

# Analysis and design of multistorey building by using STAAD Pro

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**Abstract** - The main aim of structural engineer is to design the structures for a safe technology in the computing field; the structural engineer can dare to tackle much more large and complex structure subjected to various type of loading condition. Earlier the loads acting on the structure are considered as static, but strictly speaking, with the exception of the self-weight (dead load) no structure load is static one

Now a day large number of application software's are available in the civil engineering field. All these software's are developed as the basis of advanced. Finite element analysis which include the effect of dynamic load such as wind effect, earth quake effect bets etc. in the present work, an attempt has been made to study the efficiency of certain civil engineering application software's

For this purpose an on-going project has been selected. This project belongs to the unity builders to be executed in the Gulbarga City. The name of the project is Bharat pride.

**Key Words:** Analysis, Design, STAAD PRO, Residential building, gravity load, shear force, bending moment and axial force.....

## 1. INTRODUCTION

In every aspect of human civilization we needed structures to live in or to get what we need. But it is not only building structures but to build efficient structures so that it can fulfill the main purpose for what it was made for. Here comes the role of civil engineering and more precisely the role of analysis of structure. The design consists of C+G+5 residential and Commercial building. The building is designed for the six residential flats. Residential flat consists of one 3BHK and three 2BHK. The floor to floor distance is 3m. There are many classical methods to solve design problem, and with time new software's also coming into play. Here in this project work based on software named "STAAD. Pro" has been used.

Few standard problems also have been solved to show how "STAAD. Pro" can be used in different cases. These typical problems have been solved using basic concept of loading, analysis, condition as per IS code. These basic techniques may be found useful for further analysis of problems. STAAD Pro 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, STAAD Pro is the professional's choice for steel, concrete, timber, aluminum and cold-formed steel design of low and high-rise buildings, culverts, petrochemical plants, tunnels, bridges, piles and much more.

To perform an accurate analysis a structural engineer must determine such information as structural loads, geometry, support conditions, and materials properties. The results of such an analysis typically include support reactions, stresses and displacements. This information is then compared to criteria that indicate the conditions of failure. Advanced structural analysis may examine dynamic response, stability and non-linear behavior.

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## 1.1 Stages in structural design:

The process of structural design involves the following stages: Structural planning, Computation of loads, Method of analysis, Member design and Detailing, drawing and preparation of schedules.

## 2. LITERATURE REVIEW

- V.Varalakshmi: The design and analysis of multistoried G+5 building at Kukatpally, Hyderabad, India. The Study includes design and analysis of columns, beams, footings and slabs by using well known civil engineering software named as STAAD.PRO. Test on safe bearing capacity of soil was obtained.
- P.Jayachandran: The design and analysis of multistoried G+4 building at Salem, tamilnadu, India. The study includes design and analysis of footings, columns, beams and slabs by using two

software's named as STAAD.PRO and RCC Design Suit.

- L.G.Kalurkar: The design and analysis of multistoried G+5 building using composite structure at earthquake zone-3. A three dimensional modeling and analysis of the structure are carried out with the help of SAP 2000 software. Equivalent Static Method of Analysis and Response spectrum analysis method are used for the analysis of both Composite and RCC structures. The results are compared and found that composite structure more economical.

### 3. METHODOLOGY:

- **MODELLING:**
  - (C+G+5) Residential and Commercial building.
- **LOADS:**
  - 1.5( Live Load +Dead Load ).
- **ANALYSIS:**
  - Analysis of RCC framed structure.
  - Shear Force and Bending Moment calculations.
- **DESIGN:**
  - Design of Slab, Beam, Column, Footing and Staircase.
- **GEOMETRIC PARAMETRS:**
  - Beam = 230 \* 300mm.
  - Column = 230 \* 300mm.
  - Slab = 150mm.

### 4. OBJECTIVES:

- Test for safe bearing capacity of soil.
- Generating structural framing plan
- Creating model in STAAD PRO
- Application of loads on the member
- Analysis of the structure
- Design the structure (manual design).

### 5. INTRODUCTION OF STAAD PRO

It is one of the effective software which is used for the purpose of analysis and design of structure by the structural engineers. Our project is aimed to complete with the help of Staad.pro STAAD Pro gives more precise and accurate results than manual techniques.

Features

- Analysis and design tool
- GUI based modeling
- Input file/Output file
- Results as per Indian & other standards
- Report generation

### 5.1 ANALYSIS DESIGN OF STRUCTURAL ELEMENTS

The modeling analysis is done in the STAAD PRO,

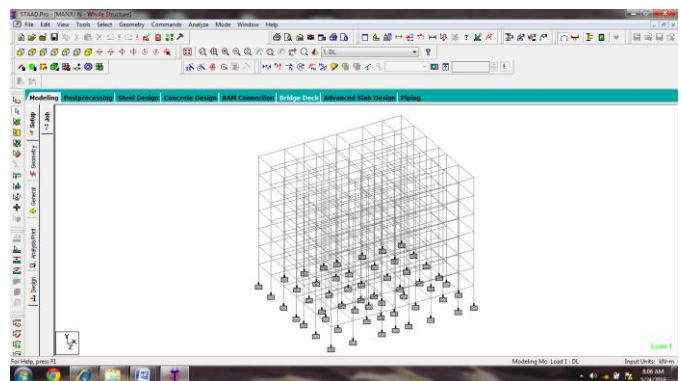


Fig 1. 3D modeling in STAAD PRO

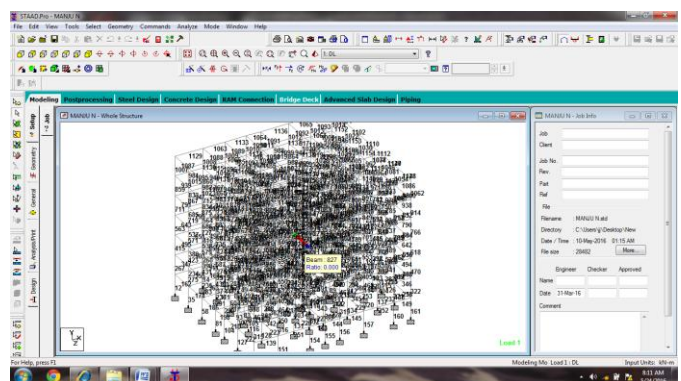


Fig 2. Beam number

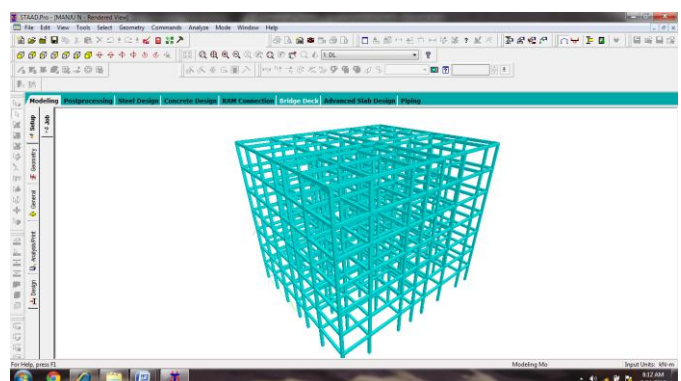


Fig 3. 3D rendering

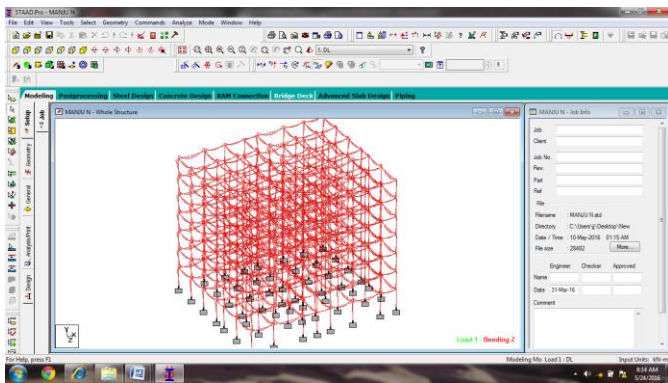


Fig 4. Bending moment diagram

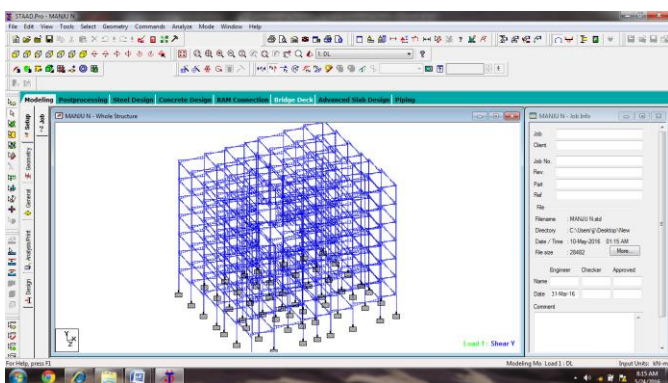


Fig 5. Shear force diagram

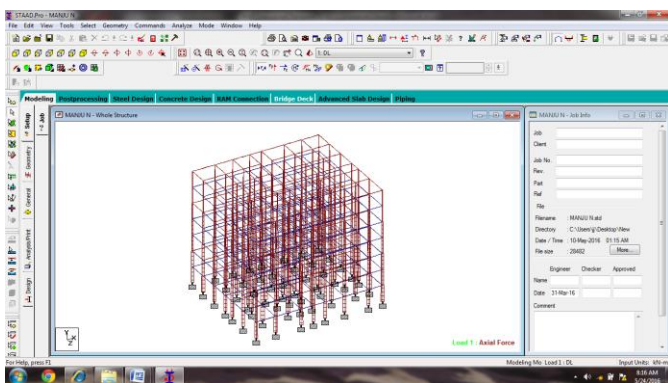


Fig 6. Axial force diagram

## 5.2 Design of RCC elements

The RCC are slab, beam, column, footing and stair case etc...

### 5.2.1 Design of slab

Slabs are most widely used structural elements forming floor and roof of building. Slab support mainly transverse load and transfer them to supports by bending actions more or one directions.

On the basis of spanning direction: It is two type one way slabs and two way slab.

**5.2.1.1 One way slab:** When the slab is supported on two opposite side parallel edges, it spans only in the directions perpendicular to the supporting edges. It bends in one directions and main steel is provided in the directions of the span. Such a slab is known as one-way slab.

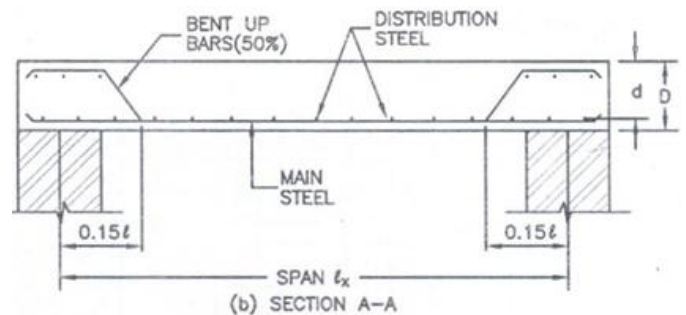


Fig 7. One way slab reinforcement

**5.2.1.2 Two way slab:** When the is supported on four edges and the load distribution is also on four edges of the panel. The reinforcement is provided on both the sides. Such slab is known as two way slab.

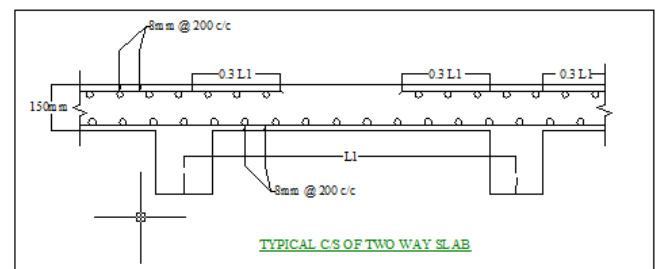


Fig 7. Two way slab reinforcement

## 5.2.2 Design of beam

There are three types of reinforced concrete beams

- 1 Single reinforced beams
- 2 Double reinforced beams

**5.2.2.1 Single reinforced beams:** In singly reinforced simply supported beams steel bars are placed near the bottom of the beam where they are effective in resisting in the tensile bending stress.

### 5.2.2.2 Double reinforced beams:

It is reinforced under compression tension regions. The necessities of steel of compression region arise due to two reasons. When depth of beam is restricted. The strength availability singly reinforced beam is in adequate.

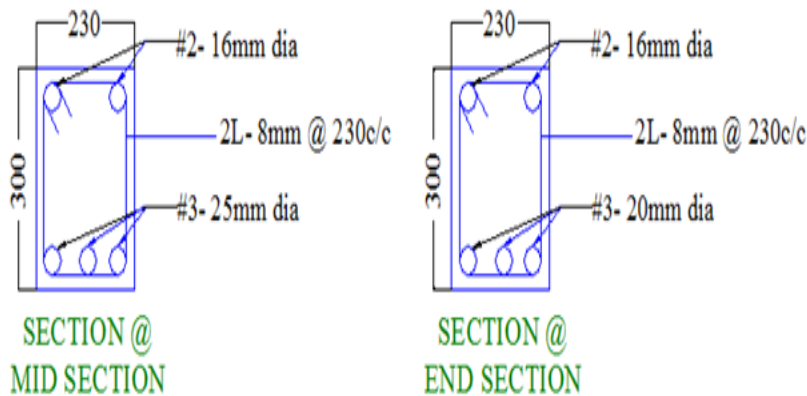


Fig 8. Beam reinforcement

### 5.2.3 COLUMN

A column may be defined as an element used primary to support axial compressive loads and with a height of a least three times its lateral dimension.

The strength of column depends upon the strength of materials, shape and size of cross section, length and degree of proportional and dedicational restrains at its ends.

### 5.2.4 FOOTING

Foundations are structural elements that transfer loads from the building or individual column to the earth .If these loads are to be properly transmitted, foundations must be designed to prevent excessive settlement or rotation, to minimize differential settlement and to provide adequate safety against sliding and overturning.

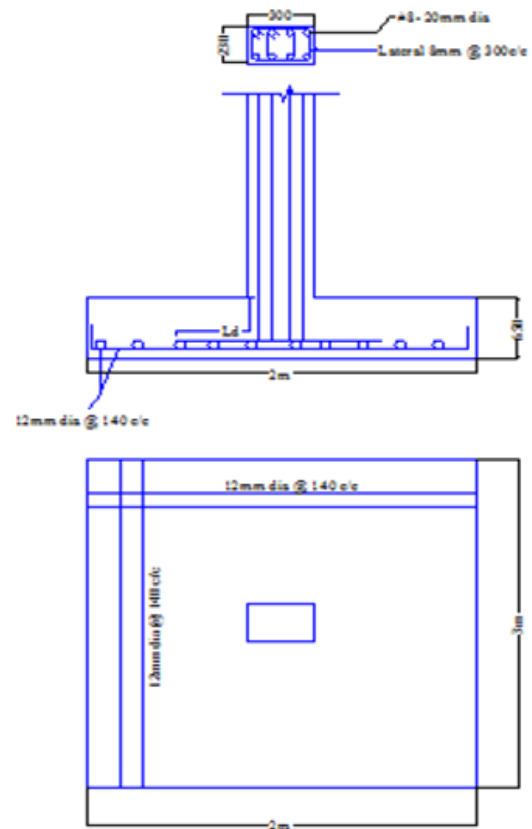


Fig 9. Column and footing reinforcement

### 5.2.5 Design of stair case

The purpose of a stair case to provide access to pedestrian in a building. The geometrical forms of staircase may be quite different depending on the individual circumstances involved. The shape and structural arrangement of a staircase would generally depend on two main factors.

1. Type of construction of structure around the stair case that is load bearing brick structure or reinforced concrete framed structure.
2. Availability of space.

Type of staircase provided for the proposed building is Bifurcated staircase, which consists of two flights. The first flight starts from plinth level to lintel level and second flight starts from lintel level to roof level.

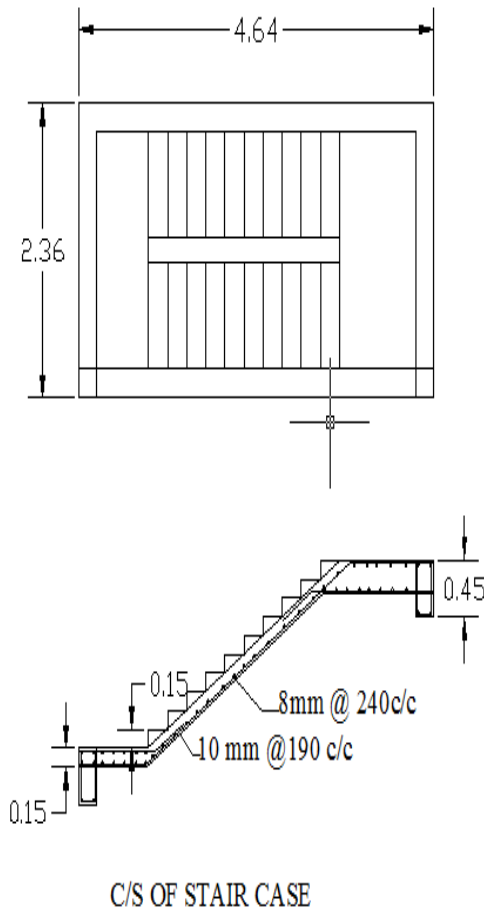


Fig 10. Stair case reinforcement

## 6. Conclusions

1. Short term deflection of all horizontal members is within 20mm.
2. The structural components of the building are safe in shear and flexure.
3. Amount of steel provided for the structure is economic.
4. There is no such large difference in analysis results of STAAD Pro and Kanis method.
5. Proposed sizes of the elements can be used in the structure.

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## IS CODES :

- \* IS 456-2000 ( Design of RCC structural elements )
- \* IS 875-Part 1 ( Dead Load )
- \* IS 875-Part 2 ( Live Load )
- \* SP-16 ( Depth and Percentage of Reinforcement)
- \* SP-34 ( Detailing ).