



DESIGN AND ANALYSIS OF COMMERCIAL BUILDING USING OF STAAD.PRO

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Abstract : Unique structures need more time for its time consuming calculations, if we use manual methods. STAAD Pro provides us a quick results. It is easy to use for analysed and design any structure for more accuracy. In the STAAD Pro limit state method is use as per Indian Standard Code and Practices. STAAD Pro is the new advancement in structural engineering. This software is used for analysis and design of concrete, steel, timber and aluminum. The model is been created and analyzed under various load condition such as dead load, live load, and some combination.

In the STAAD Pro limit state method is use as per Indian Standard Code and Practices. In this paper we study the analysis and design of the G+4 multi-storied building starts with the planning of the commercial building . The building has an overall area of 650 SQ.M. (7000SQF). Total building is planing by AutoCAD and analysed by STAAD Pro. After being analyzed by STAAD Pro the results are verified by manual design using code books IS 456-2000 and SP-16.

IndexTerms - RCC, STAAD.Pro, Bending Moment, Shear Force.

I. INTRODUCTION

Structural design is an art and science of designing with economy and elegance, safe and serviceable and durable structure. The entire process of structural planning and designing require not only imagination and conceptual thinking but also sound knowledge of science of structural engineering beside knowledge of practical aspect, such as relevant design codes. In this project work it is proposed to design of multistoried commercial building consisting of 5 floors. Each floor consist of 10 shops, public washroom, passage and also cafeteria in fourth floor. For analysis and designing of building. The plan draft by AUTO CAD software which plan creating in STAAD.PRO software for designing and analysis. STAAD.Pro is the structural software is nowadays accepted by structural engineer which can solve typical software like static analysis, wind analysis, seismic analysis using various load combination to confirms various codes such as IS456:2000, 1893:2002, is 875:1987 etc. we have chosen STAAD.Pro because of its following advantages

- Easy to use interface.
- Conformation with Indian standard code.
- Versatile nature for solution of the structure.
- Cover all aspects of structural engineer.
- Accuracy of the solution.

II. OBJECTIVES

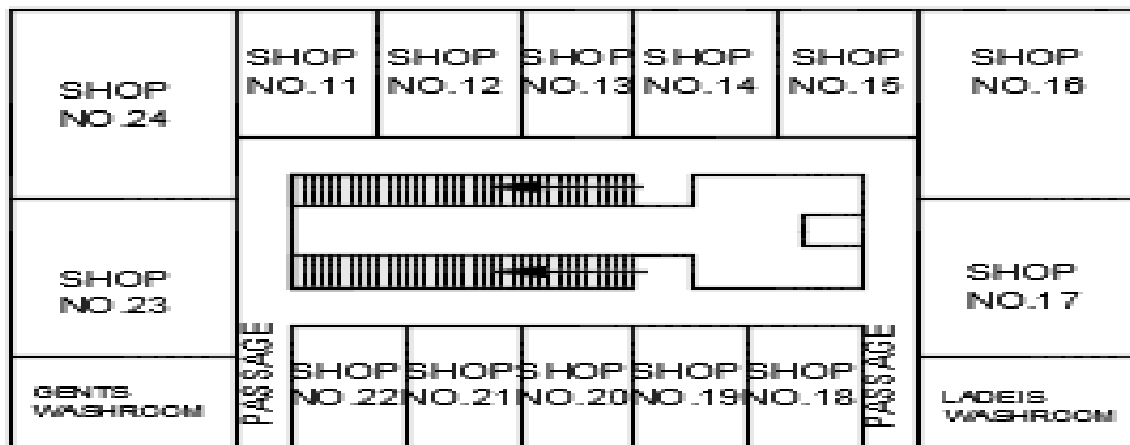
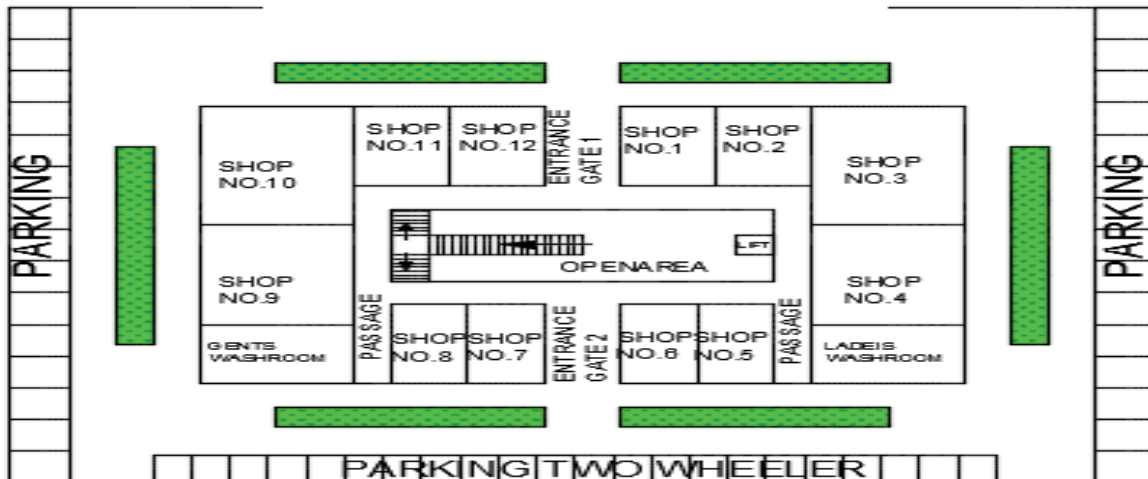
- The main objective of this study is to analyze and design of G+4 commercial building using STAAD.Pro software and the planning of the structure is plan by AUTOCAD software .
- To perform and design the structure without any type of failure.
- To understand the parameter of the design for the beam, column, slab and other structural component.
- To verify the deflection obtain by the STAAD.Pro with IS code limit.
- To check shear force, maximum bending moment and stress of structural component.

III. PLANNING

THE PROPOSED FIVE STORIED COMMERCIAL BUILDING CONSIST OF AREA OF EACH FLOOR IS 650 SQUARE METER. THE (G+4) COMMERCIAL BUILDING IS CONSIDERED WHOSE ARCHITECTURAL PLAN AND STRUCTURAL FRAMING PLAN WERE PREPARED AS SHOWN IN FIGURE BELOW AFTER IT IS MODELING IN STAAD.PRO. THE PLANNING OF THIS (G+4) STORIED BUILDING IS SO PLANNED TO MEETOUT AL THE ABOVE FACTORS.

TYPICAL PLAN OF GROUND FLOOR: IN THIS FLOOR ENTRANCE GATE AT TWO SIDE, VARIOUS SHOPS, ESCALATOR, LIFT, CAFETERIA, OPEN AREA, TOILET BLOCK ARE PROVIDED.

TYPICAL FLOOR PLAN OF FIRST TO FOURTH FLOOR: IN THIS FLOOR PLAN VARIOUS SHOPS, SUPER MARKET , ESCALATOR, LIFT AND TOILET BLOCK ARE PROVIDED.



IV. LITRETURE REVIEW

Y.Stalin, K. Pranaya; Analysis of commercial building using STAAD.Pro. commercial building represent the large portion of new project throughout the world commercial building design for the consumer interaction and sales often the unique structural and architectural due to emphasis on aesthetic and performance. In this project work on the design of two story with alarge span and lobby for the agent and consumer. They concluded that STAAD.Pro analysis and design for the given structure the total deflection due dead load and live load for different load combination is differ. The failure loads are identified and structure is designed for loads that can withstand wind loads and seismic load.

Falak Vats; Review paper on design analysis of multi- storey building by using STAAD.Pro. structure designing requires a detail structural analysis on which the design of the structure based. but it is not possible to do manual calculation hence we need programing tool was found. for which several of power tool formed among which most widely use one is STAAD.Pro. STAAD.Pro for computing the load and its combination and analyzing the structure and designing the structure based on the analysis.

Devi Krishna Chaitanya(2017); Analysis and design of G+6multi storey building using STAAD.Pro. they use static indeterminacy method to calculate known fixed and moment to satisfy the condition of compatibility by iteration method. Kani's method was used to distribute the moments joints in frames and continuous beam for stability of the members of building structure. They used the design software STAAD.Pro. which reduce lot of time in design , give accuracy of the solution.

Indian Standard CODE are used

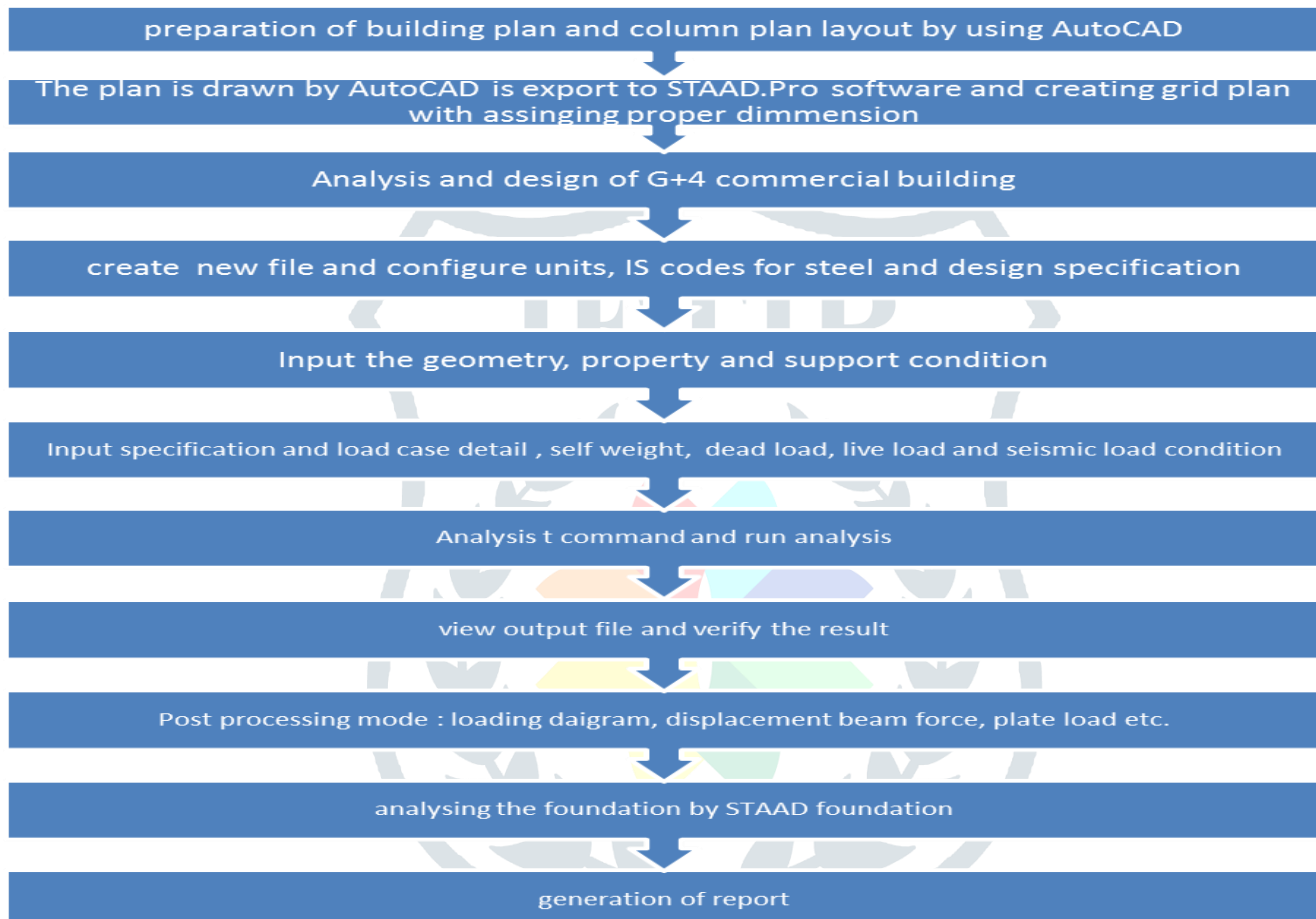
IS 456-2000 Plain and Reinforced Concrete - Code of Practice is an Indian Standard code of practice for general structural use of plain and reinforced concrete. The latest revision of this standard was done in year 2000.This code uses the limit state

design approach as well as the working stress design approach. However the Code recommends use of the limit state design approach.[1] It is written for use in India. It gives extensive information on the various aspects of concrete.

IS875: As per IS 875. The building is designed as two dimensional vertical frame and analyzed for the maximum and minimum bending moments and shear forces by trial and error methods as per IS 456-2000. As per IS 875. Dead loads depends upon the unit weight of the material. Dead loads includes, the self weight of walls, floors beams, columns etc. and also the permanent fixtures present in the structure. The unit weight of commonly used building materials are given in the code IS 875 (part-I)-1987.

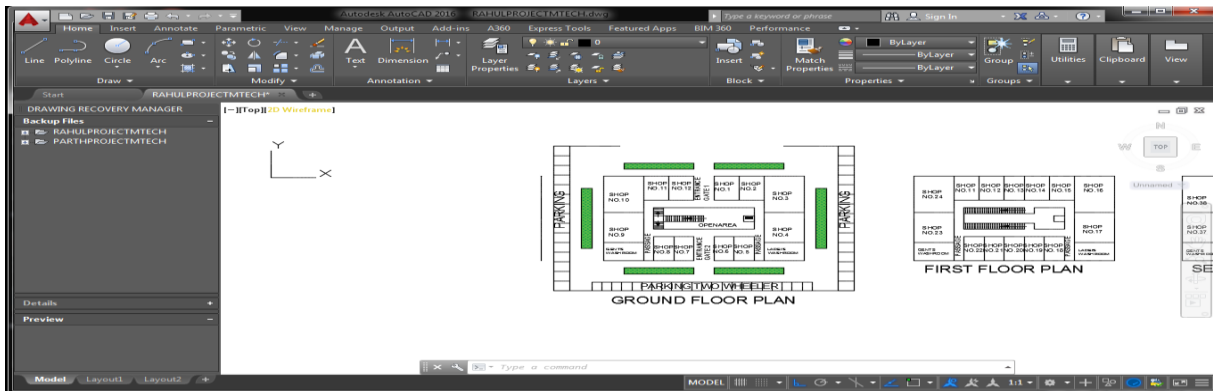
V. METHODOLOGY

A model of G+4 storey building is analysed and design by using STAAD.Pro software and architectural planning created by AUTOCAD. The building plan size is (100'X70') the building supposed situated in Raipur in earthquake zone II. Which seismic zone coefficient is taken 0.1. as per IS code. The following flowchart shows the method of designing and analysing of the project.



V.I. Preparation Building Plan and Column layout by using AutoCAD

The layout has been mostly completed by line command. The unit for layout is meters with the accuracy of '0.000'. In below figure shows the line diagram showing center line of the beam and column layout. The beam has a cross section of 0.230m x 600mm and the column cross section is 0.600m x 0.230m. The slab has a uniform thickness of 0.150m. The floor to floor height of the building is 3.6m.



V.II. Analysis and design of building by using STAAD.Pro

The layout of the building is approved by the architect. The layout plan was exported to STAAD.Pro. The layout was plotted in STAAD.Pro, then numbers of the stories are created by using the command of transitional repeat. After this, member properties and size are assigned to the plan, and next load cases are generated and applied to the structure. Once the process is complete, so we analyse the structure before checking errors and warnings.

After the analysis, the designing of the project will be started by entering DESIGN in the STAAD.Pro, choosing standard code, concrete strength, and steel grade and all other design parameters and load combinations. The complete design of beam, column, and slab was found.

After the designing process is completed, the STAAD foundation program was opened. Once we load cases and beam, column size are transferred and entering of soil condition and type of foundation. Then providing of complete analysis and design of foundation.

- Creating of nodes and 3-D model
- Generation of member and member property
- Creation of support
- Assigning material properties
- Assigning of the loads and load combinations

V.III. Load and Load combination

The loads that have been considered on the structure are as follows:

1. Dead load
2. Live load
3. Seismic load
4. Load combination

1. Dead load : In STAAD.Pro the applying of the dead load by assigning self weight command of the structure, which entire weight of the structure is assigned.

Dead load of slab in STAAD.Pro is generated by floor loads command. Specifying the slab thickness and the load on the floor per square meter. The slab dead load taken 5.75KN/M.

Dead load of wall is generated on the STAAD.Pro with the help of Member load command, specifying the thickness and height of wall and the load of masonry per square meter. The member load should be taken is 16KN/M and for parapet wall is 4KN/M.

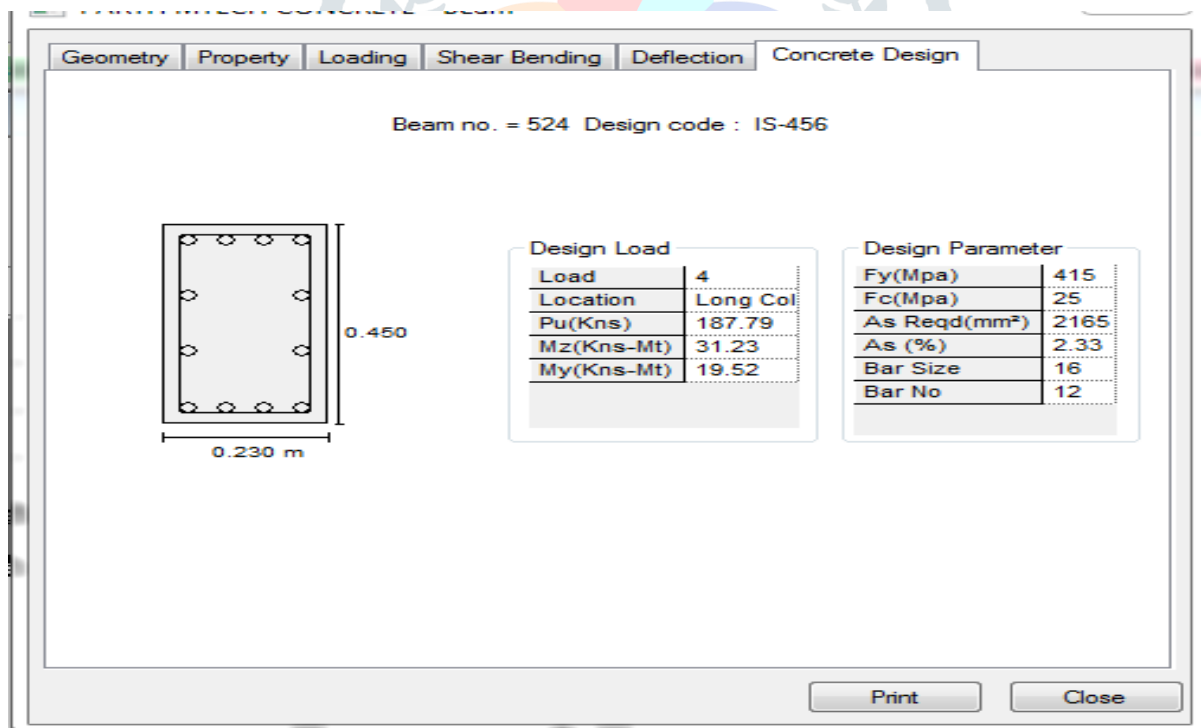
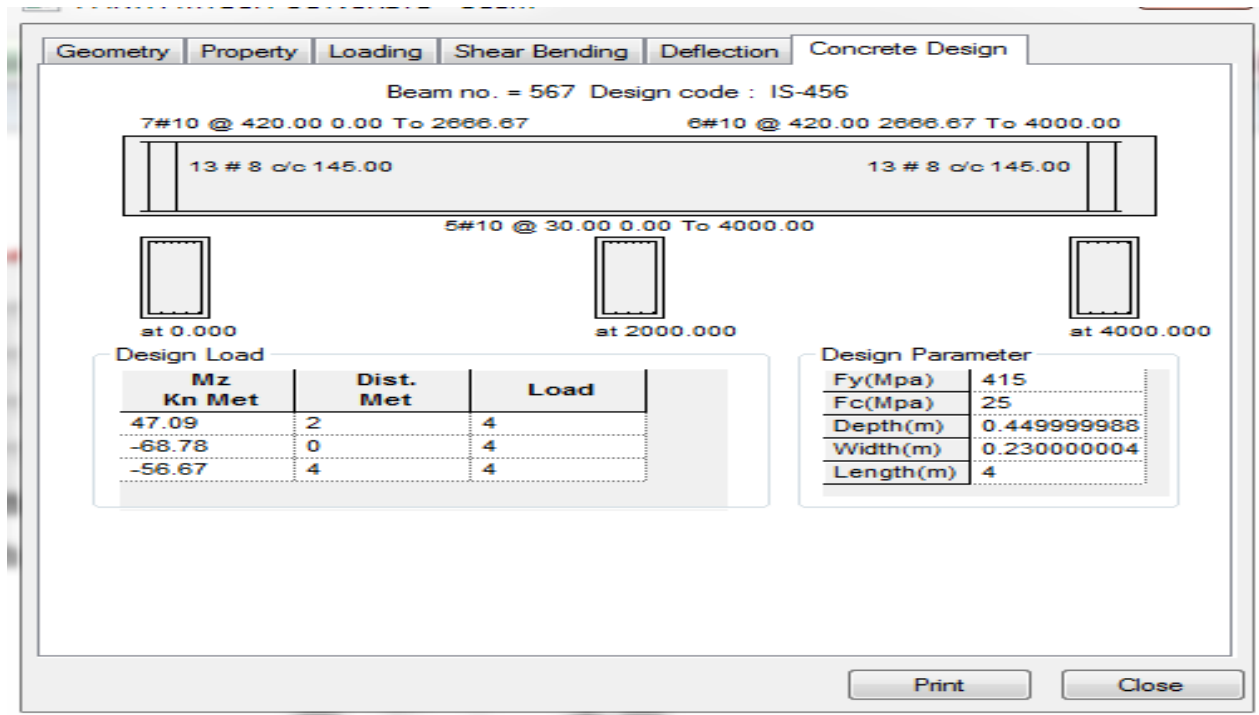
2. Live Load : The live load for each floor should be considered is 5KN/M. The live load are generated same way as dead load.
3. Seismic Load : The seismic loads derived from IS1893:2002 and these load are generated by STAAD.Pro seismic load generator loads generate in X and Z direction only. Y direction only contain gravity load.
4. The structure has to be analysed for load combination all the previous load in proper ratio. The combination are generated by the inbuilt auto-load generator for various load combination as per IS code.

- 1.5DL+1.5LL
- 1.2DL+ 1.2LL
- 1.2DL +1.2LL +1.2EQ

VI. DESIGN OF STRUCTURE

After the completing of analysis part of whole structure in STAAD.pro. we can now proceed designing part of the structure. STAAD.Pro can be design the structure for various type structure like steel, concrete etc. we will choose reinforced cement concrete for our structure . after completion of the analysis we go back to modeling mode and click on the design tab were we select concrete as the material and we select the design code which should be followed. We select IS456.

Once all the parameter and data are entered into the STAAD. We run the the analysis again so as to get the value.



VII. RESULT

Comparing shear force and bending moment of the beam

	SHEAR FORCE OF BEAM	BENDING MOMENT OF BEAM
STAAD.PRO	87.238KN	74.374 KH-M
MANUAL METHOD	65.910 KN-M	81.738KN-M

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C O L U M N N O. 98 D E S I G N R E S U L T S

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 4500.0 mm CROSS SECTION: 230.0 mm X 600.0 mm COVER: 40.0 mm

** REQUIRED STEEL AREA = 4084.80 Sq.mm.

** SECTION IS NOT ADEQUATE
 WARNING:Unable to accommodate required reinforcement

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STAAD SPACE

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C O L U M N N O. 99 D E S I G N R E S U L T S

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 4500.0 mm CROSS SECTION: 230.0 mm X 600.0 mm COVER: 40.0 mm

** REQUIRED STEEL AREA = 4195.20 Sq.mm.

** SECTION IS NOT ADEQUATE
 WARNING:Unable to accommodate required reinforcement

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B E A M N O. 139 D E S I G N R E S U L T S

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 5000.0 mm SIZE: 230.0 mm X 600.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1250.0 mm	2500.0 mm	3750.0 mm	5000.0 mm
TOP REINF.	502.94 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	584.93 (Sq. mm)
BOTTOM REINF.	0.00 (Sq. mm)	268.52 (Sq. mm)	354.62 (Sq. mm)	268.52 (Sq. mm)	0.00 (Sq. mm)

SUMMARY OF PROVIDED REINF. AREA

SECTION	0.0 mm	1250.0 mm	2500.0 mm	3750.0 mm	5000.0 mm
TOP REINF.	3-16i 1 layer(s)	2-16i 1 layer(s)	2-16i 1 layer(s)	2-16i 1 layer(s)	3-16i 1 layer(s)
BOTTOM REINF.	4-10i 1 layer(s)	4-10i 1 layer(s)	5-10i 1 layer(s)	4-10i 1 layer(s)	4-10i 1 layer(s)

Discussion :

- The shear force of STAAD.PRO is higher than manual method and bending moment of the beam is less.
- The structural component of the building are safe in shear force and flexure and the amount of steel is estimated by STAAD.Pro is economic. All kind of errors are identified with the help of STAAD.Pro.

VIII. CONCLUSION

- The structure component of the building are safe in shear and flexure.
- Amount of steel provided for the structure is economic.
- Analysis and evaluating of entire structure with the help of STAAD.pro taking shorter time as compare to manual design method. And give more accurate results.
- All kinds of errors in the structure can be identified with the help of STAAD.Pro software.
- Details of the construction of all members such as (slab, beam, column, footing) can be easily identified.
- The project is improved by modern technology and delay in starting construction work is eliminated.

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