Design And Analysis Of G+5 Commercial Building by Using Staad Pro

Ms. Sd. Farhana Tabasum[1], Mr.G. Akash[2], Mr.S.Siva Haneesh Kumar[3], Mr.J.Srinivasulu[4], Mr.S.Vishnu Vardhan[5]

[1]Assistant Professor, Department of Civil Engineering, Sree Venkateswara College of Engineering, Kodavaluru (V & M), SPSR Nellore, Andhra Pradesh, India.

[2,3,4,5]Students, Department of Civil Engineering, Sree Venkateswara College of Engineering, Kodavaluru (V & M), SPSR Nellore, Andhra Pradesh, India.

Abstract:

The main objective of this project to design and analysis of commercial building by using STAAD Pro.STAAD is the abbreviation for Structural Analysis and Design. STAAD Pro is one of the popular software that is used for analyzing & designing structures like – buildings, towers, bridges, industrial, transportation and utility structures. As the design includes the total load calculation and reinforcement details. In these project We have to analysis the G+5 Commercial building which is in C Shape and find out various parameters like Shear force, Bending moment, Deflection, Maximum absolute displacement and the various structural components (Reinforcement details of beam ,Column,Slab).The loads are applied On the building are Dead load,Live load and the total height of the building is 24 m.

 Keywords: Commercial Building, STAAD Pro, Loads, Analysis and design.

1. INTRODUCTION

STAAD.Pro is a widely used structural analysis and design software program developed by Bentley Systems. It is commonly used by civil and structural engineers for the analysis and design of various types of structures, including buildings, bridges, dams, towers, and more.

STAAD.Pro provides a comprehensive set of tools for structural analysis, including static and dynamic analysis, linear and nonlinear analysis, buckling analysis, and response spectrum analysis. It supports a wide range of international design codes, such as AISC, ACI, Euro codes, and many others, making it suitable for projects around the world.In this project there is a commercial building G+5 in "C" Shape consists of Hotels,Shops,Grocery Shops,Fashionstores,Bathrooms,Elevators…Etc

1.2 FEATURES 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. It also

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.

1.3 TYPES OF COMMERCIAL BUILDING

Office Buildings: These buildings are designed to provide space for businesses, organizations, and professionals to work. They may include amenities such as conference rooms, elevators, and parking facilities.

Retail Buildings: These buildings are designed to provide space for retail businesses such as stores, shops, and restaurants. They often have large windows and storefronts to attract customers.

Industrial Buildings: These buildings are designed for manufacturing, production, and warehousing. They may include features such as loading docks, high ceilings, and heavy-duty flooring.

Medical Buildings: These buildings are designed to provide space for medical offices, clinics, and hospitals. They often have specialized equipment and facilities to support medical practices.

Hospitality Buildings: These buildings are designed to provide space for hotels, motels, and other lodging establishments. They often include amenities such as pools, fitness centers, and restaurants.

Educational Buildings: These buildings are designed to provide space for schools, colleges, and universities. They often include classrooms, libraries, and administrative offices.

Entertainment Buildings: These buildings are designed to provide space for entertainment venues such as theaters, cinemas, and concert halls. They often have specialized acoustics and lighting systems to enhance the audience experience.

Religious Buildings: These buildings are designed to provide space for religious practices and worship. They may include features such as altars, pews, and stained glass windows.

Government Buildings: These buildings are designed to provide space for government offices, courthouses, and public facilities. They may include features such as courtrooms, holding cells, and administrative offices.

1.4 ADVANTAGES OF COMMERCIAL BUILDING

➢ **Appreciation**: Like most real estate, commercial buildings tend to appreciate in value over time. This can provide a long-term investment opportunity for the building owner.

➢ **Tax benefits**: Building owners may be eligible for tax benefits such as deductions for mortgage interest, property taxes, and depreciation.

➢ **Control over the property**: Building owners have greater control over the property compared to tenants, allowing them to make modifications or improvements to the building that can increase its value or appeal to potential tenants.

➢ **Diversification of assets**: Owning a commercial building can be a way to diversify one's assets, providing a hedge against other types of investments such as stocks or bonds.

➢ **Potential for growth**: If the building is in a desirable location and is well-maintained, it may attract more tenants and generate higher rental income, potentially leading to growth in the value of the building.

➢ **Flexibility in use**: Commercial buildings can be adapted for different types of businesses, allowing for flexibility in use and potential for different types of tenants over time.

2. LITERATURE REVIEW

➢ **Mallikarjunetal.(2016): on analysis and design of multi-storied Commercial building of using BIM software g-2+G+10:** Carried study on analysis and design of a multi-storied Commercial building of G+10 by using most economical column method and the dead load and live load was applied on the various structural component like slabs, beams and found that as the study is carried using most economical.

➢ **Stalin, K.Pranaya(2017)** - The main objective of the project is to layout a plan for G+3 commercial building design beams and columns for the structure using STAAD pro by the total deflection due to dead load and live load for different load combinations offer the building in case of the load failure conditions.

3. 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.

4. METHODOLOGY

4.1 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.
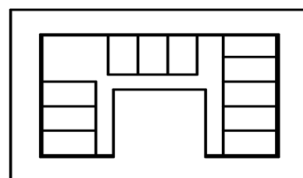
Fig 1: Plan of the building

Procedure

Step 1: Launch AutoCAD and open a new or existing drawing file.

Step 2: Set the drawing units to the desired scale (e.g. inches, feet, meters) using the "UNITS" command.

Step 3: Begin drawing the plan by selecting appropriate drawing tools from the toolbar, such as lines, arcs, circles, and polygons.

Step 4: Use the "LINE" command to draw walls, partitions, and other linear elements of the plan. Specify start and end points or lengths and angles as needed.

Step 5: Use the "ARC" and "CIRCLE" commands to draw curved elements, such as doors, windows, and rounded corners.

Step 6: Add text, dimensions, and other annotations using the "TEXT" and "DIMENSION" commands. Specify text styles, sizes, and placements as desired.

Step 7: Apply hatching or shading to indicate different materials or areas using the "HATCH" command. Specify patterns, scales, and boundaries as needed.

Step 8: Use layers to organize different types of elements, such as walls, doors, windows, and text, and assign appropriate colors, linetypes, and lineweights to each layer.

Step 9: Apply any necessary modifications, such as trimming, extending, or filleting, using various editing commands like "TRIM", "EXTEND", and "FILLET".

Step 10: Save your drawing file periodically to avoid losing any work.

Step 11: Review your plan to ensure accuracy and completeness.

Step 12: Print

4.2 Modeling of the structure in STAAD Pro

➢ Preparing of model of the structure by using STAAD Pro Software.

➢ By using in built commands in STAAD pro prepare the model up to five floors .
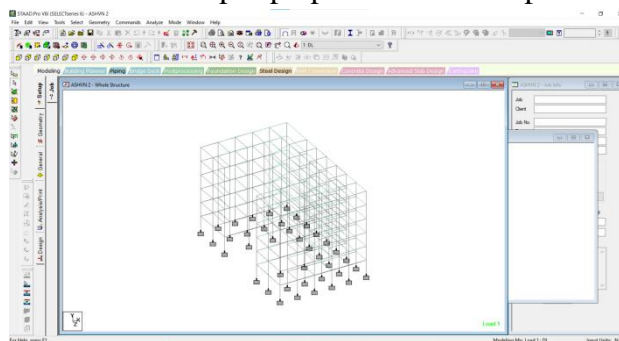
Fig 2: 3D Modeling with fixed supports
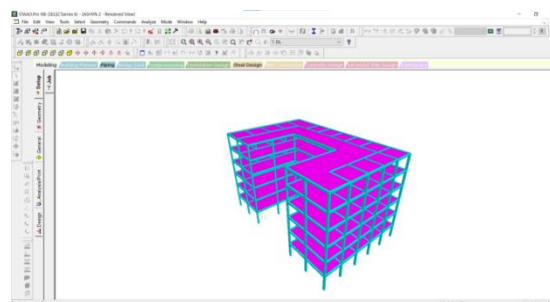
**Fig 3: 3D Rendering of the structure**

4.2 Load Calculations

➢ Dead Load calculation includes self-weight factor 1 KN/m, to the whole structure and also includes the member load 9KN/m. Along X and Z directions(i.e Beams)

➢ Live load includes floor load of 6 KN/m in global Y direction range minimum 0 to maximum 20m.

These values are taken from IS Code books and implemented in the load case values

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	4m
3	No of Floors	5
4	Materials used	Concrete - M30 Steel - Fe415
5	Column Size	0.3m X 0.45m
6	Beam Size	0.45m X 0.3m
7	Loads	Dead load - 9KN/m Live load - 6KN/m
8	Plate Thickness	0.150m
9.	Length of the building	40 m
10	Width of the building	25m

Table no 1 Building data
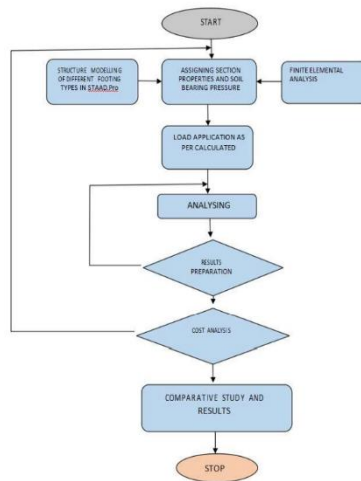
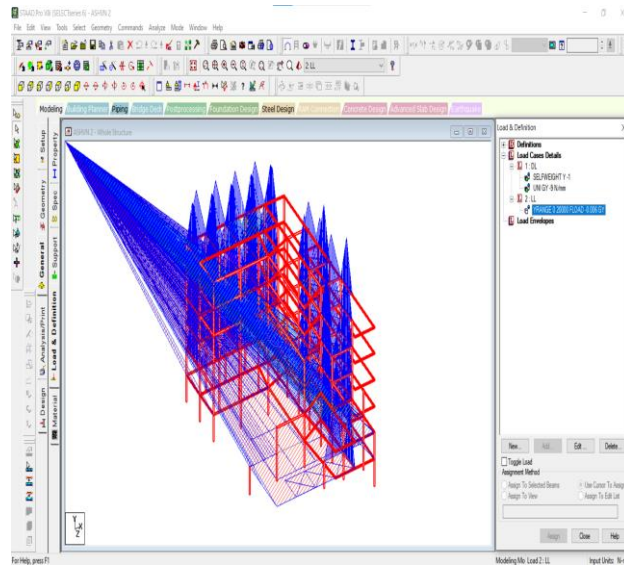**Fig 4:Flowchart of STAAD Pro procedure**
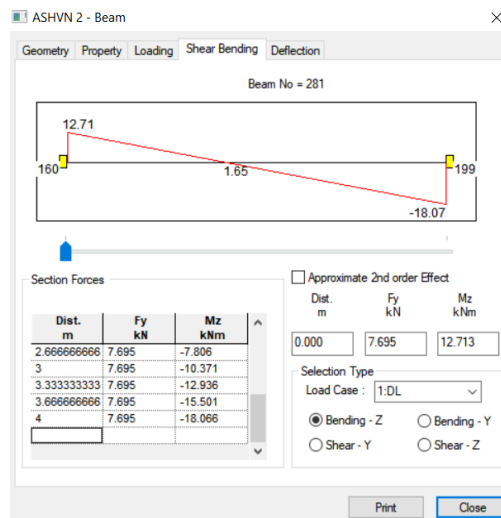
Fig 5: Shear Bending of beam

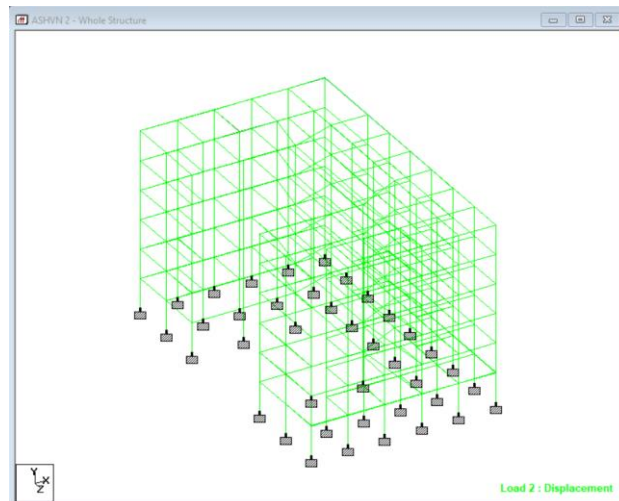**Fig 5:When Self Weight is applied**
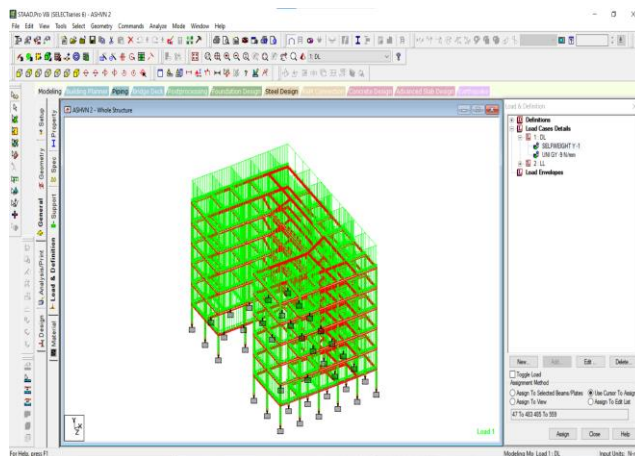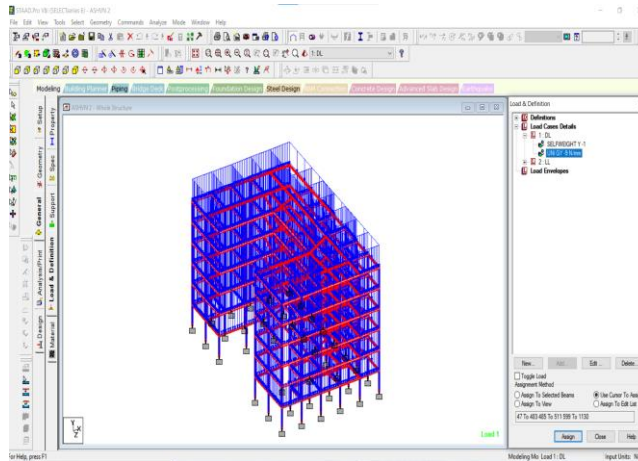
Fig 6: When Dead load is applied

Fig 7: When Live load is applied

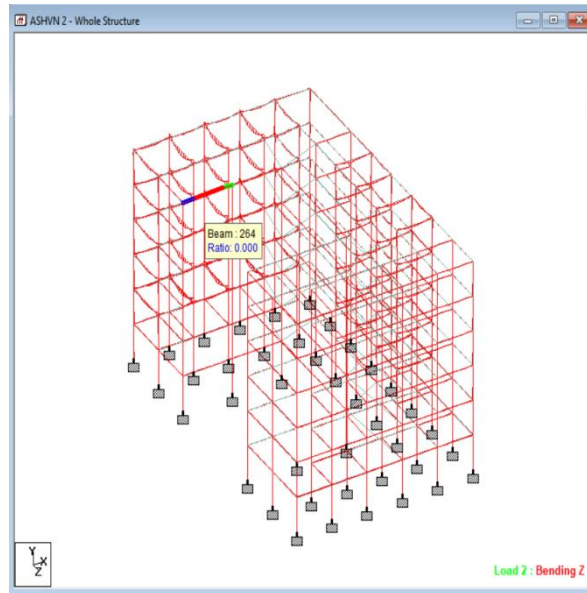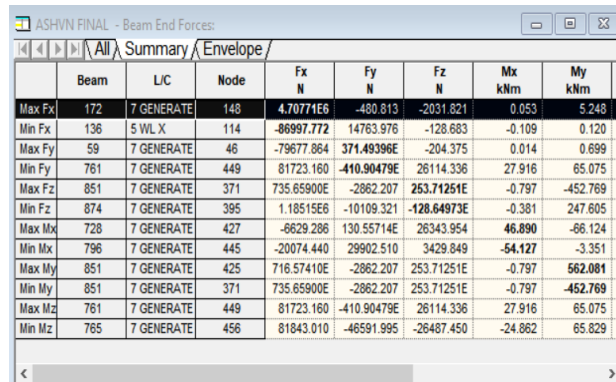**Fig 8: Displacement of the structure**

Fig 9: Bending moment in Z Direction and Shear force in Y direction

4. RESULTS

|	Beam	L/C	Node	Fx N	Fy N	Fz N	Mx kNm	My kNm
Max Fx	172	7 GENERATE	148	4.70771E6	-480.813	-2031.821	0.053	5.248
Min Fx	136	5 WL X	114	-86997.772	14763.976	-128.683	-0.109	0.120
Max Fy	59	7 GENERATE	46	-79677.864	371.49396E	-204.375	0.014	0.699
Min Fy	761	7 GENERATE	449	81723.160	-410.90479E	26114.336	27.916	65.075
Max Fz	851	7 GENERATE	371	735.65900E	-2862.207	253.71251E	-0.797	-452.769
Min Fz	874	7 GENERATE	395	1.18515E6	-10109.321	-128.64973E	-0.381	247.605
Max Mx	728	7 GENERATE	427	-6629.286	130.55714E	26343.954	46.890	-66.124
Min Mx	796	7 GENERATE	445	-20074.440	29902.510	3429.849	-54.127	-3.351
Max My	851	7 GENERATE	425	716.57410E	-2862.207	253.71251E	-0.797	562.081
Min My	851	7 GENERATE	371	735.65900E	-2862.207	253.71251E	-0.797	-452.769
Max Mz	761	7 GENERATE	449	81723.160	-410.90479E	26114.336	27.916	65.075
Min Mz	765	7 GENERATE	456	81843.010	-46591.995	-26487.450	-24.862	65.829

Fig 10: Member End Forces
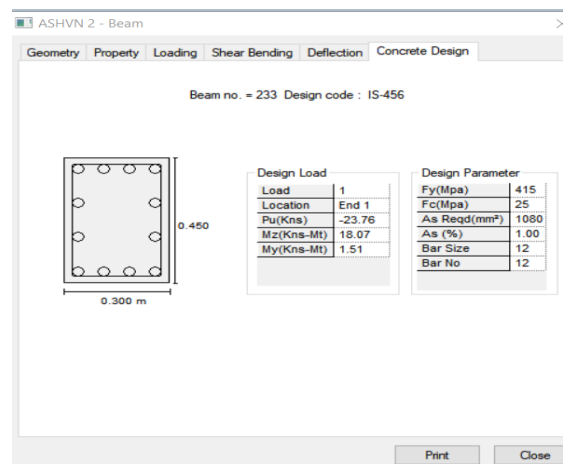
Fig 10: Reinforcement Details of column
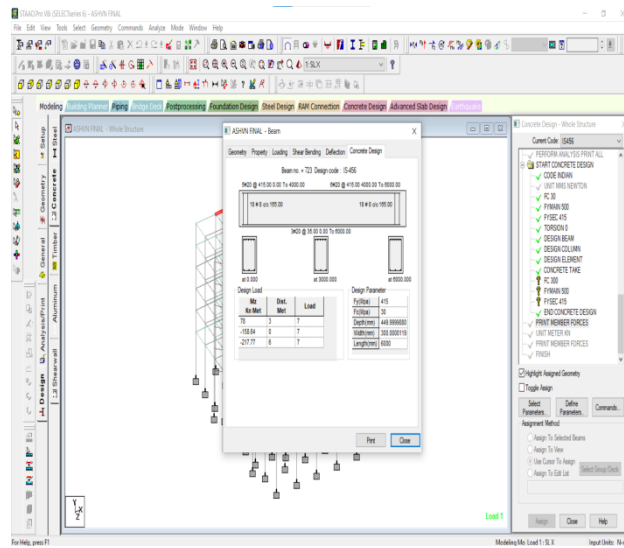
Fig 11: Reinforcement Details of beam
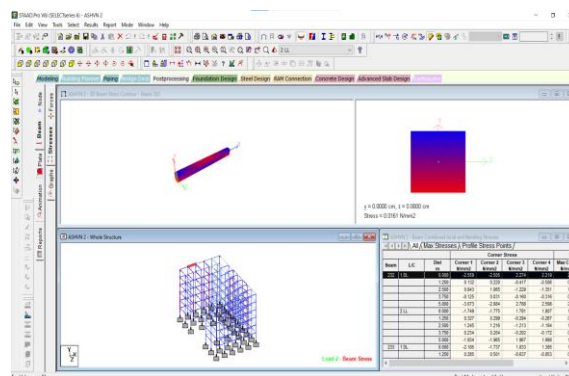
Fig 12: Stresses of the Structure

5. CONCLUSION

➢ The structure is totally analyzed using STAAD PRO v8i.And Proposed sizes of the elements can be used in the commercial building.

➢ The structural components of the building (i.e Columns,Beams,Slabs) are completely safe in shear.

➢ Also check the deflection and maximum displacement of various member under the given loading combination.

➢ Very less amount of space is required for the storage of the structural data.

➢ It is easy and simple to change the value at the place where error occurred and the obtained result are generated in the data.

➢ Structure model can be able to view in both 2D & 3D state.

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