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# Design And Analysis Of School Building by Using Staad Pro

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**ABSTRACT:**

Using STAAD, this project investigates many aspects of the examination and the school construction design. Pro. Primary planning necessitates a detailed investigation of the foundation upon which the building design is built. However, as the need for programming tools was identified, manual estimating became infeasible. Consequently, many intensity devices were developed, the most popular of which being STAAD. Pro, which allows for pre-development subsurface and seismic investigation. When designing a high-rise, it is quite feasible to use pro to calculate the loads, analyze the structure, and base the design on the results. After that, the shear and bending conditions are checked in the produced design using the analytical program STAAD pro. The kind of slab, end conditions, and loading are the three main factors that are considered while constructing a slab. It all starts with the slabs, moves to the beams, then the columns, and finally the footings, bearing the weights that the beams carry. The project's primary concern is with the building's structural design and making sure it satisfies all functional, safety, and stability standards. The spatial affordance of school buildings, more especially the affordance of "informal learning spaces" for student activities like "self directed learning," is the selected emphasis of this research.

**KEYWORDS**: Evaluation, Structural design, STAAD.pro, Load types

## INTRODUCTION

These days, building structures that can withstand earthquakes is the biggest obstacle structural engineers face. The problem is exacerbated since there are more visually appealing high-rise projects with architectural issues. When confronted to destructive earthquakes, these aesthetically beautiful constructions with uneven shapes cause worry. How an earthquake's forces are transmitted to the ground, as well as the building's general size, geometry, and form, play crucial roles in determining the building's behavior during earthquakes. For the case study, a collegiate building is used. A detailed study of this building for dead ,live and earthquake loads are analyzed and results like shear, moment carrying capacity and reinforcements required are compared. Our current knowledge of seismic demand on buildings, along with our experiences with major earthquakes close to cities, has led to a deeper comprehension of this topic.

## 1.1FEATURES OF STAAD PRO

**Modeling**: STAAD. Pro allows users to create 3D models of structures using a variety of modeling techniques, including manual input of nodes and members, importing from other CAD software, and generating models from templates.
**Analysis**: STAAD.Pro offers a wide range of analysis capabilities, including static and dynamic analysis, linear and nonlinear analysis, and specialized analysis for seismic and wind loads. provides advanced features for performing time history analysis, buckling analysis, and response spectrum analysis.
**Design**: STAAD. Pro includes powerful design capabilities for a wide range of structural elements, including beams, columns, slabs, walls, foundations, and more. It automatically checks and designs the members based on the selected design codes and provides detailed design reports.
**Visualization**: STAAD.Pro offers advanced visualization tools, including 3D rendering, animation, and graphical display of analysis results, making it easy to understand and present the structural behavior and results.
**Interoperability**: STAAD.Pro allows for seamless integration with other software tools, such as AutoCAD, Revit, and other Bentley software products, enabling efficient data.

### *BENEFITS OF STAAD.Pro*

The ability to accurately analyze structures under a variety of loads, such as dead, live, wind, and seismic, is a key feature of structural analysis software. Helps with design in accordance with a number of worldwide standards, such as IS, ACI, Eurocode, and others, ensuring code compliance.

Reduces human work and saves time by automating complicated computations.

The design is versatile and can support a wide range of materials, including cold-formed steel, concrete, wood, aluminum, and more.  Visualization and Reporting: It helps with documentation and comprehension by providing visual representations and full reporting on output. • A Streamlined Design Process: Interoperable with Popular Software Like AutoCAD, Revit, and Building Information Modeling (BIM).

***OBJECTIVES***

- Creating layout plan of commercial building on AUTO-CAD software and model of structure on STAAD-PRO.
- To find out various load Conditions (DL, LL) applied on structure.

***3.1 CREATING PLAN ON AUTOCAD***

- AutoCAD is a commercial software application for 2D and 3D computer aided design and drafting for various fields in engineering like civil, mechanical, electrical, automation, architecture etc. It was first launched in 1982 by Autodesk, Inc.
- By using the inbuilt commands given by Autodesk.

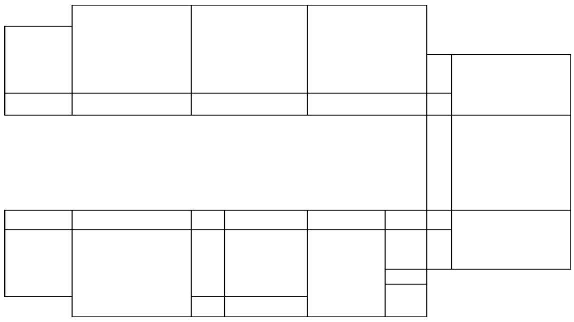

**Fig 1: plan of the building**

***Procedure***

Step 1: Start up AutoCAD and go to the File menu. Select New > Open Drawing File.
Step 2: For example, you may use the "UNITS" command to change the drawing units to inches, feet, or meters.
Step 3: To start sketching the idea, go to the toolbar and choose the right drawing tools like lines, arcs, circles, and polygons.
Step 4: To start sketching the idea, go to the toolbar and choose the right drawing tools like lines, arcs, circles, and polygons.
Step 5: Doors, windows, and rounded corners may be easily drawn with the ARC and CIRCLE commands.
Step 6: Use the "TEXT" and "DIMENSION" commands to add text, dimensions, and other comments. Make your selections for fonts, sizes, and positions.
Step 7: To distinguish between various materials or regions, you may use the "HATCH" command to apply hatching or shading. Patterns, sizes, and limits may be defined as required.
Step 8: Assign suitable colors, linetypes, and lineweights to each layer to arrange various components like text, walls, doors, and windows.
Step 9: Use the editing tools at your disposal, such as TRIM, EXTEND, and FILLET, to make any required adjustments, such as trimming, extending, or filleting.
Step 10: To prevent your work from being lost, save your drawing file at regular intervals.
Step 11: Make sure your strategy is accurate and comprehensive by reviewing it.
Step 12: Print

***3.2 ARCHITECTURAL BEHAVIOUR OF A BUILDING***

On occasion, the building's structural system is what draws in visitors, while on other instances, the building's form and structural system combine to create a marvel. An abnormally shaped building will experience an abnormally high amount of deflection and twisting moment in the event of an earthquake. The architectural challenge encompasses several visually pleasing structures that exhibit inconsistencies. Buildings with plan or vertical irregularities include those with several stories, an L-or C-shaped layout, a huge horizontal footprint, or a square design with a central entrance.

***3.3 STUDY AREA***

Research in the field of earthquake engineering is extensive. The analysis and design of superstructure is our major interest. Superstructures, including those with permanent bases, are analyzed and designed to withstand earthquakes. It also covers the process by which geometrically irregular superstructures collapse.

***3.4 AIM OF THE PRESENT PROJECT***

• Locating faults in a building's design that might propagate an earthquake. But architects propose fantastic and inventive buildings because they want to make things that look well and work well. However, in reality, the building's resistance to earthquakes and lateral pressures decreases as the number of abnormalities increases.
• When an existing school building is located in earthquake zone III but was not originally built to seismic standards, appropriate measures are taken to modify it.

## 4.1Modeling of the structure in STAAD Pro

Using STAAD Pro software, the structural model is being prepared.
Get the model ready for up to three stories by using the in-built commands in STAAD pro.

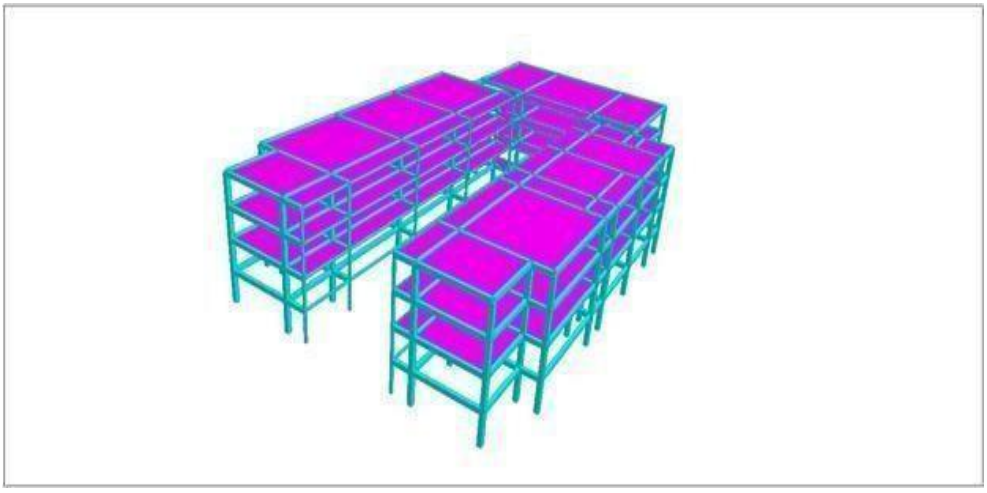

**Fig 3: 3d Top View**

### *4.2 Load Calculations*

The self-weight factor of 1 KN/m is included in the dead load calculation, which also includes the member load of 5.62 KN/m for the whole structure. The live load encompasses a floor load of 3 KN/m in the global Y direction, which may vary from 0 to 20 meters, along the X and Z directions, or beams. The values used in the load cases are derived from the IS code books.
Ceiling loads: 2.5 kN/m²(In accordance with Part 2 of IS 875)
Gravity force: 1 kN/m
The slab weighs 3.75 kN/m2 (or 0.15 times 25).
floor finish value is 1KN/m2
live load According to Table-1 of IS-875(part2)
Beams supporting interior walls: 5.244 ≈6kN/m, calculated as 0.115 X 19 X 2.55.
The beams support about 12 kN/m of exterior walls, which is equal to 11.141.

### *4.3 Analysis and Design of the structure*

- By following the data we can analysis the structure.
- Analysis includes of bending moment, shear force, deflection and maximum absolute of beam, column and slab.

| | | |
|---|---|---|
| 1 | Type of the building | G+5 Commercial Building |
| 2 | Floor Height | 3 m |
| 3 | No of Floors | 3 |
| 4 | Materials used | Concrete – M25 Steel - Fe415 |
| 5 | Column Size | 0.45m X 0.45m |
| 6 | Beam Size | 0.45m X 0.45m |
| 7 | Loads | Dead load – 5.62KN/m Live load - 3KN/m |
| 8 | Plate Thickness | 0.125m |
| 9. | Length of the building | 72.33m |

| | | |
|---|---|---|
| 10 | Width of the building | 46.77m |

**Table no 1 Building data**

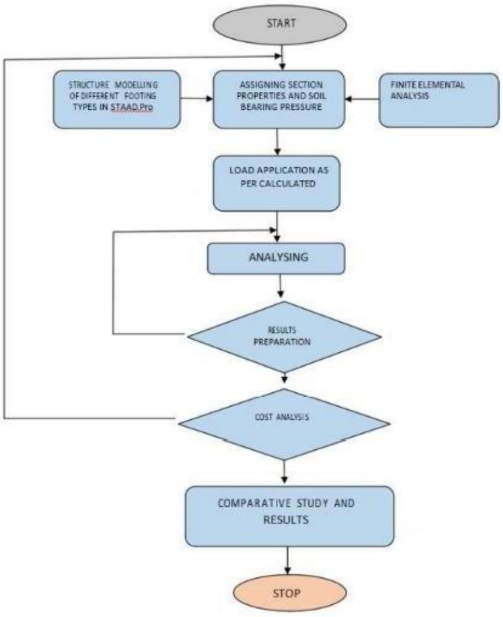


**Fig 4:Flow Chart Of STAAD Pro Procedure**

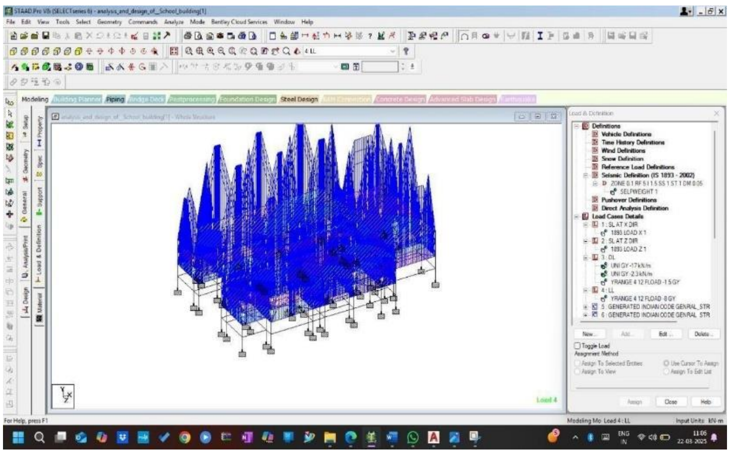

**Fig 5: When Seismic Load Is Applied**

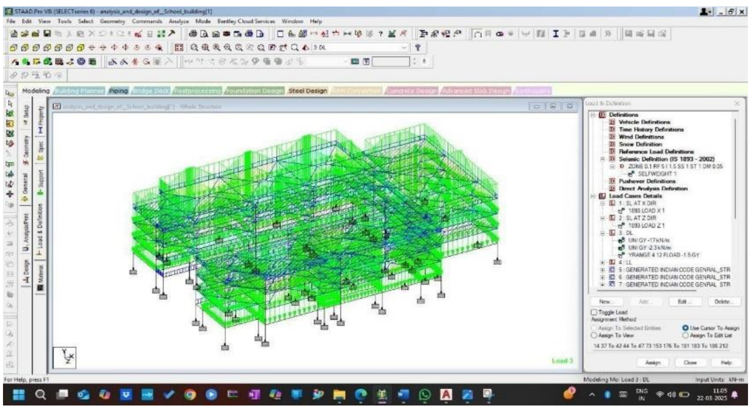

**Fig 6: When Floor Load Is Applied**

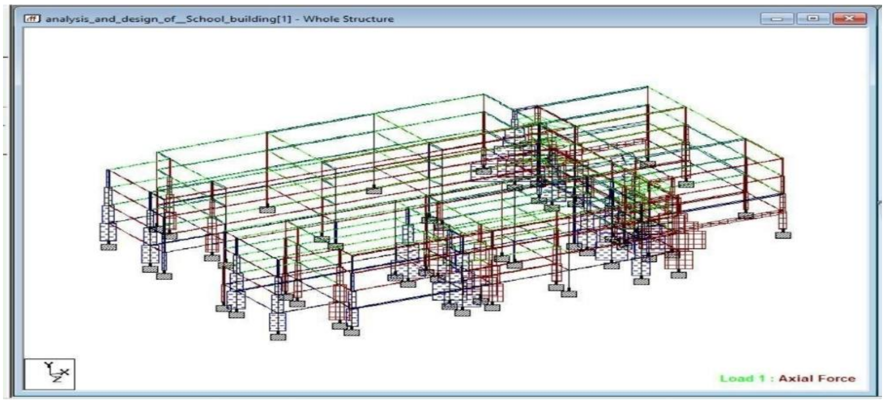


**Fig 7: Beam Axial Force Along X&Y Direction**


**Fig 8: Shear Force Of a Structure**

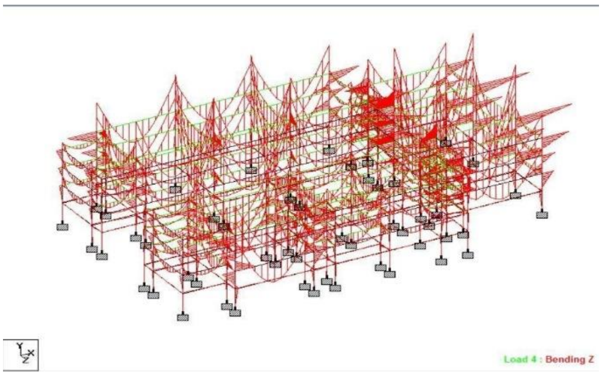


**Fig 9: Bending Moment Of a Complete Structure**

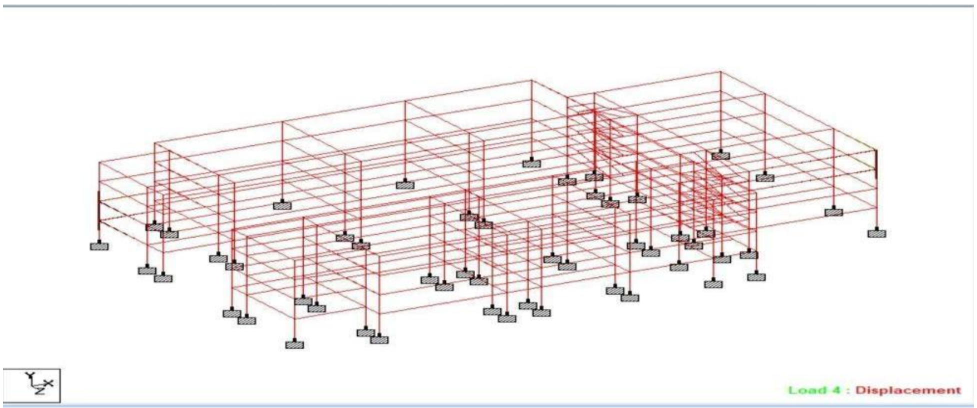


**Fig 10:Maximum Displacement**

analysis_and_design_of__School_building[1] - Node Displacements:

All | Summary

| | | Horizontal | Vertical | Horizontal | Resultant | Rotational | | |
|---|---|---|---|---|---|---|---|---|
| Node | L/C | X mm | Y mm | Z mm | mm | rX rad | rY rad | rZ rad |
| 1 | 1 SL AT X DI | 1.364 | -0.015 | -0.009 | 1.364 | -0.000 | -0.000 | -0.00 |
| | 2 SL AT Z DI | -0.040 | 0.059 | 1.211 | 1.213 | 0.000 | -0.000 | 0.00 |
| | 3 DL | 0.041 | -0.463 | 0.048 | 0.467 | -0.000 | -0.000 | 0.00 |
| | 4 LL | 0.065 | -0.722 | 0.061 | 0.727 | 0.000 | -0.000 | -0.00 |
| | 5 GENERATE | 0.158 | -1.776 | 0.163 | 1.791 | -0.000 | -0.000 | 0.00 |
| | 6 GENERATE | 0.127 | -1.421 | 0.131 | 1.433 | -0.000 | -0.000 | 0.00 |
| | 7 GENERATE | 1.764 | -1.439 | 0.119 | 2.279 | -0.000 | -0.000 | -0.00 |
| | 8 GENERATE | 0.078 | -1.350 | 1.583 | 2.083 | 0.000 | -0.000 | 0.00 |
| | 9 GENERATE | -1.510 | -1.403 | 0.142 | 2.067 | -0.000 | -0.000 | 0.00 |
| | 10 GENERAT | 0.175 | -1.492 | -1.322 | 2.001 | -0.000 | -0.000 | 0.00 |
| | 11 GENERAT | 0.061 | -0.694 | 0.072 | 0.700 | -0.000 | -0.000 | 0.00 |

analysis_and_design_of__School_building[1] - Beam Relative Displacement Detail:

All Relative Displacement | Max Relative Displacements

| Beam | L/C | Dist m | x mm | y mm | z mm | Resultant mm |
|---|---|---|---|---|---|---|
| 1 | 1 SL AT X DI | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | 2.635 | -0.199 | 0.498 | -0.050 | 0.538 |
| | | 5.270 | -0.000 | 0.163 | -0.099 | 0.191 |
| | | 7.905 | -0.199 | -0.254 | -0.149 | 0.355 |
| | | 10.540 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 2 SL AT Z DI | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | 2.635 | -0.199 | -0.019 | 0.000 | 0.199 |
| | | 5.270 | -0.000 | -0.011 | 0.000 | 0.011 |
| | | 7.905 | -0.199 | 0.002 | 0.000 | 0.199 |
| | | 10.540 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 3 DL | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | 2.635 | 0.198 | -2.125 | -0.000 | 2.134 |
| | | 5.270 | -0.000 | -3.574 | 0.000 | 3.574 |

**Fig 11: Displacement Data**

kalyan project - STAAD Output Viewer

File Edit View Help

WARNING
NOTES
RESULTS
TOTAL APPLIED LOAD 1
TOTAL REACTION LOAD 1
TOTAL APPLIED LOAD 2
TOTAL REACTION LOAD 2
TOTAL APPLIED LOAD 3
TOTAL REACTION LOAD 3
TOTAL APPLIED LOAD 4
TOTAL REACTION LOAD 4
CONCRETE DESIGN

```
=====================================================================
              B E A M  N O.      1   D E S I G N  R E S U L T S

   M25                   Fe500 (Main)              Fe415 (Sec.)

  LENGTH:  5276.0 mm     SIZE:   230.0 mm X  500.0 mm   COVER: 25.0 mm

                   SUMMARY OF REINF. AREA (Sq.mm)
---------------------------------------------------------------------
SECTION      0.0 mm     1319.0 mm    2638.0 mm    3957.0 mm    5276.0 mm
---------------------------------------------------------------------
 TOP         183.38       183.38       183.38       183.38       183.38
REINF.     (Sq. mm)     (Sq. mm)     (Sq. mm)     (Sq. mm)     (Sq. mm)

BOTTOM       183.38       183.38       183.38       183.38       183.38
REINF.     (Sq. mm)     (Sq. mm)     (Sq. mm)     (Sq. mm)     (Sq. mm)
---------------------------------------------------------------------

                   SUMMARY OF PROVIDED REINF. AREA
---------------------------------------------------------------------
SECTION      0.0 mm     1319.0 mm    2638.0 mm    3957.0 mm    5276.0 mm
---------------------------------------------------------------------
 TOP         3-12i        3-12i        3-12i        3-12i        3-12i
REINF.    1 layer(s)   1 layer(s)   1 layer(s)   1 layer(s)   1 layer(s)

BOTTOM       3-12i        3-12i        3-12i        3-12i        3-12i
REINF.    1 layer(s)   1 layer(s)   1 layer(s)   1 layer(s)   1 layer(s)

SHEAR    2 legged  8i 2 legged  8i 2 legged  8i 2 legged  8i 2 legged  8i
REINF.   @ 150 mm c/c @ 150 mm c/c @ 150 mm c/c @ 150 mm c/c @ 150 mm c/c
---------------------------------------------------------------------
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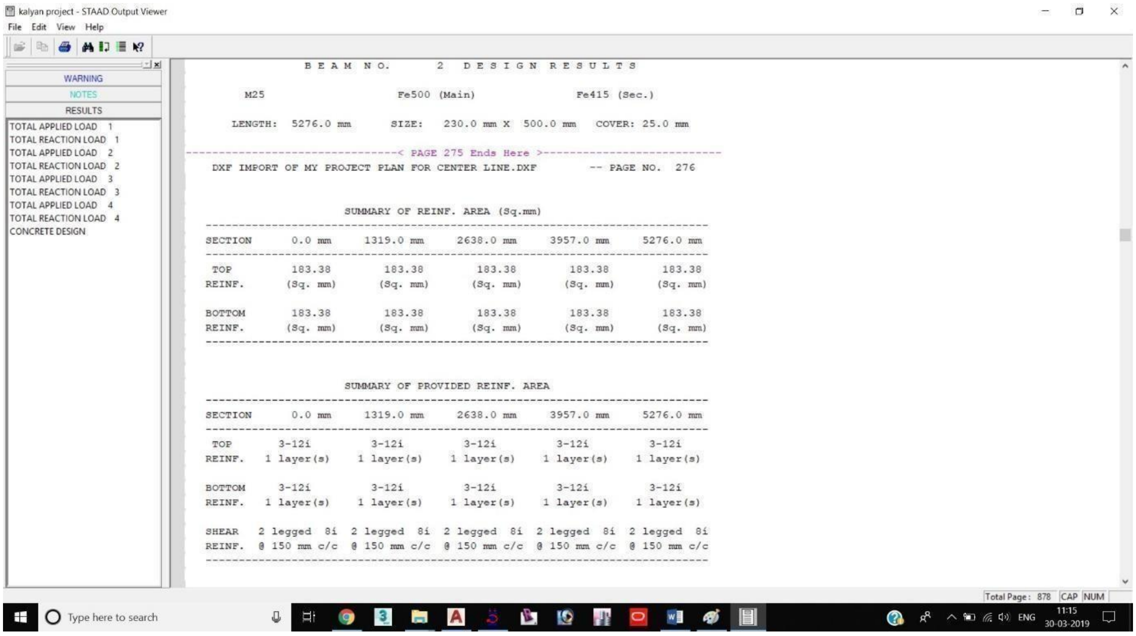
**Fig 12: Beam Rresults**



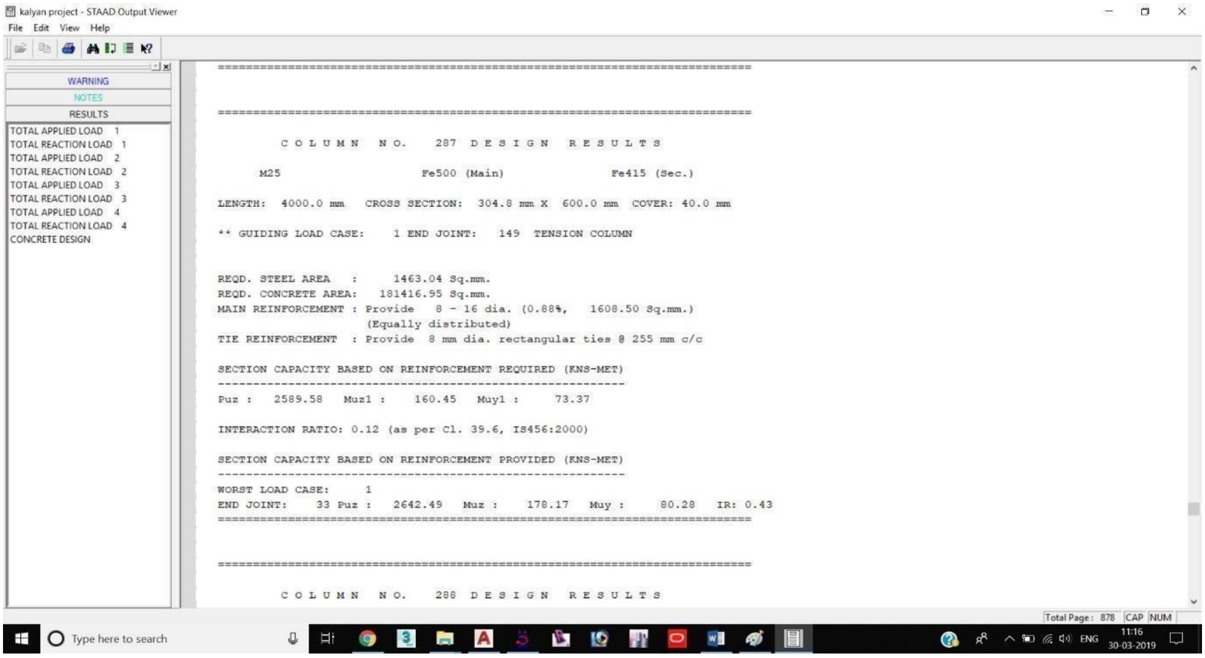
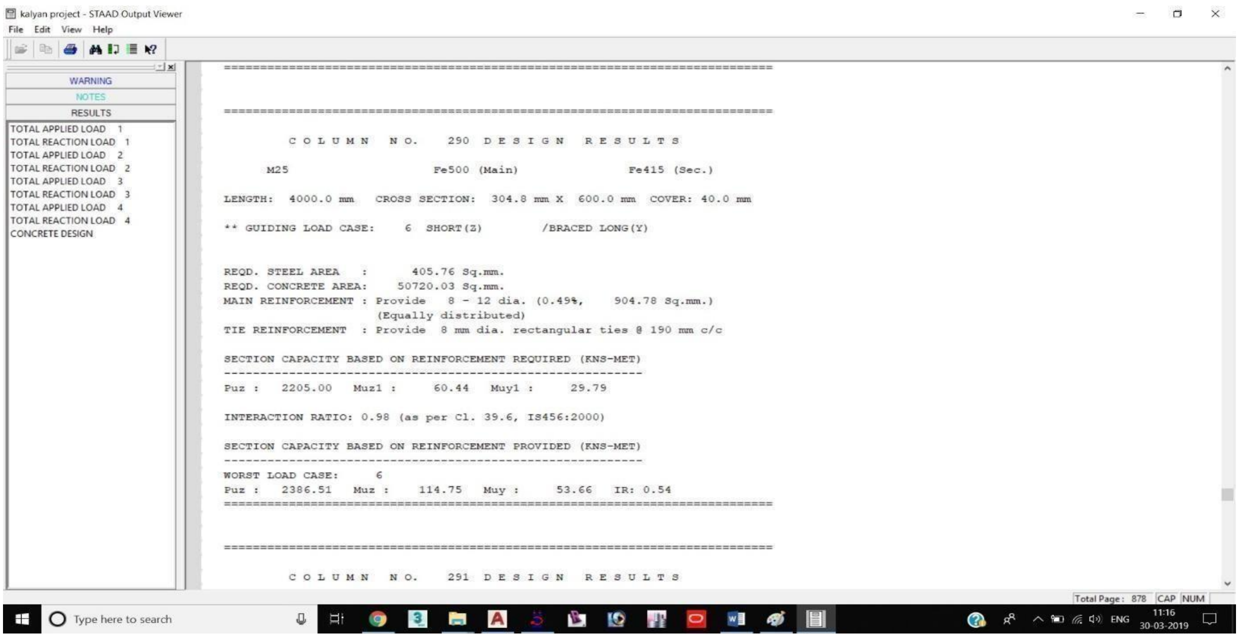




**Fig 13: Column Results**



## CONCLUSION

By carrying out this project to the letter of all applicable codal regulations, especially those stated in IS 456:2000, we have learned invaluable lessons about the approach of constructing a school building. Thanks to this hands-on experience, we now know that standards are crucial for structural performance, serviceability, and safety. One of the most important things I learned was how to distinguish between abstract ideas and their practical implementation. Practical design and site-related issues provide a much more in-depth and thorough understanding, building upon theoretical knowledge. For structural design and construction to be successful, it is vital to integrate both elements.

We selected and developed the slabs as two-way slabs during the structural design phase based on the lx/ly ratio, which is the ratio of longer span to shorter span. In addition, the loads that were transmitted to the beams and columns were carefully studied and calculated to make sure that all structural parts could safely and effectively handle the imposed loads.

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