CERTIFICATE

This is to certify that the report titled "**INTEGRATION OF REVIT AND ETABS SOFTWARE TOOLS FOR ANALYSIS, DESIGN AND QUANTITY ESTIMATION OF AN EDUCATIONAL COMPLEX"** Submitted by

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In partial fulfilment of the requirements for the degree of Bachelor of Engineering in Civil Engineering, is a record of their work carried out in Department Of Civil Engineering of this institute.

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GUIDE

(DR. RAJENDRA MAGAR) (HOD**)**

(ABDUL RAZZAK HONNOTAGI) **(**DIRECTOR)

DECLARATION

I, Mr. _______________ Civil engineering student of Anjuman Islam Kalsekar Technical Campus, hereby declare that I have completed the project titled _______________ during the academic year 2013-2017. I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

(Signature)

(Name of student and Roll No.)

Date

ACKNOWLEDGEMENT

We have taken effort in this project. However, it would not have been possible without the kind support and help of many individuals and organization. We would like extend our sincere thanks to all of them.

We thank our GOD for providing us everything that we required in completing this project.

We would like to express our deep sense of gratitude to our director **Dr. ABDUL RAZZAK HONNUTAGI** for providing all the facilities in the college.

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We would like to express our special gratitude and thanks to **ER. KHAN ZIYAUR REHMAN** for giving me such attention and time

ABSTRACT

The following project deals with the planning, analysis, designing, modelling and Quantity Estimation of a 7-storey Hostel building using advance Civil Engineering softwares like AutoCAD, ETABS, Autodesk Revit and Microsoft Excel Spreadsheet. Project starts with planning of the building using AutoCAD. Then analysis of building is carried out using ETABS and Microsoft Excel Spreadsheet. Also detailing of reinforcement is done in ETABS. Then finally for Modelling and Estimation purpose, Autodesk Revit is used.

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CHAPTER 1

1.0 INTRODUCTION

AIKTC is a constituent college within the University of Mumbai (MU) due to good reputation, AIKTC experienced a tremendous growth over the period till now resulting in introduction of new faculties hence an increased intake. In view of this, there has been an increase in demand for accommodation on campus. AIKTC lacks accommodation facilities for its students. In an endeavor to maintain the increased number of intake, we introduced non-residential system whereby only few students are accommodated on campus. For instance, College of has a total of 4373 students of which 450 and 50 staff are accommodated on campus.

For planning purpose AutoCAD software is used and by referring bye-laws of hostel, planning is done. AutoCAD is a commercial software application for 2D and 3D computer-aided design (CAD) and drafting available since 1982 as a desktop application and since 2010 as a mobile, web- and cloud-based app marketed as AutoCAD 360.

AutoCAD was derived from a program begun in 1977 and released in 1979 called Interact CAD, also referred to in early Autodesk documents as MicroCAD, which was written prior to Autodesk's (then Marinchip Software Partners) formation by Autodesk cofounder Mike Riddle

For analysis purpose ETABS software is recommended. The innovative and revolutionary new ETABS is the ultimate integrated software package for the structural analysis and design of buildings. Incorporating 40 years of continuous research and development, this latest ETABS offers unmatched 3D object based modeling and visualization tools, blazingly fast linear and nonlinear analytical power, sophisticated and comprehensive design capabilities for a wide-range of materials, and insightful graphic displays, reports, and schematic drawings that allow users to quickly and easily decipher and understand analysis and design results. From the start of design conception through the production of schematic drawings, ETABS integrates every aspect of the engineering design process. Creation of models has never been easier - intuitive drawing commands allow for the rapid generation of floor and elevation framing. CAD drawings can be converted directly into ETABS models or used as templates onto which ETABS objects may be overlaid.

Design of steel and concrete frames (with automated optimization), composite beams, composite columns, steel joists, and concrete and masonry shear walls is included, as is the capacity check for steel connections and base plates. Models may be realistically rendered, and all results can be shown directly on the structure. Comprehensive and customizable reports are available for all analysis and design output, and schematic construction drawings of framing plans, schedules, details, and cross-sections may be generated for concrete and steel structures. ETABS provides an unequaled suite of tools for structural engineers designing buildings, whether they are working on one-story industrial structures or the tallest commercial high-rises. Immensely capable, yet easy-to-use, has been the hallmark of ETABS since its introduction decades ago, and this latest release continues that tradition by providing engineers with the technologically-advanced, yet intuitive, software they require to be their most productive.

Microsoft Excel is a spreadsheet developed by Microsoft for Windows, macOS, Android and iOS. It features calculation, graphing tools, pivot tables, and a macro programming language called Visual Basic for Applications. It has been a very widely applied spreadsheet for these platforms, especially since version 5 in 1993.

Microsoft Excel has the basic features of all spreadsheets, using a grid of cells arranged in numbered rows and letter-named columns to organize data manipulations like arithmetic operations. It has a battery of supplied functions to answer statistical, engineering and financial needs. In addition, it can display data as line graphs, histograms and charts, and with a very limited three-dimensional graphical display. It allows sectioning of data to view its dependencies on various factors for different perspectives .It has a programming aspect, Visual Basic for Applications, allowing the user to employ a wide variety of numerical methods, It also has a variety of interactive features allowing user interfaces that can completely hide the spreadsheet from the user, so the spreadsheet presents itself as a so-called application, or decision support system (DSS), via a custom-designed user interface,. In a more elaborate realization, an Excel application can automatically poll external databases and measuring instruments using an update schedule, analyze the results, make a Word report or PowerPoint slide show, and e-mail these presentations on a regular basis to a list of participants

After analysis, Autodesk Revit software for modeling purpose is used. Autodesk Revit is building information modeling software for architects, structural engineers, MEP engineers, designers and contractors developed by Autodesk. It allows users to design a building and structure and its components in 3D, annotate the model with 2D drafting elements, and access building information from the building model's database. You can extract any data from it. Plan, elevations, sections, it’s also easy to create color fill, 3D perspective, rendering, detailed drawing, and limited walkthrough animation.by creating building plan other data you can collect from your model is your building schedule. You can create a report wall length, number of doors and windows, and other schedule easily, you are actually creating it in 3D, visualization is easy to make. Just place your camera, tweak it a little bit, then you’ll have a nice perspective!
Revit is 4D BIM capable with tools to plan and track various stages in the building's lifecycle, from concept to construction and later demolition.

1.1 AIM AND OBJECTIVE

The aim is to create the best learning and training environment for students by improving their accommodation that has proved to be a contributing factor to quality education. The main object is to learn Autodesk (AutoCAD and Revit) and CSI (ETABS) softwares and other objectives are:

- To improve Poor quality of accommodation.

Most of the off-campus accommodations do not meet the acceptable standards that a student requires. They consist of poor building structures, furniture and building services (electrical and plumbing fixings and fittings).

- To provide Security.

There is low security especially for female students who run a higher risk of being robbed when traveling from school to hostels at night.

- To Absenteeism.

It is difficult to arrange for make-up classes since transport for off campus students is problematic. Where the make-up classes are inevitable, majority of off campus students do not attend.

- Provide Hygienic food

Most of the students who reside off-campus have limited access to quality and safe food. Students buy food based on the availability and convenience and disregard the quality and safety hence putting their health at stake;

- To provide better sanitation system

Generally, there is poor sanitation in most of the places that off-campus students reside.

- Convenient studying places.

The College Library normally operates from 08:00am to 10:00pm; however, off campus students have a limited opportunity to fully utilize the same due to unavailability of transport to their respective hostels. The problem extends to the use of College Internet on campus as well as clinical-training experience conducted in hospital wards.

- To avoid disturbance

Off-campus students face many disturbance during festivals and other programs, hence we are providing smooth environment for study.

1.2 SCOPE

Based on the aim and objective mentioned in the preceding section, the scope of the present investigation is outlined as under:

By doing this project we will come to know some software of civil engineering related to planning, analysis and modeling of structures like AutoCAD, ETABS and Autodesk Revit.

The best learning and training environment for students by improving their accommodation that has proved to be a contributing factor to quality education.

CHAPTER 2

2. REVIEW OF LITERATURE

2.1 AutoCAD

Azidah Abu Ziden (2012), studied the effectiveness of AutoCAD software in learning of Engineering Drawing to enhance students understanding. It concludes that AutoCAD increase the performance of high and medium level students group gave a positive impact on the study. Effective use of this software proved to be helpful based on the data obtained.

Asmaa G. Salih *et. al.* (2014), presents the significant revolution with computers usage in civil engineering business and construction process has been presented. AutoCAD software is an extremely powerful tool and can be adapted to specific needs in order to serve the intended purpose of any project. Civil engineering professionals use this software for variety of infrastructure projects, like: land development, transportation, water projects and road design..

Amol A. Metkari *et. al.* (2015), proposed Ladies Hostel building for Rajarambapu Institute of Technology College, Rajaramnagar. In that case study, building project, included real life examples of BIM and AutoCAD uses and benefits. Also in the case study, a prototype building project, examined the 2D, 3D, 4D and 5D model by using AutoCAD & BIM tools

Prakash Chandar *et. al.* (2015), research on Integrating Building Information Modelling (BIM) and Construction Project Scheduling to Result in 4D Planning for a Construction Project, the conventional 2D drawings are prepared in AutoCAD 2010. The 2D drawings are converted into 3D model in Revit Architecture 2014 and the Time Scheduling is done in Microsoft Office project 2007.

Raiyan Mansoori *et. al.* (2016), studies the planning and design of Residential building (G+16) By Using AutoCAD & Revit Softwares taking 4th dimension as time. In this paper study is restricted to civil engineering construction planning

& scheduling by creating a 4D model, further other dimensions like cost, resources, materials etc. can be taken as nth dimensions.

2.2 ETABS

Abhay Guleria (2014) presents the analysis of the multistoried building using ETABS reflected that the storey overturning moment varies inversely with storey height. Moreover, L-shape, I-shape type buildings give almost similar response against the overturning moment. Storey drift displacement increased with storey height up to 6th storey reaching to maximum value and then started decreasing. From dynamic analysis, mode shapes are generated and it can be concluded that asymmetrical plans undergo more deformation than symmetrical plans. Asymmetrical plans should be adopted considering into gap.

Arpit A. Bhusar et. al. (2014) shows Building information models let structural engineers design, visualize, simulate, analyze, document and build projects more efficiently, accurately, and competitively. Among the most important benefits of BIM for structural engineer are productivity, coordination and consistency of data, and improved visualization and simulation of problems and situations. Structural engineers can easily spend more time coordinating a project than performing the structural analysis. With the use of BIM, the time spent in coordination is reduced, allowing structural engineers to focus all their efforts in solving problems, instead of having to constantly be checking for errors or coordinating changes made.

Sonia Longjam et. al. (2014), publishes the paper that presents the plan, model, analyze and design of a vertical irregular shopping mall structure of G+10 storey and investigate its performance under various lateral loading conditions. The main goal is to assess current Indian Standard design practice and to provide design guidelines using ETABS, presents the manual design calculation satisfying the necessary requirements as per BIS specification as well as various Indian standard code specifications.

D.Ramya et. al. (2015), principle objective of the project is comparative study on design and analysis of multistoried building (G+10) by STAAD Pro and ETABS software. STAAD Pro is one of the leading software for the design of structures. G+10 building is analyzed for finding the shear forces, bending moments, deflections & reinforcement details for the structural components of building (such as Beams, columns & slabs) to develop the economic design. ETABS is also a leading design software in present days used by many structural designers. Analyzed the same structure using ETABS software for the design. Finally an attempt to define the economical section of G+10 multistoried building using both STAAD Pro and ETABS comparatively. By the intensive study come to know that the "economical sections" was developed using ETABS software.

S. Vijaya Bhaskar Reddy et. al. (2015), published a paper which describes the salient features of ETABS and its various applications in civil engineering, using ETABS software the analysis of two multi storeyed buildings is carried out with different heights (15m and 10m). Thus it can be help the consulting engineers, construction experts, research scientists and students in the analysis of concrete structures. The essential features of ETABS is explained and the capability of the important concepts of effective memory management, plot options and user interface are described.

B. Anjaneyulu et. al. (2016), studies the analysis and design of Flat Slab By Using ETABS Software, concludes that flat plate/slab can be designed and built either by conventional reinforced concrete. or posttensioning. However, due to issues mentioned above with post- tensioning construction in India and its higher cost, conventional reinforced concrete design should be preferred choice for spans up to 10 meters.

2.3 REVIT

Ajla Aksamija et. al. (2011), Parametric design offers some advantages over traditional modeling methods, since it allows adaptation of an object through the use of rules and constraints or "parameters" to influence the object's properties. These processes as well as parametric computational tools, are relatively new in architectural design. They enable the adaptation of model geometry based on rules or data values, eliminating the need to recreate the model for every design change.

Cesar Augusto Hunt (2013), the benefits of using building information modeling are evident, especially when analyzing the way that this methodology enhances the structural design workflow. Engineers are realizing the power of BIM for more efficient and intelligent design, and most firms using BIM are reporting strong favor for this technology. Using the building information model not only enables the production of construction documents, but it also serves as a base to present the results from the structural analysis and design in an easy sharable way, keeping all the information regarding the analysis, design and documentation of a structural project in one place.

Nisarg M. Mistry et. al. (2014) worked on Softwares for Building Information Modeling (BIM) for Project Management and Controlling.It can be concluded that Revit helps to provide immediate competitive advantage, better coordination and quality, and can contribute to higher profitability for architects and the rest of the building team. It can also be concluded that BIM is an efficient and reliable tool of project management. Project management can be done more effectively by using this type of tool.

Wei Peng (2014), the art of architecture refers to the law of beauty, and uses the unique architectural art language, so the building image has cultural value and aesthetic value, with symbolic and formal beauty, reflecting the national character and sense of the times. This paper takes the BIM building information modeling as integrated platform, through the Revit data interface, and uses 3Ds max software to design the art shape of building structure.

Shashank.R.Chandak (2016), presents the cost of optimization of construction projects using BIM Software Revit. The projects concludes that by using BIM method 80% reduction in time to generate estimates, 10% saving on construction cost through clash detection. 20% saving through construction cost simulation.

Based on the afore-mentioned literature review it is observe that AutoCAD, ETABS and Revit are user friendly softwares. Hence we have decided to do planning, analysis and quantity estimation of an educational complex by AutoCAD, ETABS and Revit.

CHAPTER 3

3. METHODOLOGY:

The project (An Educational complex-AIKTC) is software based, planning, analysis, designing and modelling will be done by using AutoCAD, ETABS and Autodesk Revit. This project consist of three main parts as follows:

3.1 Planning:

Planning of a hostel building has been done as per building Bye-Laws and IS Code requirement, keeping in mind the accommodation requirement for 450 students and 50 staff members, for this purpose, AutoCAD software is used. Hostel consist of 7 floors. Ground floor, 1st floor and 5th floor are master storeys.

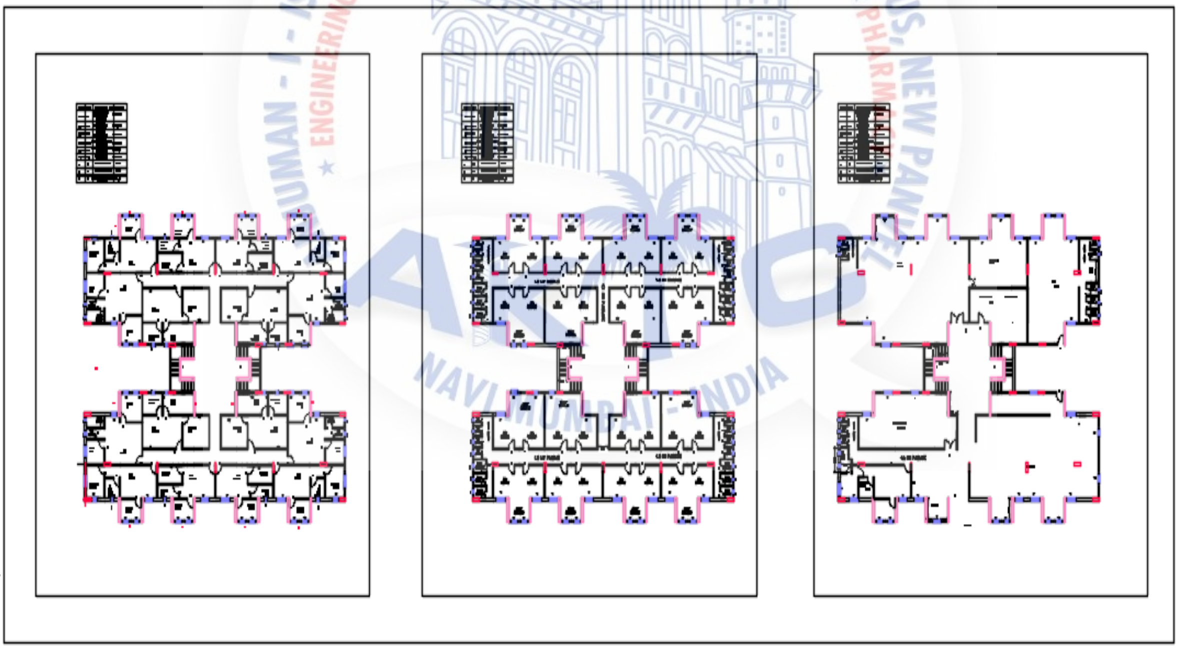

FIG.3.1 (I)

3.1.1 Ground Floor Plan (Refer Fig. 3.1.1 (I)):

- Ground floor consist of all fundamental amenities like Canteen, Indoor games, Gym, Library and Digital Library.
- Warden Office and Reception is also provided at Ground Floor itself in order to maintain discipline and better coordination for assistance to students.
- Server and Maintenance room is provided for systematic monitoring of electricity and computer servers.
- In order to avoid unnecessary chaos and disturbance, the door of Gym is provided outside the building and not from the lobby itself.
- Library and Digital Library is provided away from other distracting units like Canteen and Indoor games in order to maintain silence and better environment for studying.
- Opening for Canteen is wider for easy motion of students.

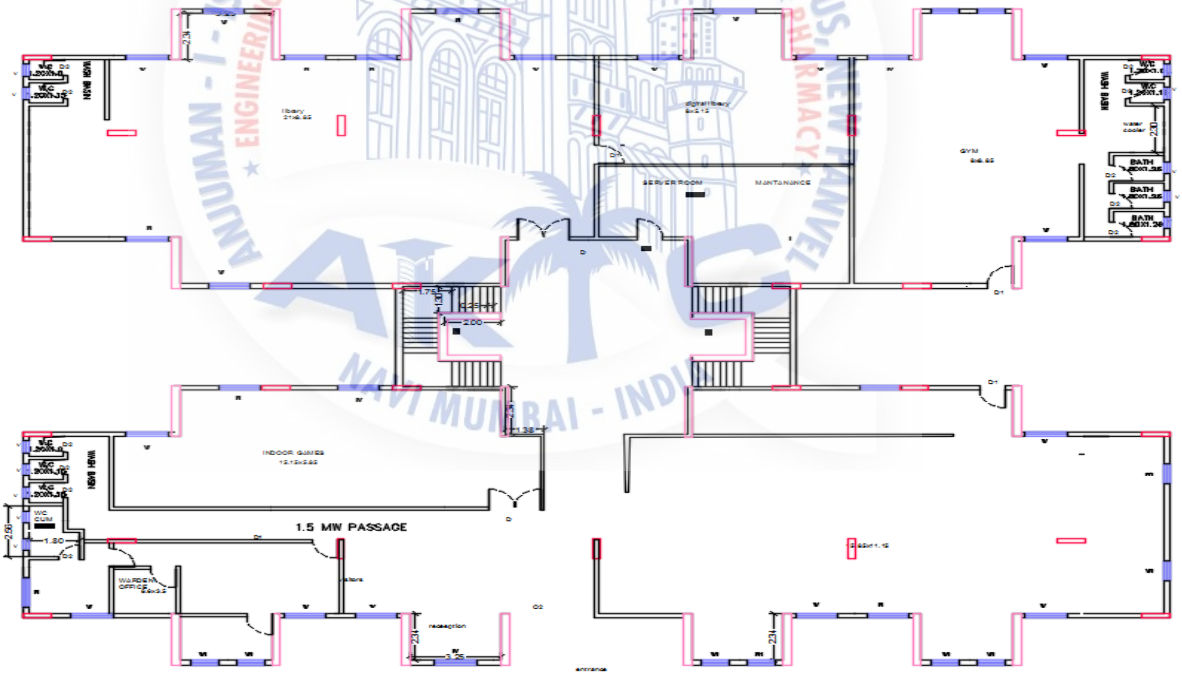

FIG.3.1.1

3.1.2 First Floor Plan (Refer Fig. 3.1.2 (I)):

- First Floor is the Master Floor for 2nd, 3rd & 4th floor, planned specifically 2-seaters and a common study room. Each room will be accommodating 8 for stud
- For every 4 rooms, 4 WC and 3 Bathrooms are provided at the corner of each floor.
- Passage way of 1.5m width is provided for easy movement.
- Open Well Staircase is provided throughout the building with Elevators on opposite sides.
- Each Floor consist of 16 Rooms, and each room consist of 4 beds of students.

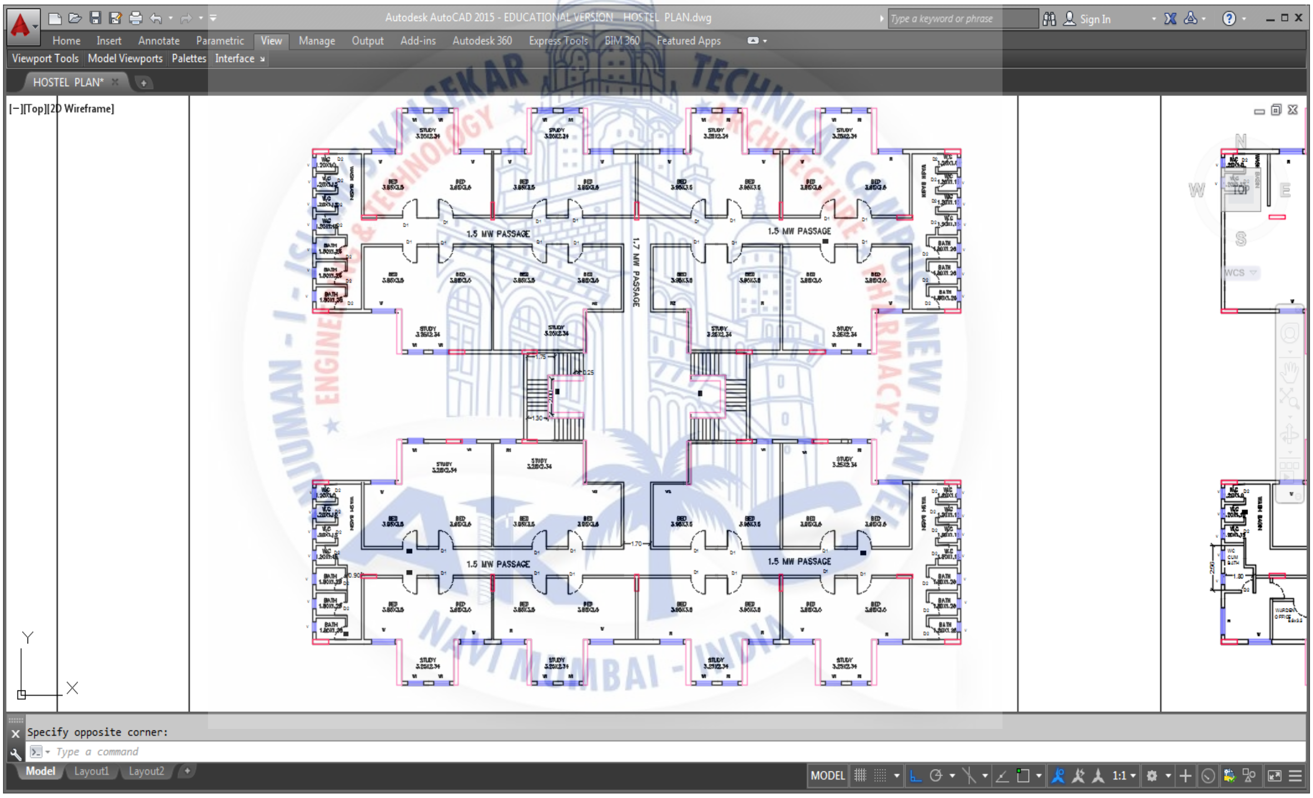

FIG.3.1.2

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3.1.3 Fifth Floor Plan (Refer Fig. 3.1.3 (I)):

- Fifth Floor is the Master Floor for 6th & 7th Floors, planned specifically for Staff members.
- Each floor consist of 16 rooms. Each room is assigned to individual staff members and their family.
- Every room is equipped with attached W.C and Bath, and a modern furnished Kitchen and Bedroom.
- There are 4 rooms with 1RK and rest all rooms are 1BHK.

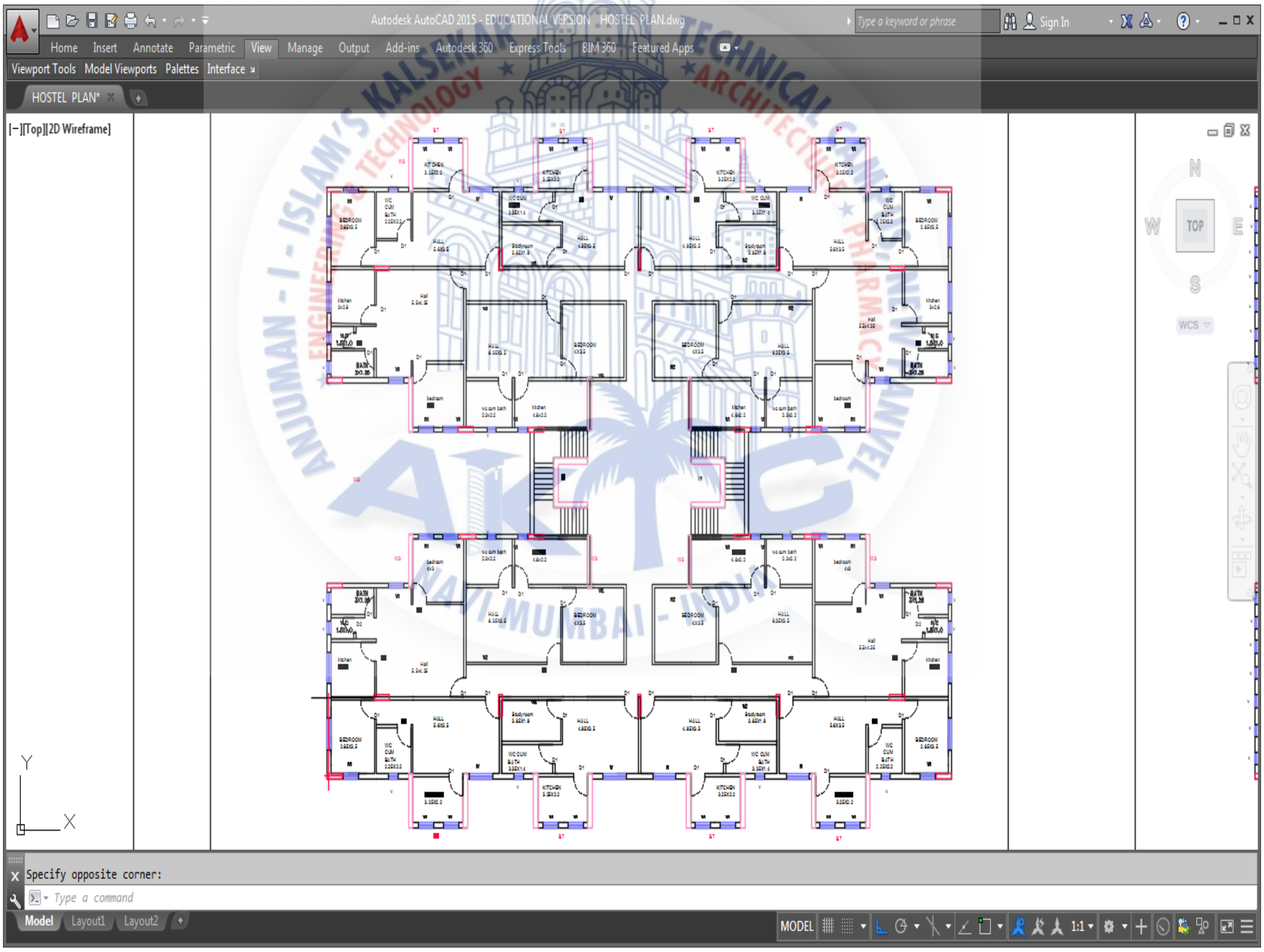


FIG.3.1.3

3.1.4 Obtaining Center-Line Plan (Refer Fig. 3.1.4 (I)) :

- After planning all the floors and its various unit, we extracted the Center-Line plan for importing the plans in ETABS for analysis purpose.

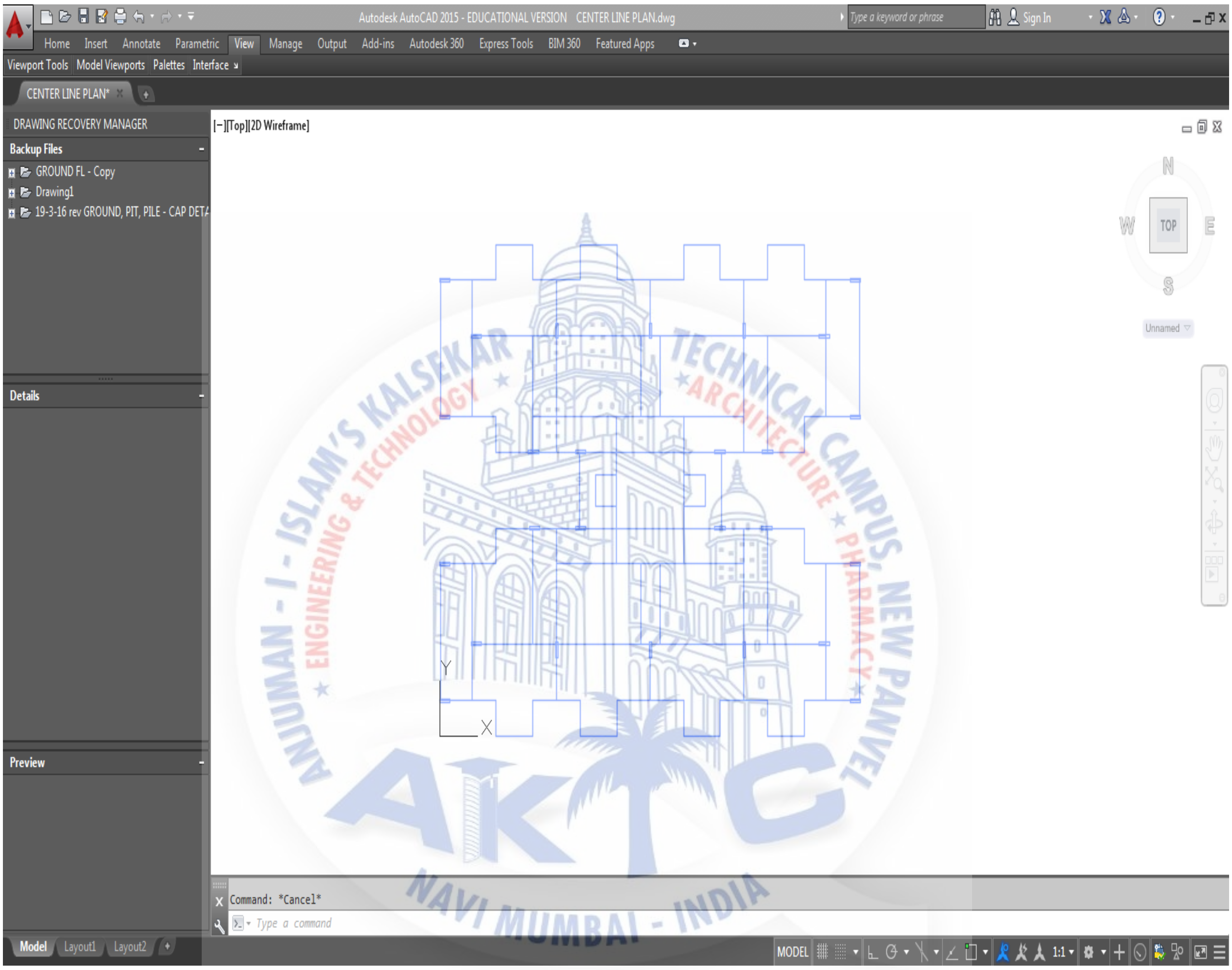
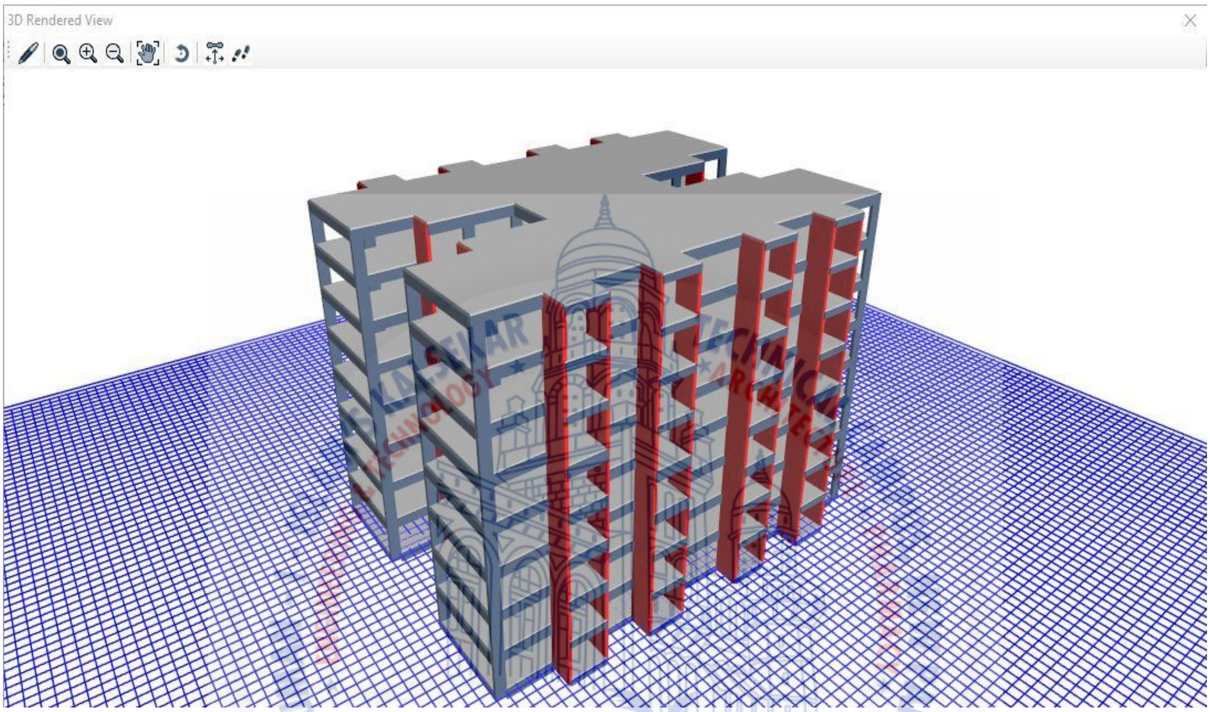


FIG.3.1.4

3.2 ANALYSIS

After completion of planning the project will move ahead by analyzing and designing process with the help of ETABS software. ETABS offers a single user interface to perform: Analysis, Design, Detailing, and Reporting. This software will analyze and design an educational complex with much ease. ETABS gives analysis and design for beams and columns only.



There is a step-by-step procedure followed by us for analyzing and designing the structure. The steps are explained in detail in proper sequence below:

1. Saving AutoCAD file as .DXF file. .

2. Opening .DXF file in ETABS and provide Unit in meters.

3. Define Material like M30, M35 etc. Grades of Concretes & Fe 415, Fe500, etc. Steel As per IS code provided in options.

4. Define Section Properties:

5. Frame section: In this section, Beams and Columns can be defined. Beams are as follows:

Beam B1 : (230X600)mm

Beam B2 : (300X600)mm

Beam B3: (300X500)mm, etc.

Column are as follows:

Column C1 : (300X1000)mm.

Slab section: From this section, thickness of slab in defined.

Wall section: From this section, thickness of shear wall is define with suitable concrete grade.

6. Placement of beams and columns: Beams and columns are placed as indicated in Centre line plan. After placement of beams and columns, the view typical floors are as follows (Refer Fig.3.2.1, 3.2.2,and 3.2.3):

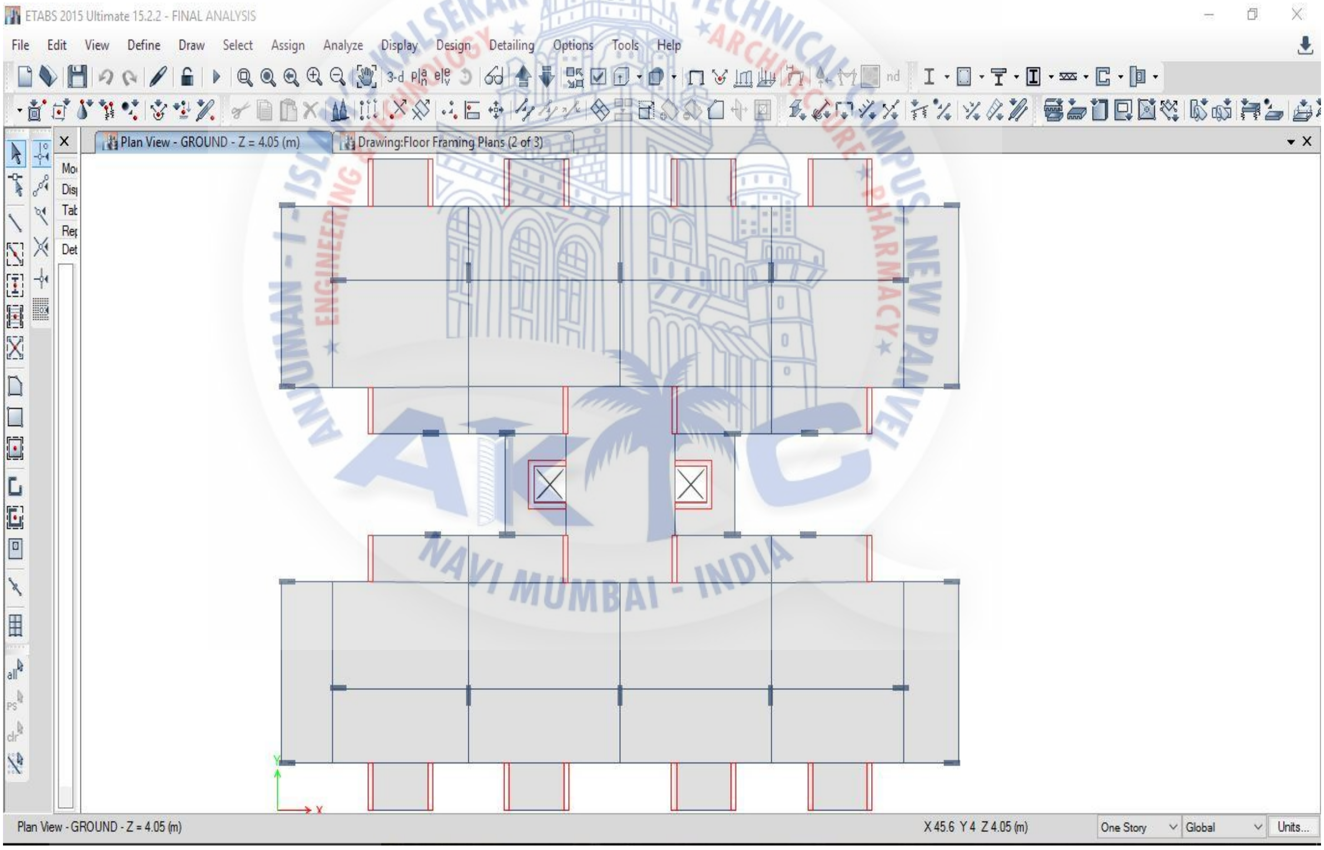


FIG.3.2.1

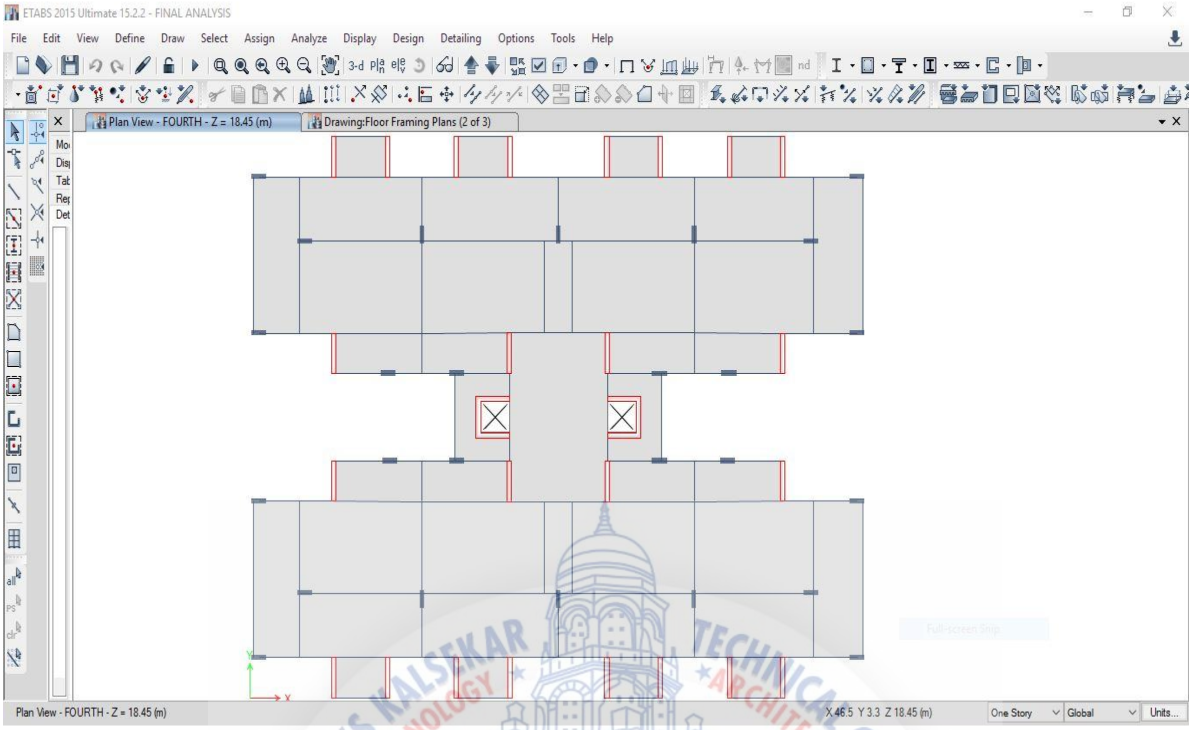


FIG.3.2.2

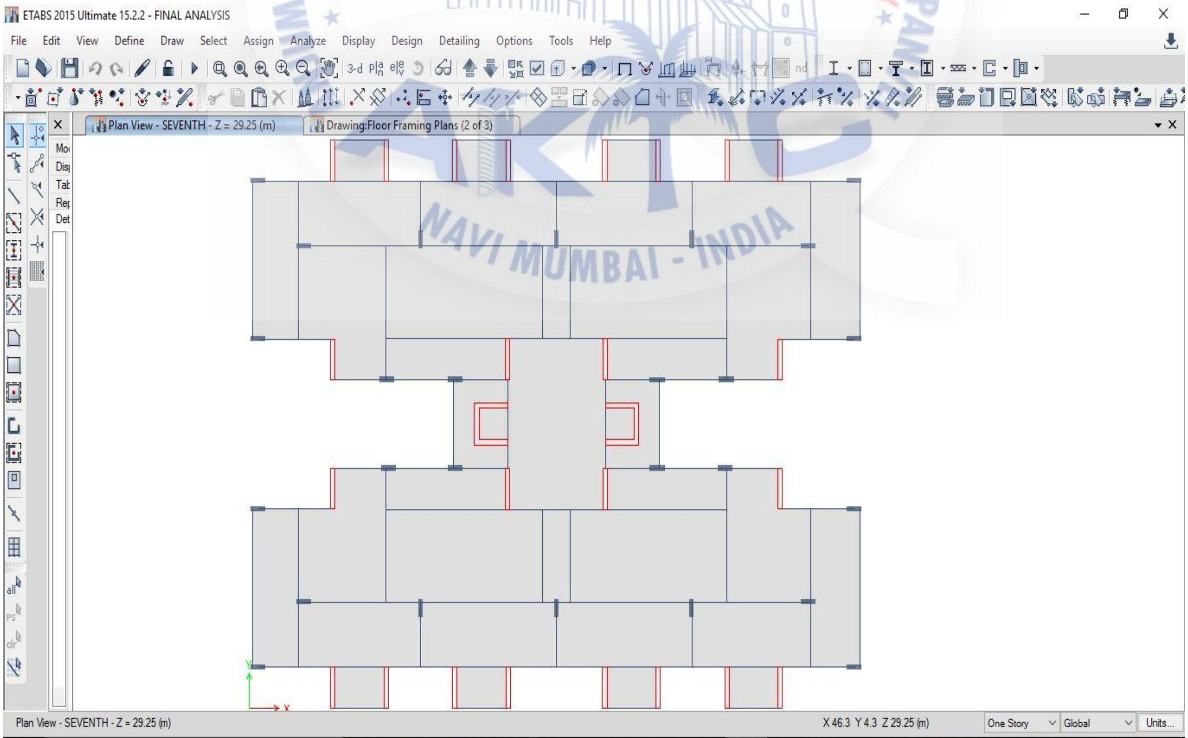


FIG.3.2.3

1. Load Define: Different type of load such as Live, Dead, Masonry, Seismic Loads, etc. are defined.
2. Assign of loads: loads are assign on beams, columns and slabs.
3. Load Cases: Different type of load cases are defined.
4. Load Combinations: Different combination of loads are embedded in ETABS as per IS code.
5. Defining Functions: Functions for Seismic load for X & Y direction are defined under Response Spectrum.
6. Assigning Diaphragm: Rigid Diaphragm is provided.
7. Joints are restrained at plinth level.
8. Checking the model for assigned beams, columns and slabs (Refer Fig 3.2.4).

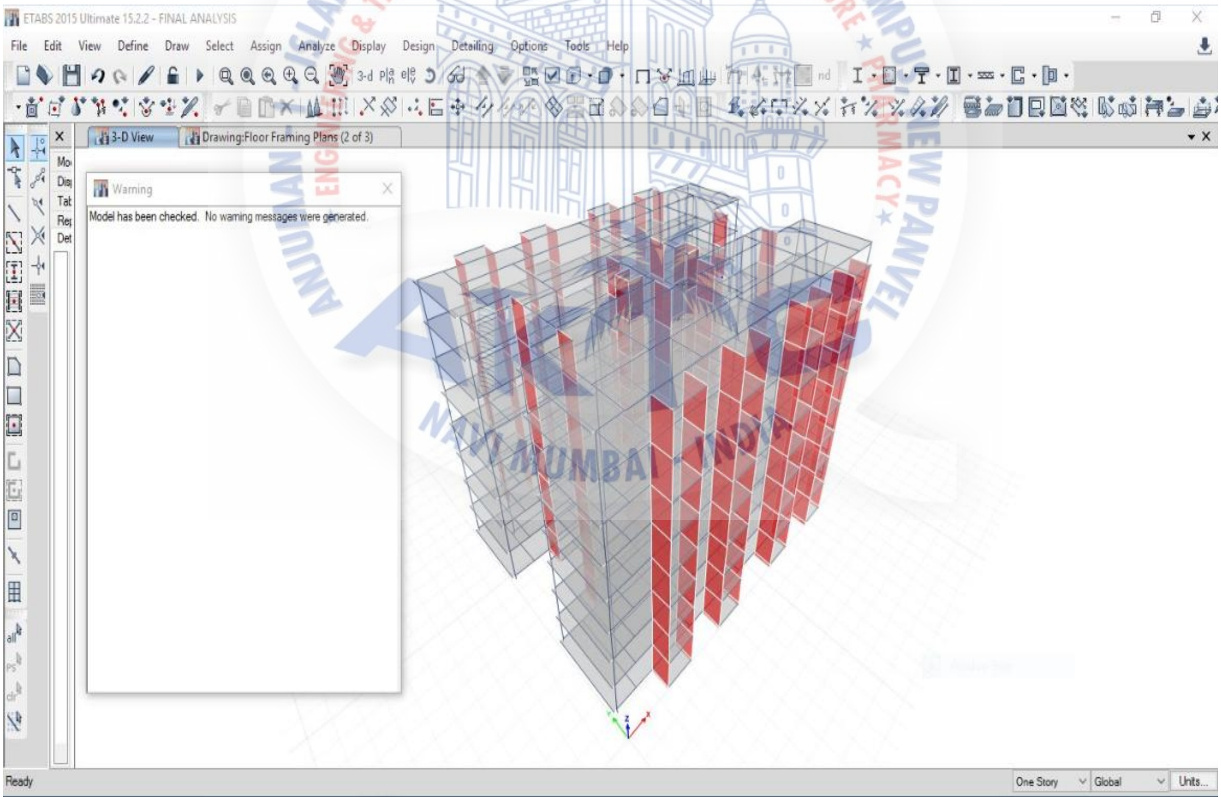


FIG.3.2.4

- After checking the model, analysis is run and the model is found to be safe (Refer Fig.3.2.5)

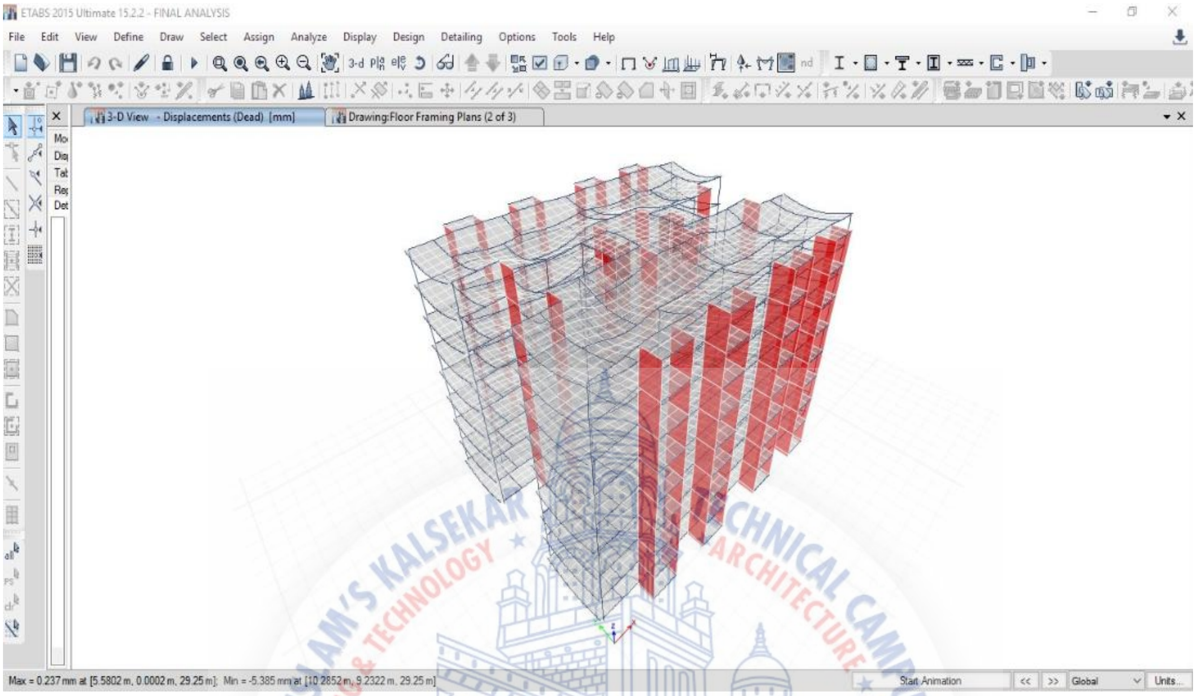


FIG.3.2.5

After analyzing the structure, we did the design check of frame section and obtained the required area of steel for each structural member. Also we get to know that none of the beam or column is Over-Stressed. (Refer Fig 3.2.6)

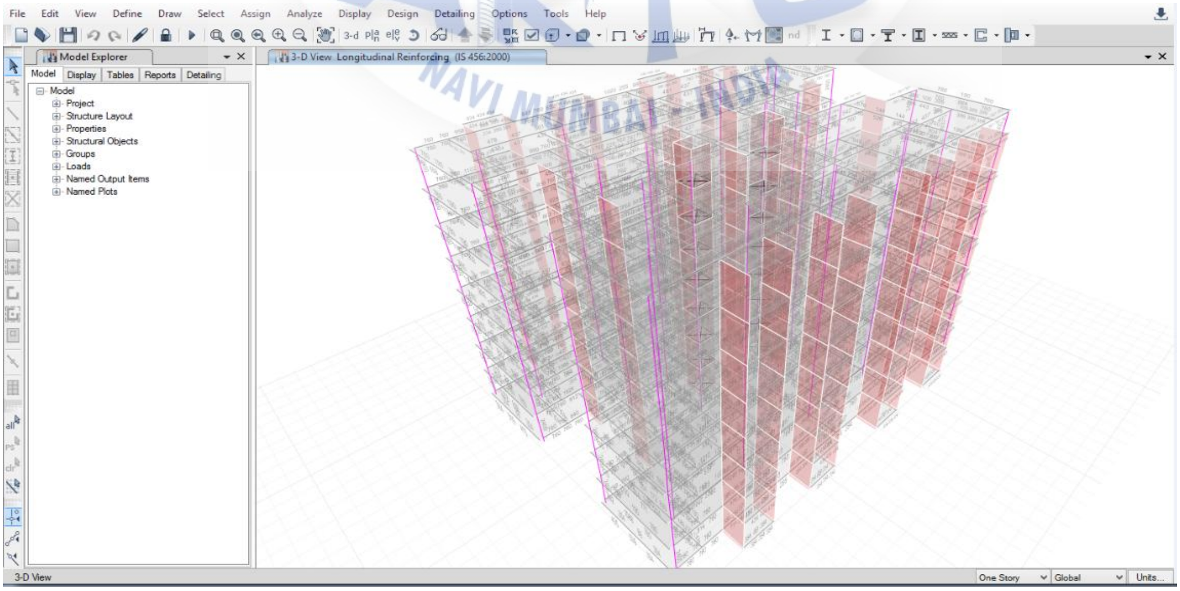


FIG.3.2.6

3.3 DESIGNING AND DETAILING:

After analyzing the structure, detailing of the structural members is done. Under this head, we can provide the number of main bars, number of distribution bars and spacing between the stirrups (tie bars) as per the area of steel obtained from the analysis of structure. Different structural members on different floors may or may not have same design and detailing schedule.

Some of the reinforced sections are shown below. It consist of longitudinal sections of column, beams and shear walls.

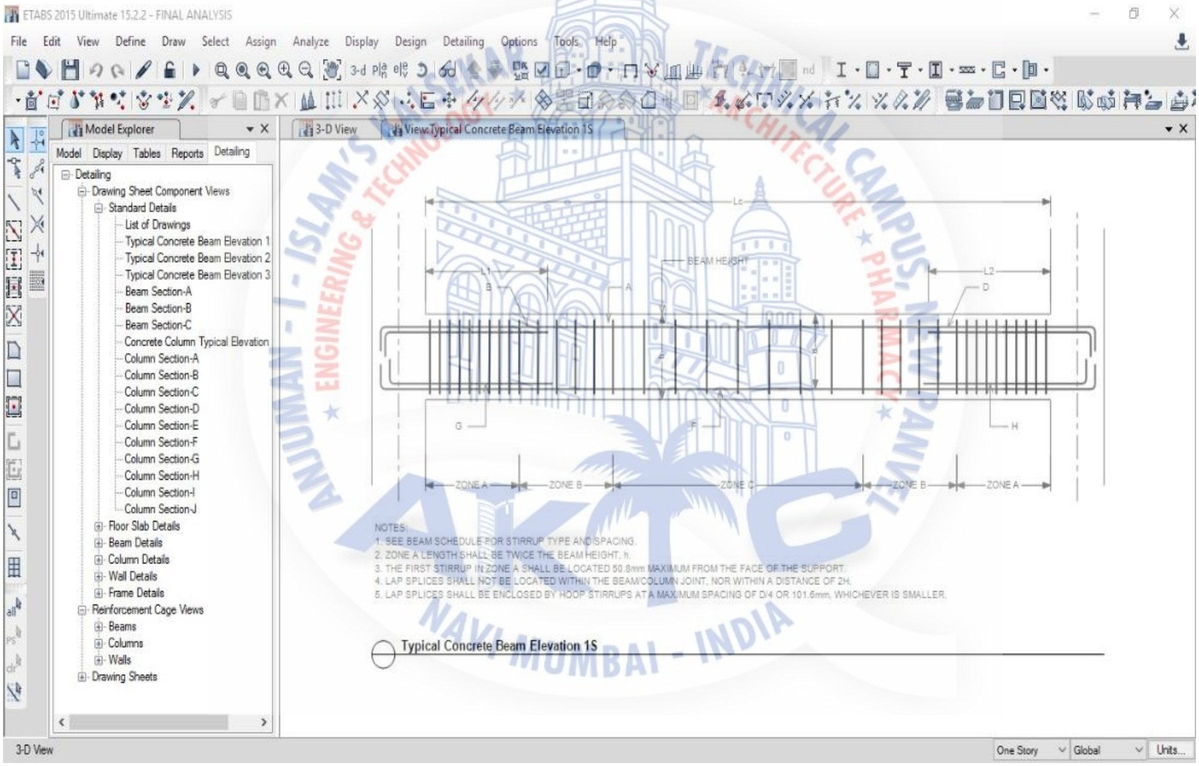


FIG.3.3.1

The above Figure shows the reinforcement details of Typical Beam (Elevation view) for single slab.

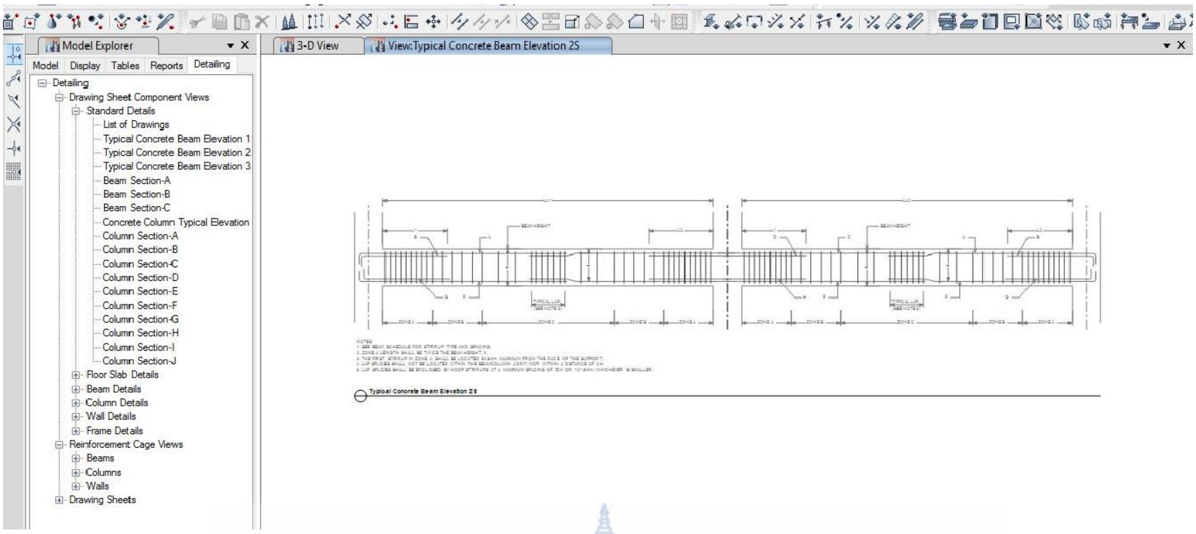


FIG.3.3.2

The above Figure shows the longitudinal reinforced section for typical beams beneath the two adjacent slabs.

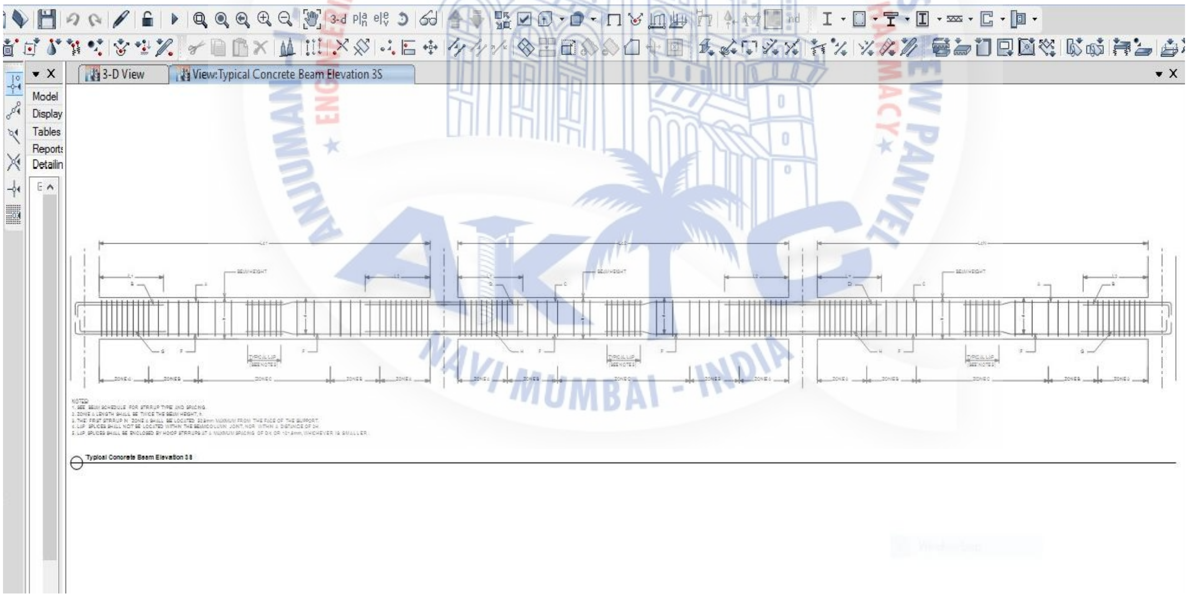


FIG.3.3.3

The above Figure shows the longitudinal reinforced section for typical beams beneath three adjacent slabs.

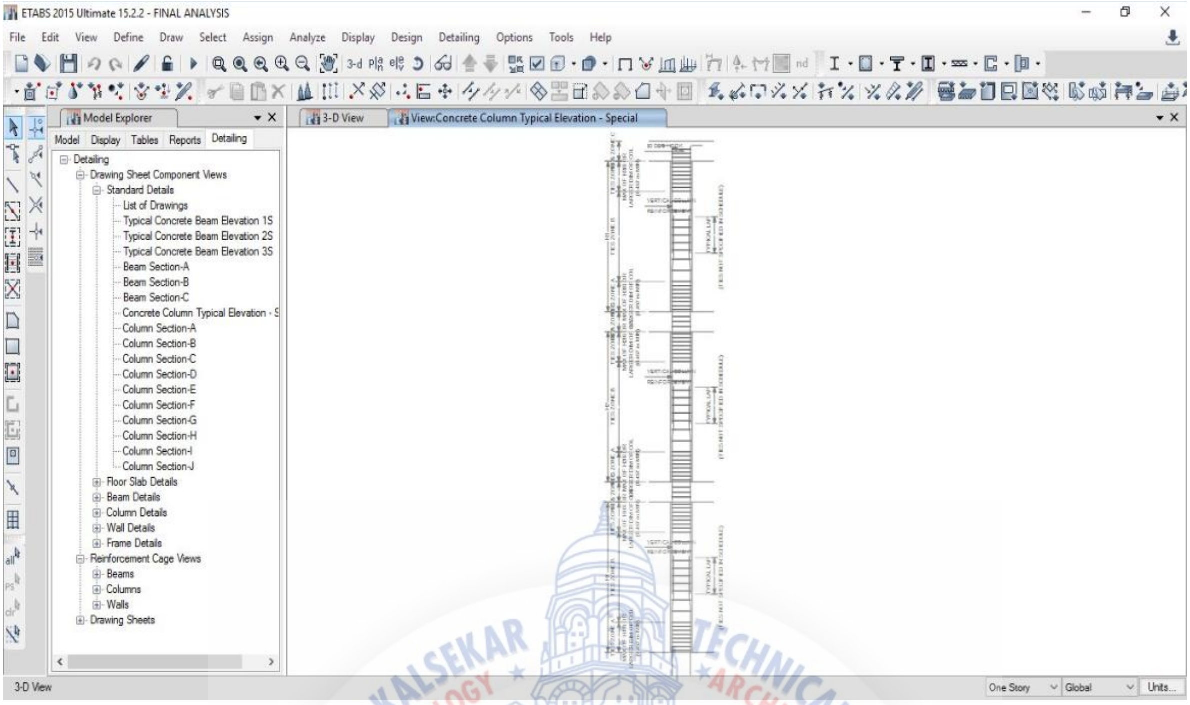


FIG.3.3.4

The above Figure shows the reinforcement details for Columns.

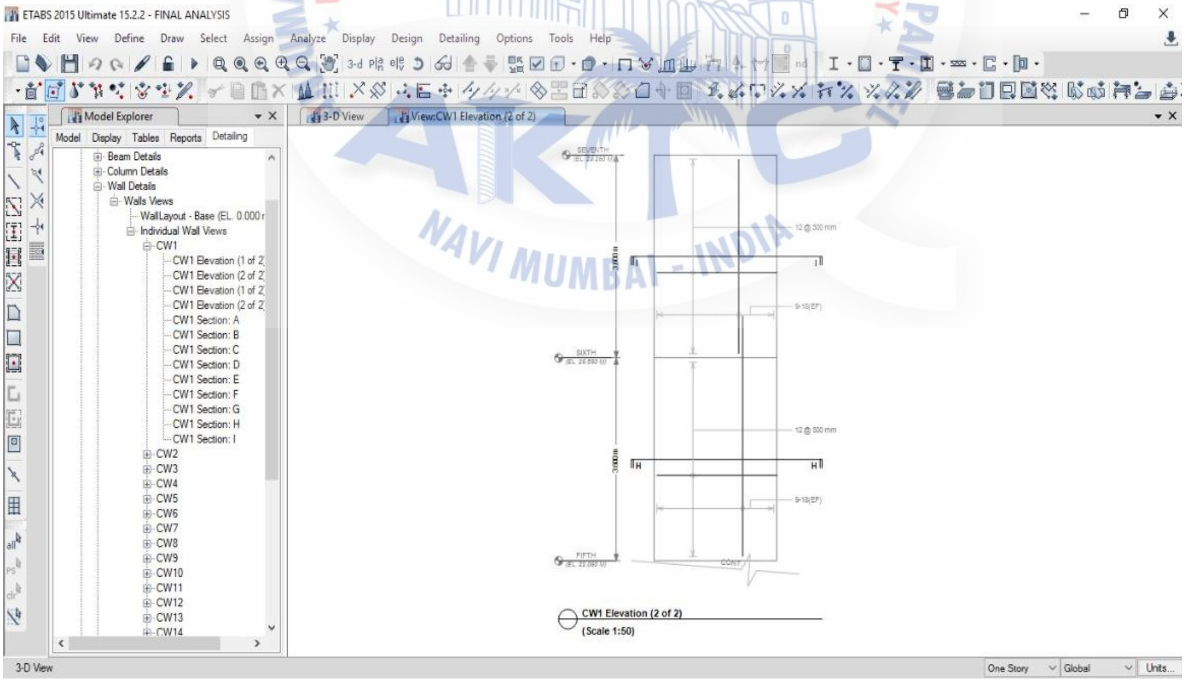


FIG.3.3.5

The above Figure shows the Spacing of main bars in Shear Walls.

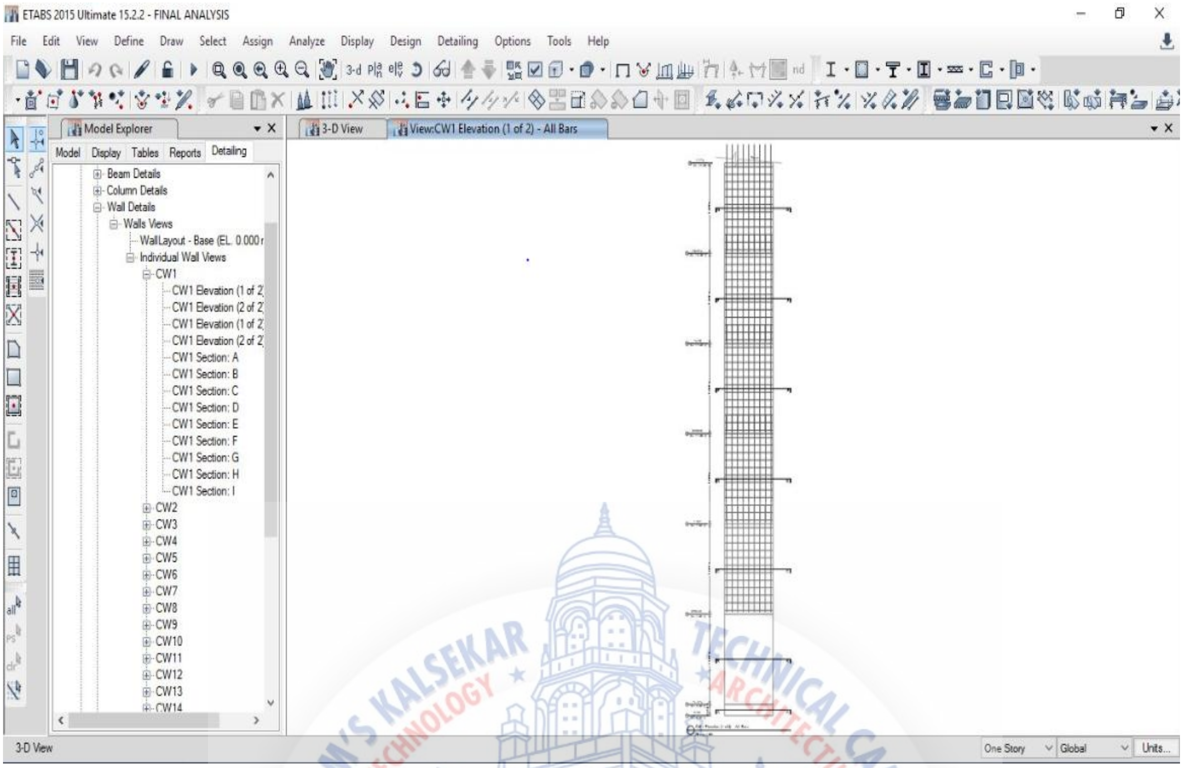


FIG.3.3.6

The Figure indicates the Elevation view of shear wall with reinforcement details.

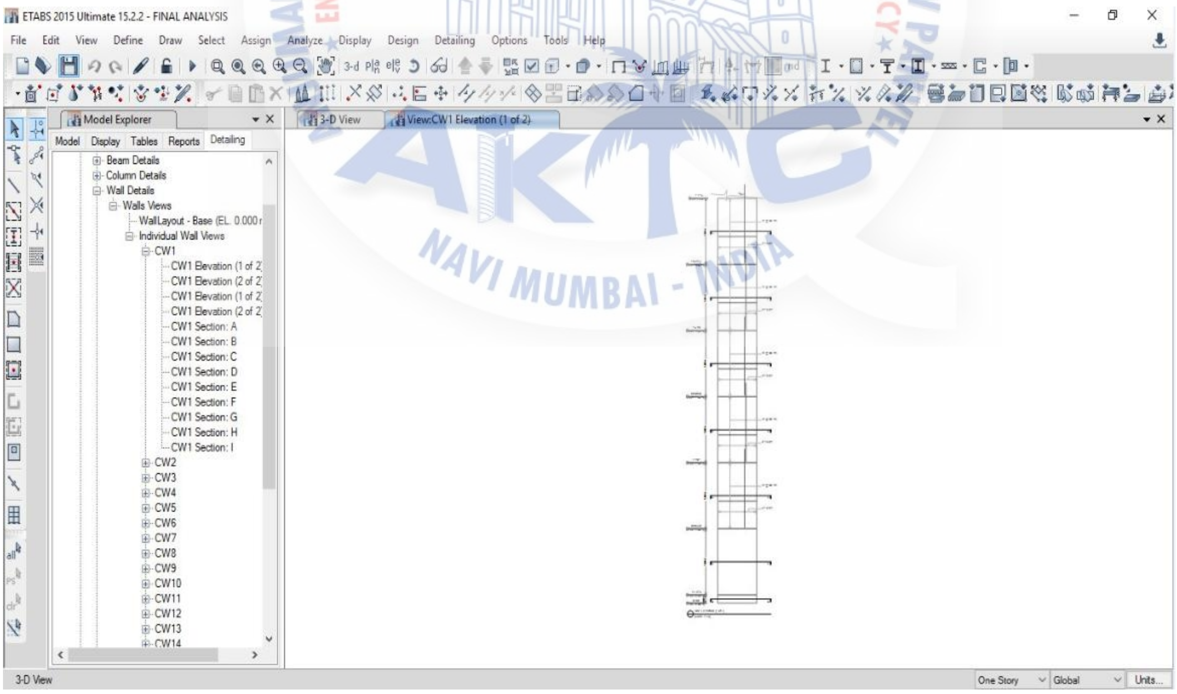


FIG.3.3.7

The above Figure shows the reinforced section of Shear Wall.

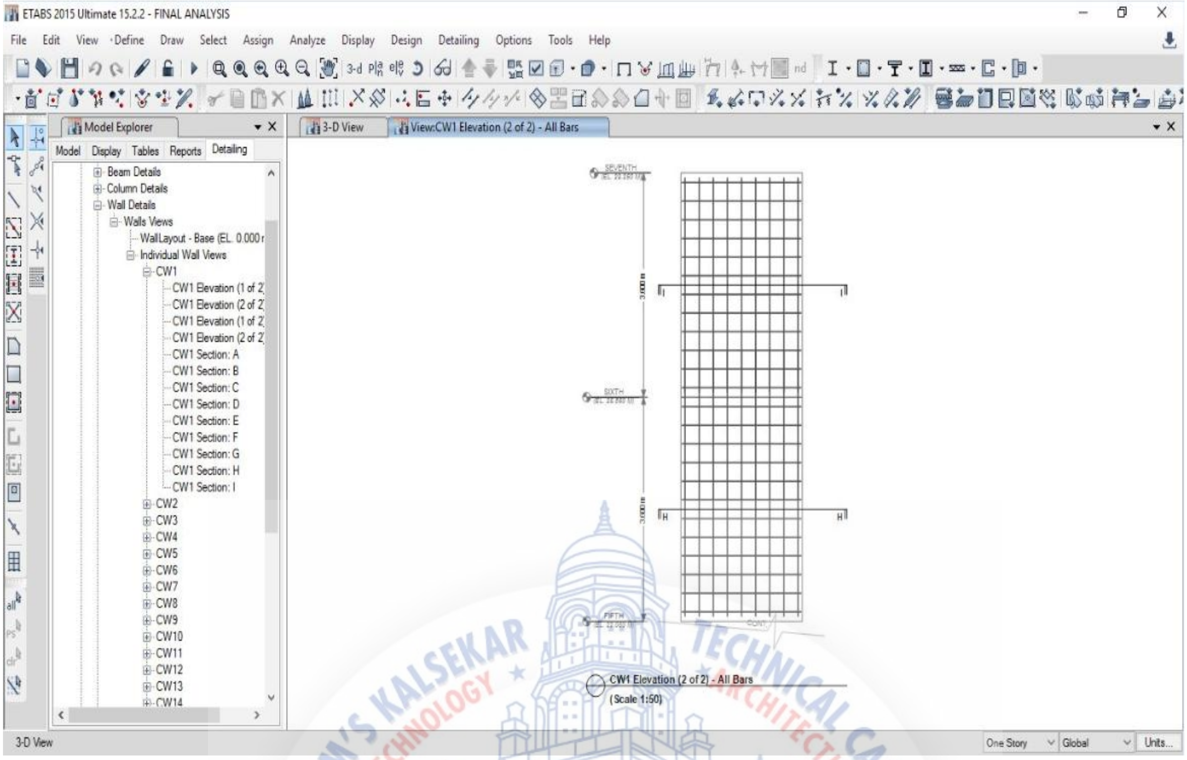


FIG.3.3.8

The above Figure shows the Meshing in Shear Wall.

3.4 DESIGNING OF SLAB AND FOOTING ON MICROSOFT EXCEL SPREADSHEET:

Since ETABS gives analysis and designing for beams and columns only, the analysis of slab and footing is done on Microsoft Excel Spreadsheet.

- **DESIGN OF SLAB:**

A. Design of slab S1:

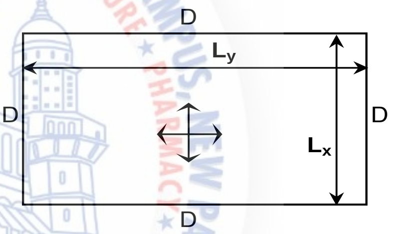
DESIGN OF SLAB AS PER IS-456 2000 | **s1**

Job No :- | **Date :-** 4/30/2017

Project :- | **Slab ID :** **s1**

Thickness of slab, D =	250	mm.		
Grade of concrete f_{ck} =	25	N/mm^2.		
Grade of Steel f_y =	415	N/mm^2.		
Clear cover =	20	mm.		
sunk in slab =	0	mm.		
diameter of short bar =	10	mm.		
diameter of long bar =	10	mm.		
Span & End Conditions for :				
short bar L_x =	3	m.	10	
long bar L_y =	9	m.	10	

self load	625	kg/m^2
live	300	kg/m^2
floor finish	100	kg/m^2
sunk load	0	kg/m^2
cobba	0	kg/m^2
TOTAL	**1025**	kg/m^2



(L_y/L_x) = 3.00

Aspect ratio α_y = 0.01

α_x = 0.99

SHORT BAR: *(To be provided along the shorter direction).*

Mux =	1.37	t-m.	
K =	0.27		*Section is singly reinforce.*
Pt =	0.12	%.	*Provide min reinf. of 0.12%. (cl.26.5.2.1), IS-456: 2000).*
Ast =	300	mm^2.	
Deflection δ =	0.33	mm.	*Safe in deflection.*
spacing require, s =	262	mm c\c.	*< 3d, hence ok. (cl.26.3.3.b(1), IS-456: 2000).*

provide 10 mm diameter bar @ 262 c\c.

LONG BAR: *(To be provided along the longer direction).*

Muy =	0.15	t-m.	
K =	0.03		*Section is singly reinforce.*
Pt =	0.12	%.	*Provide min reinf. of 0.12%. (cl.26.5.2.1, IS-456: 2000).*
Ast =	300	mm^2.	
Deflection δ =	0.37	mm.	*Safe in deflection.*
spacing require, s =	262	mm c\c.	*< 5d, Hence ok. (cl.26.3.3.b(2), IS-456: 2000)*

provide 10 mm diameter bar @ 262 c\c.

Summary			**Quantity**	*(approx.)*
	mm.	@		
Thickness.	250		6.75	cum.
short bar.	10	262	66.55	kg.
long bar.	10	262	72.10	kg.
sunk.	0		20.54	kg/cum.

VALID FOR	*(tick appropriate block).*
Tender.	
Approval.	
Execution.	

TABLE NO.3.4.1

B. Design of slab S2:

DESIGN OF SLAB AS PER IS-456 2000 | s2

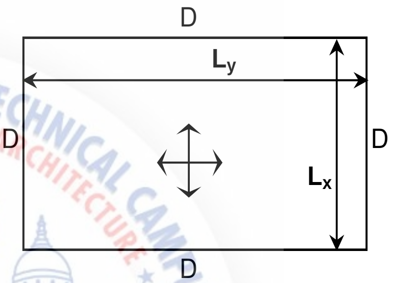
Job No :- **Date :-** 4/30/2017

Project :- **Slab ID :** s2

Thickness of slab, D =	200	mm.		**self load**	500	kg/m^2
Grade of concrete f_{ck} =	25	N/mm^2.		**live**	300	kg/m^2
Grade of Steel f_y =	415	N/mm^2.		**floor finish**	100	kg/m^2
Clear cover =	20	mm.		**sunk load**	0	kg/m^2
sunk in slab =	0	mm.		**cobba**	0	kg/m^2
diameter of short bar =	10	mm.		**TOTAL**	**900**	kg/m^2
diameter of long bar =	10	mm.				

Span & End Conditions for :

short bar	L_x =	3.7	m.	10
long bar	L_y =	8	m.	10



	(L_y/L_x) =	2.16
Aspect ratio	α_y =	0.04
	α_x =	0.96

SHORT BAR: *(To be provided along the shorter direction).*

Mux =	1.77	t-m.	
K =	0.58		*Section is singly reinforce.*
Pt =	0.16	%.	*> 0.12%, Hence ok. (cl.26.5.2.1, IS-456: 2000).*
Ast =	287.7	mm^2.	
Deflection δ =	1.26	mm.	*Safe in deflection.*
spacing require, s =	273	mm c\c.	*< 3d, hence ok. (cl.26.3.3.b(1), IS-456: 2000).*

provide 10 mm diameter bar @ 273 c\c.

LONG BAR: *(To be provided along the longer direction).*

Muy =	0.38	t-m.	
K =	0.14		*Section is singly reinforce.*
Pt =	0.12	%.	*Provide min reinf. of 0.12%. (cl.26.5.2.1, IS-456: 2000).*
Ast =	240	mm^2.	
Deflection δ =	1.41	mm.	*Safe in deflection.*
spacing require, s =	328	mm c\c.	*< 5d, Hence ok. (cl.26.3.3.b(2), IS-456: 2000)*

provide 10 mm diameter bar @ 328 c\c.

Summary			**Quantity**	*(approx.)*	**VALID FOR**	*(tick appropriate block).*
	mm.	@				
Thickness.	200		5.92	cum.	Tender.	
short bar.	10	273	70.68	kg.	Approval.	
long bar.	10	328	64.09	kg.	Execution.	
sunk.	0		22.76	kg/cum.		

TABLE NO.3.4.2

C. Design of slab S3:

DESIGN OF SLAB AS PER IS-456 2000 s3

Job No :- **Date :-** 4/30/2017

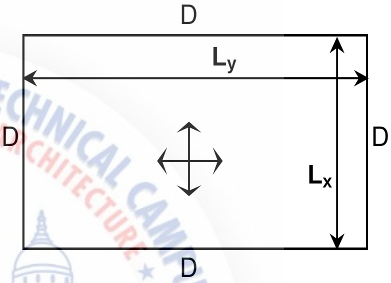
Project :- **Slab ID :** s3

Thickness of slab, D =	200	mm.
Grade of concrete f_{ck} =	25	N/mm^2.
Grade of Steel f_y =	415	N/mm^2.
Clear cover =	20	mm.
sunk in slab =	0	mm.
diameter of short bar =	10	mm.
diameter of long bar =	10	mm.

self load	500	kg/m^2
live	300	kg/m^2
floor finish	100	kg/m^2
sunk load	0	kg/m^2
cobba	0	kg/m^2
TOTAL	**900**	kg/m^2

Span & End Conditions for :

short bar	L_x =	5.36	m.	10
long bar	L_y =	8.15	m.	10



(L_y/L_x) = 1.52

Aspect ratio α_y = 0.16

α_x = 0.84

SHORT BAR: *(To be provided along the shorter direction).*

Mux =	3.27 t-m.		
K =	1.07	*Section is singly reinforce.*	
Pt =	0.31 %.	*> 0.12%, Hence ok.*	*(cl.26.5.2.1, IS-456: 2000).*
Ast =	545.6 mm^2.		
Deflection δ =	4.89 mm.	*Safe in deflection.*	
spacing require, s =	144 mm c\c.	*< 3d, hence ok.*	*(cl.26.3.3.b(1), IS-456: 2000).*

provide 10 mm diameter bar @ 144 c\c.

LONG BAR: *(To be provided along the longer direction).*

Muy =	1.41 t-m.		
K =	0.52	*Section is singly reinforce.*	
Pt =	0.15 %.	*> 0.12%, Hence ok.*	*(cl.26.5.2.1, IS-456: 2000).*
Ast =	243.29 mm^2.		
Deflection δ =	5.47 mm.	*Safe in deflection.*	
spacing require, s =	323 mm c\c.	*< 5d, Hence ok.*	*(cl.26.3.3.b(2), IS-456: 2000)*

provide 10 mm diameter bar @ 323 c\c.

Summary			**Quantity**	*(approx.)*	**VALID FOR**	*(tick appropriate block).*
	mm.	@				
Thickness.	200		8.74	cum.	Tender.	
short bar.	10	144	191.57	kg.	Approval.	
long bar.	10	323	90.40	kg.	Execution.	
sunk.	0		32.27	kg/cum.		

TABLE NO.3.4.3

A. The following is the design calculation for isolated footing of shear wall.

Isolated Footing

1 **Footing Size Design**

Load	Pu	2000 KN
Design Load	P	1467 KN
Moment in x dir	Mux	0 KN-m
Moment in y dir	Muy	10 KN-m
Column size	cx	2600 mm
	cy	300 mm
SBC	q	350 KN/sqm
Footing Size required	A req	4.19 sqmm
Footing Size Provided	L	3.00 meters
	B	1.80 meters
Area Provided	A prvd	5.40 meters
	Zx	1.62
	Zx	2.70
Net upward pressure	Nup	274 KNm2

Footing Size OK

2 **Slab Design**

	lx	0.200
	ly	0.750
Bending Moment in x dir	Mx	8 KN-m
Bending Moment in y dir	My	116 KN-m
Concrete	fck	20 MPa
Steel	fy	415 MPa
Minimum Depth Required	dmin	205
Depth Provided	D	**500 mm**
Clear Cover	c	50 mm
Effective Cover	d'	56 mm
Effective Depth	d'	444 mm

Area of Steel	Spacing c/c in mm		
	12#	16#	20#
533 sqmm	212 c/c	377 c/c	590 c/c
748 sqmm	151 c/c	269 c/c	420 c/c

Minimum Ast required across x direcion

Ast across x direction	**12 mm dia @ 200 mm c/c**	**565 sqmm**
Ast across y direction	**12 mm dia @ 150 mm c/c**	**754 sqmm**

width	1000 mm		
Mulim/bd^2	Mulim		
2.76	544 KN-m		
xumax/d	xumax	Rumax	Section Check
0.48	213	0.138	7.1
SRB			
a	0.7529		
b	-3.6105		
c	0.0417		
-p	0.0116		
Ast	51		
Min steel %	0.205		
Ast	51		
Min Steel	533		
Max Steel	17760		
Ast	533		
Pt provided	0.1200		
β	19.352		
ks trial	0.61538462		
ks	0.61538462		

width	1000 mm		
Mulim/bd^2	Mulim		
2.76	544 KN-m		
xumax/d	xumax	Rumax	Section Check
0.48	213	0.138	7.1
SRB			
a	0.7529		
b	-3.6105		
c	0.5865		
-p	0.1684		
Ast	748		
Min steel %	0.205		
Ast	748		
Min Steel	533		
Max Steel	17760		
Ast	748		
Pt provided	0.1684		
β	13.793		
ks trial	0.61538462		
ks	0.61538462		

3	**One Way Shear along x direction**		
		Vu1	-181 KN
		ζv	-0.226 MPa
		ζc	0.260 MPa
		Vc1	208 KN
		One Way Shear Check OK	
4	**One Way Shear along y direction**		
		Vu1	377 KN
		ζv	0.283 MPa
		ζc	0.303 MPa
		Vc1	403 KN
		One Way Shear Check OK	
5	**Two Way Shear**		
		Vu2	1289 KN
		ζv	0.383 MPa
		ks*ζc	0.688 MPa
		Vc1	2314 KN
		Two Way Shear Check OK	

TABLE NO.3.4.4

B. There are 3 types of columns dealing with different loadings i.e. 3000KN, 4000KN and 5000KN (approximately). So we have designed 3 different columns individually. The calculations are shown below.

a) FOR 3000KN LOAD:

Isolated Footing

1 **Footing Size Design**

Load	Pu	3000 KN
Design Load	P	2200 KN
Moment in x dir	Mux	30 KN-m
Moment in y dir	Muy	30 KN-m
Column size	cx	1000 mm
	cy	300 mm
SBC	q	350 KN/sqm
Footing Size required	A req	6.29 sqmm
Footing Size Provided	L	**2.80 meters**
	B	**2.40 meters**
Area Provided	A prvd	6.72 meters
	Zx	2.69
	Zx	3.14
Net upward pressure	Nup	341 KNm2

Footing Size OK

2 **Slab Design**

	lx	0.900
	ly	1.050
Bending Moment in x dir	Mx	207 KN-m
Bending Moment in y dir	My	282 KN-m
Concrete	fck	30 MPa
Steel	fy	500 MPa
Minimum Depth Required	dmin	266
Depth Provided	D	**750 mm**
Clear Cover	c	50 mm
Effective Cover	d'	58 mm
Effective Depth	d'	692 mm

Area of Steel	Spacing c/c in mm		
	12#	16#	20#
830 sqmm	136 c/c	242 c/c	378 c/c
960 sqmm	118 c/c	210 c/c	327 c/c

Minimum Ast required across x direcion

Ast across x direction	**16 mm dia @ 230 mm c/c**	**874 sqmm**
Ast across y direction	**16 mm dia @ 200 mm c/c**	**1005 sqmm**

width	1000 mm		
$Mulim/bd^2$	Mulim		
3.99	1911 KN-m		
xumax/d	xumax	Rumax	Section Check
0.46	316	0.133	8.3
SRB			
a	0.7286		
b	-4.3500		
c	0.4329		
-p	0.1012		
Ast	700		
Min steel %	0.170		
Ast	700		
Min Steel	830		
Max Steel	27680		
Ast	830		
Pt provided	0.1200		
β	29.028		
ks trial	0.8		
ks	0.8		

width	1000 mm		
$Mulim/bd^2$	Mulim		
3.99	1911 KN-m		
xumax/d	xumax	Rumax	Section Check
0.46	316	0.133	8.3
SRB			
a	0.7286		
b	-4.3500		
c	0.5892		
-p	0.1387		
Ast	960		
Min steel %	0.170		
Ast	960		
Min Steel	830		
Max Steel	27680		
Ast	960		
Pt provided	0.1387		
β	25.121		
ks trial	0.8		
ks	0.8		

3 **One Way Shear along x direction**

Vu1	255 KN
ζv	0.154 MPa
ζc	0.265 MPa
Vc1	440 KN

One Way Shear Check OK

4 **One Way Shear along y direction**

Vu1	513 KN
ζv	0.265 MPa
ζc	0.283 MPa
Vc1	549 KN

One Way Shear Check OK

5 **Two Way Shear**

Vu2	2580 KN
ζv	0.695 MPa
ks*ζc	1.095 MPa
Vc1	4069 KN

Two Way Shear Check OK

TABLE NO.3.4.5

b) FOR 4000KN LOAD:

Isolated Footing

1 Footing Size Design

Load	Pu	4000 KN
Design Load	P	2933 KN
Moment in x dir	Mux	30 KN-m
Moment in y dir	Muy	30 KN-m
Column size	cx	1000 mm
	cy	300 mm
SBC	q	350 KN/sqm
Footing Size required	A req	8.38 sqmm
Footing Size Provided	L	3.00 meters
	B	2.90 meters
Area Provided	A prvd	8.70 meters
	Zx	4.21
	Zx	4.35
Net upward pressure	Nup	347 KNm2

Footing Size OK

2 **Slab Design**

	lx	1.000
	ly	1.300
Bending Moment in x dir	Mx	260 KN-m
Bending Moment in y dir	My	439 KN-m
Concrete	fck	30 MPa
Steel	fy	500 MPa
Minimum Depth Required	dmin	332
Depth Provided	D	900 mm
Clear Cover	c	50 mm
Effective Cover	d'	58 mm
Effective Depth	d'	842 mm

Area of Steel	Spacing c/c in mm		
	12#	16#	20#
1010 sqmm	112 c/c	199 c/c	311 c/c
1229 sqmm	92 c/c	164 c/c	256 c/c

Minimum Ast required across x direcion

Ast across x direction	16 mm dia @ 190 mm c/c	1058 sqmm
Ast across y direction	16 mm dia @ 160 mm c/c	1257 sqmm

width	1000 mm		
Mulim/bd^2	Mulim		
3.99	2829 KN-m		
xumax/d	xumax	Rumax	Section Check
0.46	384	0.133	8.3
SRB			
a	0.7286		
b	-4.3500		
c	0.3666		
-p	0.0855		
Ast	720		
Min steel %	0.170		
Ast	720		
Min Steel	1010		
Max Steel	33680		
Ast	1010		
Pt provided	0.1200		
β	29.028		
ks trial	0.8		
ks	0.8		

width	1000 mm		
Mulim/bd^2	Mulim		
3.99	2829 KN-m		
xumax/d	xumax	Rumax	Section Check
0.46	384	0.133	8.3
SRB			
a	0.7286		
b	-4.3500		
c	0.6195		
-p	0.1460		
Ast	1229		
Min steel %	0.170		
Ast	1229		
Min Steel	1010		
Max Steel	33680		
Ast	1229		
Pt provided	0.1460		
β	23.860		
ks trial	0.8		
ks	0.8		

3 One Way Shear along x direction

Vu1	238 KN
ζv	0.098 MPa
ζc	0.265 MPa
Vc1	647 KN

One Way Shear Check OK

4 One Way Shear along y direction

Vu1	714 KN
ζv	0.283 MPa
ζc	0.290 MPa
Vc1	732 KN

One Way Shear Check OK

5 Two Way Shear

Vu2	3429 KN
ζv	0.682 MPa
ks*ζc	1.095 MPa
Vc1	5505 KN

Two Way Shear Check OK

TABLE NO.3.4.6.

c) FOR 5000KN LOAD:

Isolated Footing

1 **Footing Size Design**

Load	Pu	5000 KN
Design Load	P	3667 KN
Moment in x dir	Mux	30 KN-m
Moment in y dir	Muy	30 KN-m
Column size	cx	1000 mm
	cy	300 mm
SBC	q	350 KN/sqm
Footing Size required	A req	10.48 sqmm
Footing Size Provided	L	3.50 meters
	B	3.20 meters
Area Provided	A prvd	11.20 meters
	Zx	5.97
	Zx	6.53
Net upward pressure	Nup	334 KNm2

Footing Size OK

2 **Slab Design**

	lx	1.250
	ly	1.450
Bending Moment in x dir	Mx	391 KN-m
Bending Moment in y dir	My	526 KN-m
Concrete	fck	30 MPa
Steel	fy	500 MPa
Minimum Depth Required	dmin	364
Depth Provided	D	**1000 mm**
Clear Cover	c	50 mm
Effective Cover	d'	58 mm
Effective Depth	d'	942 mm

Area of Steel	Spacing c/c in mm		
	12#	16#	20#
1130 sqmm	100 c/c	178 c/c	278 c/c
1315 sqmm	86 c/c	153 c/c	239 c/c

Minimum Ast required across x direcion

Ast across x direction	**16 mm dia @ 170 mm c/c**	**1183 sqmm**
Ast across y direction	**16 mm dia @ 150 mm c/c**	**1340 sqmm**

width	1000 mm		
Mulim/bd^2	Mulim		
3.99	3541 KN-m		
xumax/d	xumax	Rumax	Section Check
0.46	430	0.133	8.3
SRB			
a	0.7286		
b	-4.3500		
c	0.4408		
-p	0.1031		
Ast	971		
Min steel %	0.170		
Ast	971		
Min Steel	1130		
Max Steel	37680		
Ast	1130		
Pt provided	0.1200		
β	29.028		
ks trial	0.8		
ks	0.8		

width	1000 mm		
Mulim/bd^2	Mulim		
3.99	3541 KN-m		
xumax/d	xumax	Rumax	Section Check
0.46	430	0.133	8.3
SRB			
a	0.7286		
b	-4.3500		
c	0.5932		
-p	0.1396		
Ast	1315		
Min steel %	0.170		
Ast	1315		
Min Steel	1130		
Max Steel	37680		
Ast	1315		
Pt provided	0.1396		
β	24.948		
ks trial	0.8		
ks	0.8		

3 **One Way Shear along x direction**

Vu1	493 KN
ζv	0.164 MPa
ζc	0.265 MPa
Vc1	799 KN

One Way Shear Check OK

4 **One Way Shear along y direction**

Vu1	890 KN
ζv	0.270 MPa
ζc	0.284 MPa
Vc1	937 KN

One Way Shear Check OK

5 **Two Way Shear**

Vu2	4400 KN
ζv	0.734 MPa
ks*ζc	1.095 MPa
Vc1	6571 KN

Two Way Shear Check OK

TABLE NO.3.4.7.

3.5 MODELLING

This project demonstrates how to create and manage more complex projects and draw model using Autodesk Revit software as the base layer. The group focuses on the modeling of civil and building engineering structures, both linear and non-linear. In modeling the quantity of material will be estimated and the 3-Dimensional view will be displayed. Revit is a single software application that supports a BIM (Building Information Modelling) work flow from concept to construction. Use Revit to model designs with precision, optimize performance and collaborate more effectively.

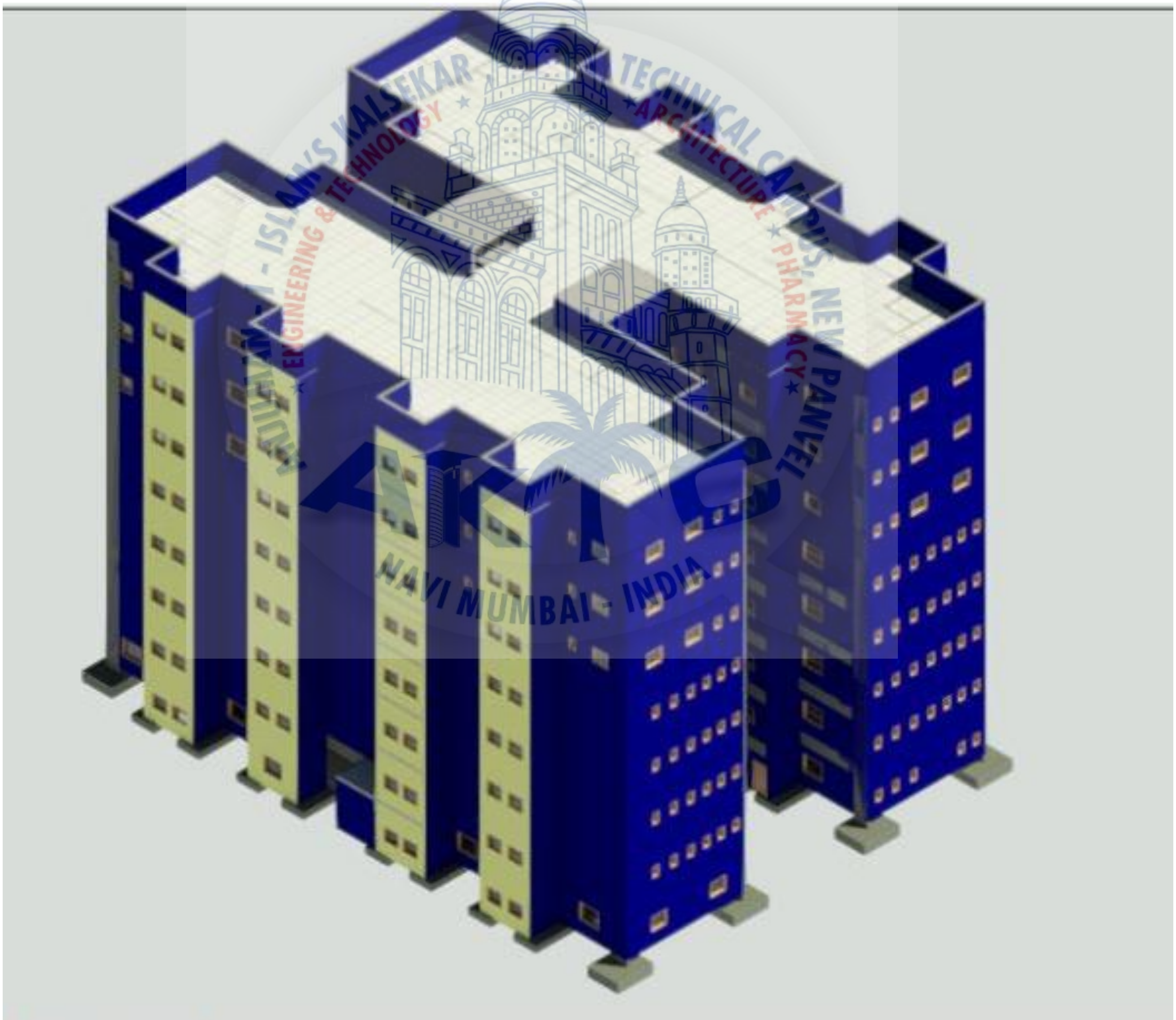


FIG.3.5

The step by step procedure for modelling in Autodesk Revit is mentioned below:

1. Importing the AutoCAD plans for ground, 1st & 5th floor.
2. Defining levels: Levels are defined from plinth level to 7th floor.
3. Editing walls beams and columns: dimensions for different walls beams and columns are duplicated as per schedule obtained from ETABS analysis.
4. Modelling of ground floor: Beams, columns and walls which are required on ground floor as per the AutoCAD drawing is placed.(Refer Fig.3.3.1 and 3.3.2)
   - In Canteen, dining tables & cooking utensils are provided for students and canteen staff respectively.
   - Indoor games room consist of all modern gaming facilities including snooker, carrom board, chess, table tennis, etc.
   - Gymnasium is equipped with all advance and reputed workout equipment.
   - Library & Digital Library are loaded with all the required study materials.
   - Warden Office and Reception is provided at necessary location.

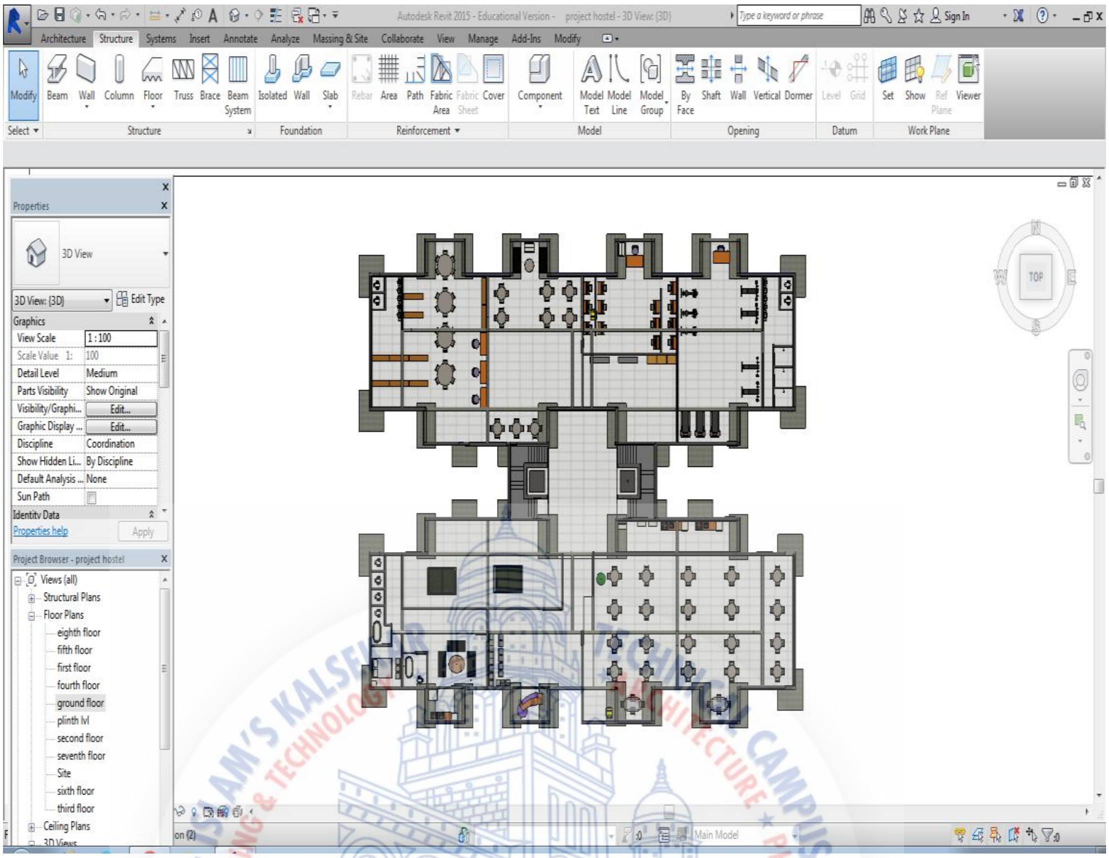


FIG.3.5.1

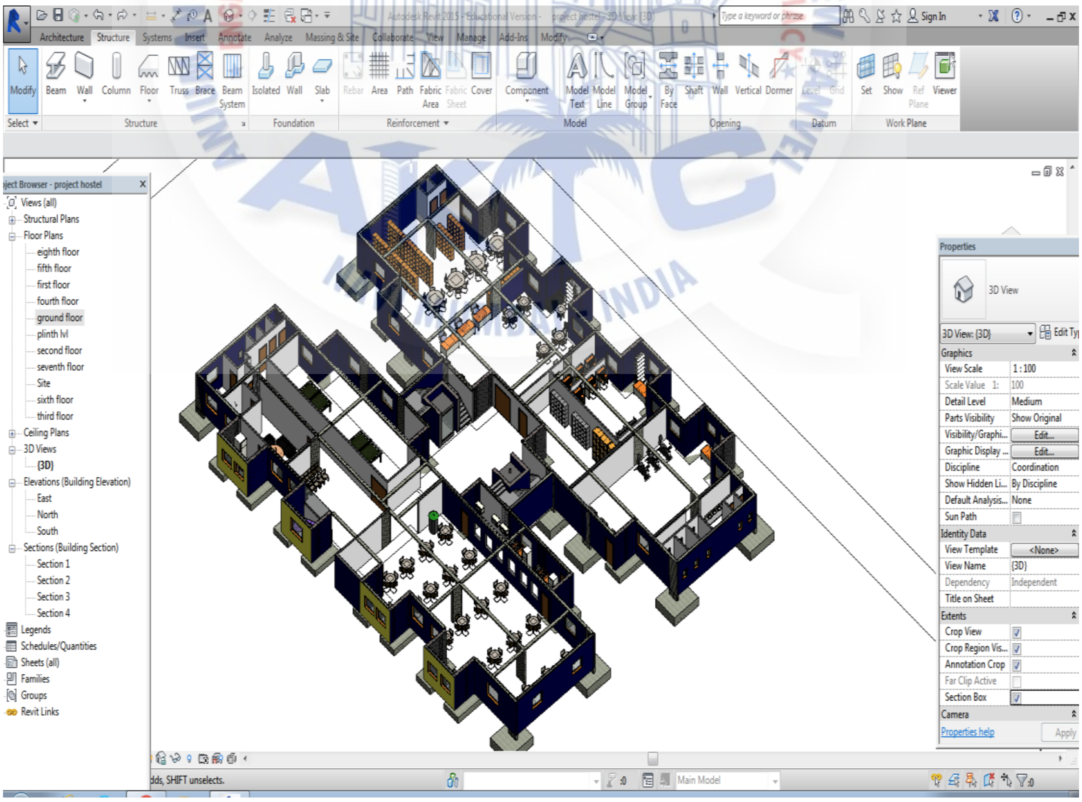


FIG.3.5.2

5. Modelling of 1st floor: This floor is being modelled as per the comfort of the students. Floors 2nd, 3rd & 4th are replica of 1st Floor. (Refer Fig 3.3.3 and 3.3.4)

- Each room consist of 4 Double-Bed for 8 students.
- A common study is provided with chairs and tables.
- Book Shelves, Cupboards and Study table is provided in each room.

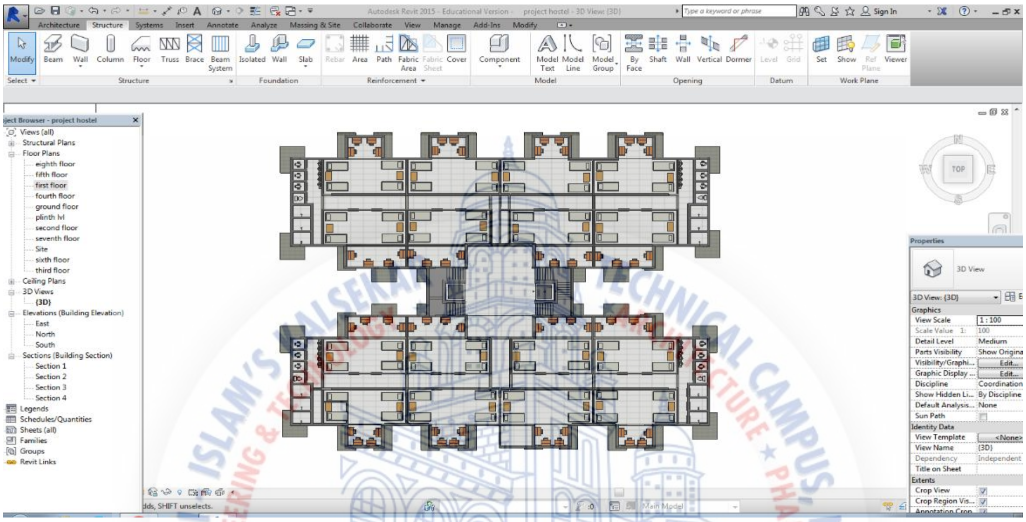


FIG.3.5.3

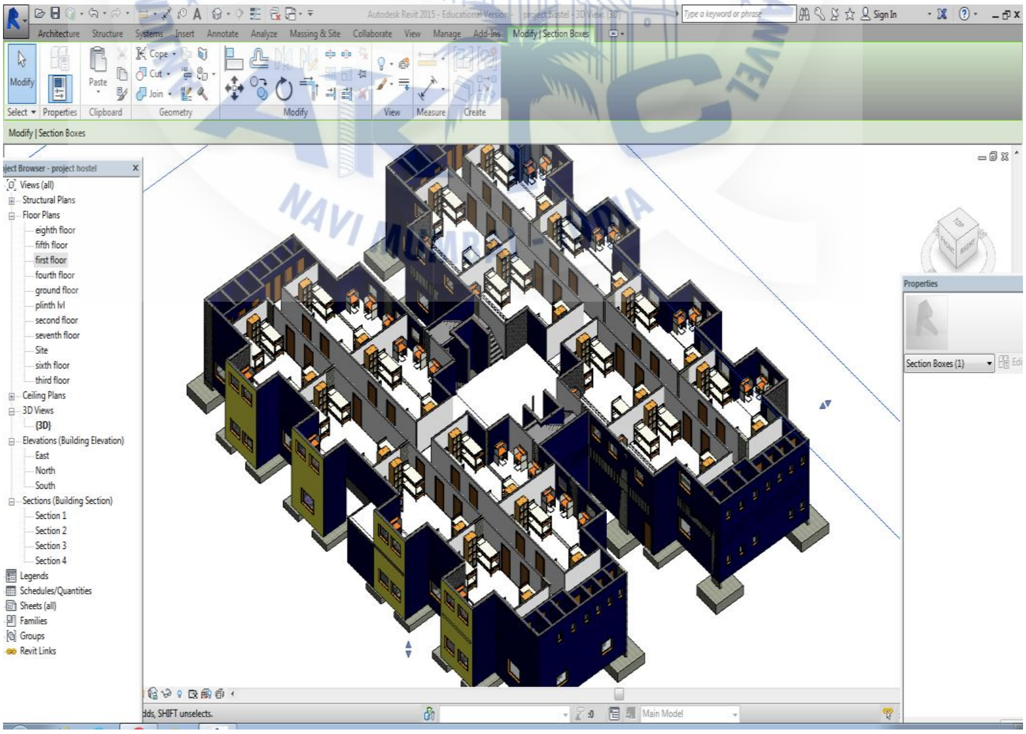


FIG.3.5.4

6. Modelling of 5th floor: This floor is modelled for staff members of college. 6th and 7th floors are replica of 5th floor. (Refer Fig 3.3.5 and 3.3.6)

   - The rooms on this floor are modelled for staff teachers to be residing with their families.
   - There are 8 rooms on each floor with 6 1BHK rooms and 2 1RK rooms.
   - Each Living Room is equipped with 2 Sofas and a center table.
   - Kitchen is provided in each room with latest amenities

.

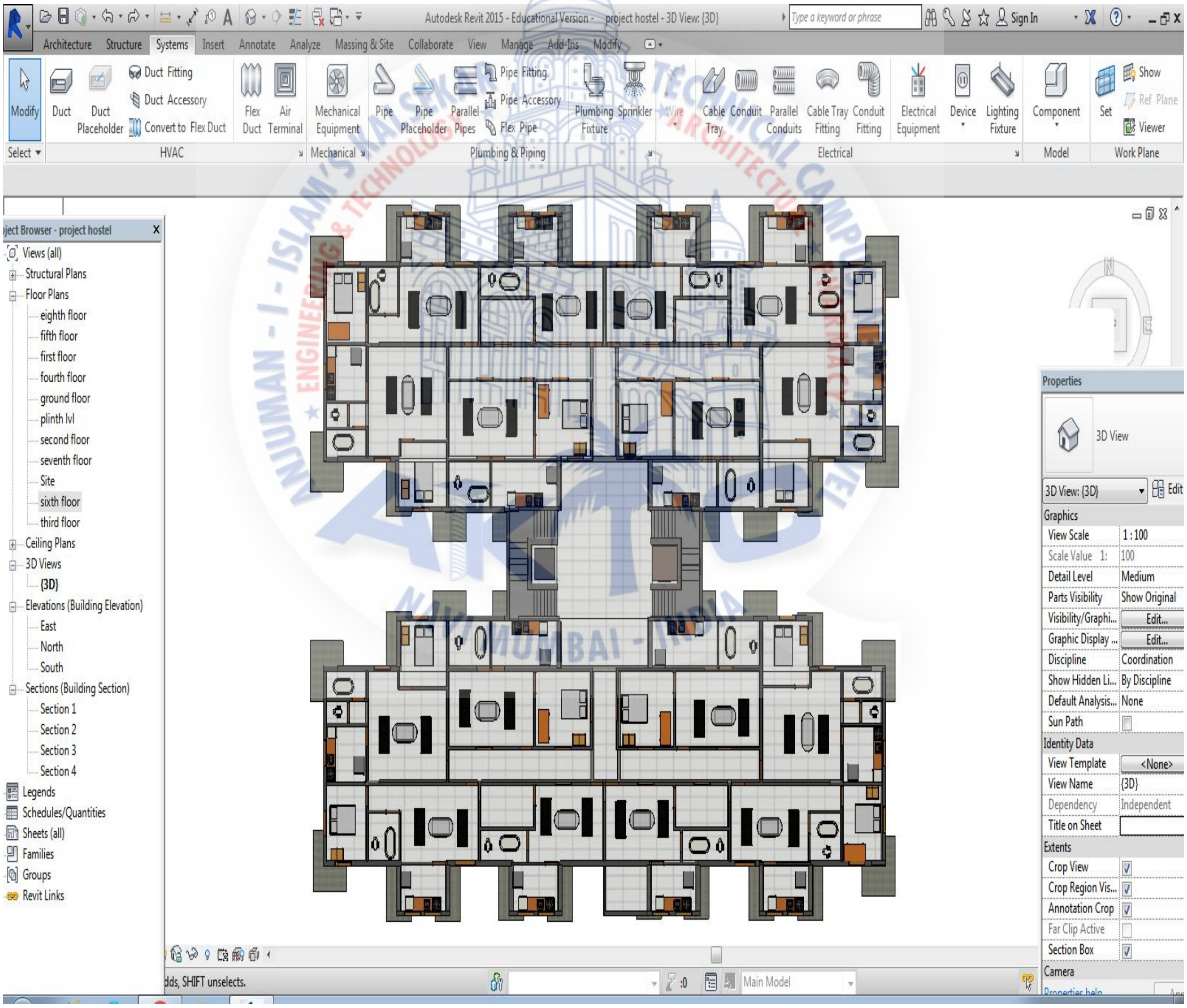


FIG.3.5.5

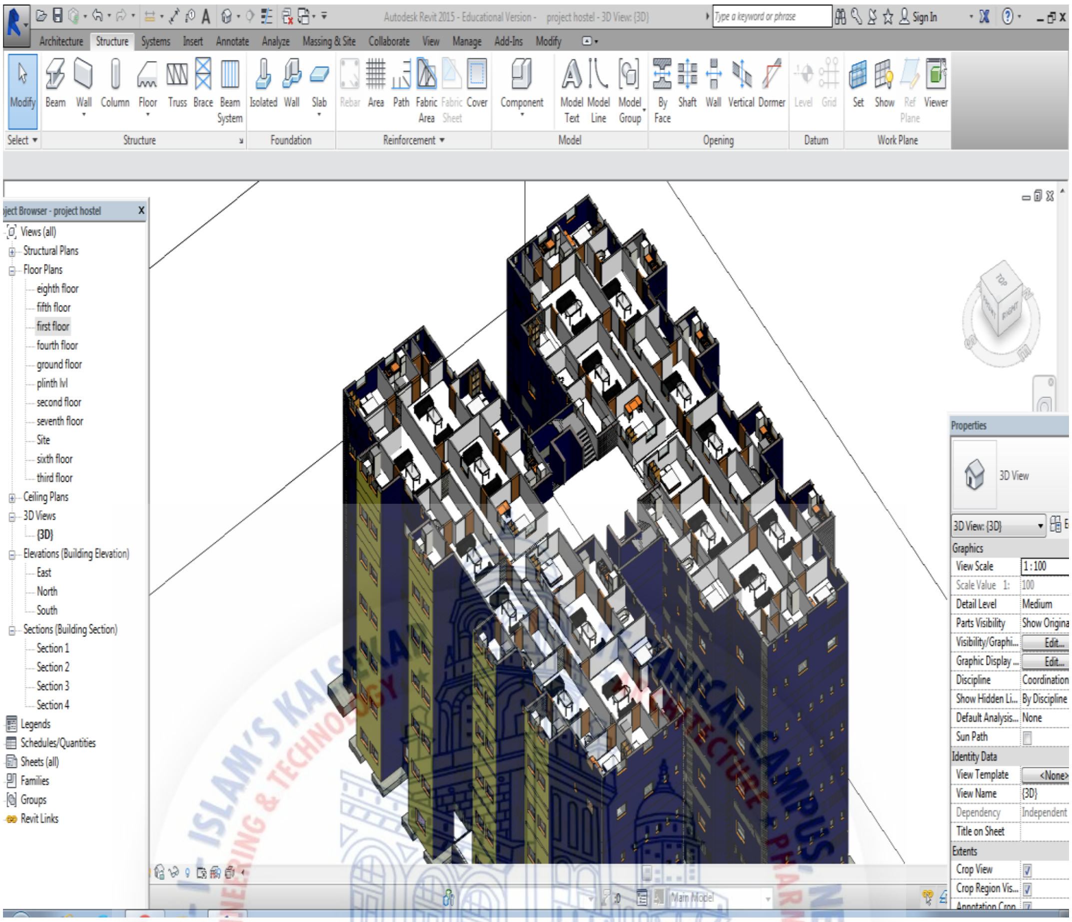


FIG.3.5.6

7. Placement of members: walls, beams and columns are placed on respective floors as per AutoCAD drawing.

3.6 QUANTITY ESTIMATION

Estimation of the quantities of materials is generated using Autodesk Revit software

Estimation is generated automatically in this software. We have estimated the quantity of steel and concrete in structural beams, columns and footing for the whole structure.

This is done by selecting “View” option. Then go in “Scheduling” on the “Task Bar”.

Then we sort the table columns by Family Type, Count, Volume and Estimated Rebar Volume as shown in Figure below. (Refer Fig.3.4.1)

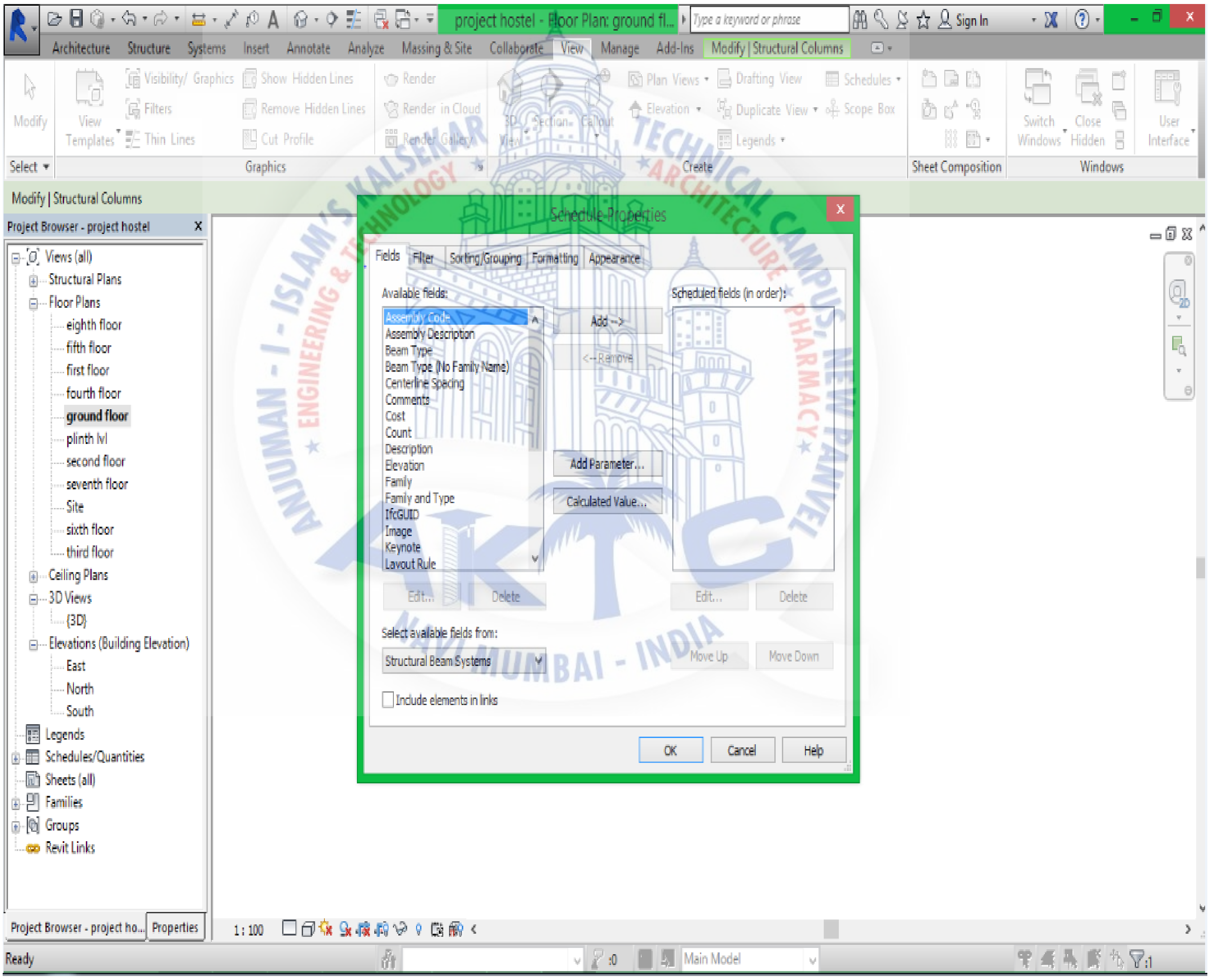


FIG.3.6.1

CHAPTER 4

4.0 RESULT AND DISCUSSION:

4.1. ETABS:

After the detailed analysis of structure, the following results is obtained which shows the area of steel required in respective structural members (beams, columns, shear walls). Along with the steel area, the bending moment details, shear force details and deflections in each beam is also obtained in a systematic manner. All these details are obtained in an auto-generated ".docx" file which is generated automatically by ETABS software while we work on the structure. Necessary snapshots are provided below.

Following are some of the cross-sections and longitudinal sections from the structure along with the reinforcement details:

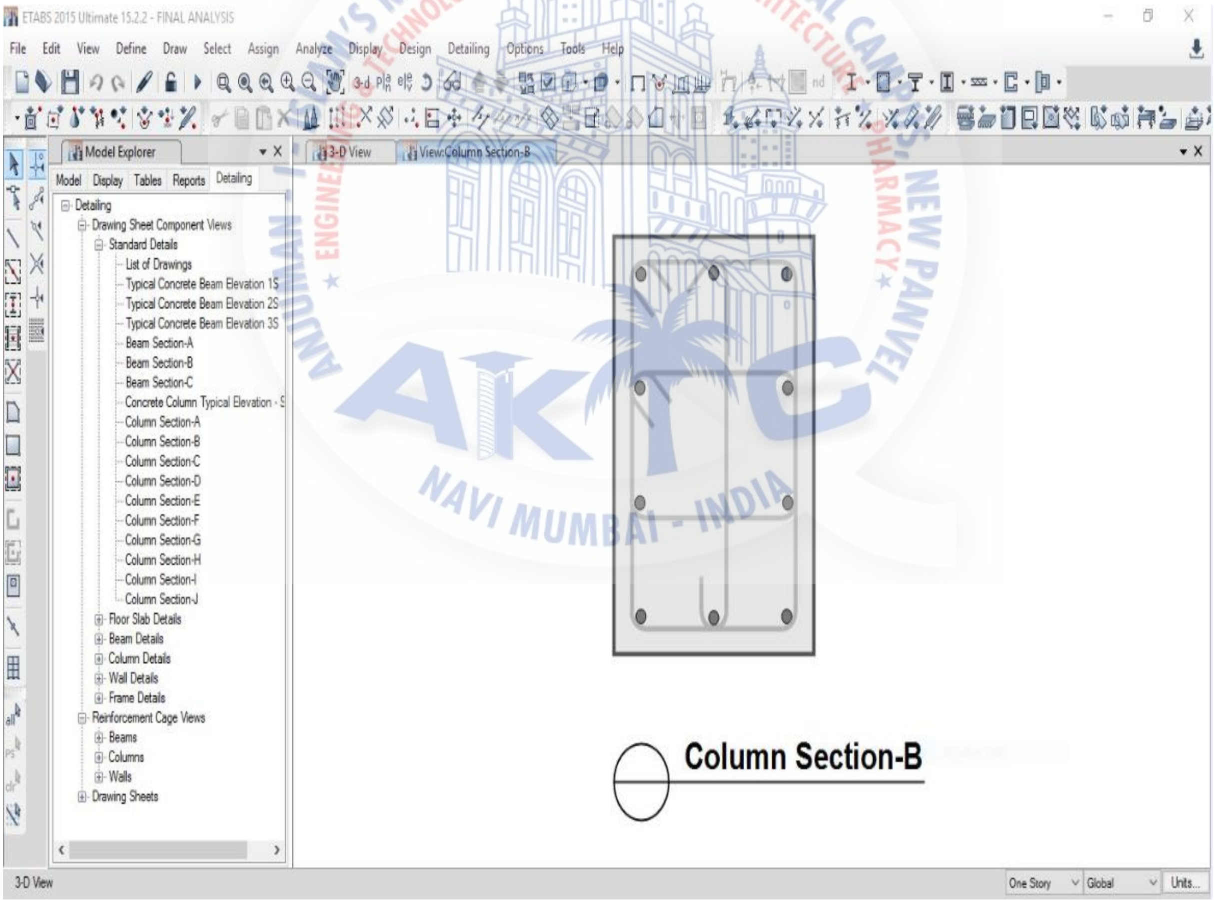


FIG.4.1.1

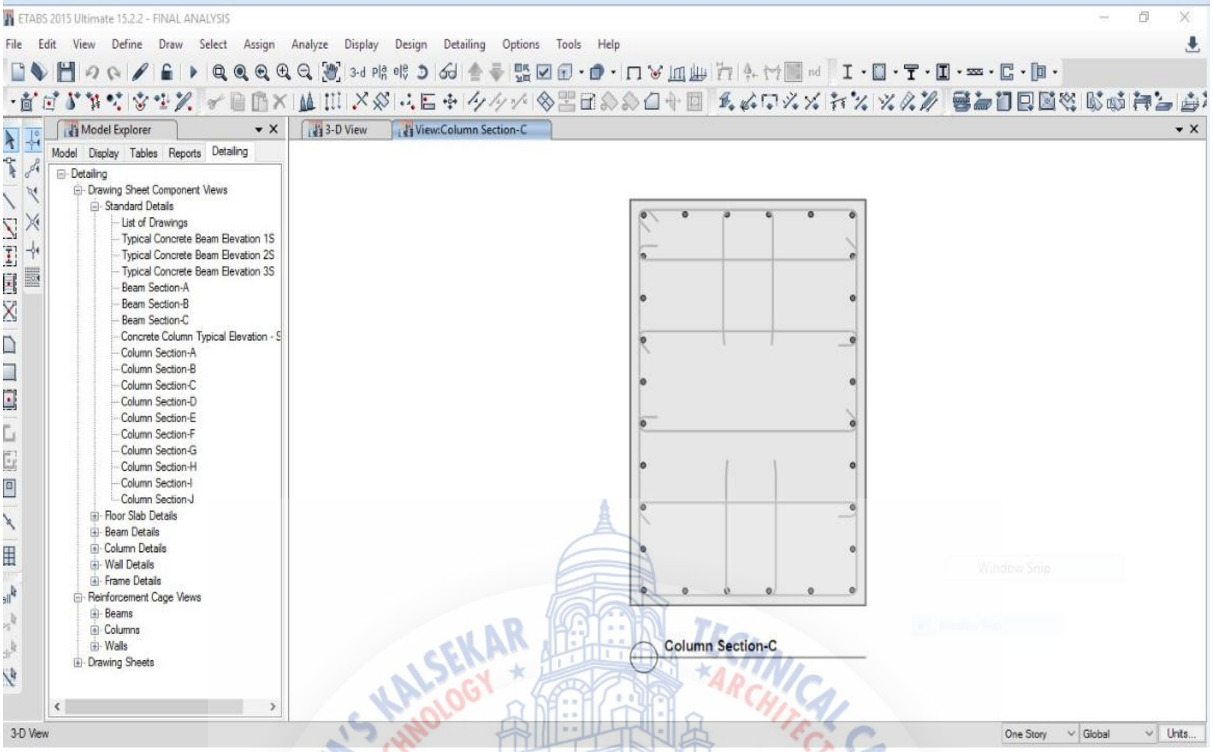


FIG.4.1.2

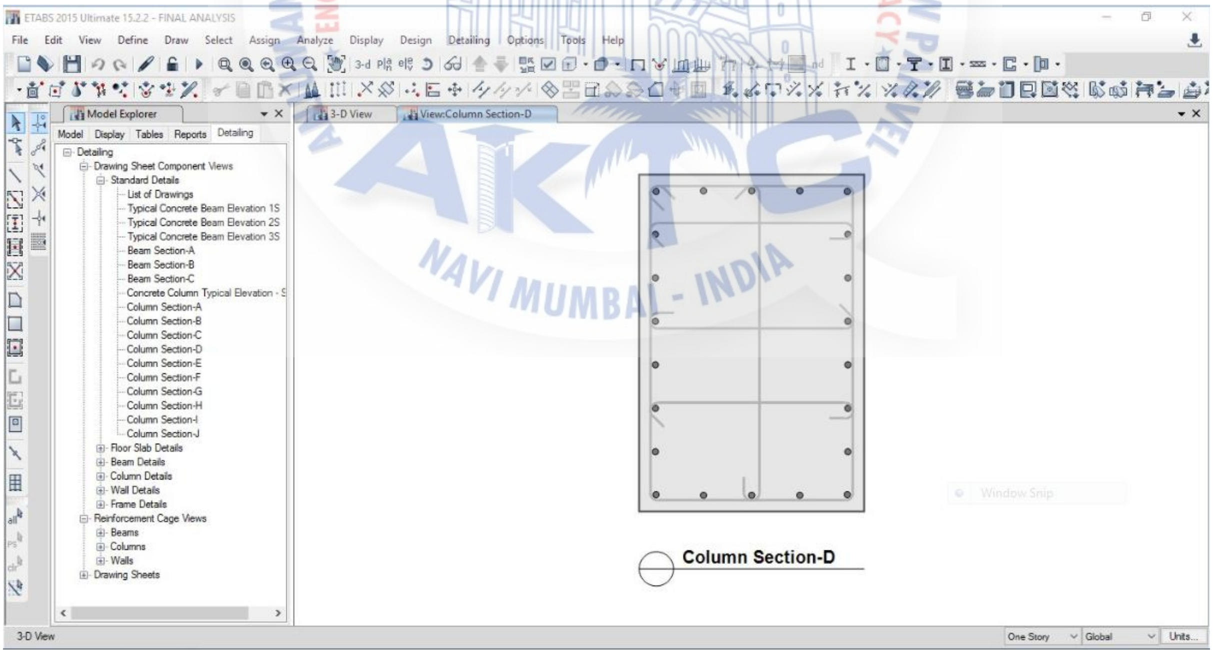


FIG.4.1.3

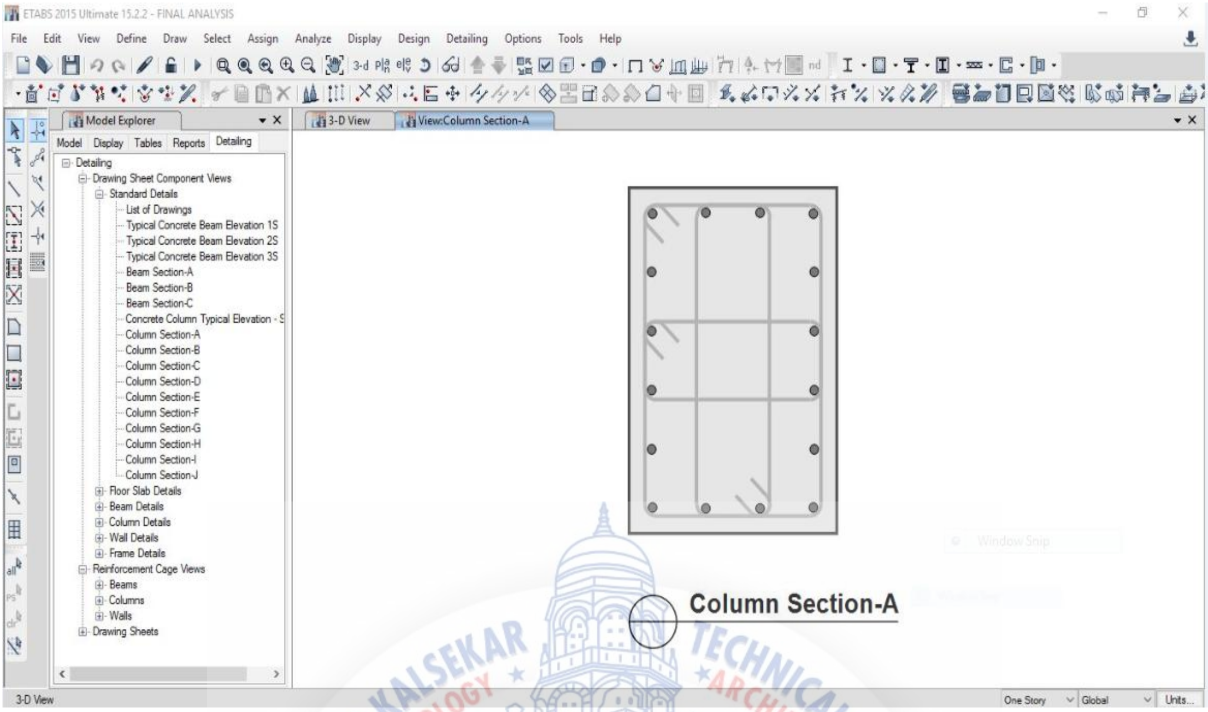


FIG.4.1.4

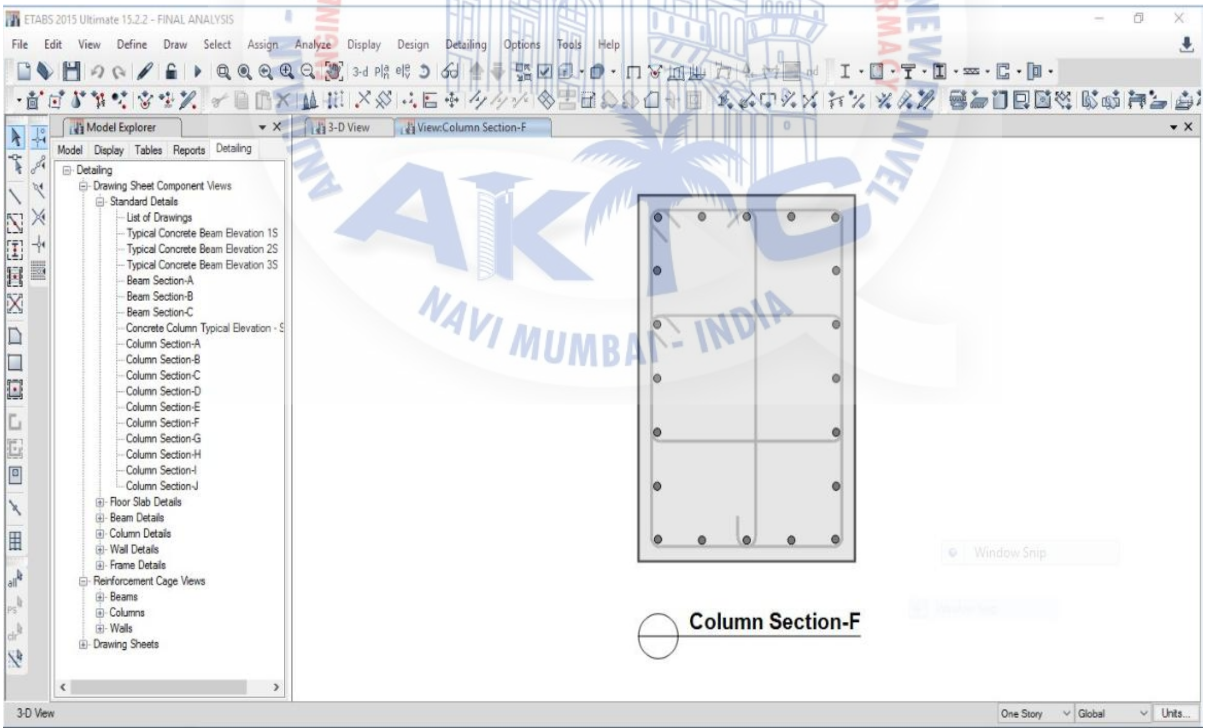


FIG.4.1.5

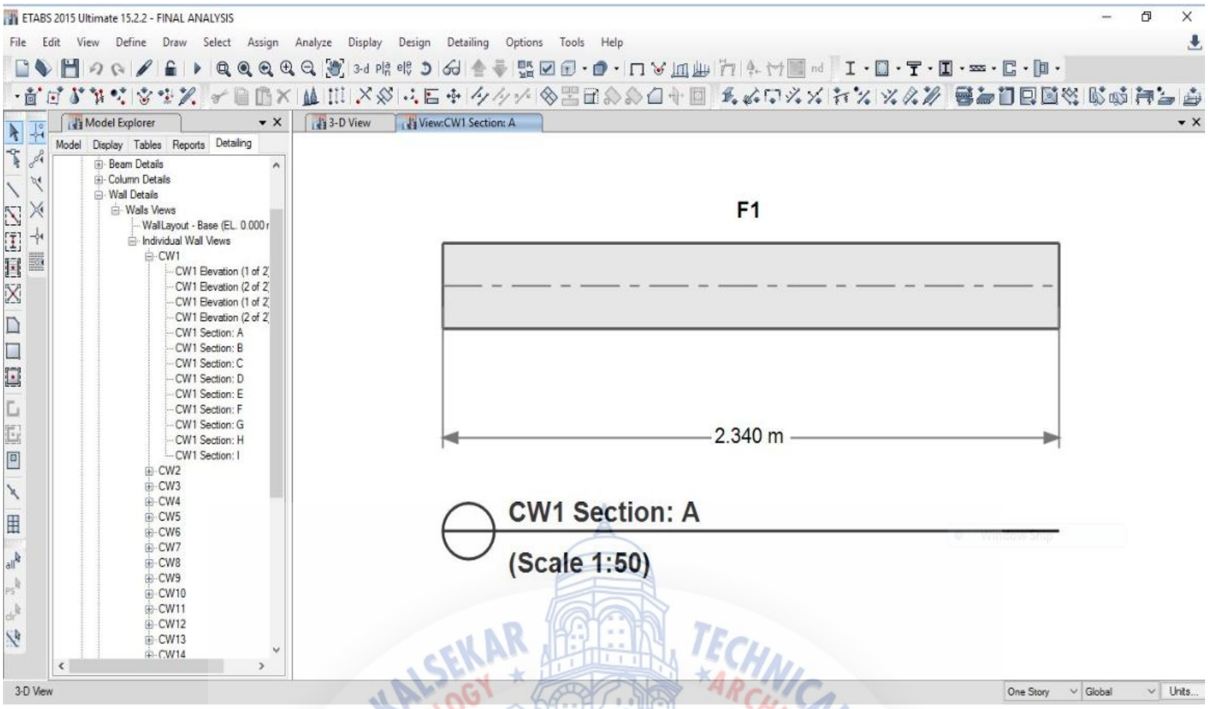


FIG.4.1.6

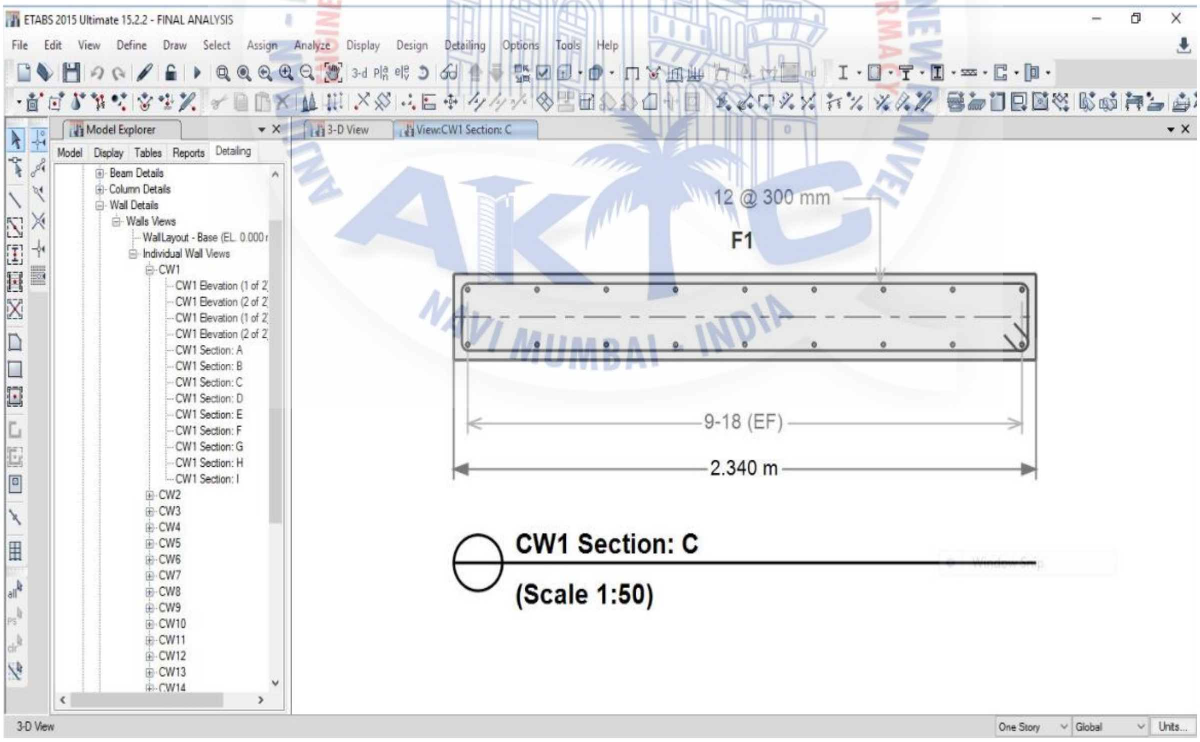


FIG.4.1.7

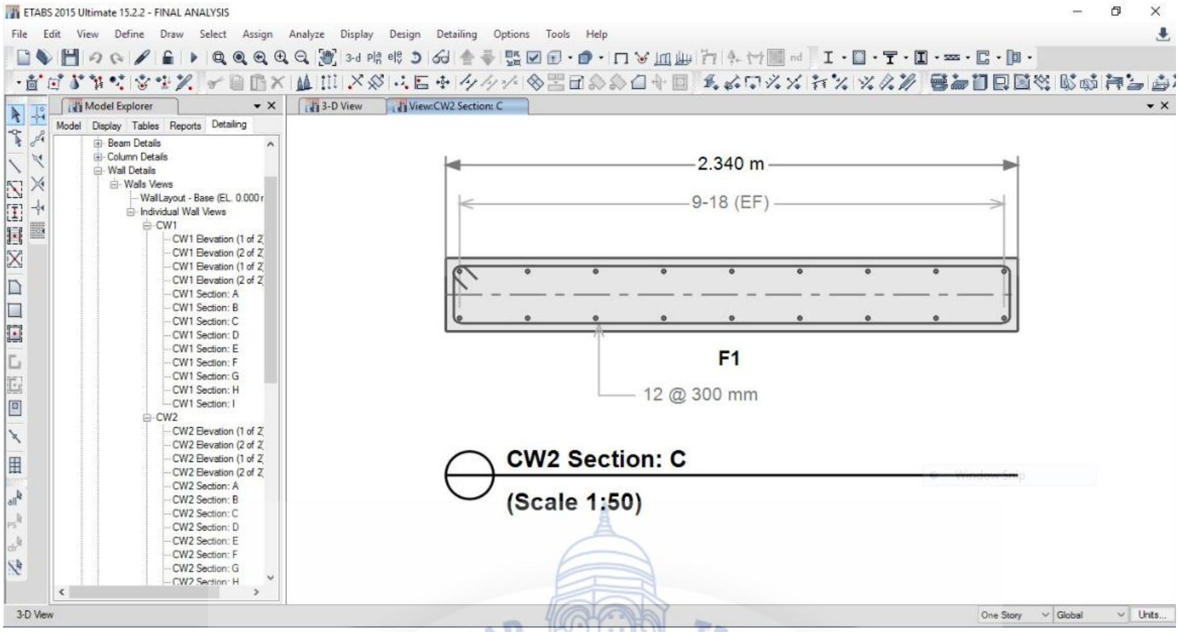


FIG.4.1.8

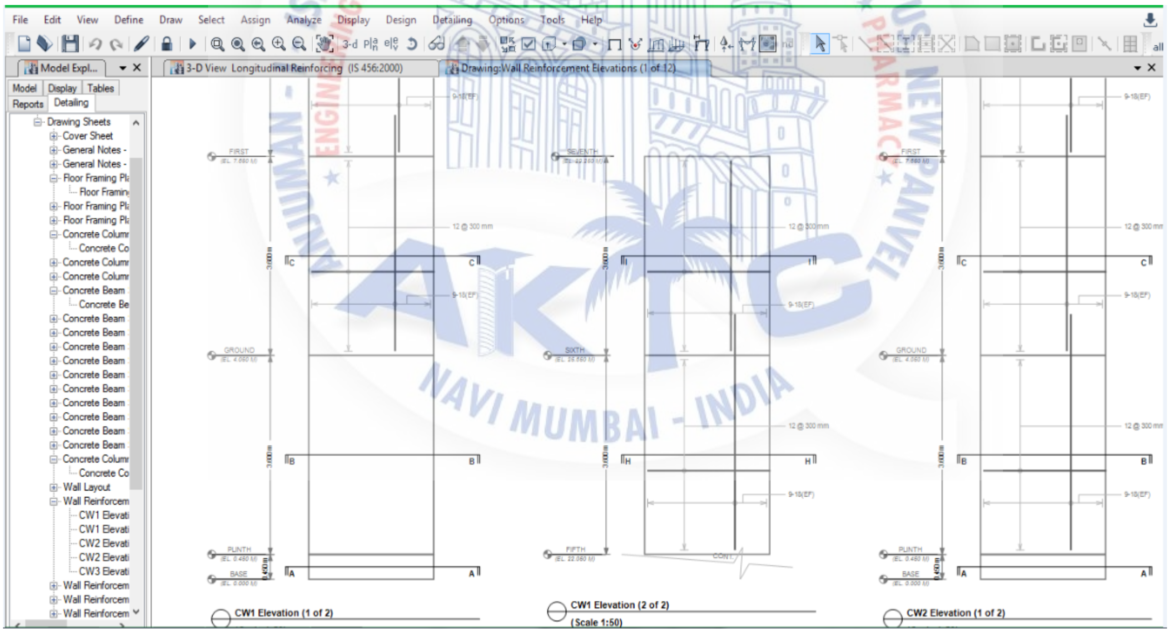


FIG.4.1.9

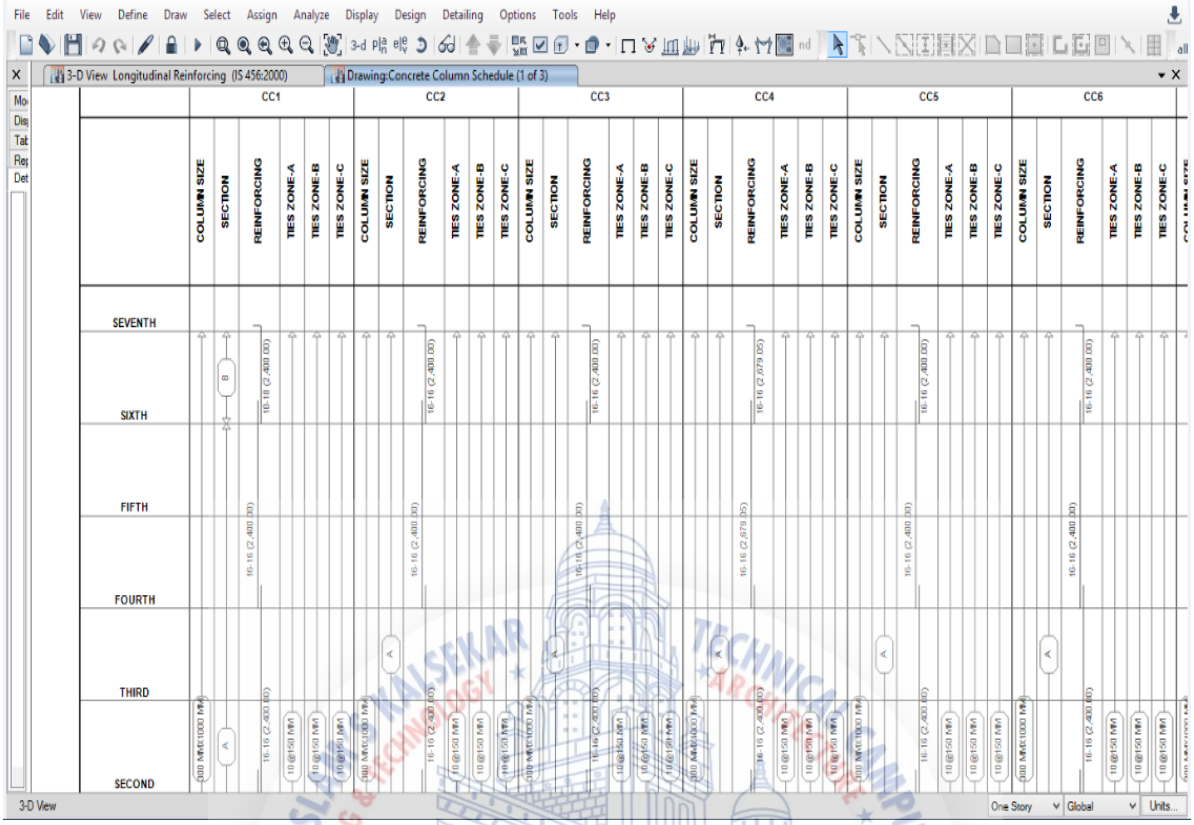
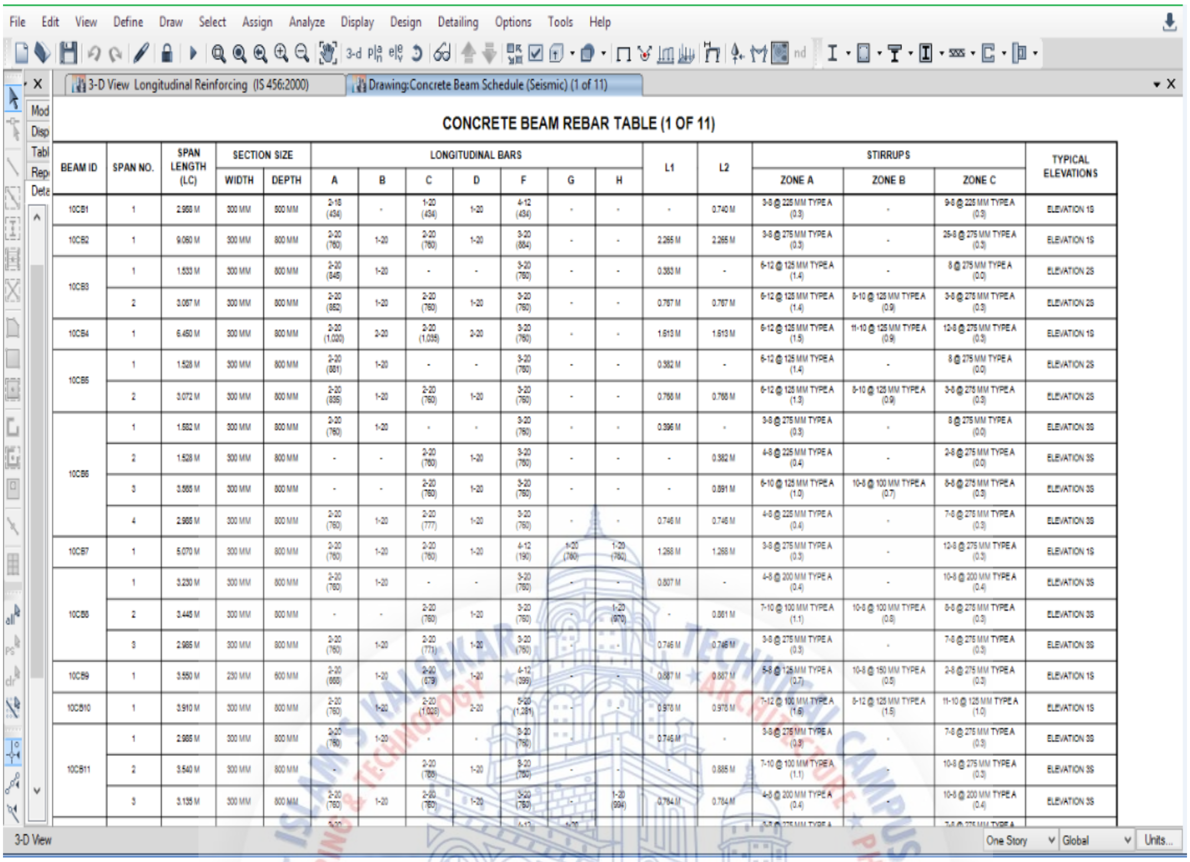

File Edit View Define Draw Select Assign Analyze Display Design Detailing Options Tools Help
3-D View Longitudinal Reinforcing (IS 456:2000)
Drawing:Concrete Column Schedule (1 of 3)
CC1
CC2
CC3
CC4
CC5
CC6
COLUMN SIZE
SECTION
REINFORCING
TIES ZONE-A
TIES ZONE-B
TIES ZONE-C
SEVENTH
SIXTH
FIFTH
FOURTH
THIRD
SECOND
3-D View
One Story
Global
Units...

FIG.4.1.10



CONCRETE BEAM REBAR TABLE (1 OF 11)

BEAM ID	SPAN NO.	SPAN LENGTH (LC)	SECTION SIZE		LONGITUDINAL BARS							L1	L2	STIRRUPS			TYPICAL ELEVATIONS
			WIDTH	DEPTH	A	B	C	D	F	G	H			ZONE A	ZONE B	ZONE C	
10CB1	1	2.968 M	300 MM	800 MM	2-16 (434)	-	1-20 (434)	1-20	4-12 (434)	-	-	-	0.740 M	3-8 @ 225 MM TYPE A (0.3)	-	9-8 @ 225 MM TYPE A (0.3)	ELEVATION 1S
10CB2	1	9.060 M	300 MM	800 MM	2-20 (760)	1-20	2-20 (760)	1-20	3-20 (884)	-	-	2.265 M	2.265 M	3-8 @ 275 MM TYPE A (0.3)	-	25-8 @ 275 MM TYPE A (0.3)	ELEVATION 1S
10CB3	1	1.533 M	300 MM	800 MM	2-20 (845)	1-20	-	-	3-20 (760)	-	-	0.383 M	-	6-12 @ 125 MM TYPE A (1.4)	-	8 @ 275 MM TYPE A (0.0)	ELEVATION 2S
	2	3.067 M	300 MM	800 MM	2-20 (852)	1-20	2-20 (760)	1-20	3-20 (760)	-	-	0.767 M	0.767 M	6-12 @ 125 MM TYPE A (1.4)	8-10 @ 125 MM TYPE A (0.9)	3-8 @ 275 MM TYPE A (0.3)	ELEVATION 2S
10CB4	1	6.450 M	300 MM	800 MM	2-20 (1,020)	2-20	2-20 (1,035)	2-20	3-20 (760)	-	-	1.613 M	1.613 M	6-12 @ 125 MM TYPE A (1.5)	11-10 @ 125 MM TYPE A (0.9)	12-8 @ 275 MM TYPE A (0.3)	ELEVATION 1S
10CB5	1	1.528 M	300 MM	800 MM	2-20 (881)	1-20	-	-	3-20 (760)	-	-	0.382 M	-	6-12 @ 125 MM TYPE A (1.4)	-	8 @ 275 MM TYPE A (0.0)	ELEVATION 2S
	2	3.072 M	300 MM	800 MM	2-20 (835)	1-20	2-20 (760)	1-20	3-20 (760)	-	-	0.768 M	0.768 M	6-12 @ 125 MM TYPE A (1.3)	8-10 @ 125 MM TYPE A (0.9)	3-8 @ 275 MM TYPE A (0.3)	ELEVATION 2S
10CB6	1	1.582 M	300 MM	800 MM	2-20 (760)	1-20	-	-	3-20 (760)	-	-	0.396 M	-	3-8 @ 275 MM TYPE A (0.3)	-	8 @ 275 MM TYPE A (0.0)	ELEVATION 3S
	2	1.528 M	300 MM	800 MM	-	-	2-20 (760)	1-20	3-20 (760)	-	-	-	0.382 M	4-8 @ 225 MM TYPE A (0.4)	-	2-8 @ 275 MM TYPE A (0.0)	ELEVATION 3S
	3	3.565 M	300 MM	800 MM	-	-	2-20 (760)	1-20	3-20 (760)	-	-	-	0.891 M	6-10 @ 125 MM TYPE A (1.0)	10-8 @ 100 MM TYPE A (0.7)	8-8 @ 275 MM TYPE A (0.3)	ELEVATION 3S
	4	2.985 M	300 MM	800 MM	2-20 (760)	1-20	2-20 (777)	1-20	3-20 (760)	-	-	0.746 M	0.746 M	4-8 @ 225 MM TYPE A (0.4)	-	7-8 @ 275 MM TYPE A (0.3)	ELEVATION 3S
10CB7	1	5.070 M	300 MM	800 MM	2-20 (760)	1-20	2-20 (760)	1-20	4-12 (190)	1-20 (760)	1-20 (760)	1.268 M	1.268 M	3-8 @ 275 MM TYPE A (0.3)	-	12-8 @ 275 MM TYPE A (0.3)	ELEVATION 1S
10CB8	1	3.230 M	300 MM	800 MM	2-20 (760)	1-20	-	-	3-20 (760)	-	-	0.807 M	-	4-8 @ 200 MM TYPE A (0.4)	-	10-8 @ 200 MM TYPE A (0.4)	ELEVATION 3S
	2	3.445 M	300 MM	800 MM	-	-	2-20 (760)	1-20	3-20 (760)	-	1-20 (970)	-	0.861 M	7-10 @ 100 MM TYPE A (1.1)	10-8 @ 100 MM TYPE A (0.8)	8-8 @ 275 MM TYPE A (0.3)	ELEVATION 3S
	3	2.985 M	300 MM	800 MM	2-20 (760)	1-20	2-20 (771)	1-20	3-20 (760)	-	-	0.746 M	0.746 M	3-8 @ 275 MM TYPE A (0.3)	-	7-8 @ 275 MM TYPE A (0.3)	ELEVATION 3S
10CB9	1	3.550 M	230 MM	600 MM	2-20 (668)	1-20	2-20 (679)	1-20	4-12 (399)	-	-	0.887 M	0.887 M	5-8 @ 125 MM TYPE A (0.7)	10-8 @ 150 MM TYPE A (0.5)	2-8 @ 275 MM TYPE A (0.3)	ELEVATION 1S
10CB10	1	3.910 M	300 MM	800 MM	2-20 (760)	1-20	2-20 (1,028)	2-20	5-20 (1,281)	-	-	0.978 M	0.978 M	7-12 @ 100 MM TYPE A (1.6)	8-12 @ 125 MM TYPE A (1.5)	11-10 @ 125 MM TYPE A (1.0)	ELEVATION 1S
10CB11	1	2.985 M	300 MM	800 MM	2-20 (760)	1-20	-	-	3-20 (760)	-	-	0.746 M	-	3-8 @ 275 MM TYPE A (0.3)	-	7-8 @ 275 MM TYPE A (0.3)	ELEVATION 3S
	2	3.540 M	300 MM	800 MM	-	-	2-20 (768)	1-20	3-20 (760)	-	-	-	0.885 M	7-10 @ 100 MM TYPE A (1.1)	-	10-8 @ 275 MM TYPE A (0.3)	ELEVATION 3S
	3	3.135 M	300 MM	800 MM	2-20 (760)	1-20	2-20 (760)	1-20	3-20 (760)	-	1-20 (994)	0.784 M	0.784 M	4-8 @ 200 MM TYPE A (0.4)	-	10-8 @ 200 MM TYPE A (0.4)	ELEVATION 3S

FIG.4.1.11

4.2. MICROSOFT EXCEL SPREADSHEET:

As beams, columns and shear walls are designed in detailed manner in ETABS, the design of slabs and footing are done in Microsoft Excel Spreadsheets. Also calculation of beams and columns are done on excel sheet for cross checking. The details of designs can be seen in the following Figure.

- SCHEDULE FOR SLABS :

						slab design							
Sr.NO	Mark	Count	Thickness (mm)	Grade of concrete	Grade of steel	Total Load (Kn/m)	Area of steel X	Y	Diameter of bar (mm)	Spacing (X-direction)	Spacing (Y-direction)	Total Quantity of steel (Kg)	Total Quantity of concrete cum
1	S1	32	200	25	415	9	240	240	10	300	320	114.62	5.4
2	S2	64	200	25	415	9	287.7	240	10	270	320	134.77	5.92
3	S3	40	200	25	415	9	545.6	243.29	10	140	320	281.97	8.74
4	S4	32	200	25	415	9	240	240	10	300	320	118.25	5.48
5	S5	64	200	25	415	9	240	240	10	300	320	37.07	1.67
6	S6	10	200	25	415	9	240	240	10	300	320	43.64	1.98
7	S7	8	200	25	415	9	823.18	375.18	10	100	210	612.74	12.73
8	S8	12	200	25	415	9	373.49	331.84	10	210	230	182.31	6.27
9	S9	12	200	25	415	9	609.49	240	10	120	320	386.68	11.19
											Total Quantity	1912.05	59.38

TABLE NO.4.2.1

1. FOOTING FOR SHEAR WALL:

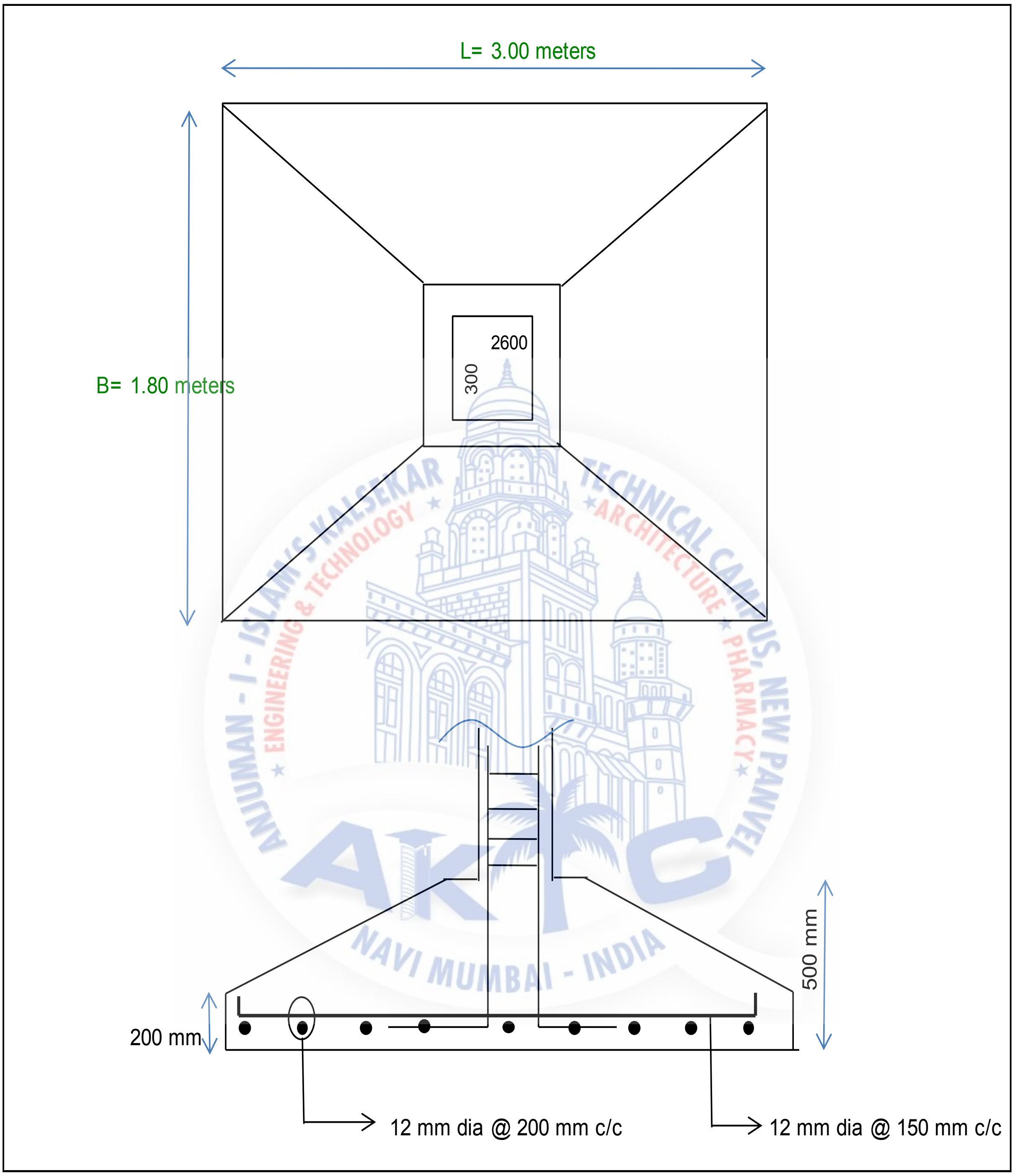


TABLE NO.4.2.2

1. FOOTING FOR COLUMN WITH 3000KN LOAD:

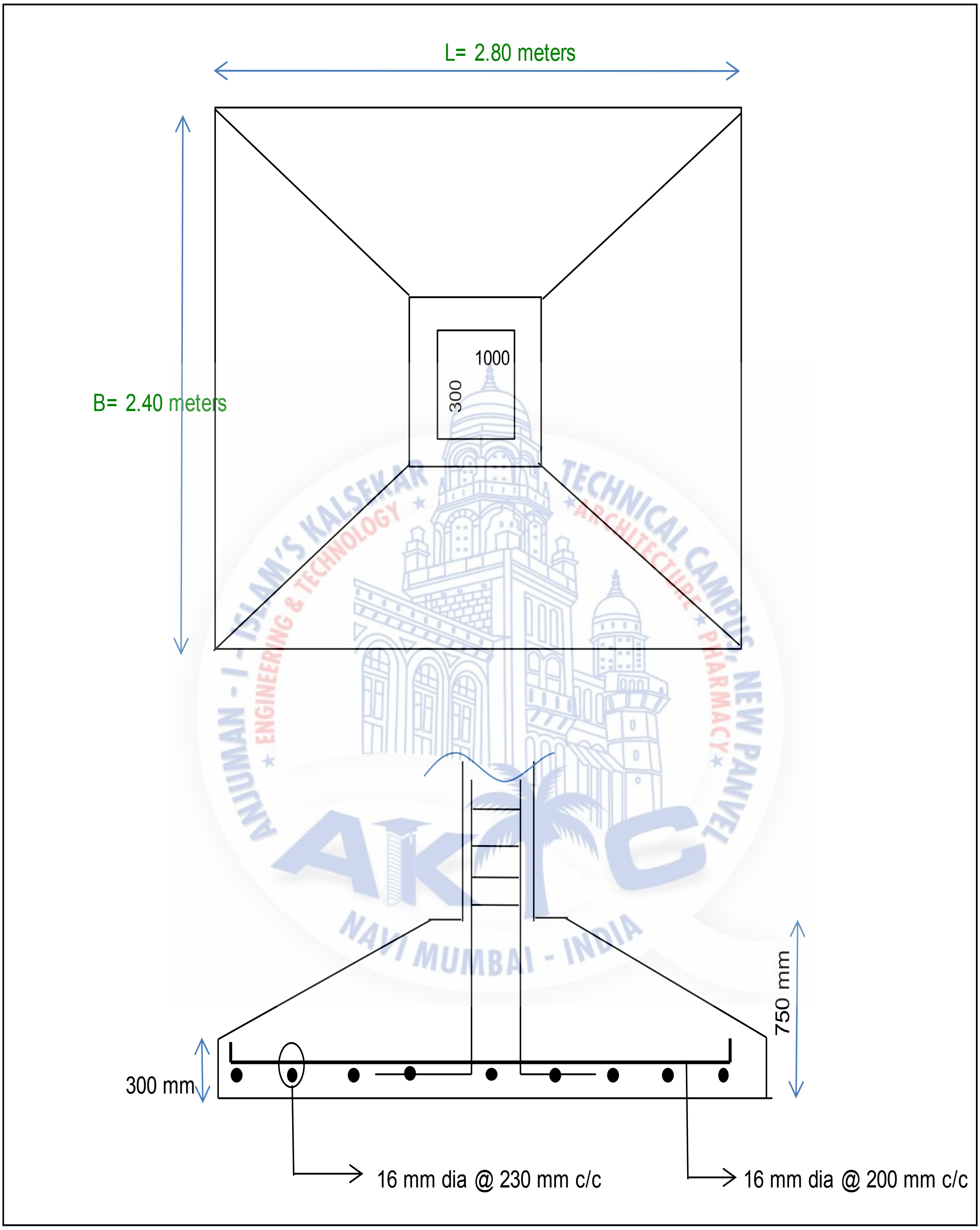


TABLE NO.4.2.3

2. FOOTING FOR COLUMN WITH 4000KN LOAD:

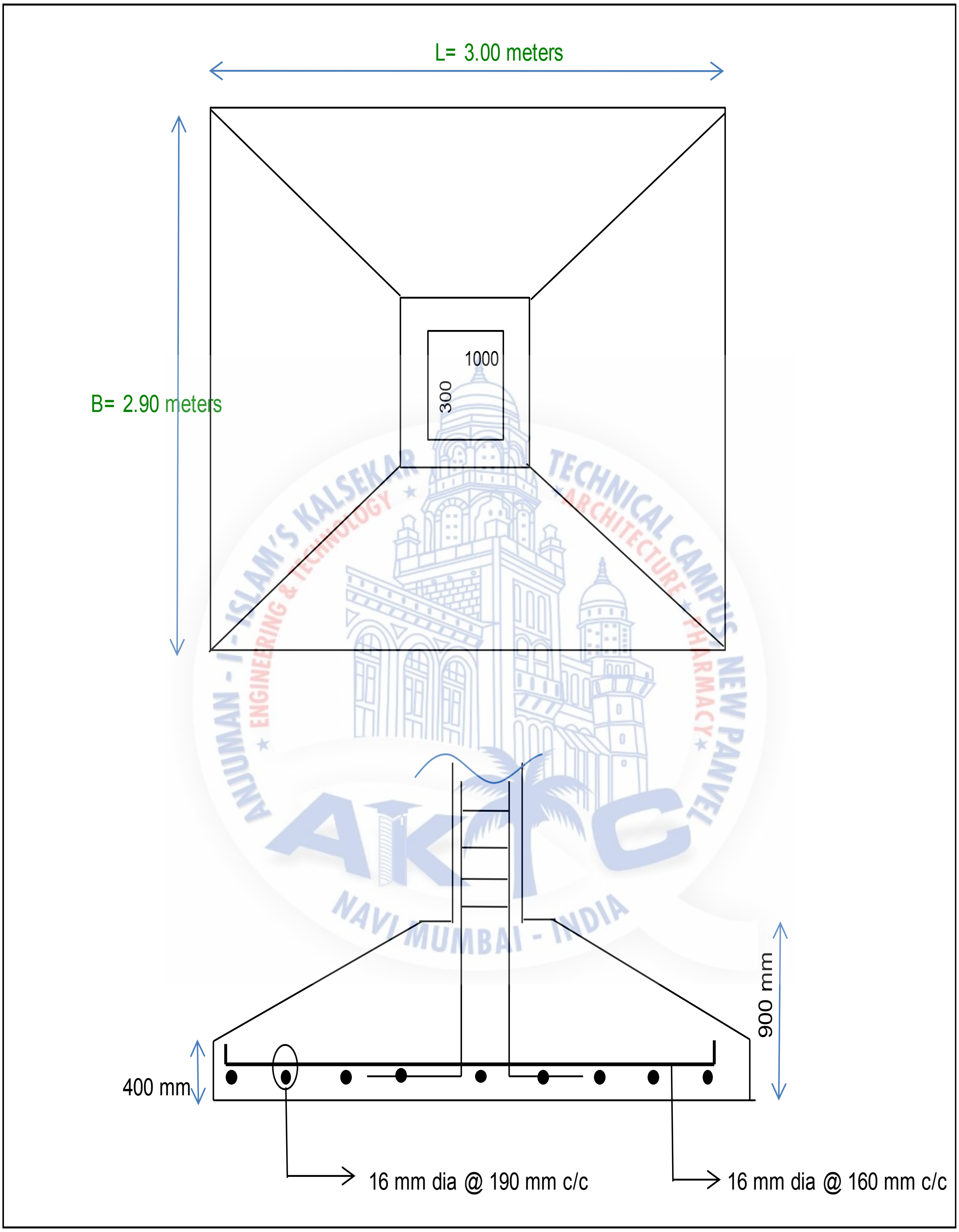


TABLE NO.4.2.4

3. FOOTING FOR COLUMN WITH 5000KN LOAD:

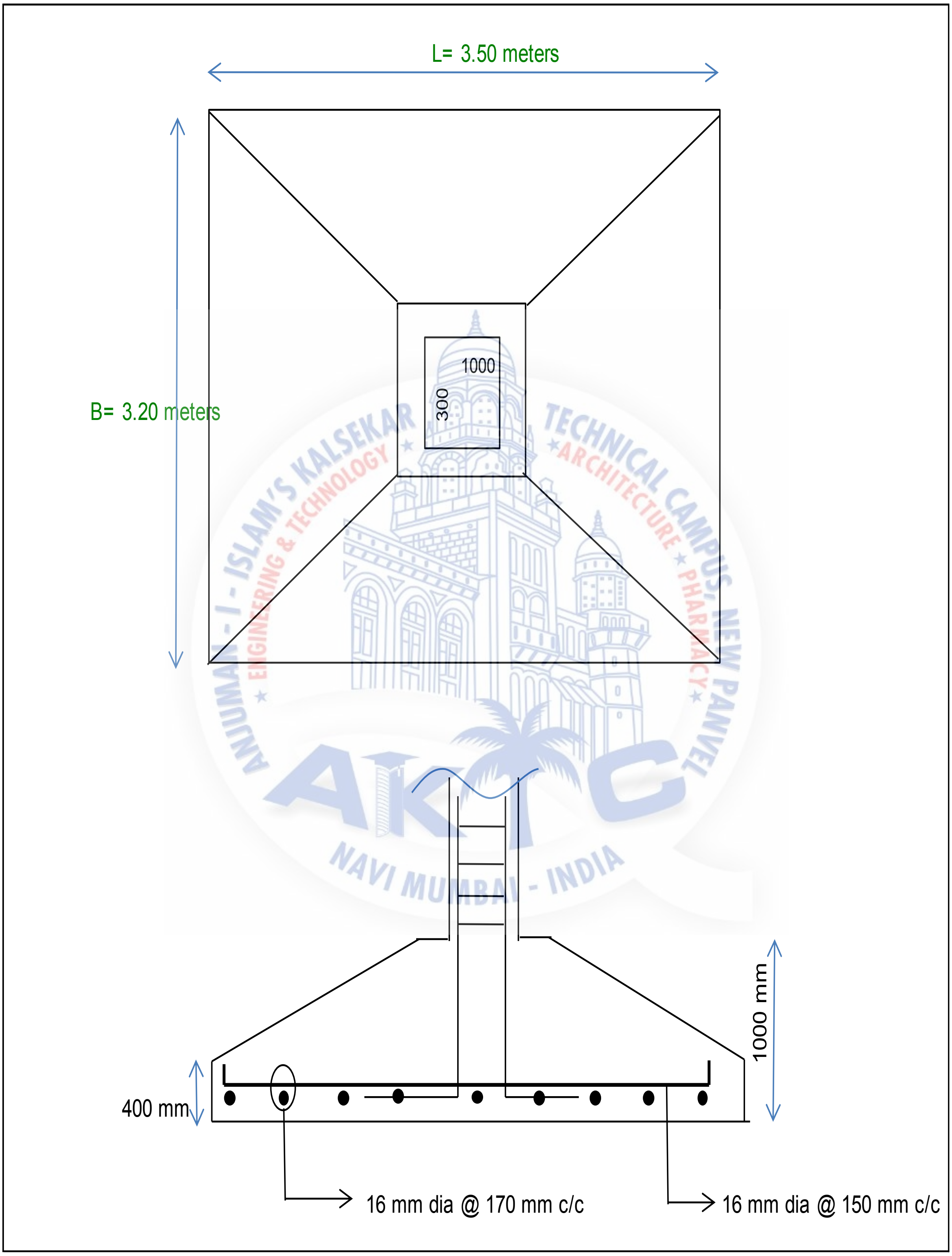


TABLE NO.4.2.5

4.3. AUTODESK REVIT:

After obtaining the detailed design reports and necessary AutoCAD plans, the 3D modelling of the structure is carried out in Autodesk Revit. We have also done the Rebar Modelling on Revit which shows the reinforcement details in particular structural members as per the design. The following are some of the screenshots of reinforced structural members obtained after Rebar Modelling.

I. Reinforcement details in Column and Footing:

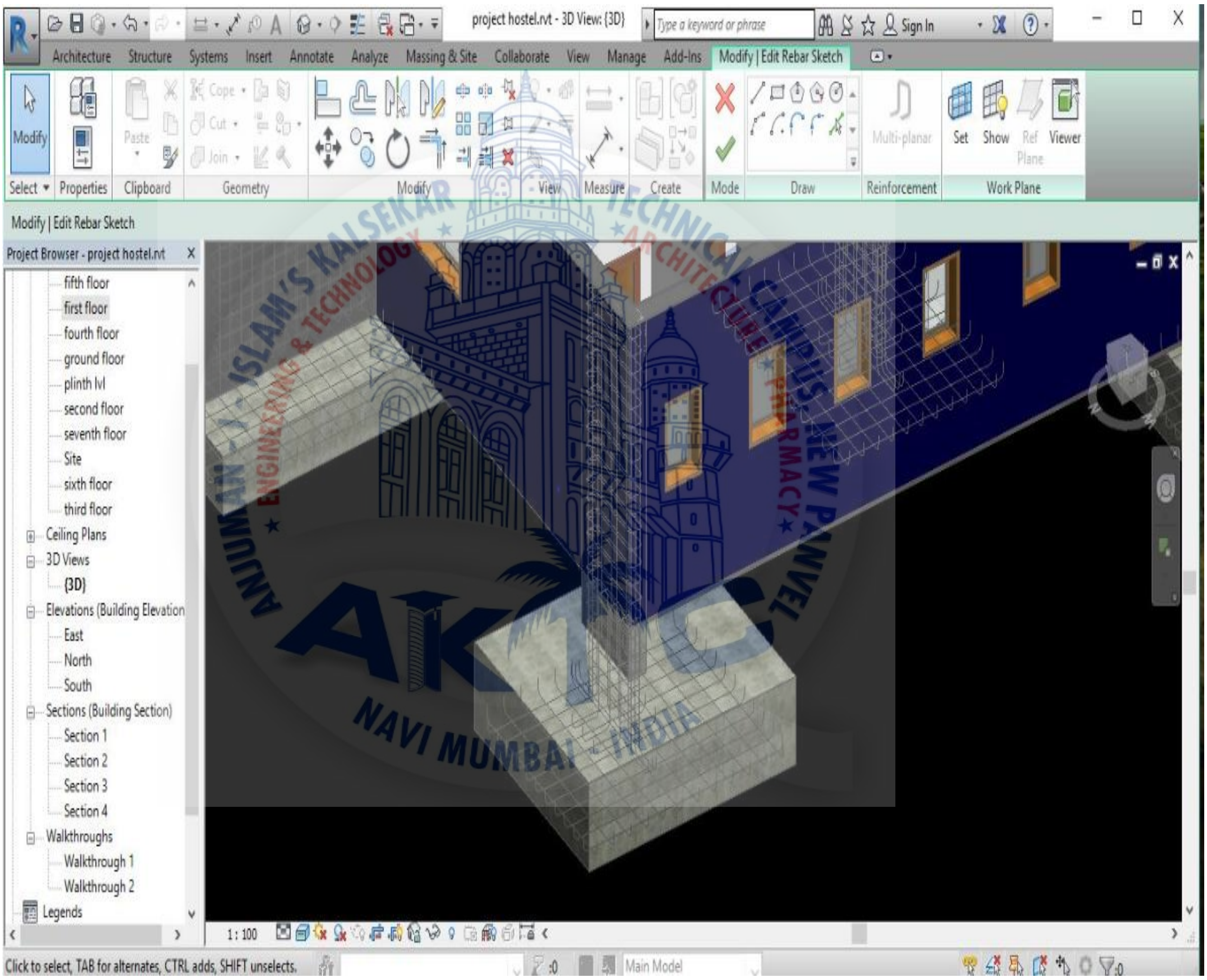


FIG.4.3.1

II. Reinforcement details in Beams:

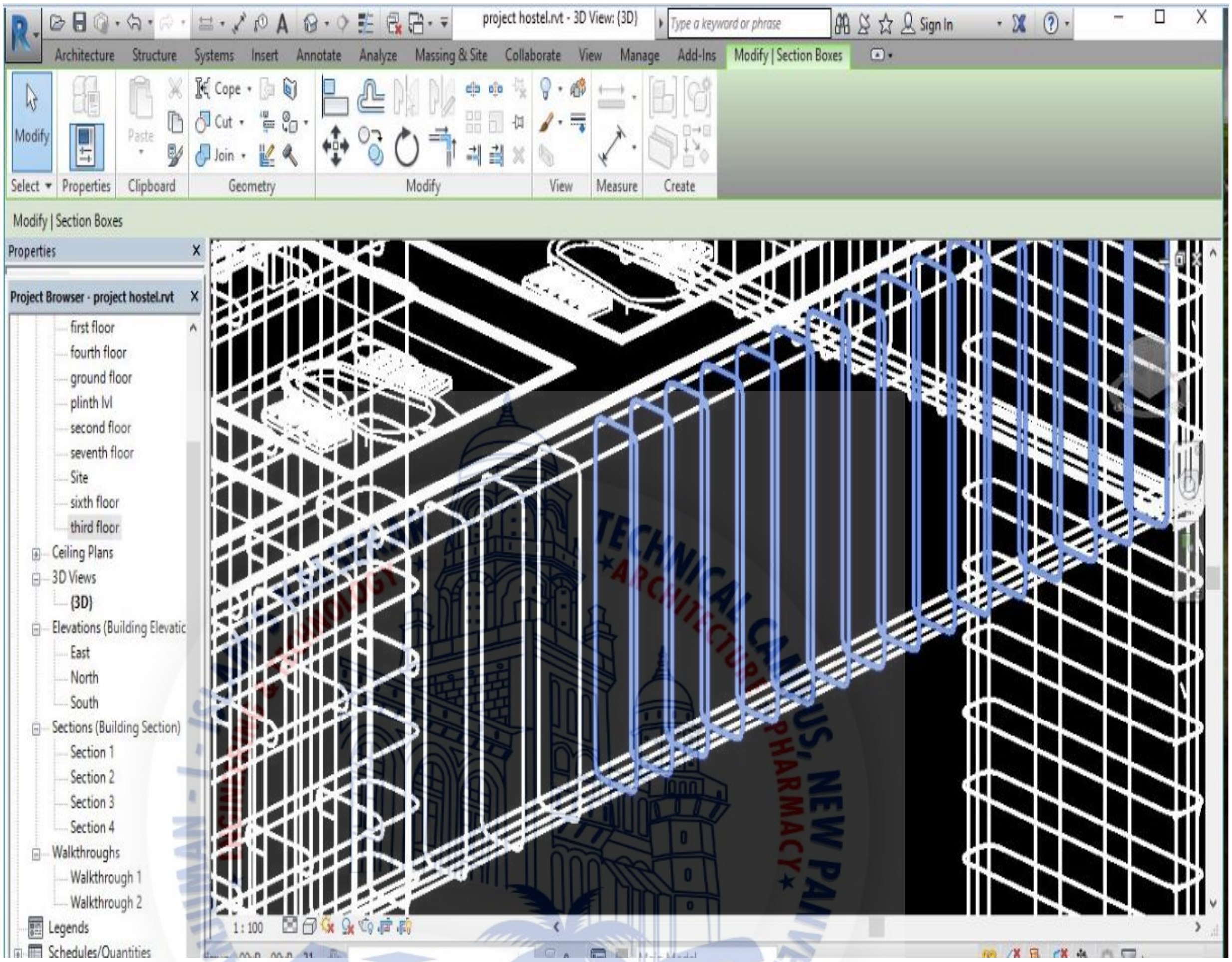
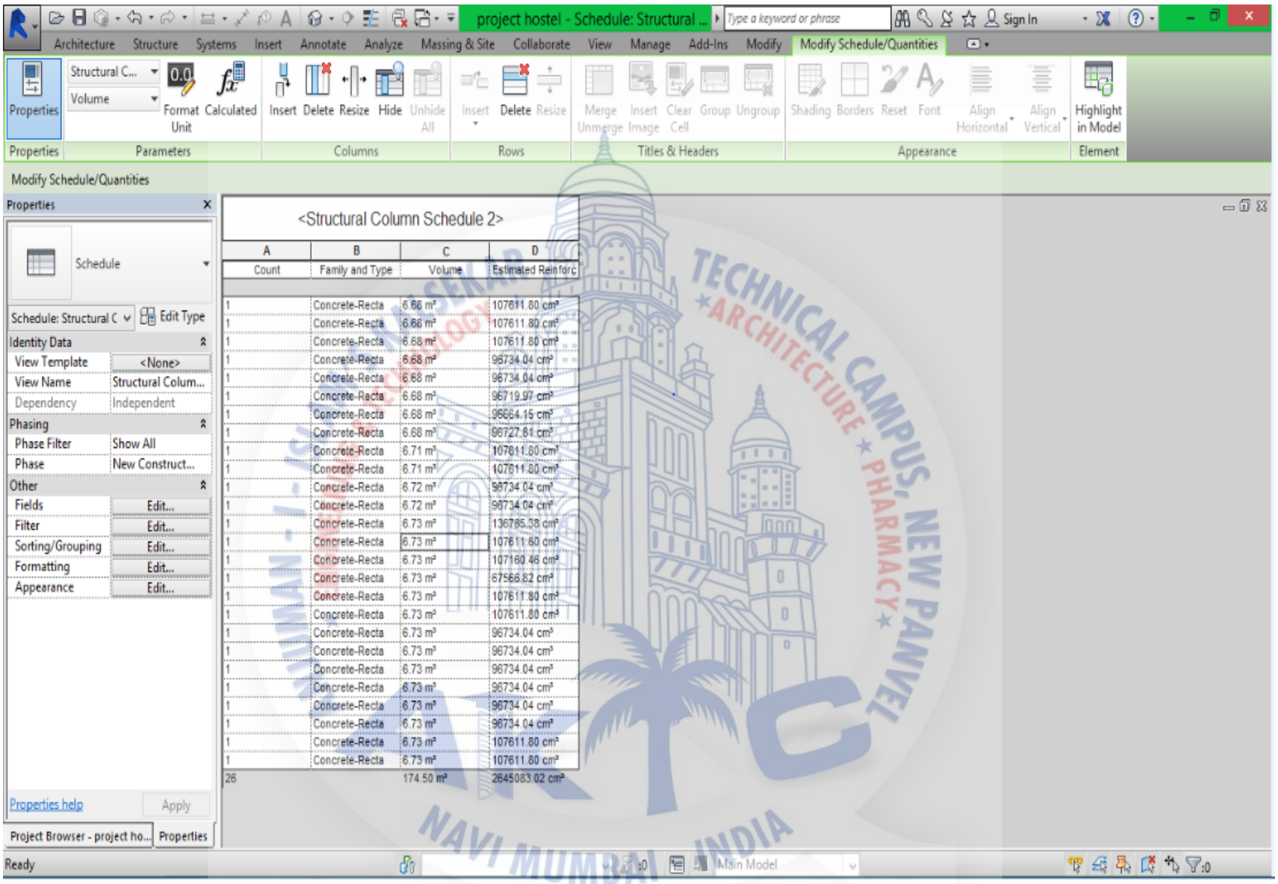


FIG.4.3.2

QUANTITY ESTIMATION:

After completing the modelling part, we have done the quantity estimation from Autodesk Revit software. Quantity of Concrete and Steel is obtained successfully for all structural members. Following are the snaps showing the total quantity of steel and concrete for individual structural members.

i. QUANTITY ESTIMATION FOR COLUMNS:



<Structural Column Schedule 2>

A	B	C	D
Count	Family and Type	Volume	Estimated Reinforc
1	Concrete-Recta	6.68 m³	107611.80 cm³
1	Concrete-Recta	6.68 m³	107611.80 cm³
1	Concrete-Recta	6.68 m³	107611.80 cm³
1	Concrete-Recta	6.68 m³	96734.04 cm³
1	Concrete-Recta	6.68 m³	96734.04 cm³
1	Concrete-Recta	6.68 m³	96719.97 cm³
1	Concrete-Recta	6.68 m³	96664.15 cm³
1	Concrete-Recta	6.68 m³	96727.81 cm³
1	Concrete-Recta	6.71 m³	107611.80 cm³
1	Concrete-Recta	6.71 m³	107611.80 cm³
1	Concrete-Recta	6.72 m³	96734.04 cm³
1	Concrete-Recta	6.72 m³	96734.04 cm³
1	Concrete-Recta	6.73 m³	136785.38 cm³
1	Concrete-Recta	6.73 m³	107611.80 cm³
1	Concrete-Recta	6.73 m³	107160.46 cm³
1	Concrete-Recta	6.73 m³	67566.82 cm³
1	Concrete-Recta	6.73 m³	107611.80 cm³
1	Concrete-Recta	6.73 m³	107611.80 cm³
1	Concrete-Recta	6.73 m³	96734.04 cm³
1	Concrete-Recta	6.73 m³	96734.04 cm³
1	Concrete-Recta	6.73 m³	96734.04 cm³
1	Concrete-Recta	6.73 m³	96734.04 cm³
1	Concrete-Recta	6.73 m³	96734.04 cm³
1	Concrete-Recta	6.73 m³	96734.04 cm³
1	Concrete-Recta	6.73 m³	107611.80 cm³
1	Concrete-Recta	6.73 m³	107611.80 cm³
26		174.50 m³	2645083.02 cm³

FIG.4.3.3

ii. QUANTITY ESTIMATION FOR FOOTING:

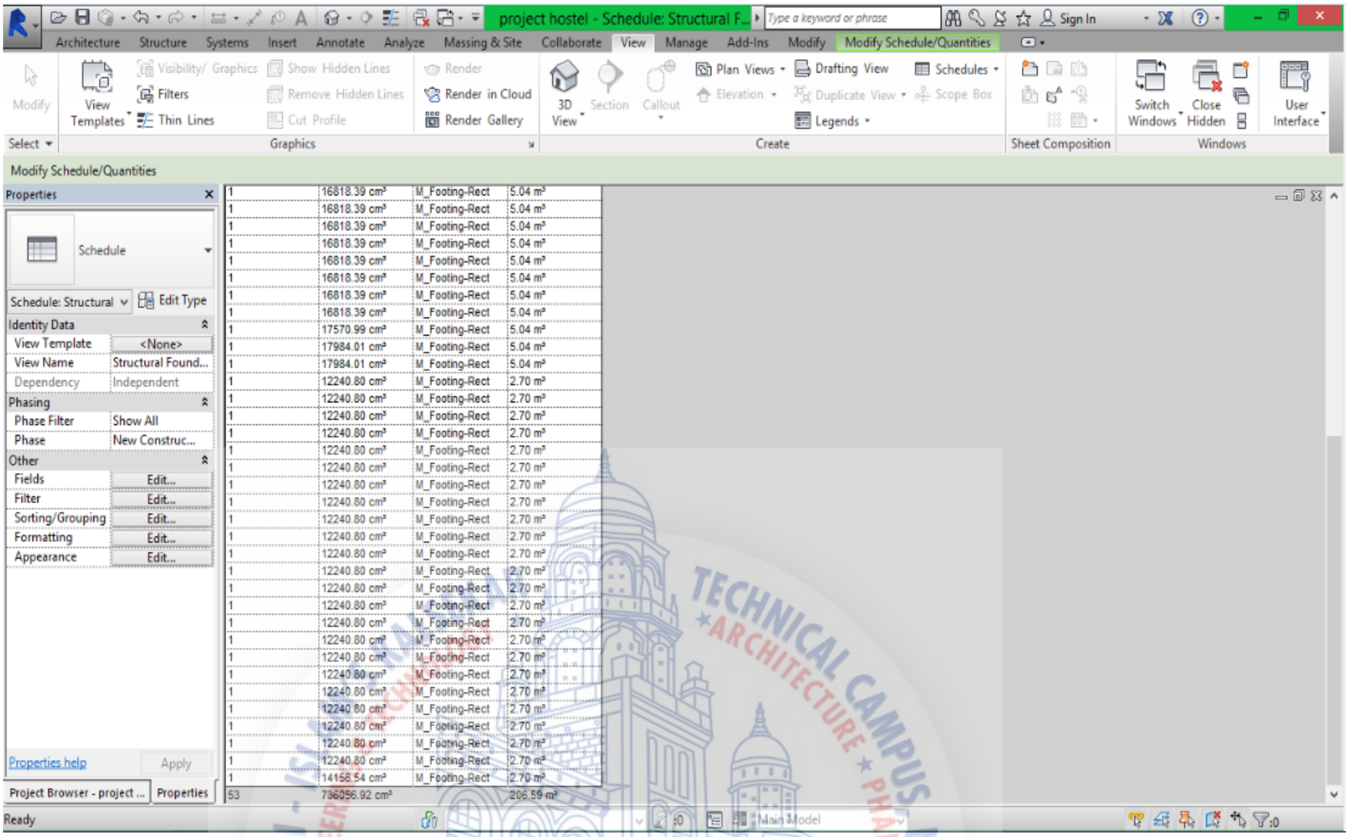


FIG.4.3.4

iii. QUANTITY ESTIMATION FOR BEAMS:

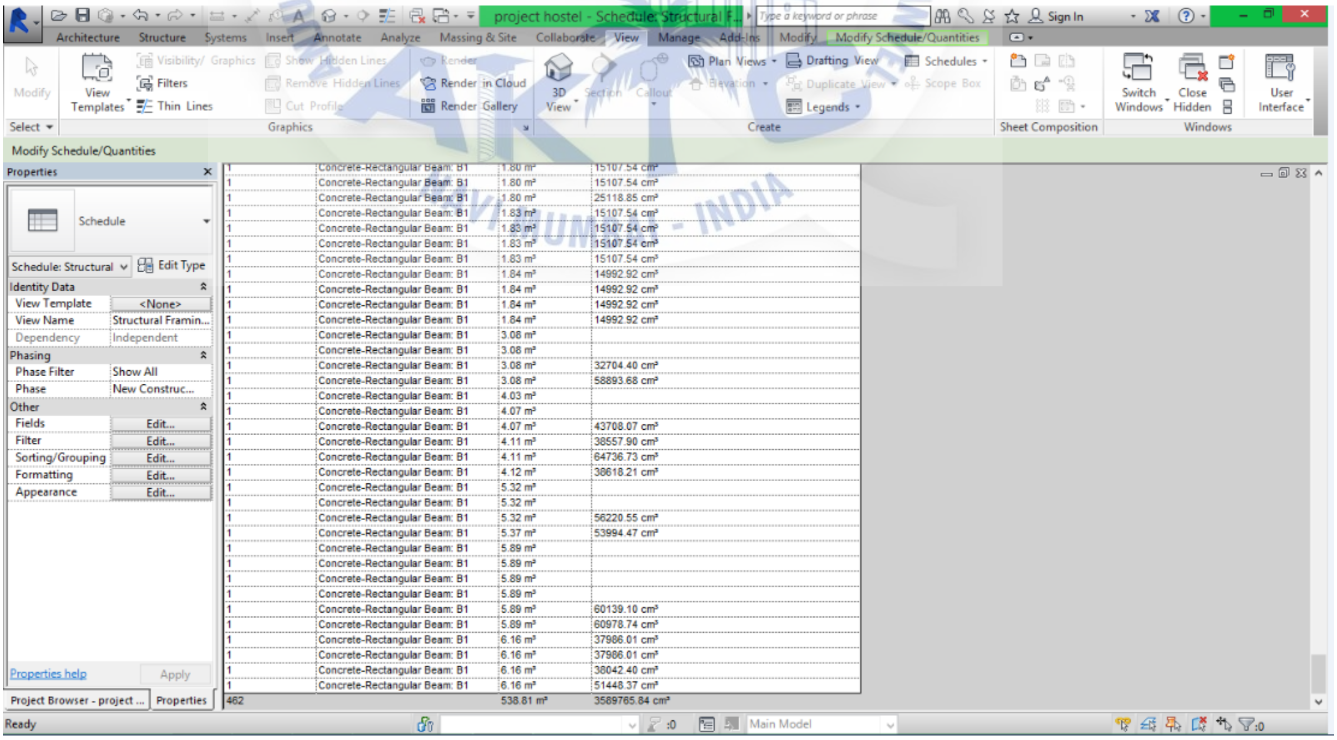


FIG.4.3.5

							Quantity Estimation
	Beam	Column	Footing	Wall	Slab		Total Quantities
Concrete (cum)	538.81	174.5	206.95	3230.98	60		4211.24
Steel (Kg)	8615.43	6348.199	1766.53	19903.82	1912.05		38546.0292

TABLE NO.4.3.6

This is the final table concluding the total quantity of construction materials required in execution of all the units in the whole structure.

After overviewing the above three softwares, discussion can be done that AutoCAD is one of the most efficient and user-friendly software for planning purpose. ETABS give the user a wide possibilities for designing almost any kind of structure in any region and under various conditions. Autodesk Revit is the most comfortable and user friendly software for 3D modelling as it is very easy to understand the commands as well as to execute them. It also provide a wide range of libraries for massing as well as for interior designing purpose.

CHAPTER 5

- **CONCLUSION**

After the completion of project, we end up with the conclusion that all the softwares used by us for completing this project is of great significance and unique of its kind.

AutoCAD is an advanced software which is very user-friendly and efficient for planning any kind of structure.

Analysis and designing part can be done most efficiently and quickly with the help of ETABS.

Designing of Slabs and Footings is done very easily and in detailed manner using Microsoft Excel Spreadsheet.

Autodesk Revit is a very efficient and beneficial software for Modelling and Quantity Estimation of any structure.

In all, we can conclude that we have successfully gained enough basic knowledge about the above mentioned softwares and it will be beneficial for us in our near future.

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