, Support Displacement, Pre stressed and Fixed-end Loads.
- Global, Local and Projected Loading Directions.
- Uniform or varying Element Pressure Loading on entire or selected portion of elements.
- Floor / Area Load converts load-per-area to member loads based on one-way or two-way actions.
- Automatic Moving Load Generation as per standard AASHTO or user defined loading.
- UBC 1997.AIJ/IS1893/Cypriot Seismic Load Generation.
- Automatic Wind Load Generation. Factored Load Combinations including algebraic, absolute and SRSS combination scheme

G. Finite Element Capabilities

- Accurate and numerically Efficient Plate / Shell Element in corporation out-of-plane shear and in-plane rotation.
- Automatic Element Mesh Generation.
- Comprehensive Element Stress Output including in-plane stresses, out-of-plane shears, bending and principal stresses at nodal as well as user specified points.

H. Steel Design

Built-In Steel Tables Including Aisc, Australian, British, Canadian, Chinese, European, Indian, Japanese, Korean, Russian, And South African. Shapes Include I Beam With Or Without Cover Plates, Channels, Angles, Double Angles / Channels, Pipes And Tubes.

- User-specified Design Parameters to customize design.
- Code Check, Member selection and Optimized Member Selection consisting of Analysis / Design cycles.
- Design codes include AISC (ASD and LRFD), AASHTO. Optional codes include ASCE52, BS5950, Canadian, Chinese, French, German, Japanese, Indian and Scandinavian. Weld design for all steel shapes.

I. Concrete Design

- Design of Concrete Beam / Column / Slab / Footing as per all major international codes.
- Numerical and Graphical Design outputs with complete reinforcement details.
- IS 456-2000 for RCC design implemented
- RC detailer as per IS456-2000 has been implemented which has given a new dimension to RCC design never witnessed in Etabs before.

V. RESULT VERIFICATION:

- Result verification and display.
- Deflected and Mode Shapes based on Joint / Section Displacement for user-specified loading.
- Bending Moment and Shear force diagrams of individual members as well as the entire structures.
- Calculation of percentage of steel for columns (most economical)
- Calculation of percentage of steel for beams.

A. Special Features: Query and Report Generator:

- These powerful graphics based facilities provide on-screen result verification and customized report generation. User-friendly navigation and organization of data helps you get the information you need with a few simple clicks.
- Point and click on a member to obtain all the information on its Geometry, Cross-sectional properties, Forces, etc. even design information such as Allowable Stresses, Governing Code Criteria, Reinforcement layout are available.

B. General

A structure can be defined as a body, which can resist the applied loads without appreciable deformations. Civil engineering structures are created to serve so ma specific like, Human habitation, transportation, bridges, storage etc. in safe and economical way. A structure is assembling of individual elements like pinned elements (truss elements), beam elements, column, and shear walls lab able or arch. Structural engineering is concerned with the planning, designing and the construction of structures. Structural analysis involves the determination of the forces and displacements of the structures or components of a structure that make up the structural system. Wind is air in motion relative to the surface of the earth. The primary cause of wind is traced to earth's rotation and differences in terrestrial radiation. The radiation effects are primarily responsible for convection either upwards or downwards. The wind generally blows horizontal to the ground at high wind speeds. Since vertical components of atmospheric motion are relatively small, the term 'wind' denotes almost exclusively the horizontal wind, vertical winds are always identified as such. The wind speeds are assessed with the aid of anemometers or anemographs which are installed at meteorological observatories at heights generally varying from 10 to 30 metres above ground. The

basic wind speed (V_b) for any site shall be obtained from and shall be modified to include the following effects to get design wind velocity at any height (V_d) for the chosen structure, The main object of reinforced concrete design is to achieve a structure that will result in as an economical solution.

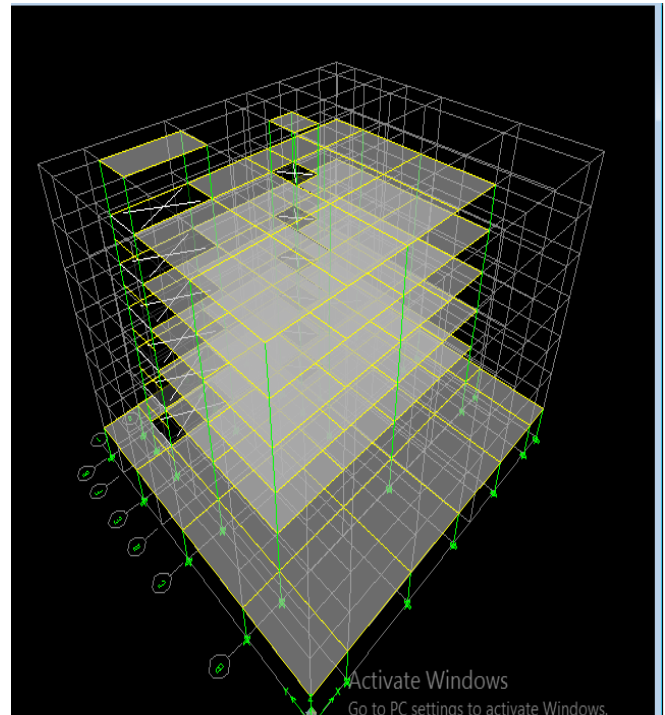
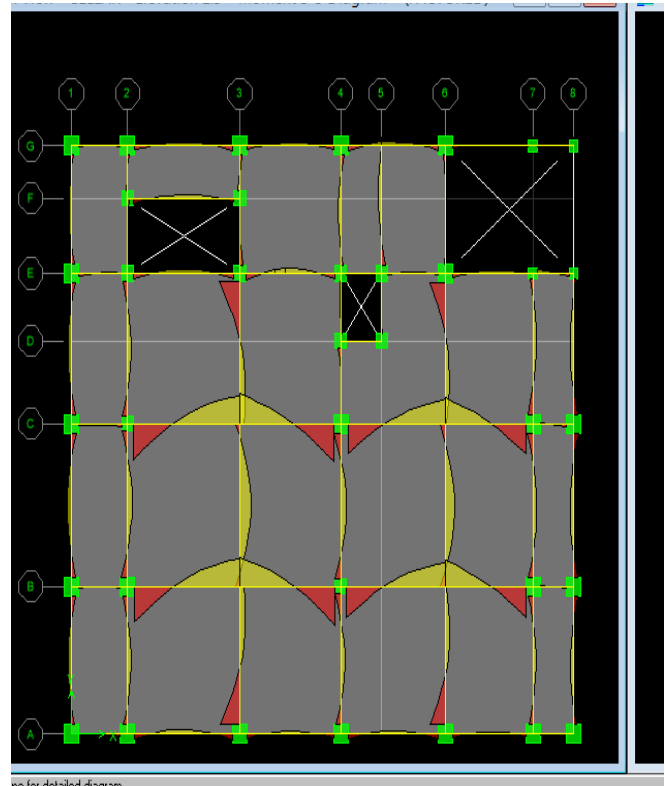


Fig1. Bending moment



Design And Analysis of Commercial G+5 Under Wind Load Analysis using E.Tab

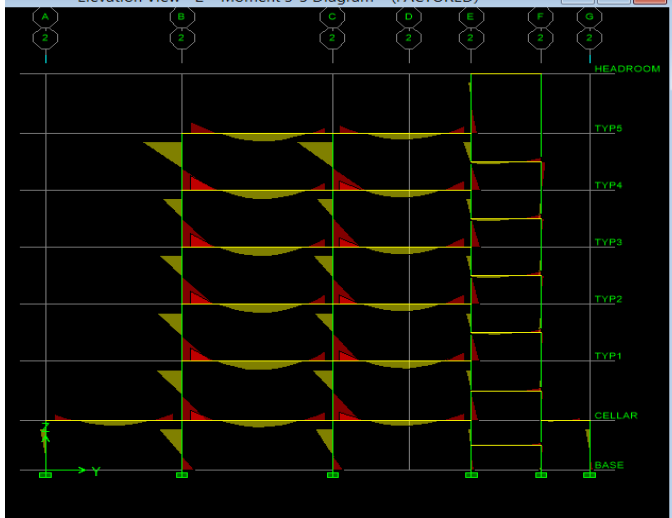


Fig2. Bending moment: In elevation.

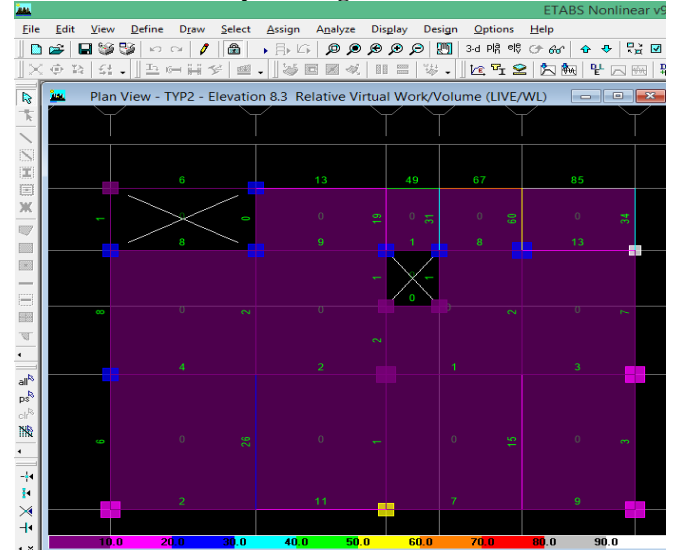


Fig4. Shear Force.

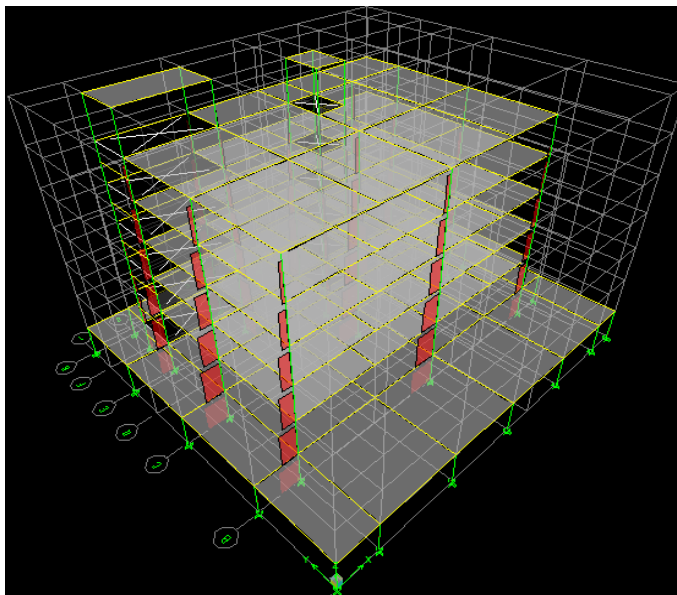
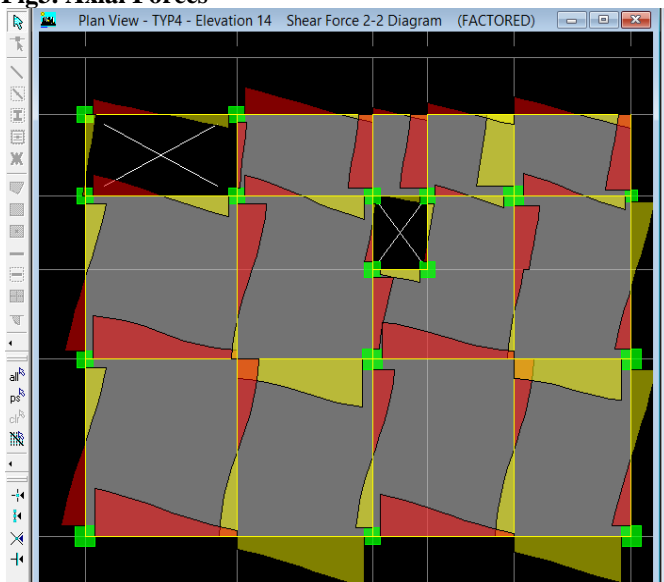


Fig3. Axial Forces



VI. CONCLUSION

From the data revealed by the manual design as well as Software analysis for the structures following conclusions Are drawn:

1. Analysis was done by using ETABS software and successfully verified manually as per IS456.
2. Calculation by both manual work as well as software analysis gives almost same result.
3. Further the work is extended for a 5 story building and found that the results are matching
4. As per 5-story building has similar floors ETABS is the perfect software which can be adopted for Analysis and Design
5. Usage of ETABS software minimizes the time required for analysis and design

VII. BIBLIOGRAPHY

We have used a number of books and code as a reference for carrying out this project work. Some of the books (s) 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 3

Author's Profile:

Mohd Muddassir Ahmed B.Tech student in the Civil Engineering from Sri Visvesvaraya Institute of Technology and Science, MBNR.

Mohd Abdul Imran B.Tech student in the Civil Engineering from Sri Visvesvaraya Institute of Technology and Science, MBNR

Mohd Jalees Ahmed B.Tech student in the Civil Engineering from Sri Visvesvaraya Institute of Technology and Science, MBNR.

MOHD MUDDASSIR AHMED, MOHD ABDUL IMRAN, MOHD JALEES AHMED, MOHD ABDUL ADIL, AKBAR HUSSAIN, SYED SABEL PASHA

Mohd Abdul Adil B.Tech student in the Civil Engineering from Sri Visvesvaraya Institute of Technology and Science, MBNR.

Mohd Akbar Hussain B.Tech student in the Civil Engineering from Sri Visvesvaraya Institute of Technology and Science, MBNR.

Syed Sabeel Pasha, Asst. Professor, Civil Engineering from Sri Visvesvaraya Institute of Technology and Science, MBNR.