

Design and Analysis of a Gated Community

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Abstract:- Construction technology is being advanced day by day. Today we see high-rise buildings, high-rise towers, and skyscrapers with different aesthetic appearances. These not only resemble the aesthetic advancement too. In this project “Designing and Analysis of a Gated Community” planning of the building is done according to the Bye-Laws and IS Code recommendations manual design is complex and takes longer time to analyse and design. So, we have chosen software for analysis and design. The software gives accurate analysis and design results in a short amount of time. So, we will analyze and design the apartments using the software.

➤ *The Basic Steps Involved in this are:*

- *Planning*
- *Modelling*
- *Designing*
- *Analysis*

Planning is done by considering “Building Bye-Laws” according to the G.O.M.S.No.156. The 2D Planning and floor plans of the apartments are made in AUTOCAD & SWEET HOME 3D and 3D Modelling is made in SKETCHUP in feet and inches templet and Rendering and walkthrough designing are done in LUMION. This project involves analysing the whole structure by AUTODESK ROBOT STRUCTURAL ANALYSIS under various loads according to the IS:875part-II. The main objective of this project is how software outputs are implemented in the real-time construction field.

I. INTRODUCTION

A usually multi-story, roofed, enclosed, and quite permanent building situated on a piece of land that serves a number of functions, including dwelling, entertainment, manufacturing, and so on. Depending on the intended function of the building, several construction types and components are used. Purchasing a home is most likely the biggest investment one will ever make. Therefore, every component of designing it deserves the utmost care and attention. A house, bungalow, apartment, or even a cottage can be classified as a residential building since they are constructed for habitation. With the availability of modern amenities and the rapid increase in population, many people are choosing well-furnished, modern apartments. An apartment is often a collection of rooms built exclusively for habitation by a tenant. It could be a bedroom or a group of bedrooms. Overall, the benefits of a multi-story building

outweigh the drawbacks by the amount, and many people who want to live in a well-appointed, safe, and secure home can afford it.

II. LITERATURE REVIEW

2014 saw the research and design of a multi-story skyscraper employing a composite construction by Mahesh Suresh Kumawat and L.G. Kalurkar.

The planning and evaluation of a multi-story G+ 5 skyscraper located in seismic zone 3 that uses composite construction. SAP 2000 software allows a three-dimensional modelling and study of the structure. The response spectrum analysis method and the equivalent static approach are used to analyse the composite and RCC structures, respectively. Comparing the results, it is discovered that the composite construction is more cost-effective.

PSG College of Technology, Coimbatore, Tamilnadu, India, 2006; P. Jayachadran and S. Rajasekharan, Structural design of multi-story residential building for in Salem, India, mini project report.

The multi-story G+ 4 building's design and analysis in Salem, Tamilnadu, India. Using two software programs, Staad Pro and RCC design suit, the research involves the design and analysis of footings, columns, beams, and slabs.

The study conducted by Poonam, Kumar Anil, and Gupta Ashok K in 2012 was published in the International Journal of Civil, Structural, Environmental, and Infrastructure Engineering Research and Development (IJCSIEIRD) vol. 2, issue 2(2012), pages 25–31.

In the current situation, a large number of buildings have uneven elevation and plan configurations. This might experience destructive earthquakes in the future. In the event that determining the effectiveness of both new and old structures to withstand disasters is required. The impact of different vertical irregularities on the structure's seismic response is the topic of this research. The primary goal of the study is to perform reaction spectrum analysis (RSA) on RC buildings that are vertically irregular. The analysis and design outcomes of irregular structures were compared to those of regular structures.

III. INTRODUCTION TO SOFTWARES

Almost every facet of daily living involves software in some capacity. It may be characterized as the set of instructions that offer the program's functionality and are necessary to do tasks requiring a certain kind of expert data processing. Computer program sizes, numbers, and application domains have all increased significantly. The livelihood and lives of the majority of people depend on the success of software development, which has resulted in the spending of hundreds of billions on it. This project made use of the following software:

➤ *Autodesk AutoCAD:*

Renowned for its 2D and 3D sketching and modelling capabilities, Autodesk AutoCAD is a top computer-aided design (CAD) program. Featuring a user-friendly interface, AutoCAD empowers architects, engineers, and designers to create precise drawings and intricate 3D models. Its collaborative tools facilitate team projects, while customization options and parametric drawing enhance efficiency. AutoCAD seamlessly integrates with other Autodesk products, fostering a comprehensive design and engineering workflow. With a subscription-based model, regular updates, and broad file compatibility, AutoCAD remains a pivotal tool in industries such as architecture, engineering, and construction, providing professionals with powerful design solutions. It is widely used in industries such as architecture, engineering, construction, and manufacturing, and it has become a standard tool for professionals in these fields. It continues to evolve with new features and improvements to meet the changing needs of design and drafting professionals.

➤ *Sweet Home 3D:*

Sweet Home 3D is an intuitive interior design tool that lets users see 3D models of homes and interiors and create 2D floor plans. With an intuitive interface, it allows easy placement of furniture and decorations, providing a virtual environment for planning and previewing home design projects efficiently.

➤ *Google Sketchup:*

Google SketchUp, now known as Trimble SketchUp, is a versatile 3D modeling software for architectural, interior design, and construction projects. It offers a user-friendly interface for creating detailed 3D models and architectural designs. SketchUp allows users to visualize concepts quickly, making it popular among architects, designers, and hobbyists.

➤ *Lumion:*

A 3D visualization program called Lumion is used to produce 3D computer visuals and animations for a variety of applications, including architecture, construction, general design, landscaping, and garden architecture. Using GPU instead of HLSL is not the same as other programs with similar objectives. Based on the scene's real-time view, the customized interface is rendered by the GPU. Because of the display's exceptional real-time accuracy, you can reduce the amount of user needs. Based on the graphics hardware, the application processes the thumbnail (nearly final) render at a pace of 1-150 frames per second.

➤ *Autodesk Robot Structural Analysis:*

A popular program for structural analysis and design in civil and structural engineering is Autodesk Robot Structural Analysis. It enables engineers to simulate and analyse complex structures, ensuring compliance with international standards. The software provides tools for modeling, loads and boundary conditions application, and detailed analysis of various structural elements. With its ability to perform linear and nonlinear analyses, Autodesk Robot Structural Analysis aids in optimizing designs for safety and efficiency, making it an essential tool in the field of structural engineering and construction.

IV. SALIENT FEATURES

PLOT AREA	= AC 03.50 Cts
BUILT-UP AREA	= 12,375 Sq. Ft & 12,840 Sq. Ft
FRONT SET BACK	= 12.00 Mts
REMAINING SIDE SET BACK	= 06.00 Mts
SPACING BETWEEN TWO BLOCKS	= 09.00 Mts
No. Of STOREYS	= STLIT, G+4 Upper floors
FLATS PER FLOOR	= 10 No's

➤ *Loading Conditions:*

As per IS 875-1964 & NBC, the following loads are considered:

- Live load - 2KN/m² (for all rooms); 3KN/m² (for corridors, balconies, staircases)
- Dead load as per design
- R.C.C. unit weight: 25 kn/m³
- Masonry weight in units of 19 N/m³

➤ *Soil Conditions:*

The soil at the site is assumed to be sandy soil. The bearing capacity of the silo s taken as 200 KN/m²:

➤ *Material Used:*

Grade of concrete M30, Grade of steel HYSD bars of Fe550D

V. BUILDING BYE LAWS ACCORDING TO G.O.MS.No.156

As we followed the building bye laws according to the rules issued by the government of Andhra Pradesh followed by G.O.MS.No.156 issued by the Directorate of Town and Country Planning (DTCP).

Table 1 Minimum Abutting Existing Road Width Required

Category	Type/Use of Building Plot permissible	Minimum abutting existing road width required (in meters)
(1)	(2)	(3)
A	SITES IN OLD/EXISTING BUILT-UP AREAS/CONGESTED AREAS /SETTLEMENT/GRAM KHANTAM/ABADI (see Annexure)	
	(i) All Residential (other than Group Housing) & Commercial Buildings with maximum permissible height of 10 m. except in the plots abutting to existing 60'-0" and above wide roads.	9 *
	(ii) For other categories the Minimum road width shall be as given in B1 Category.	
B	SITES IN NEW AREAS/APPROVED LAYOUT AREAS	
	(i) Basic level social amenities like Nursery School, Primary School	

Table 2 Category wise Minimum Size of Plots

S. No.	Category	Minimum Plot Size (Sq. m)
(A)	(B)	(C)
1	Cinema Theatre / Convention Center/Game Center/ Kalyana Mandapam / Marriage hall / Social clubs and amenities	3000
2	Educational Institution	
a	Primary/Upper Primary School	2000
b	High School / Residential School	6000
c	Junior college	4000
d	Degree College	6000
e	Technical Educational Institution	10000

VI. AUTOCAD SITE PLAN

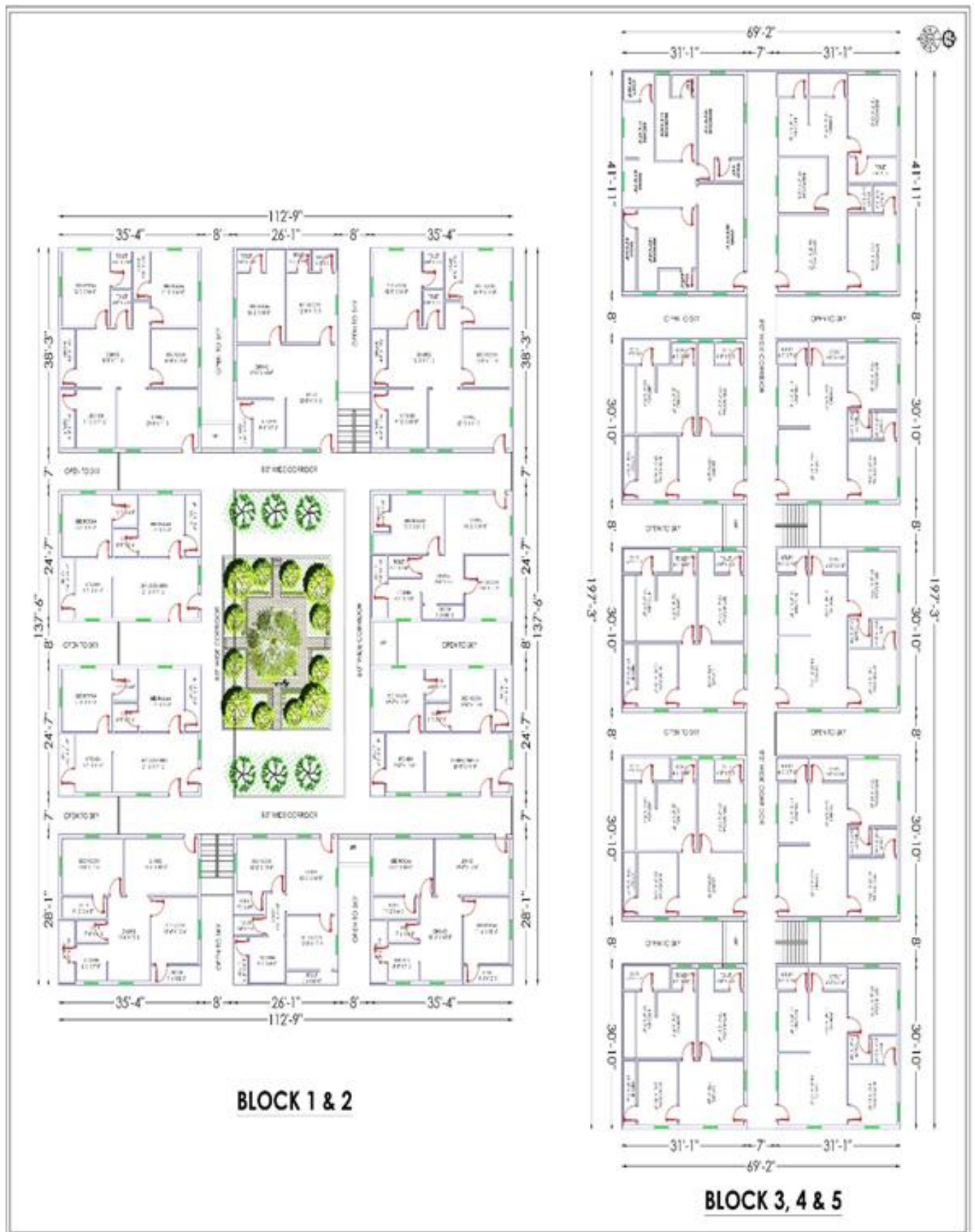


Fig 1 Area of Flats

➤ Area of Flats:

• Block 1 & 2:

- ✓ Flat 1: 1700 Sq. Ft
- ✓ Flat 2: 1245 Sq. Ft
- ✓ Flat 3: 1700 Sq. Ft
- ✓ Flat 4: 1085 Sq. Ft
- ✓ Flat 5: 1085 Sq. Ft
- ✓ Flat 6: 1085 Sq. Ft
- ✓ Flat 7: 1085 Sq. Ft
- ✓ Flat 8: 1240 Sq. Ft
- ✓ Flat 9: 910 Sq. Ft
- ✓ Flat 10: 1240 Sq. Ft

• Block 3,4&5:

- ✓ Flat 1: 1620 Sq. Ft
- ✓ Flat 2: 1620 Sq. Ft
- ✓ Flat 3: 1200 Sq. Ft
- ✓ Flat 4: 1200 Sq. Ft
- ✓ Flat 5: 1200 Sq. Ft
- ✓ Flat 6: 1200 Sq. Ft
- ✓ Flat 7: 1200 Sq. Ft
- ✓ Flat 8: 1200 Sq. Ft
- ✓ Flat 9: 1200 Sq. Ft
- ✓ Flat 10: 1200 Sq. Ft

VII. SWEET HOME 3D FLOOR PLAN



Fig 2 Block 1 & 2



Fig 3 Block 3, 4 & 5

VIII. LOADS

➤ *There are basically three types of Loads Considered for the Design of the Building.*

• **Dead Loads:**

Dead loads are caused by the structural members' self-weight.

These loads are static, meaning they will remain relatively constant throughout the duration of the building. These can be attributed to false ceilings, floors, roofing, column partition walls, floor slabs, fittings, etc. That lots are exerted in the vertical plane.

The Unit Weights of different materials may be taken from IS 875: 1987 (code of practice for design loads for buildings and structures part 1: dead loads).

$$\text{Dead load} = \text{volume of member} \times \text{Unit Material weight}$$

• **Live Loads:**

These are the loads that don't involve any research. They alter the magnitudes, in contrast to dead loads. These include of moveable loads like furniture as well as moving loads like people, cars, etc. A detailed description of live loads may be found in IS:875-1987 Part 2 Tables 1 and 11.

✓ *For Residential Buildings:*

- All rooms and kitchen - 2KN/m
- Toilet and bathrooms - 2KN/m

- Corridors balcony staircases - 3KN/m

• **Wind Loads:**

Wind loads have increased in importance recently due to the widespread use of lighter materials and more efficient building techniques. An enormous Victorian brick building. Modern industrial structures covered in steel are primarily designed to withstand wind loads; wild loads, however, have little effect on materials like wood or slate roofing.

IX. ANALYSIS

Structural study of robots Professional structural software speeds up the modelling, analysis, and coding of fundamental design for any kind of structure by engineers.. Detailed reinforcement of columns can be seen in this software. Many courts are available for different countries so that according to the Core specification they can analyse the structure.

➤ *The Analysis of the Structure is Performed in Autodesk Robot Structural Analysis.*

• **Robot Structural Analysis**

Select the toolbar, in toolbar click on job preferences. Select units as metric & set materials into Indian, select the databases option, and set them to Indian standards. Then select the design code option and give is codes for steel and concrete. click on ok. Go to preferences in the toolbar and set the language regional settings to Great Britain. Click on accept and ok.

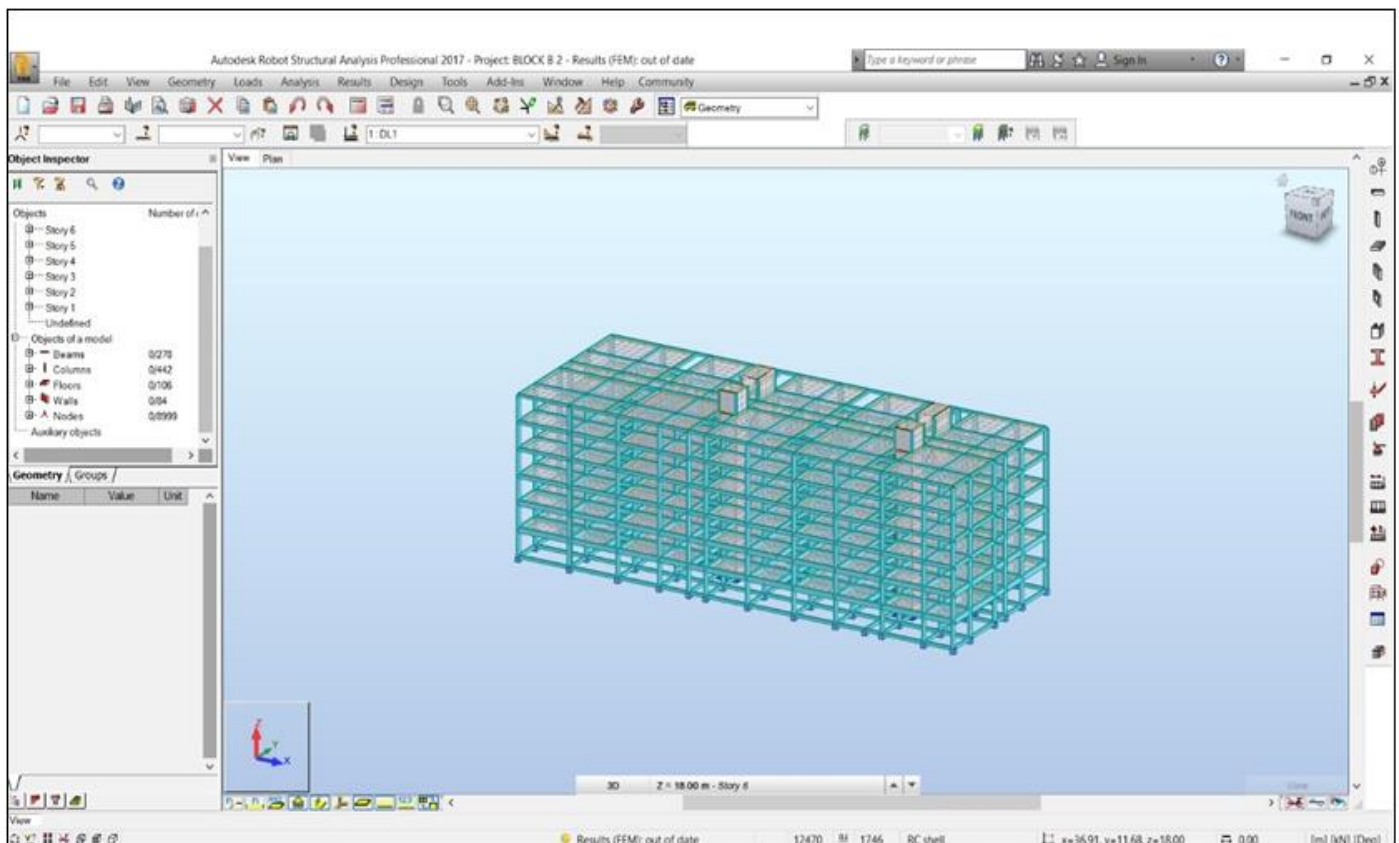


Fig 4 Robot Structural Analysis

➤ *Assigning Dead and Live Loads to the Structure.*

Click load type icons. Add dead load and assign nature to it. Select the whole structure and click load definitions. in load definitions select dead load click on self-weight mass and click on uniform planar load and apply to the whole structure. now in load type add live load and give nature as live and go to load definition option and give the loads according to IS:875 PART 1,2&3.

Click the analyze option and select calculations and start calculations.

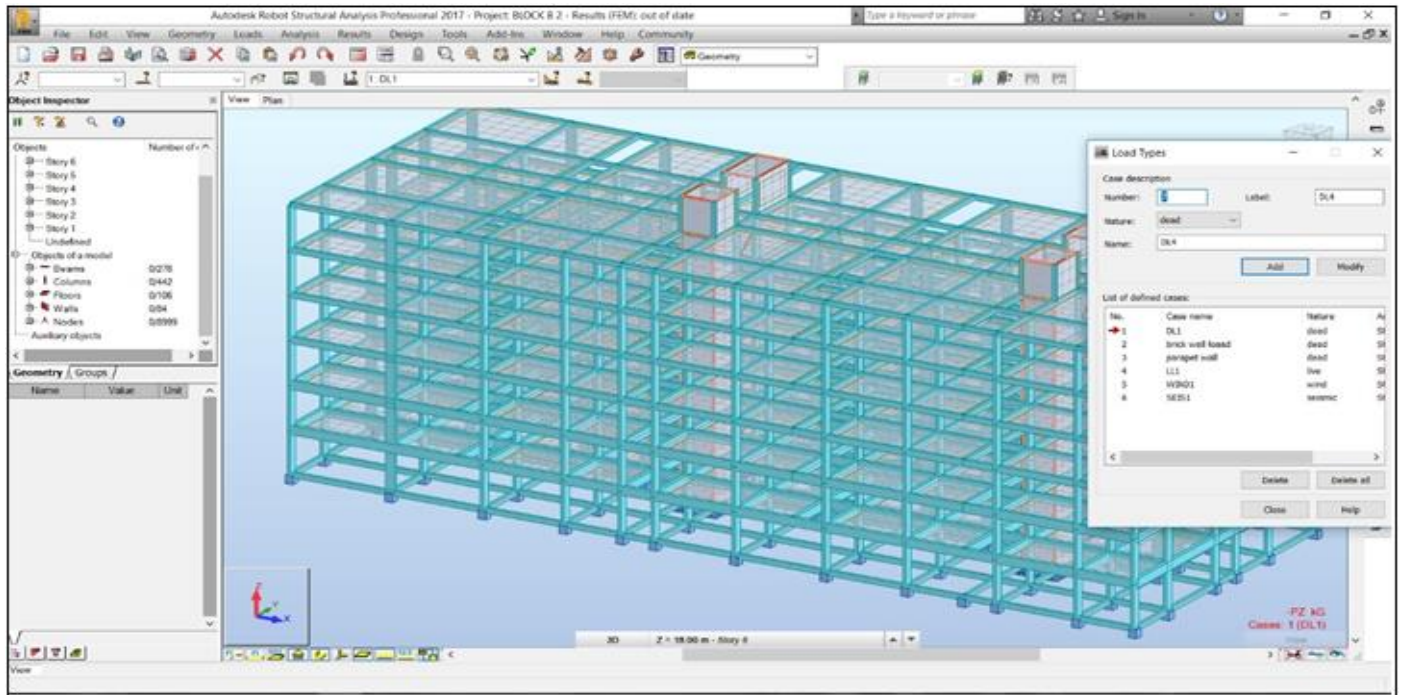


Fig 5 Assigning Dead and Live Loads to the Structure Assigning Loads

➤ *Assigning of Wind Pressure to the Structure.*

Click the load type icon. Add wind load and assign nature to it. Select the direction of wind acting on the structure and assign the basic wind speed in m/s based on the location of the structure and also according to IS:875 PART 3 Now click on the wind analysis option to generate the wind stimulation on the structure depending on the standard codes and wind intensities acting on the structure.

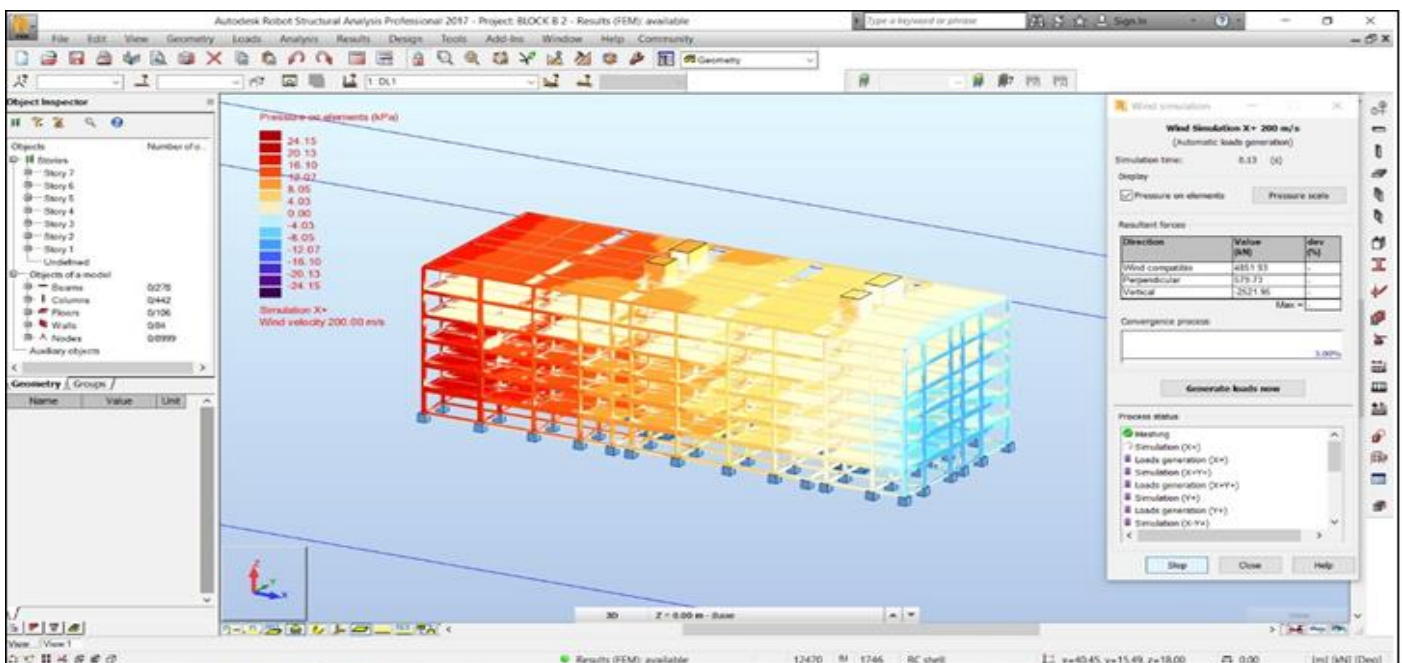


Fig 6 Assigning of Wind Pressure to the Structure

➤ *Structural Designs & Reports:*

• *Beam Structural Design*

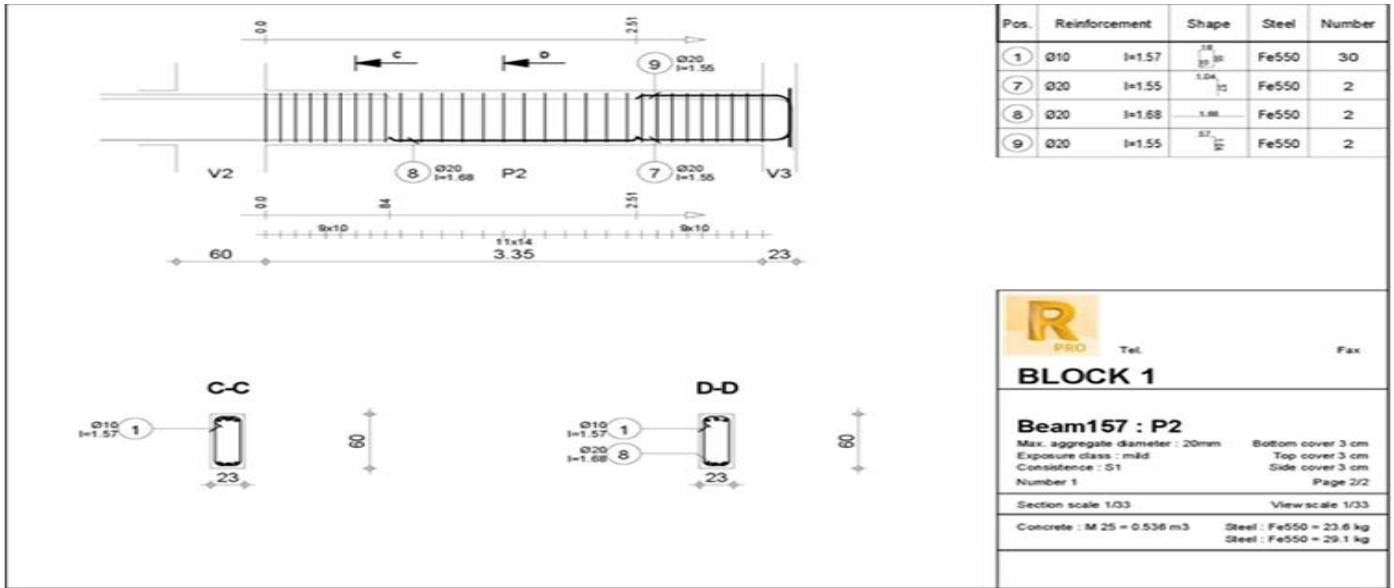


Fig 7 Beam Structural Design

• *Beam Design*

Beam: **Beam157** **Number: 1**

Material Properties:

Concrete	M 25	$f_{cu} = 25.00$ (MPa)
Unit weight	2549.29 (KG/m)	
Longitudinal rein forcement	Fe550	$f_y = 550.00$ (MPa)
Transversal rein forcement	Fe550	$f_y = 550.00$ (MPa)
Additional rein forcement:	Fe550	$f_y = 550.00$ (MPa)

• *Calculation Results :*

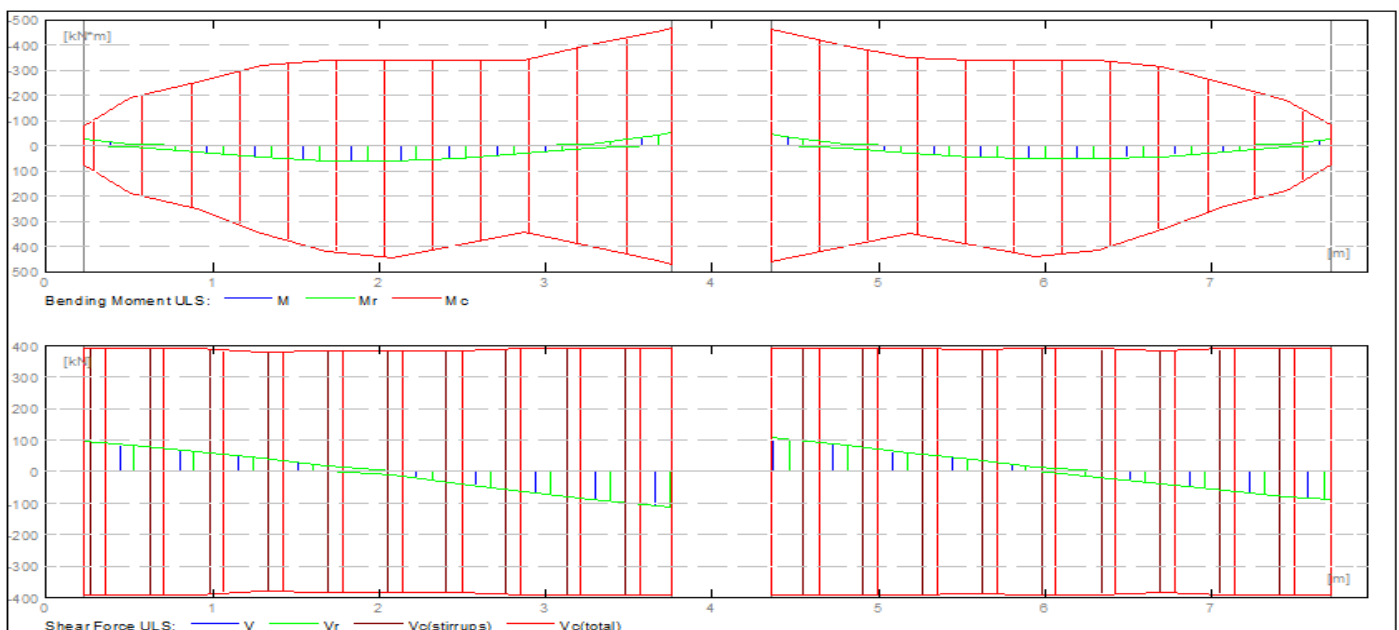


Fig 8 Internal Forces in Ultimate Limit State (ULS)

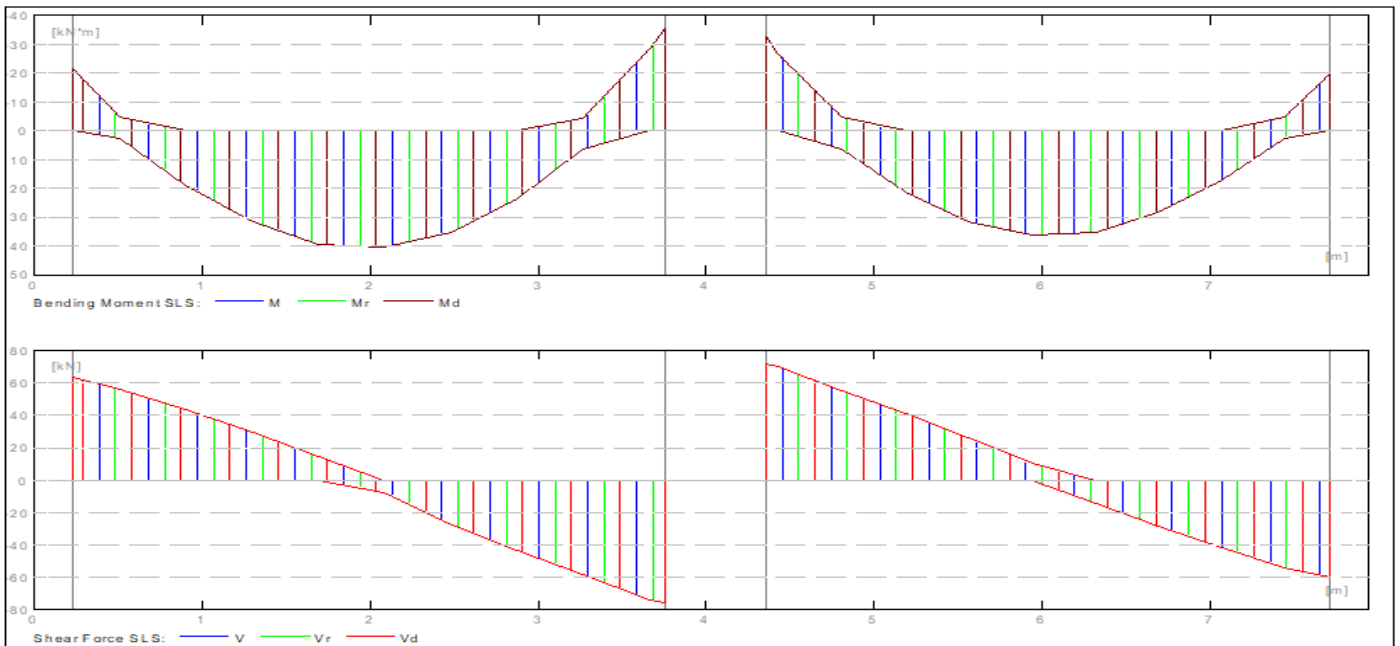


Fig 9 Internal Forces in Serviceability Limit State (SLS)

• *Cracking and Deflection :*

- at(s-t) - initial deflection due to total load
- ap(s-t) - initial deflection due to long-term load
- ap(l-t) - long-term deflection due to long-term load
- a - total deflection
- aall - allowable deflection
- Wcr - width of perpendicular cracks

Span (cm)	at(s-t) (cm)	ap(s-t) (cm)	ap(l-t) (cm)	a (cm)	a (mm)	aall	Wcr
P1	0.1	0.1	0.1	0.1=(L0/2670)	1.6	0.0	0.0
P2	0.1	0.1	0.1	0.1=(L0/3132)	1.5	0.0	0.0

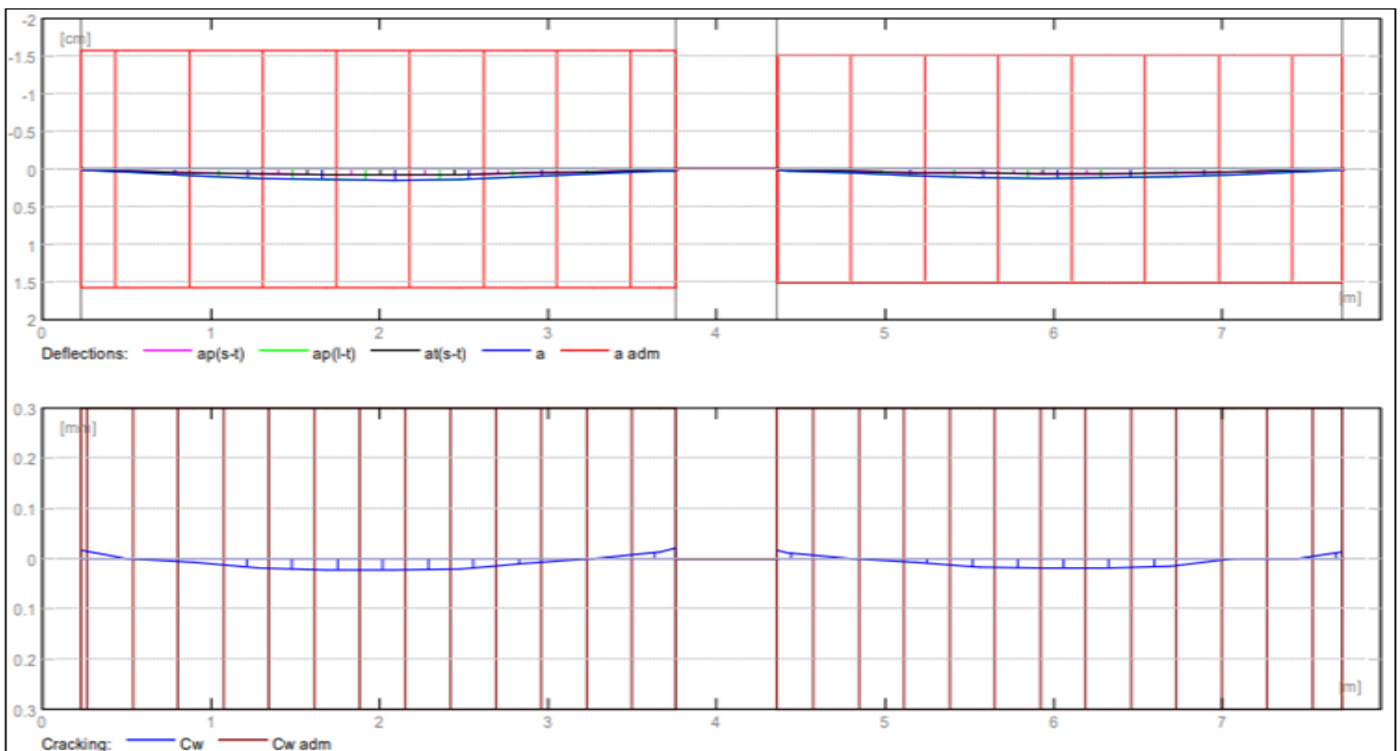


Fig 10 Cracking and Deflection

➤ Column Structural Design:

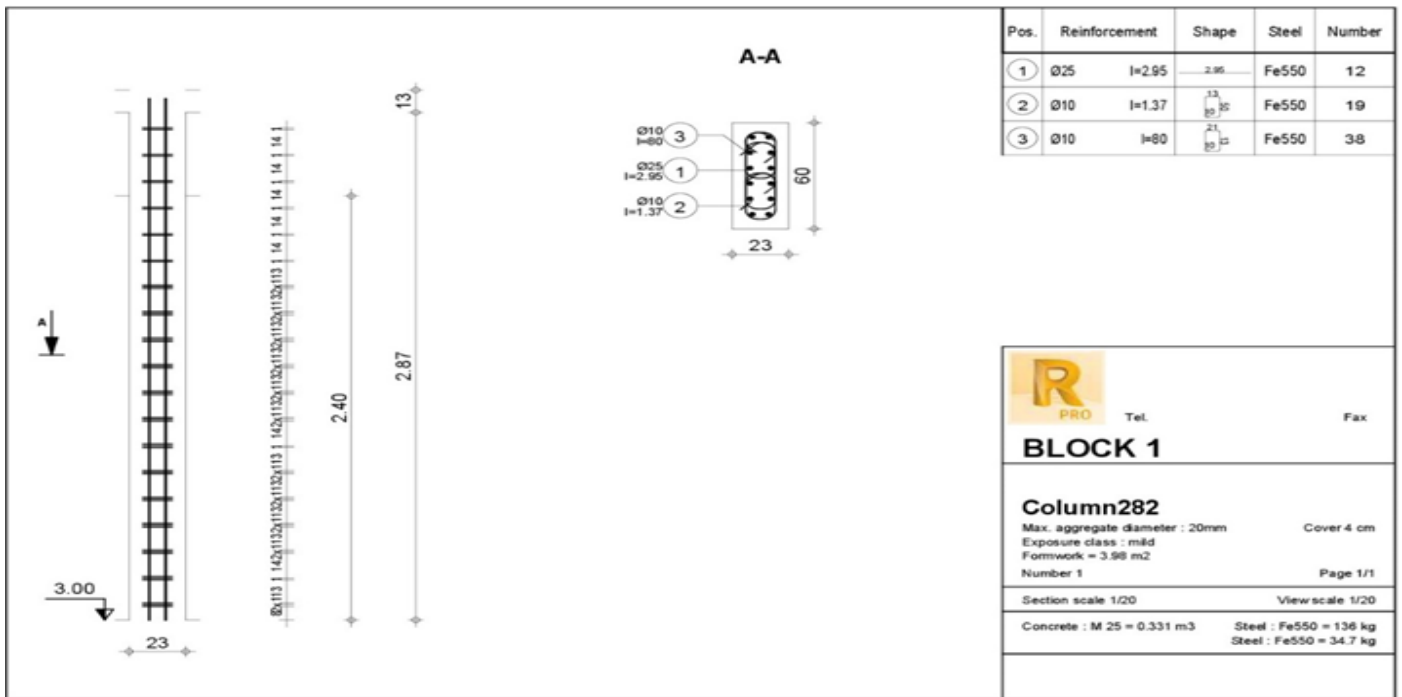


Fig 11 Column Structural Design

Column : Column282

Number : 1

Material properties :

- Concrete : M 25 $f_{cu} = 25.00$ (MPa)
- Unit weight : 2549.29 (kG/m³)
- Longitudinal reinforcement : Fe550 $f_y = 550.00$ (MPa)
- Transversal reinforcement : Fe550 $f_y = 550.00$ (MPa)

➤ Footing Structural Design:

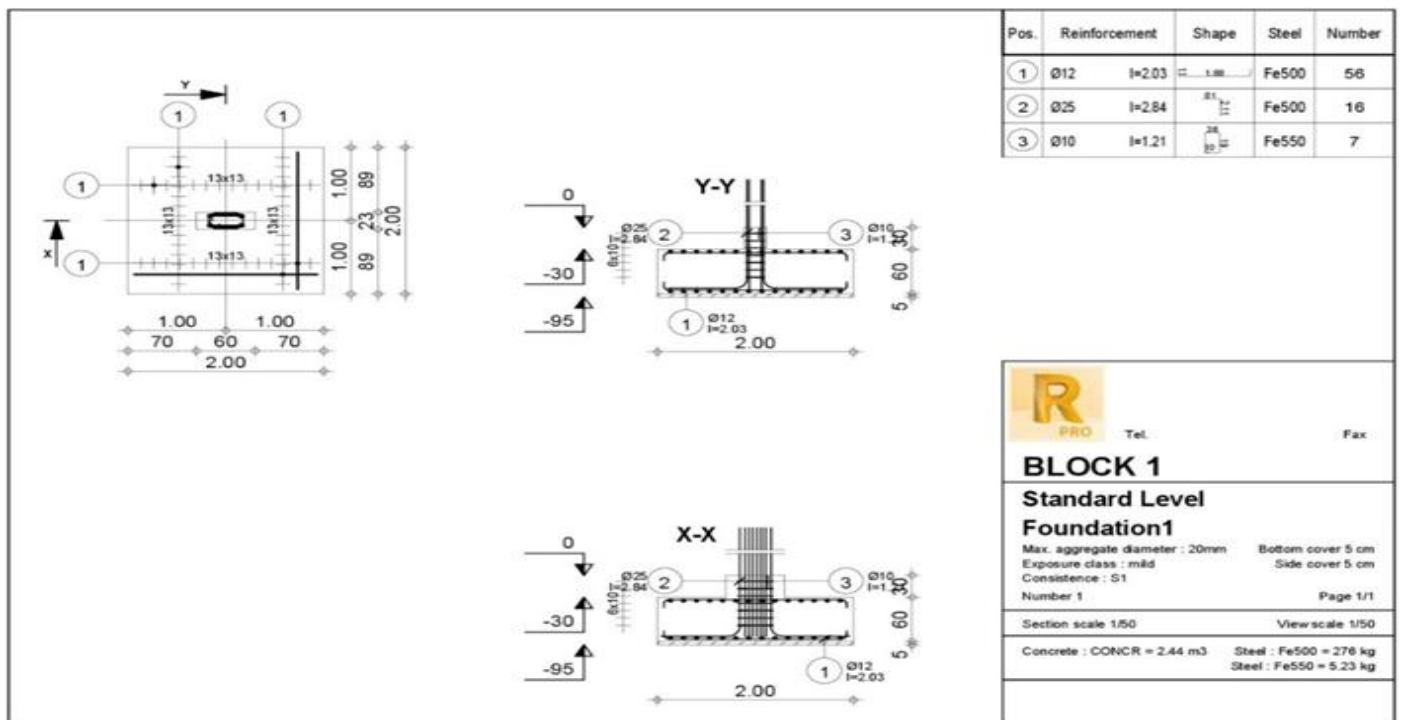


Fig 12 Footing Structural Design

Material

- Concrete : M 25 f_{cu} = 25.00 (MPa)
- Unit weight : 2549.29 (kG/m³)
- Longitudinal reinforcement : Fe550 f_y = 550.00(MPa)
- Transversal reinforcement : Fe550 f_y = 550.00(MPa)

X. GOOGLE SKETCHUP

Mainly the interior design is designed by using the latest Google Sketchup In the Google Sketchup software many types of templates are present. In this, the simple feet and inches templet are used to design the interior of the building. In Sketchup architecture, the interior structures are designed by using a 3D warehouse.

➤ *Sketch up Exterior Two-Point Perspective View of 1&2:*

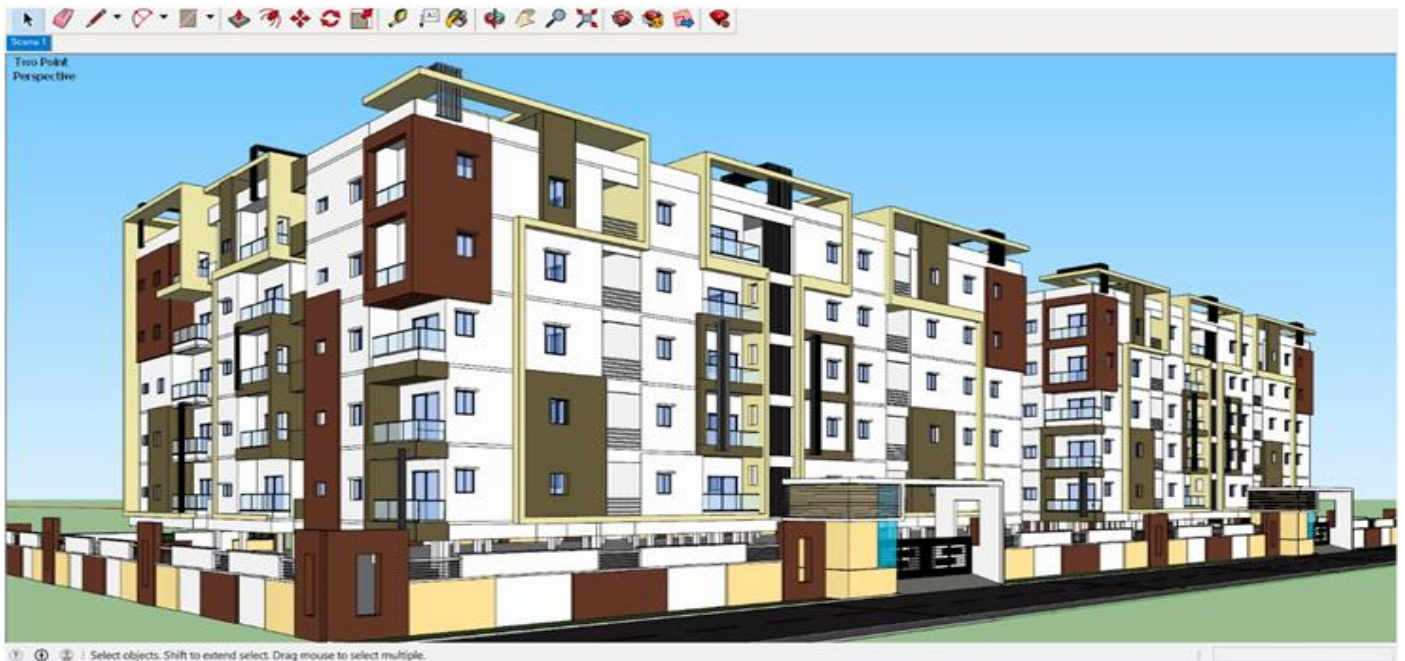


Fig 13 Sketch up Exterior Two-Point Perspective View of 1&2

➤ *Sketch up Exterior Two-Point Perspective View of 3,4&5:*

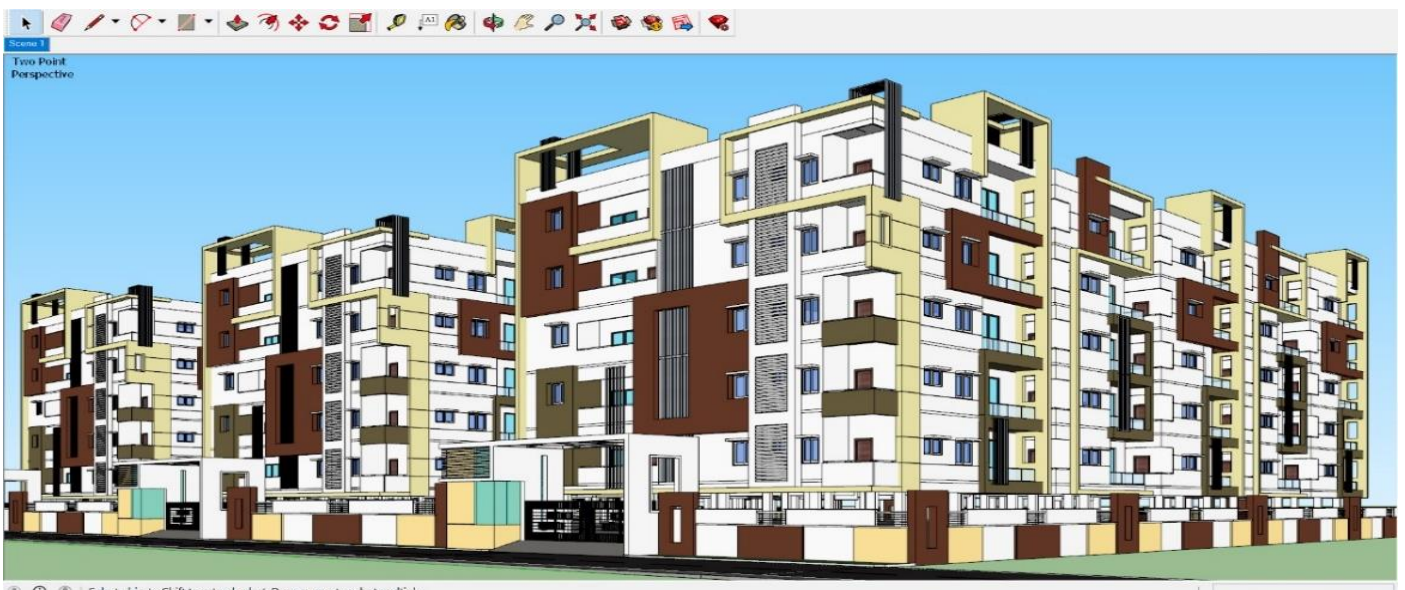


Fig 14 Sketch up Exterior Two-Point Perspective View of 3,4&5

XI. LUMION

Lumion holds immense importance in the field of architectural visualization, offering architects and designers a rapid and user-friendly platform to transform 3D models into vibrant, realistic renders and animations. Its real-time rendering capabilities, extensive asset library, and seamless integration with popular 3D modeling software make it a crucial tool for efficiently communicating and presenting design concepts. Lumion's impact lies in its ability to bring architectural visions to life, facilitating better understanding, decision-making, and collaboration throughout the design and presentation process.



Fig 15 Lumion Rendered Total Gated Community Image



Fig 16 Lumion Rendered Total Gated Community Image

XII. CONCLUSION

- As increasing land space along with population is not possible, multi-storeyed buildings are an effective construction that uses available land space accurately.
- For the plan that we prepared, more natural ventilation and air circulation can be provided.
- As we design the building with software that saves much time it will be very feasible to redesign the elements if needed.
- With the advancement of techniques and software's scope of errors can be greatly minimized.
- ROBOT analysis software takes the maximum values which will increase the quantity of reinforcement used when compared to the manual design of the structure.
- SKETCHUP and ROBOT analysis are highly accurate in terms of analysis and design which saves time and effort.
- It is very easy for the clients to understand how the building looks in the preconstruction stage. many designs and elevations can be drawn, it's all based on one's creativity.
- By using GOOGLE SKETCHUP software, exterior elevation, and interior designing can be done. before the construction and can be changed accordingly.

REFERENCES

- [1]. Limit state Design – B. C. Punmia - Ashok Kumar Jain
- [2]. Building construction - Rangawala
- [3]. Building Panning and Drawing – Guru Charan Singh
- [4]. IS code - 456: 2000
- [5]. Bureau of Indian Standards: IS-875, part 1(1987), Dead load on buildings and structures, New Delhi, Indian
- [6]. Bureau of Indian Standards: IS-875, part 2(1987), Live loads on buildings and structures, New Delhi, Indian
- [7]. Bureau of Indian Standards: IS-875, part 3(1987), Wind loads on buildings and Structures, New Delhi, India
- [8]. Bureau of Indian Standards: IS-875, part 5 (1987), Load combinations on buildings and structures, New Delhi, India
- [9]. www.3Dwarehouse.com