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DESIGN AND ANALYSIS OF COMMERICAL BUILIDING USING ETABS

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ABSTRACT: In this Commercial building we are doing G+5 office building. It consists of 5 floors. 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 Structural planning, Estimation of load, Analysis of structure, Member design, Drawing, Preparation of schedules Structural planning: Involves determination of Form of the structure, Material of the structure, Structural system, Layout of components, Method of analysis, Philosophy of structural design. In Estimation of loads we are taking dead loads, live loads according to code IS: 875 To Analysis the structure we are using ETABS. Member design: Slabs, Beams, Columns, Footings. Designing process is doing by the Limit state method & Analysis is by using ETABS. Condition of a structure just before failure is called Limit state method. The structure should have same load carrying capacity, serviceability throughout the life time.

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.

PROCESS OF STRUCTURE DESIGN INVOLVES:

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 force 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.

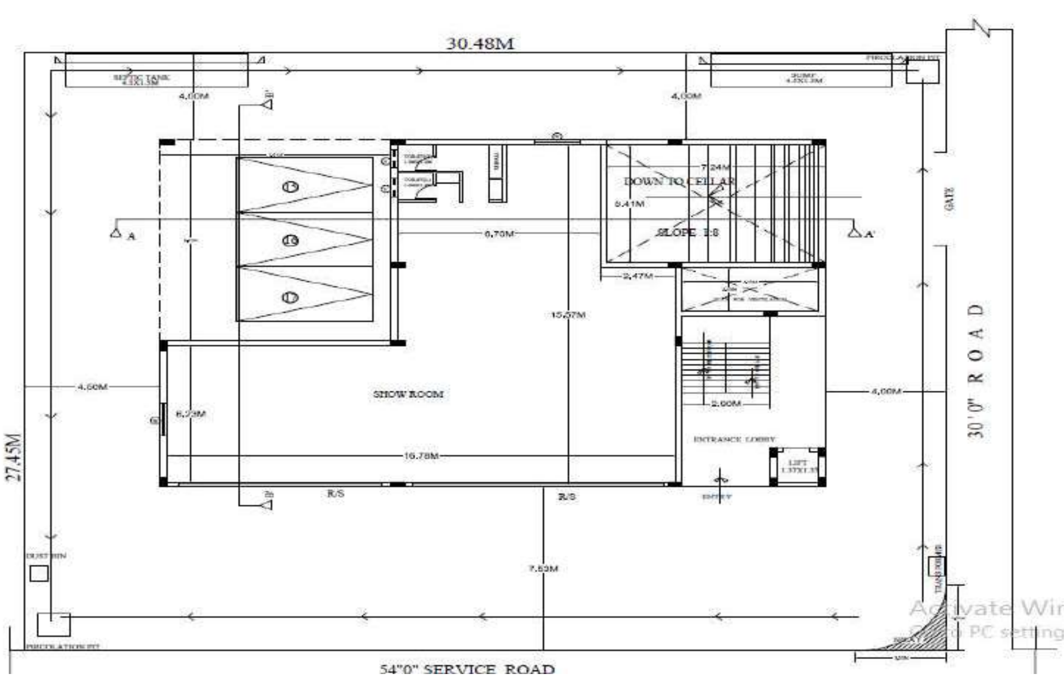
The analysis of one intermediate floor frame has been illustrated giving detailed calculations for all the substitute frames floor frame, bay frame, beam-column systems used in the analysis. The results obtained by the methods have been compared to examine the relative merits and demerits of each in regards to simplicity and degree of accuracy. Analyses of top story frame and bottom story 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.

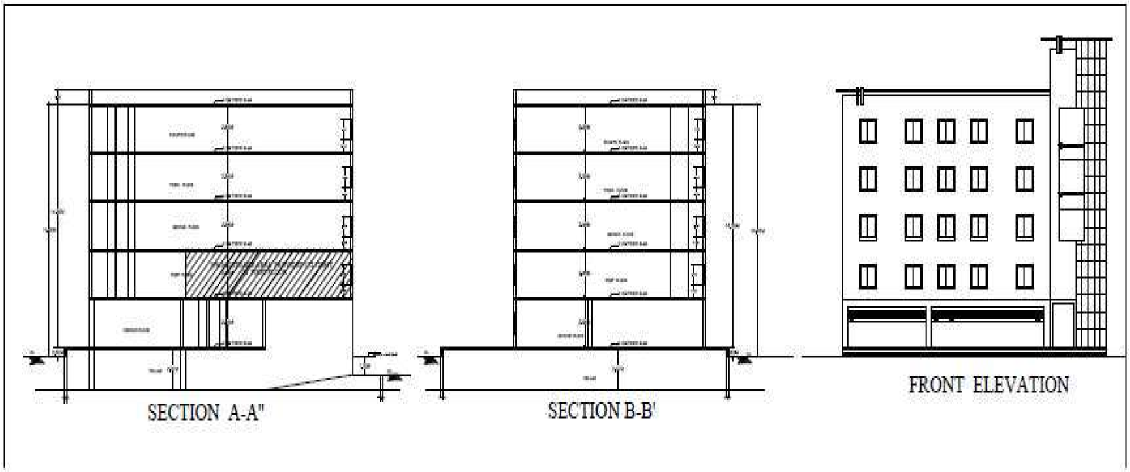
LITERATURE REVIEWS:

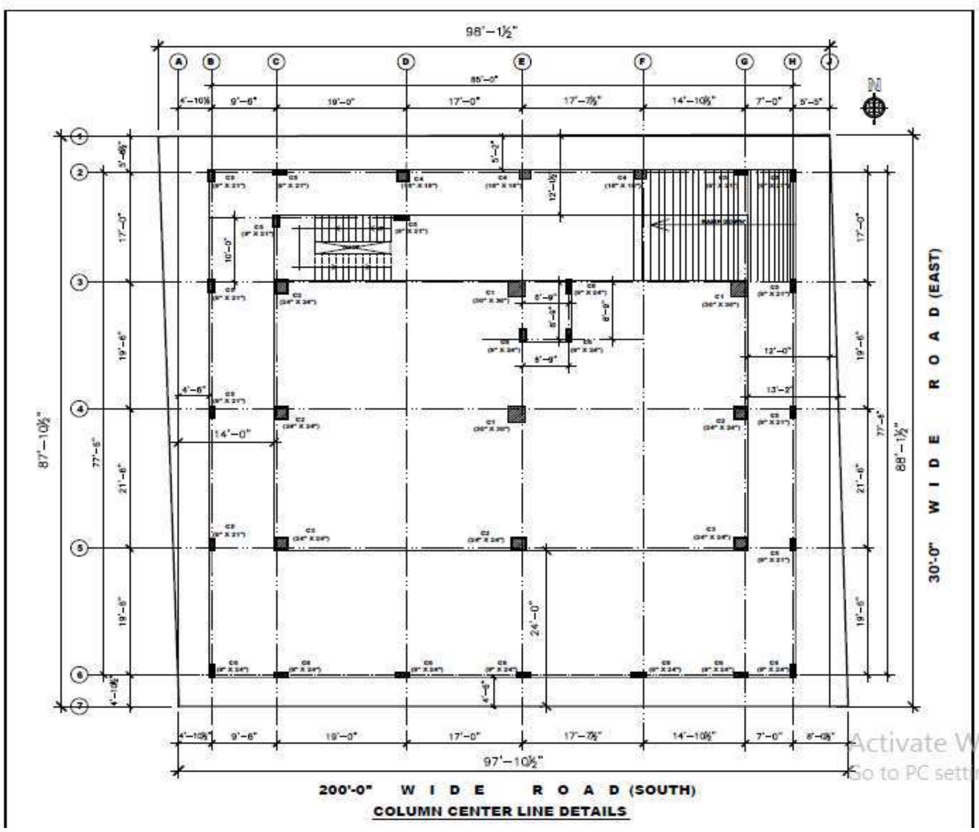
Method of analysis of statically indeterminate portal frame.

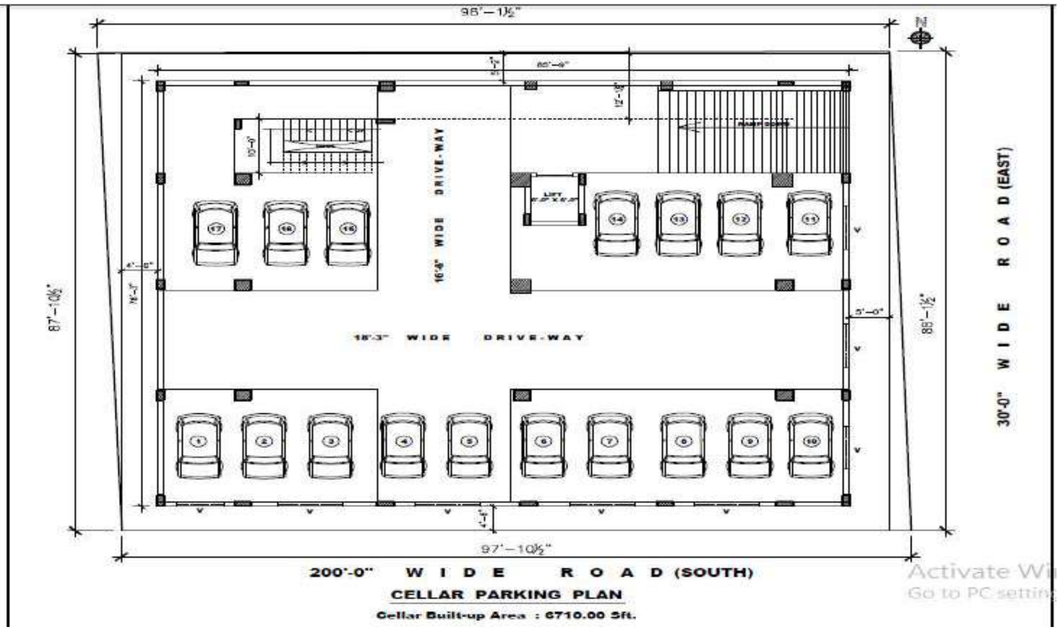
- Method of Flexibility Coefficients.
- Slope Displacement Methods (Iterative Methods)
- Moment Distribution Method.
- Kani's Method (Approximate Method).
- Cantilever Method.
- Portal Method.
- Matrix Method.
- STAAD.Pro.
- ETABS

ARCHITECTURAL LAYOUT DRAWINGS




SECTION A-A"
SECTION B-B'
FRONT ELEVATION


98'-1½"
85'-0"
97'-10½"
87'-10½"
88'-1½"
30'-0" W I D E R O A D (EAST)
200'-0" W I D E R O A D (SOUTH)
COLUMN CENTER LINE DETAILS



INTRODUCTION TO STRUCTURAL ANALYSIS

STRUCTURAL ANALYSIS

The procedure of structural analysis is simple in concept but complex. In detail it involves the analysis of a proposed structure to show that its resist an shear strength will meet or exceed a reasonable expectation.

This expectation is usually expressed by a specified load or the demand and an accept able margined of safety that constitutes as performance goal for a structure. The performance goals structural design is multi-faceted. For most, a structure must perform its intended function safely over its useful life.

The concept of useful life implies consideration of durability and established the basis for considering the cumulative exposure to time varying risks (i.e. corrosive environments, that performance is in extricable linked to cost, owners, builders, and designer must considers economic limit to the primary goal of safety and durability.

In the view of the above discussion, structural designer may appear to have little control over the fundamental goals of structural design except to comply with or exceed the minimum limits established by law. While this is generally true, a designer can still do much to optimize the design through alternative means and methods that Canfor more efficient analysis techniques, creative design detailing, and the use of innovative construction materials and methods.

In summary the goal of structural design are defined by law and reflect the collective interpretation of general public welfare by those involved in the development and local adoption of building could.

It is advantage of when kinematic indeterminacy < static indeterminacy. Alex Bender first formulated this procedure in 1914 based on the applications of compatibility and equilibrium of compatibility and equilibrium conditions.

This method derives its name from the facts that supports and displacements are explicitly computed. Setup simultaneous equation is formed from the solution of these parameters and the join moment in each or computed from these values

ETABS

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.

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.
- 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.

Beam Design

A reinforced concrete beam should be able to resist tensile, compressive and shear stress induced in it by loads on the beam.

There are three types of reinforced concrete beams.

1 Single reinforced beams.
2 Double reinforced concrete.
3 Flanged beams

Slab Design

A slab is a thin flexural member used in floor and roofs of structure to carry loads, which are usually supported by wall or beams along its edges. Slabs are plate elements forming floor and roofs of buildings carrying distributed loads primarily by flexure.

One-Way Slab

One-way slabs are those in which the length is more than twice the breadth it can be simply supported beam or continuous beam

Two-Way Slab

When the slab is supported on four edges and aspect ratio (Ly/Lx) <2 these labs are designed as two-way slabs. When slabs are supported to four sides two ways spanning action occurs. In two ways labs when load edit bends in surface along both short and long span direction causing bending moments in both directions.

Corners held down and bending moments coefficient obtained from table 26 of IS 456-2000. In slabs M25 grade concrete and Fe 415 grade steel issued

LOADS FOR RESIDENTIAL BUILDINGS:

Loads are primary consideration in any buildings design because they define the nature and magnitude of hazards or external forces that a building must resist to provide reasonable performance (i.e. safety and serviceability) throughout the structure's useful life.

The anticipated loads are influenced by a building's intended use (occupancy and function), configuration (shape and size) and location (climate and site conditions). Ultimately, the type and magnitude of the design loads affect critical decisions such has the material selection, construction details, and architectural configuration.

Thus, to optimize the value (i.e. performance versus economy) of the finished product, it is essential to apply design loads realistically. While the building consider in this guide are primary single-family detached and attached dwellings, the principles and concepts related to building loads also apply to other similar types of construction, such as low-rise apartment's buildings.

In general, the design loads recommended in this guide are based on:

1 Dead load.
2 Live load.
3 Seismic load.

Dead Loads

This is the permanent of the stationary load like self-weight of the structural elements.

This includes the following

a Self-weight
b Weight of the finished structure part.
c Weight of partition walls etc.

Dead loads are based upon the unit weights of elements, which are established taking in account materials specified for construction, given IS 875 part 1

Dead loads consists of the permanent construction material loads compressing the roof, floor, wall, and foundation system, including claddings finishes and fixed equipment. Dead load is the total load of all of the components of the building that generally do not change over time, such as the steel columns, concrete floors, bricks, roofing material etc.

Live loads

These loads are not permanent or moving loads. The following loads includes in this type of loading: imposed loads (fixed) weight of the fixed seating in auditoriums, fixed machinery, partition walls these loads through fixed in positions cannot be relieved upon to act permanently throughout the life of the structure.

Imposed loads (not fixed) these loads change either in magnitude or position very often such as the traffic loads, weight of the furniture etc.

Live loads are produced by the use occupancy of the building. Loads include those from human occupants, furnishings, no fixed equipment, storage, and constriction and maintenance activities. As required to adequately define the loading condition, loads are presented in terms of uniform are loads, concentrated loads, and uniform live loads.

EARTHQUAKE LOADS

An earthquake (also known as a quake, tremor or temblor) is the result of a sudden release of energy in the Earth Crust 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.

ANALYSIS AND RESULT

GENERAL

Structure having G+10 story is analyzed for gravity and lateral loads (seismic and wind load). The effect of axial force, out of plane moments, lateral loads, shear force, story drift, story shear and tensile force are observed for different stories. The analysis is carried out using ETABS and data base prepared for different story levels as follows.

LOAD CASES AND LOAD COMBINATIONS

In this present work consider both gravity and lateral load case (SESIMIC AND WIND). The load combinations as per the Indian standards are considered. The primary load cases and the load combinations are shown following tables respectively.

Table: Primary load cases

LOAD CASE NUMBER	LOAD TYPE	LOAD CASE NUMBER	LOAD TYPE
1	SW	6	EQX
2	WL	7	EQY
3	FFL		
4	PARTITION		
5	LIVE		

Table: Load combinations

COMBINATION NUMBER	LOAD COMBINATION
COMB1	1.5(D. L+L.L)
COMB2	1.5(D. L+EQX)
COMB3	1.5(D. L+EQY)
COMB4	1.5(D. L-EQX)
COMB5	1.5(D. L-EQY)
COMB7	1.2(D.L.+L.L+EQX)
COMB8	1.2(D.L.+L.L+EQY)
COMB9	1.2(D.L.+L.L-EQX)
COMB10	1.2(D.L.+L.L-EQY)
COMB11	1.0(D.L+L.L)
COMB12	1.0(D. L+EQX)
COMB13	1.0(D. L+EQY)
COMB14	1.0(D. L-EQX)
COMB15	1.0(D.L-EQY)
COMB16	1.0D.L.+0.8L.L+0.8EQX
COMB17	1.0D.L.+0.8L.L-0.8EQX
COMB18	1.0D.L.+0.8L.L+0.8EQY
COMB19	1.0D.L.+0.8L.L-0.8EQY

Design spectrum calculations

The design horizontal seismic coefficient Ah for a structure shall be determined by the following expression:

$$A_h = \frac{ZIS_a}{2Rg}$$

$$A_h = \frac{ZIS_a}{2Rg}$$

Where

Zone Factor (Z) = It is a factor to obtain the design spectrum depending on the perceived maximum seismic risk characterized by Maximum Considered Earthquake (MCE) in the zone in which the structure is located. The basic zone factor included in this standard is reasonable estimate of effective peak ground accelerations. Zone factor is for the Maximum Considered Earthquake (MCE) and service life of structure in a zone. The factor 2 in the denominator of Z is used so as to reduce the Maximum Considered Earthquake (MCE) zone factor to the factor for Design Basis Earthquake (DBE).

Importance factor (I) = It is a factor used to obtain the design seismic force depending on the functional use of the structure, characterized by hazardous consequences of its failure, its post-earthquake functional need, historic value, or economic importance. Importance factor, depending upon the functional use of the structures, characterized by. Hazardous consequences of its failure, post-earthquake functional needs, historical value.

Response Reduction Factor (R) it is the factor by which the actual base shear force, that would be generated if the structure were to remain elastic during its response to the Design Basis Earthquake (DBE) shaking, shall be reduced to obtain the design lateral force. Response reduction factor, depending on the perceived seismic damage performance of the structure, characterized by ductile or brittle deformations. However, the ratio (I/R) shall not be greater than 1.0.

Structural response factor (Sa /g) = It is a factor denoting the acceleration response spectrum of the structure subjected to earthquake ground vibrations, and depends on natural period of vibration and damping of the structure. Average response acceleration coefficient.

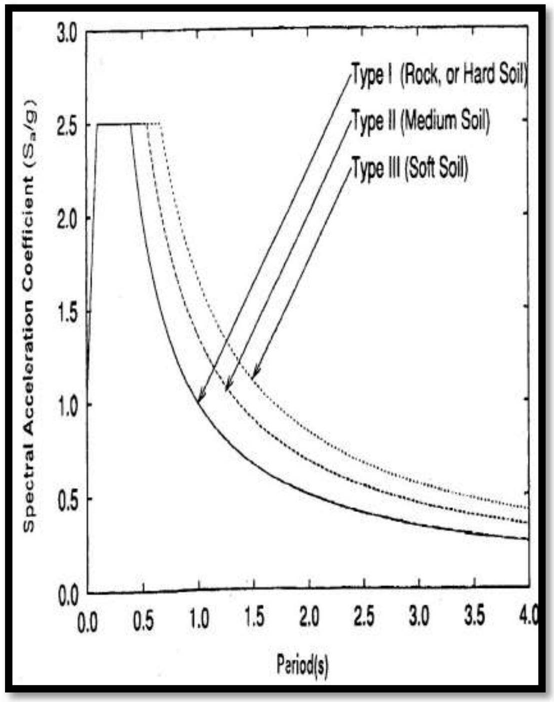
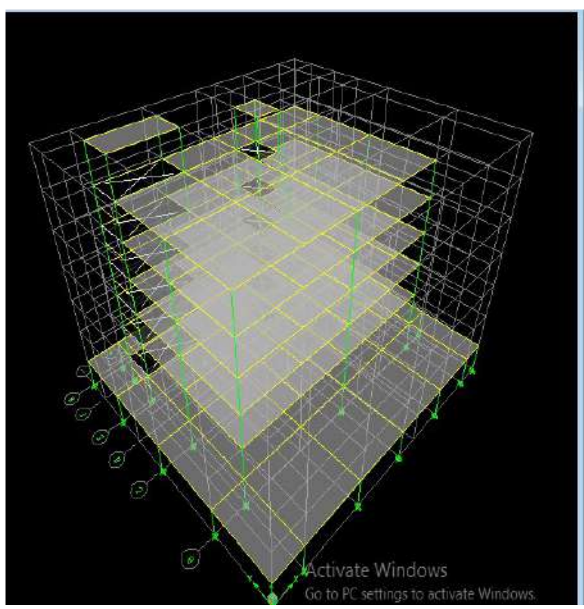
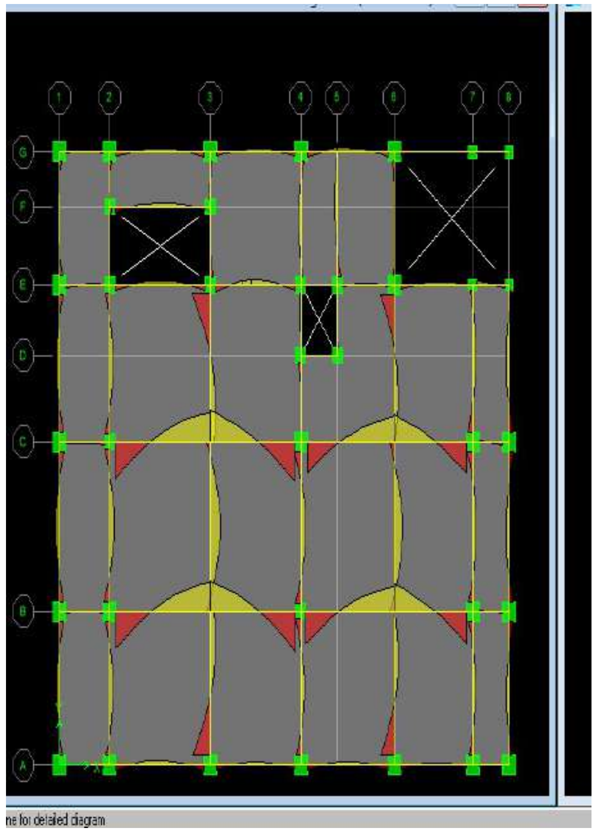


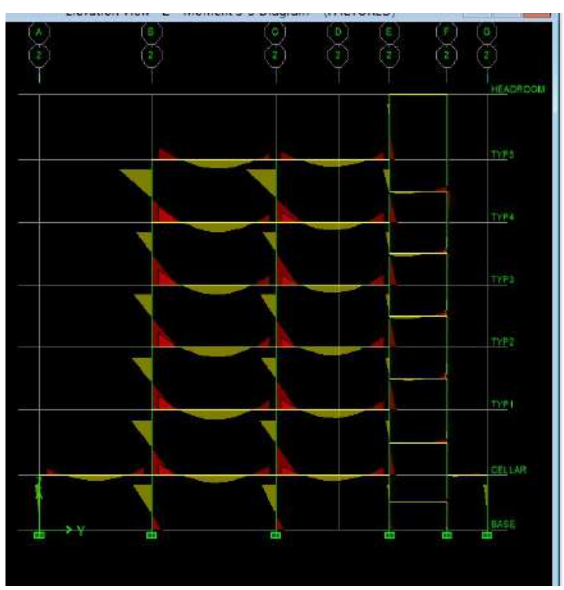
Fig: Response spectrum for rock and soil for 5 percent damping



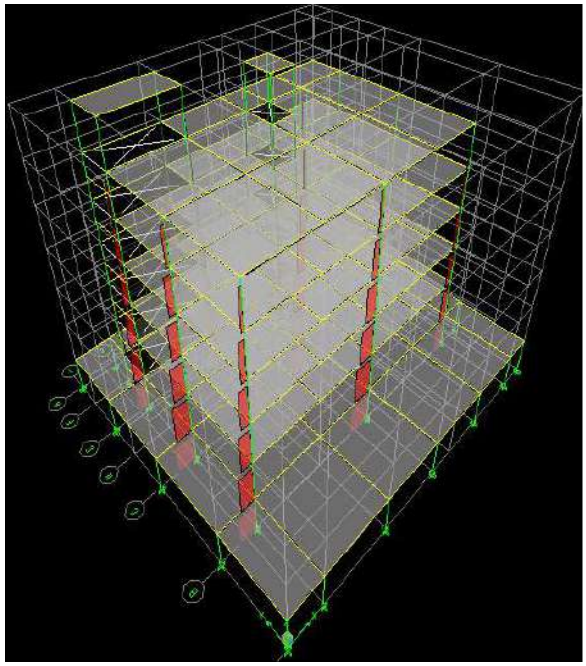
Bending moment:



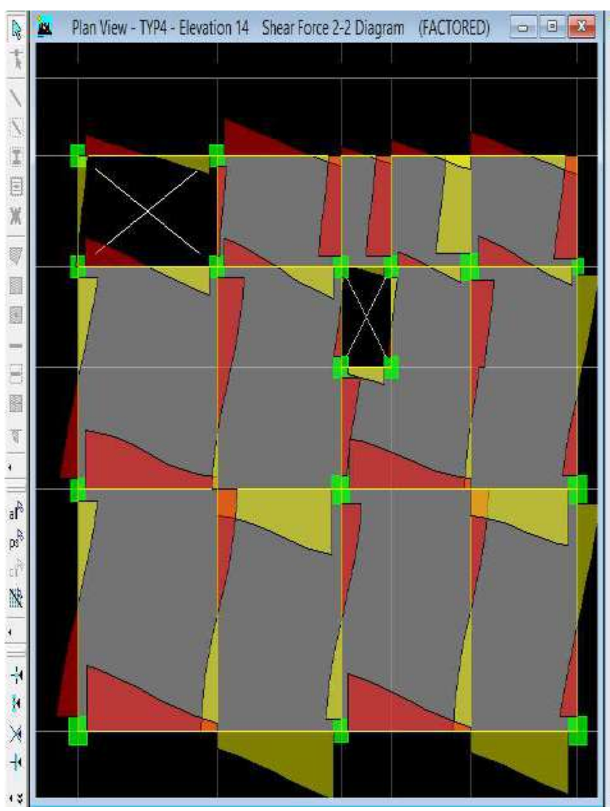
Bending moment: In elevation

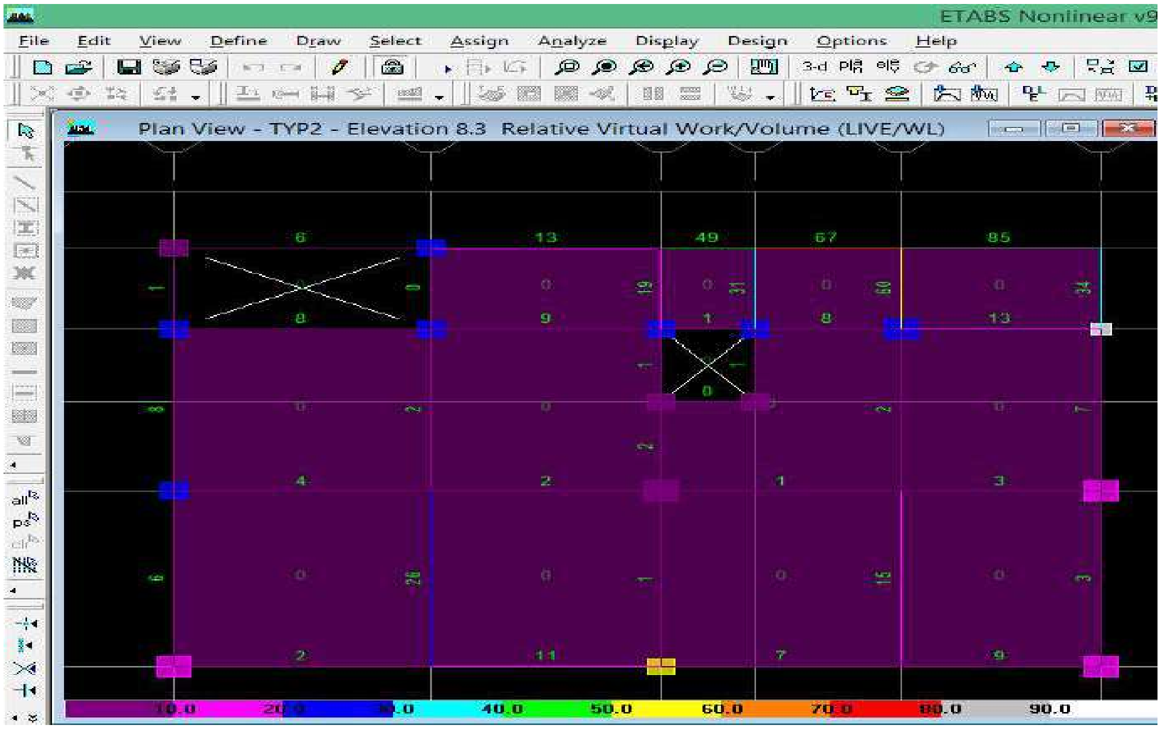


AXIAL FORCES



SHEAR FORCE:





CONCLUSION

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

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

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)
- ARRANGEMENTOF REINFORCEMENT USING SP 34

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