ANALYSIS & DESIGN OF MULTI-STORY BUILDING USING STAAD PRO AND E-TABS

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ABSTRACT:

A multistory building is a building that has multiple stories and typically contains vertical circulation in the form of ramps, stairs and lifts .Multi story building range from 2 stories to more than 150 stories. In this project we analyzed the 5-storey building using STAAD PRO and ETABS. The multistory building is designed using software STAAD PRO and ETABS & manually as per IS 456. The load used in the analysis are dead load (IS875-1987 part1), live load (IS875-1987 part2), wind load (IS875-1987 part3), seismic load (IS1893-1984 part1) and 25 load combinations are considered as per the IS875 (part5)-1987 code book The beams, columns and slabs are designedusing software and by manual procedure, reinforcement details are compared. The foundation is designed by using STAAD Foundation software.

KEYWORDS: *Analyzed, designed, Multistory, STAAD PRO, and ETABS.*

INTRODUCTION:

Building construction is the engineering deals with the construction of building such as residential houses. In a simple building can be define as an enclose space by walls with roof, food, cloth and the basic needs of human beings. In the early ancient times humans lived in caves, over trees or under trees, to protect themselves from wild animals, rain, sun, etc. as the times passed as humans being started living in huts made of timber branches. The shelters of those old have been developed nowadays into beautiful houses. Rich people live in sophisticated condition houses.Buildings are the important indicator of social progress of the county. Every human has desire to own comfortable homes on an average generally one spends his two-third life times in the houses. The security civic sense of the responsibility, these are the few reasons which are responsible that the person do utmost effort and spend hard earned saving in owning houses.

Nowadays the house building is major work of the social progress of the county. Daily new techniques are being developed for the construction of houses economically, quickly and fulfilling the requirements of the community engineers and architects do the design work, planning and layout, etc., of the buildings. Draughtsman is responsible for doing the drawing works of building as for the direction of engineers and architects. The draughtsman must know his job and should be able to follow the instruction of the engineer and should be able to draw the required drawing of the building, site plans and layout plans etc., as for the requirements.

The design is made using software on structural analysis design (staad-pro). The building subjected to both the vertical loads as well as horizontal loads. The vertical load consists of dead load of structural components such as beams, columns, slabs etc., and live loads. The horizontal load consists of the wind forces thus building is designed for dead load, live load and wind load as **per IS 875**. The building is designed as two dimensional

vertical frames and analyzed for the maximum and minimum bending moments and shear forces by trial and error methods as per **IS456-2000**. The help is taken by software available in institute and the computations of loads, moments and shear forces and obtained from this software.

DESIGN OF MULTI STORIED RESIDENTIAL BUILDING:

A structure can be defined as a body which can resist the applied loads without appreciable deformations.Civil engineering structures are created to serve some specific functions like human habitation, transportation, bridges, storage etc. in a safe and economical way. A structure is an assemblage of individual elements like pinned elements (truss elements), beam element, column, shear wall slab cable or arch. Structural engineering is concerned with the planning, designing and the construction of structures.Structure analysis involves the determination of the forces and displacements of the structures orcomponents of a structure. Design process involves the selection and detailing of the componentsthat make up the structural system.The main object of reinforced concrete design is to achieve a structure that will result in a safe economical solution.The objective of the design is

1. Foundation design
2. Column design
3. Beam design
4. Slab design

STRUCTURAL ANALYSIS METHODS:

Method of analysis of statistically indeterminate portal frames:

1. Method of flexibility coefficients.
2. Slope displacements methods (iterative methods)
3. Moment distribution method
4. Kane's method
5. Cantilever method
6. Portal method
7. Matrix method
8. Finite Element Method

LIMIT STATE METHOD:

The object of design based on the limit state concept is to achieve an acceptability that a structure will not become unserviceable in its life time for the use for which it is intended. i.e., it will not reach a limit state. In this limit state method all relevant states must be considered in design to ensure a degree of safety and serviceability.

Limit state: The acceptable limit for the safety and serviceability requirements before failure occurs is calleda limit state.

Limit state of collapse:

This is corresponds to the maximum load carrying capacity.

Violation of collapse limit state implies failures in the source that a clearly defined limit state of structural usefulness has been exceeded. However it does not mean complete collapse.

This limit state corresponds to:

a) Flexural

b) Compression

c) Shear

d) Torsion

Limit state of survivability:

This state corresponds to development of excessive deformation and is used for checking member in which magnitude of deformations may limit the rise of the structure of its components.

a) Deflection

b) Cracking

c) Vibration

SOFTWARES:

This project is mostly based on software and it is essential to know the details about these software's.

List of software's used

1. Staad pro (v8i)
2. Staad foundations 5 (v8i)
3. ETABS
4. Auto cad

STAAD:

Staad is powerful design software licensed by Bentley. Staad stands for structural analysis and design. Any object which is stable under a given loading can be considered as structure. So first find the outline of the structure, whereas analysis is the estimation of what are the type of loads that acts on the beam and calculation of shear force and bending moment comes under analysis stage. Design phase is designing the type of materials and its dimensions to resist the load. This we do after the analysis.

To calculate S.F.D and B.M.D of a complex loading beam it takes about an hour. So when it comes into the building with several members it will take a week. Staad pro is a very powerful tool which does this job in just an hour's staad is a best alternative for high rise buildings.

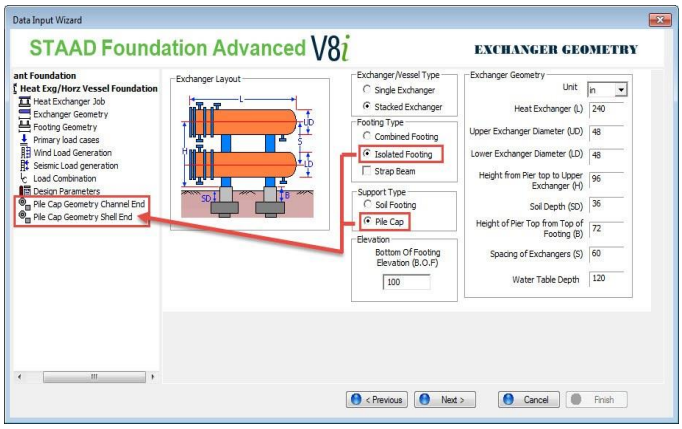
Now a day's most of the high rise buildings are designed by staad which makes a compulsion for a civil engineer to know about this software. This software can be used to carry R. C. C, steel, bridge, truss etc., according to various country codes.

ETABS:

ETABSis an engineering software product that caters to multi-story building analysis and design. Modeling tools and templates, code-based load prescriptions, analysis methods and solution techniques, all coordinate with the grid-like geometry unique to this class of structure. Basic or advanced systems under static or dynamic conditions may be evaluated using ETABS. For a sophisticated assessment of seismic performance, modal and direct-integration time-history analyses may couple with P-Delta and Large Displacement effects. Nonlinear links and concentrated PMM or fiber hinges may capture material nonlinearity under monotonic or hysteretic behavior. Intuitive and integrated features make applications of any complexity practical to implement. Interoperability with a series of design and documentation platforms makes ETABS a coordinated and productive tool for designs which range from simple 2D frames to elaborate modern high-rises.

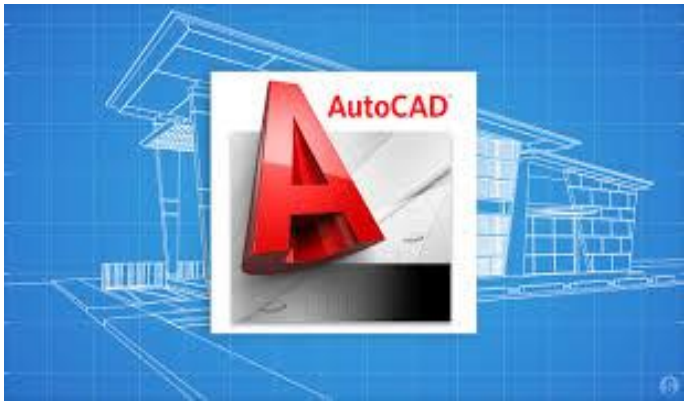
STAAD FOUNDATION V8I:

It gives efficient foundation design and documentation using plant-specific design tools, multiple design codes including Indian codes and metric bar sizes, design optimization, and automatic drawing generation. STAAD Foundation Advanced provides you with a streamlined workflow through its integration with Staad Pro or as a stand-alone application. You can design virtually any type of foundation, from basic to the most complex. Easily model complex or simple footings, such as plant foundations supporting vertical vessels, horizontal vessels, tanks and other footings Quickly model common foundations such as isolated, combined, strip, pile caps, and many more Simplify challenging scenarios such as vibrating machine foundation, lateral analysis of piers, or mat design using FEA Efficiently use your structural model with the foundation model through integration with Staad Pro, including automatically synced changes in both models



AUTOCAD:

Itis a commercial computer-aided design (CAD) and drafting software application. Developed and marketed by Autodesk AutoCAD was first released in December 1982 as a desktop app running on microcomputers with internal graphics controllers. Before AutoCAD was introduced, most commercial CAD programs ran on mainframe computers or minicomputers, with each CAD operator (user) working at a separate graphics terminal. Since 2010, AutoCAD was released as a mobile- and web app as well, marketed as AutoCAD 360. AutoCAD is used across a wide range of industries, by architects, project managers, engineers, graphic designers, and many other professionals. It was supported by 750 training centers worldwide in 1994.The 2018 release marked the 32nd major release of AutoCAD for Windows



PLAN:

The auto cad plotting represents the plan of a g+5 building. The plan clearly shows that it is a Multi storied building. In each block the entire floor consists of a two bed room house which occupies entire floor of a block. It represents a rich locality with huge areas for each house.

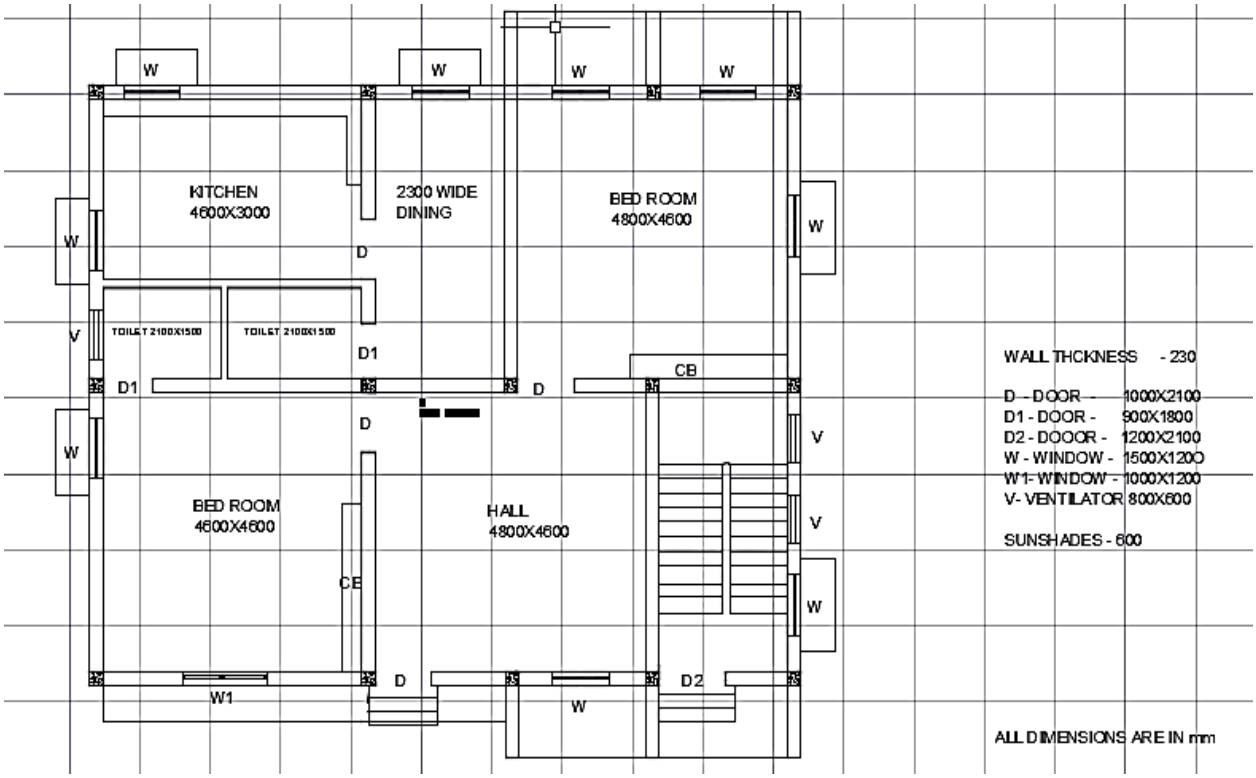


Fig.1 Plan of the multistory building

Elevation:

AutoCAD plot no.2 represents the proposed elevation of building. It shows the elevation of a g+5 building representing the front view which gives the overview of a building block.

The figure represents the site picture of our structure which is taken at the site .the building is actually under constructions and all the analysis and design work is completed before the beginning of the project. Each floor consists of height 3m which is taken as per GHMC rules for residential buildings. The building is not designed for increasing the number of floors in future. So the number of floors is fixed for future also for this building due to unavailability of the permissions of respective authorities.

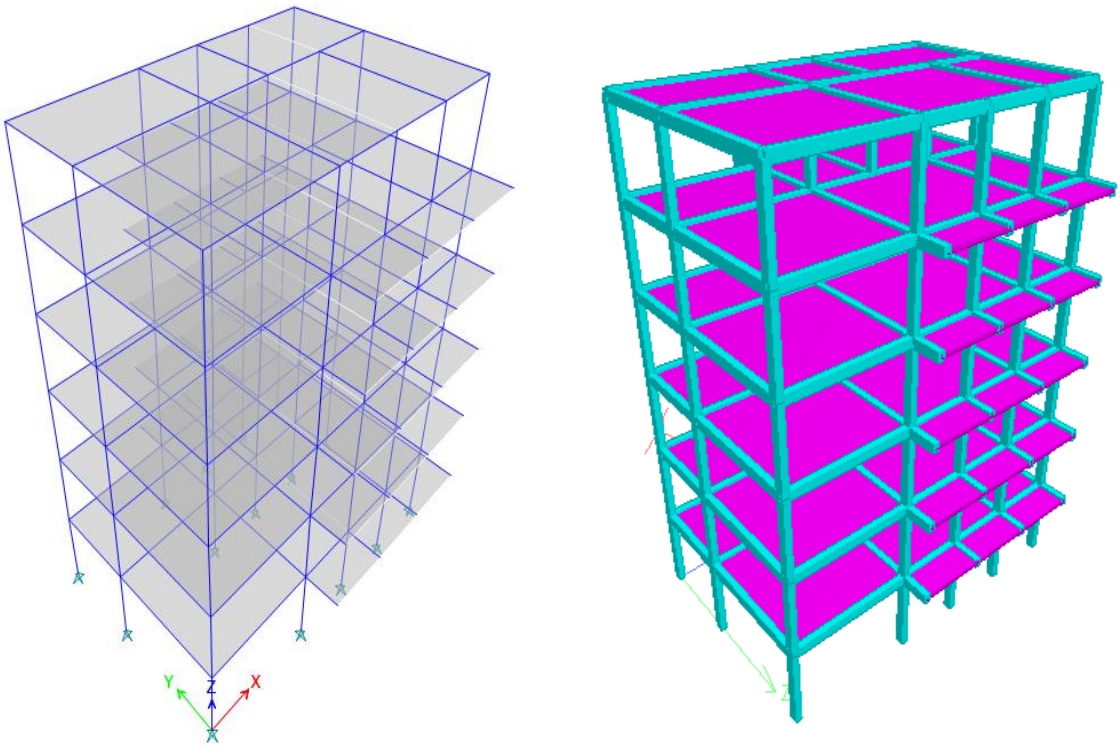


Fig.2 Multi storied building Model in STAAD & ETABS

LOADINGS:

Load Conditions and Structural System Response:

The concepts presented in this section provide an overview of building loads and their effect on the structural response of typical wood-framed homes. As shown in Table, building loads can be divided into types based on the orientation of the structural action or forces that they induce: vertical and horizontal (i.e., lateral) loads. Classifications of loads are described in the following sections.

Building Loads Categorized by Orientation:

Types of loads on a hypothetical building are as follows.

- Vertical Loads
- Dead
- Live
- Wind
- Seismic(vertical ground motion)

SALIENT FEATURES:

1. Utility of building: Residential building
2. No of stories: G+5
3. Type of construction: R.C.C framed structure
4. Types of walls: Brick wall
5. Geometric details:
6. Ground floor: 3m
7. Floor to floor height: 3m.
8. Depth of foundation: 1000mm
9. Materials:
10. Concrete grade: M30
11. All steel grades: Fe415 grade
12. Bearing capacity of soil: 300kN/m^2

LOADS:

1. Dead Load: self-weight As per IS 875 (part-1)-1987
2. Live Load: As per IS 875 (part-2)-1987
3. Wind Load: As per IS 875 (part-3)-1987
4. Seismic Load: As per IS 1893 (part-1)-1984
5. Load Combinations: As per IS 875 (part-5)-1987

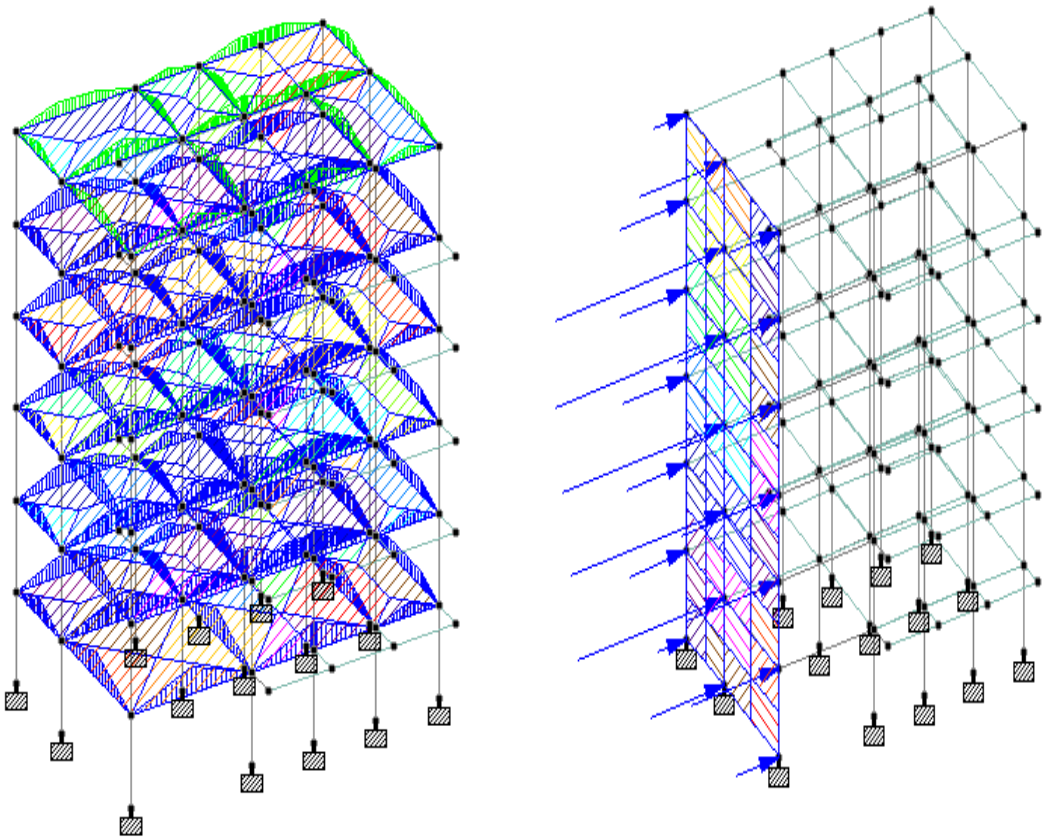
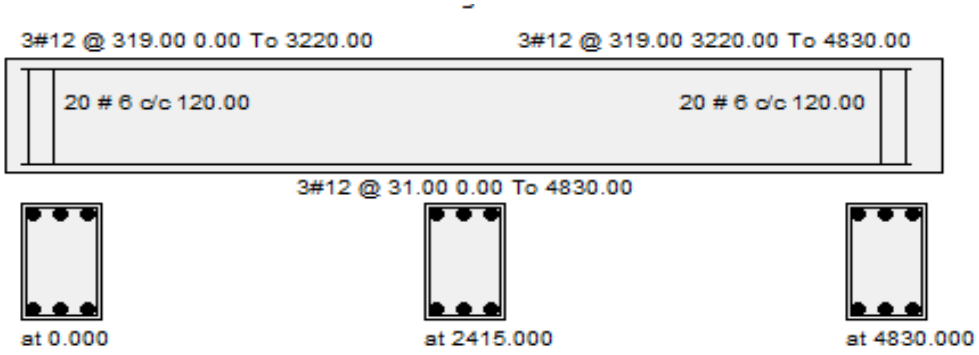


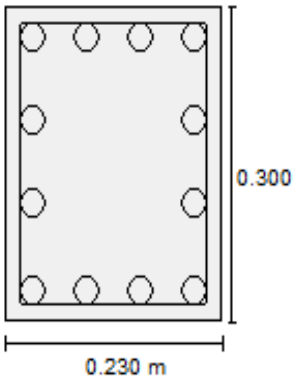
Fig.3 Diagram of Live load & wind loads

RESULTS

Beam Design:



Column Design:



Design Load

Load	11
Location	Long Col
Pu(Kns)	178.94
Mz(Kns-Mt)	11.38
My(Kns-Mt)	21.1

Design Parameter

Fy(Mpa)	415
Fc(Mpa)	30
As Reqd(mm²)	1309
As (%)	1.96
Bar Size	12
Bar No	12

Foundation Design:

Output

FootNo	GrpID	Footing Dim			Footing Reinforcement			
		Length m	Width m	Thickness m	Reinf(Mz)		Reinf(Mx)	
					Bar	Spacing	Bar	Spacing
1	1	2.00	2.00	0.50	10 mm	111.18 mm	10 mm	111.18 mm
2	2	2.30	2.30	0.60	10 mm	95.22 mm	10 mm	99.55 mm
3	3	2.10	2.10	0.55	10 mm	104.74 mm	10 mm	104.74 mm
4	4	1.85	1.85	0.50	10 mm	124.29 mm	10 mm	124.29 mm
5	5	1.90	1.90	0.50	10 mm	119.33 mm	10 mm	127.86 mm
36	6	2.35	2.35	0.60	10 mm	86.15 mm	10 mm	89.60 mm
37	7	2.60	2.60	0.70	10 mm	80.32 mm	10 mm	85.86 mm
38	8	2.15	2.15	0.55	10 mm	92.73 mm	10 mm	102.00 mm
39	9	2.15	2.15	0.55	10 mm	92.73 mm	10 mm	97.14 mm
40	10	2.10	2.10	0.55	10 mm	94.76 mm	10 mm	99.50 mm
71	11	2.10	2.10	0.55	10 mm	94.76 mm	10 mm	99.50 mm
72	12	2.40	2.40	0.65	10 mm	84.81 mm	10 mm	88.08 mm
73	13	2.00	2.00	0.50	10 mm	99.47 mm	10 mm	111.18 mm
74	14	2.20	2.20	0.55	10 mm	90.87 mm	10 mm	95.00 mm
75	15	2.05	2.05	0.55	10 mm	102.11 mm	10 mm	107.78 mm

Table.1 Dimensions & reinforcement details of footings

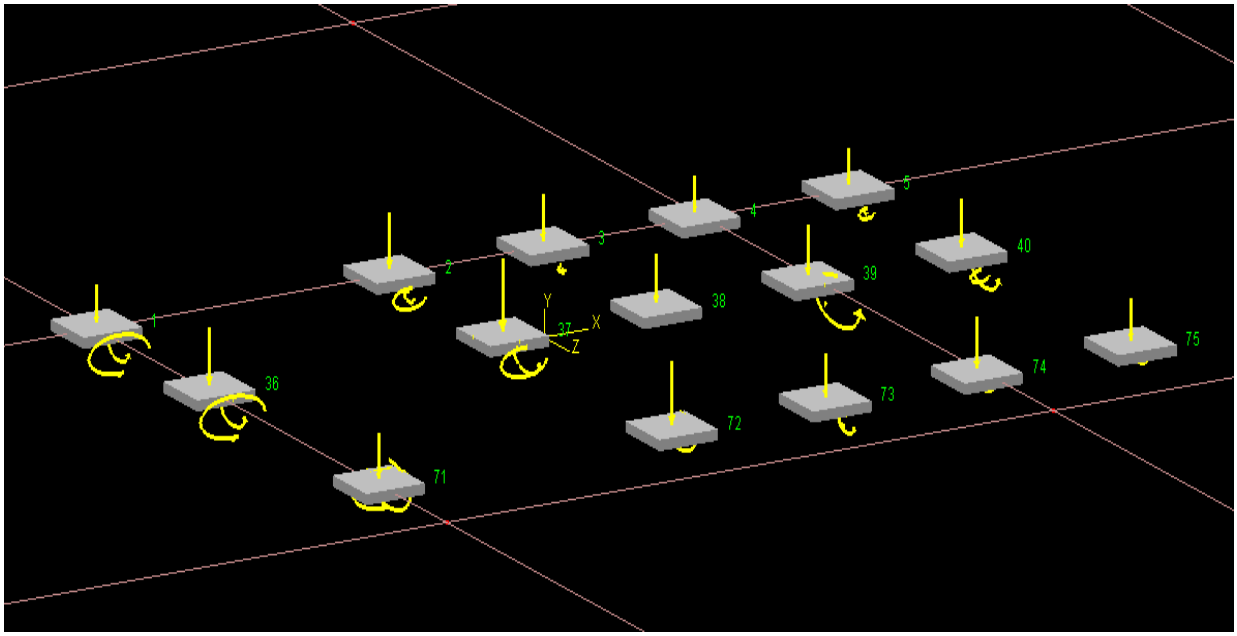


Fig.4 Position of footings

Slab Design:

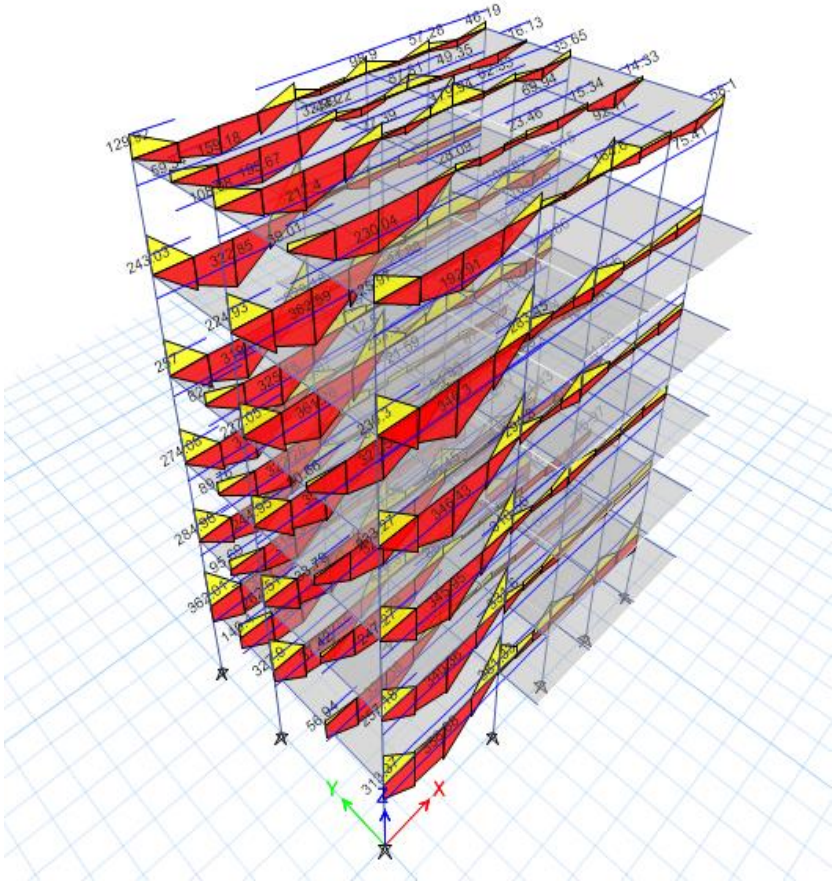


Fig.5 Reinforcement details for slabs

CONCLUSION:

1. In this project design of the residential building is done by manually, Staad pro and Etabs. In the manual process the time taken is more where as in the Staad pro and Etabs the program is predefined and accuracy is maintained.
2. Designing using software's like staad pro, Etabs reduces the lot of time in design work
3. In manual process the understanding of the structure becomes easy and the amount of steel is also maintained less where as in the Staad pro and Etabs the percentage of steel becomes more.
4. Details of each and every member can be obtained using staad pro, and Etabs.
5. Staad pro and Etabs are advanced software which is easy to design. In this the time is saved and all the design can be accurately.
6. All the list of failed beams can be obtained and also better section is given by the software
7. In designing the sections manually we can't predict which load combination is critical and also loads taken are linear static whereas by using software we can design for dynamic loads and also non-linear analysis can be done
8. The comparison between Staad pro, Etabs and manual design. Reinforcement required is uneconomical in Staad pro, when compared with Etabs and manual design.

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