REDEVELOPMENT OF MIG COLONY (MHADA) AS ENERGY EFFICIENT COLONY

Submitted in partial fulfilment of the requirements

for the degree of

BACHELOR OF ENGINEERING

in

CIVIL ENGINEERING

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CERTIFICATE

This is to certify that the project entitled **"Redevelopment of MIG Colony (MHADA) as Energy Efficient Colony"** is bonafide work of **"SHAIKH AMIR MAVIA"** (15CE43), **"ADNAN SALAHUDDIN KHAN"** (15CCE19), **"AHMED IRFAN KHAN"** (15CE08) **"SHUAIB ASLAM CHOUGLE"**, submitted to the University of Mumbai in partial fulfilment of the requirement for the award of the degree of "**Bachelor of Engineering**" in **Department of Civil Engineering**.

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DECLARATION

We declare that this written submission represents our ideas in our own words and where others ideas or words have been included, We have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We 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.

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ABSTRACT

The project deals with analysis, design, modelling and energy analysis of residential building (G+7) by using ETABS, Autodesk Revit and Microsoft excel software. Analysis and modelling is done on ETABS, energy analysis on Autodesk Revit and foundation design on excel. In ETABS, initially analysis of structure was performed based on load calculations, occupancy and expected life span. Then, after analysis of structure, the maximum shear forces and bending moments is computed. The structure is designed based on the shear force and bending moments. Analysis and design was done taking into account the requirements an standards recommended by IS codes (IS-456:2000, IS-1893:2002, IS-13920:1993). After the analysis and design of the building was successfully completed in ETABS, energy modelling and analysis was performed in AUTOdesk Revit. Modelling is done as per the requirements given by the drawings AutoCADD and then the energy simulations are performed in AUTOdesk Revit by varying different materials in the models. The results are compared and the most energy efficient materialsobtained from the simulations are suggested.

CONTENTS

LIST OF FIGURES

CHAPTER-1

INTRODUCTION

1.1 General

The Medium Income Group (M.I.G) Colony in Kurla (W) includes 9 buildings of (G+4) storeys constructed by Maharashtra Housing and Development Authority (**MHADA**) more than 4 decades ago. Therefore, the structural is dilapidated and the elements are not capable to withstand the forces for too long without major repairs. The structural repair solutionis temporary and has many drawbacks, as it not only includes a lot of cost, but thestructure needs retrofitting again after 8-10 years.

The Floor Space Index (F.S.I.) allowed by MHADA during construction was less (FSI=1.33) due to prevailing circumstances and the regulations in that era. The tremendous influx of people and rapid urbanization has caused various problems for the inhabitants due to in-sufficient shelters, open spaces and recreational facilities. Therefore, redeveloping the colony with increased FSI as per recent norms (DCR 2034-Section 33-5) approved by the authorities is the only viable option. This would not only help the tenants, peoples but also the governmental agencies (MHADA).

The rapid urbanization has increased the demand of the energy resources in building sector. Therefore, in order to match the energy supply with demand, the government is encouraging investment in renewable energy, suggesting measures in improving energy efficiency and conservation by the inhabitants. Hence, this project includes efficient measures to meet the needs of people and provide an eco-friendly environment.

Redevelopment refers to the process of reconstruction of the residential/commercial premises by demolition of the existing structure and construction of a new structure. This is done by utilizing the potential of the land by exploiting additional Transfer Development Rights (T.D.R), FSI as specified under the Development Control Regulations of Municipal Corporation of Greater Mumbai (MCGM).

Energy efficiency refers to a method of reducing energy consumption by using less energy to attain the same amount of useful output. For example, an energy-efficient 12-watt LED bulb uses 75-80% less energy than a 60-watt traditional bulb but provides the same level of light.

Figure 1.1: Funds allotted by MHADA for redevelopment (source:www.timesgroup.com)

The government's policy agency, Niti Aayog, estimates that energy demand from India's buildings will increase by more than 800 percent in 2047 compared to 2012. Figure 1.2 shows

India's projected energy demand

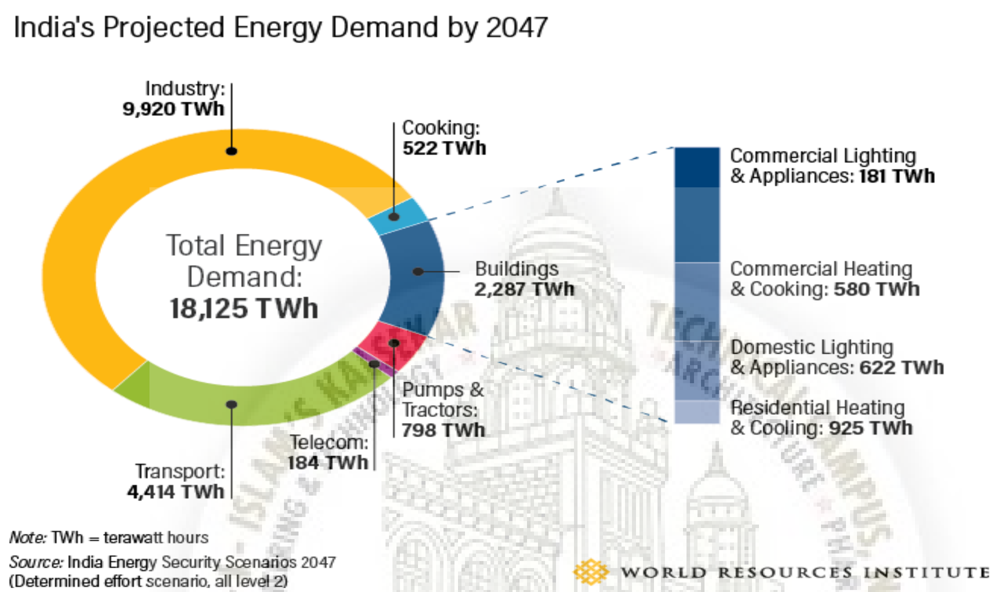


Fig 1.2: Graph showing India's Projected Energy Demand 2047

1.2 Problem Statement:

There are many old structures in Mumbai and other suburban centres in India, which were built decades back. They cannot withstand the loads unless severe structural modifications to the project are carried out. But the inhabitants are reluctant to permit major structural modifications or altogether reconstruction of these structures due to the tremendous costs involved. This puts their lives in jeopardy. The only solution that can be envisaged is that if the residents are proved the benefits of a newly constructed energy-efficient building through proper modelling and life-cycle analysis. Here, an attempt is made to model, analyse, design and simulate an energy efficient building in Kurla for MIG colony.

1.3 Aim and objective of Study:

The following four-point objectives are set for the project

- To design the 7-buildings under ETABS (Extended Three Dimensional Analysis of Building) software for designing various structural elements.
- To workout various quantities of essential elements required for the project and estimate cost of the total project
- To apply techniques of Energy Efficiency by Revit Architect (BIM tool) and redevelop the MIG colony as Energy Efficient Society

1.4 Scope

The following scope of the project is identified:

- The modelling of the new proposed structure is to be done which is (G+7) storey structure.
- The designing of the structural element like is slabs, beams and columns is to be done.
- 3-D Modelling is to be done in Revit Architect
- Energy simulation through the model.in Revit Architect.
- Costing is to be worked out for the entire project.

Chapter 2

Literature review

The literature survey presents a critical appraisal of the previous work published in the literature pertaining to the designing of structure using ETABS, energy modelling using REVIT and other techniques. A number of research papers were studied and analysed from various domains as follows:

1) Designing of structure using ETABS software,
2) Designing of structure using different techniques and,
3) Energy efficiency techniques using Revit Architect (BIM TOOL).

Kannan*et al.*(2014)[9] developed an innovative methodology for producing automatic energy estimates from 3D-BIM model developed using Autodesk Revit. A 3D-BIM model of G+2 building is used as a reference for executing the energy simulations in the six major climatic zones (Cold and Sunny Zone, Cold and Cloudy Zone, Warm and Humid Zone, Hot and Dry Zone, Composite Zone and Moderate Zone) of India.To develop building energy simulation in the 3D-BIM Model, they initially developed a 3D-BIM (Solid Model) of the structural systems using the Autodesk Revit or any other 2D-CADD software, then it is to be incorporated

in BIM software to develop the 3D BIM (Solid Model). Then, setting the project boundary and location in the project browser in the Autodesk Revit is done. After that, the 3D BIM by the analysis tab in the Autodesk Revit is used for energy analysis. The simulation is run and results are tabulatedand evaluated.

Rodrigues*et al.* (2016) [6] depicted the results about the reliability and flexibility of energy analysis using BIM-based simulations (with Revit software and Green Building Studio Autodesk), as well as the benefits and challenges of these BIM tools when compared with Energy Plus. Revit software is a BIM tool that allow professional designers to build and maintain higher-quality and more energy-efficient buildings. The information of the models designed with Revit allows architects, engineers, and construction firms to collaborativelydecideimportant elements in the design process at an earlier stagefor delivering projects more efficiently. Any design changes made in any Revit plan, elevation or cross section are automatically updated throughout the model, keeping designs and documentation coordinated.

Kumar *et al.* (2017) [2] emphasized that most builders are under the wrong impression that shear wall system is more costly than beam-column framed system. To emphasize this fact, studies were conducted on a 18-storied residential building, which was proposed to be constructed at Visakhapatnam city of Andhra Pradesh, India (seismic zone II). The structure was designed by ETABS software. Two numerical models were developed under different structural configurations such as beam column slab (BCS) system of RC moment resistance frame, and shear wall flat slab (SWFS) system the design methodology was followed by IS 456-2000 Limit State Method. It was found that the cost of super-structure decreased by 2% in shear wall system (Rs. 17 lakhs) when compared to beam column framed system. .

Chen*et al.* (2017) [3] discussed thattheory of open building is not only limited to the transformation of architectural space, but also the change of relationship among time, function and people. They divided different walls of an opening building's feature into three levels, viz., the walls that can never be changed (Black Wall), the walls that can be changed by the developers (Grey Wall) and the walls that can be changed by the users (Red Wall), i.e internal filled wall. Users can change the internal filling wall of the separation of space according to their own needs to meet the needs of different periods of living, to achieve the vision of a century.Upside-down (inverted beam system) is a system of inverted beams.The method of operation is to flip the beam at the floor, the ceiling, wall, and floor layer in the pipeline system of traditional residential are all collected in the inverted beam system**.** It wasfound that the

adaptability of space has been greatly improved, spatial division is more flexible and more chances and possibilities are provided for residents in their later life according to their own needs after the open architectural concept was applied to residential design.

Subhashchandra *et al.* (2017) [8] informed that during the execution of slum upgrading projects, resident families can experience significant social and economic disruptions. They presented an integrated urban-construction planning framework for slum upgrading projects. They definerredevelopment as reconstruction of residential or commercial building by demolition, if necessary, of the existing structure and construction of new building(s) using the full potential of the land including the additional potential granted under the regulations like the Development Control Regulations of Municipal Corporation of Greater Bombay, 1991 (D.C. Regulation) by way of Transferable Development Rights (TDR). They concluded that thepresent practices of redevelopment of housing societies need to be reviewed so that these can be more technically and commercially viable. Planned redevelopment of the existing old part of the society can help in solving the problems of ccongestion and can provide better services.

Gopal *et al.* (2017) [5]used the ETABS software foranalysing slab for stress, beam for shear force. They found out that reinforcement area for the columnand design the foundation depends upon the reaction and height of the foundation level, which further depends upon site conditions and safe bearing capacity of the soil.They designed the retaining wall for stability. The scope of the study is to produce good structural work for performing analysis and design for a residential building

Shivsharan *et al.* (2017) [4]analysed the Autodesk BIM capabilities to perform energy analysis of a G+9 Residential building. Theytry to integrate the use of BIM energy analysis results in the predicting the energy consumption of the building. Revit is a used throughout the 3-Dmodelling process and it is a full-featured building information modelling platform. “Building Elements” like walls, roofs, windows, and floors to create 3-D models are used in the Autodesk Revit software. They conclude that Revit Architecture facilitates the very complex process of sustainable design like daylighting and solar access, and automates the laborousand time consuming activities like material take offs, etc. all the while capturing and coordinating information in the documentation set. Linking this product to Revit Architecture make this technology far more accessible

Ren*et al* (2018) [7]applied building information modelling (BIM) in the reformation design of old building structure, and the performance was simulated and analysed. Moreover, it was applied in pracical construction. An old building in Guangdong, China was divided into two areas and a courtyard using BIM. Relevant reformation countermeasures were put forward to solve the problems of the building. Then simulation analysis was performed. The results demonstrated that BIM could be applied in the reconstruction of old buildings BIM in the reconstruction design of the old building was explained in the aspects of lighting and ventilation and opening sunshading

Kumar *et al.* (2018) [1] analysed a G+1 commercial building located at Hyderabad, India under effect of seismic forces. Shear forces and bending moments of beams and columns were observed and they concluded that larger span have more shear forces and bending moment. They stressed that effective design and construction of an earthquake resistant structures is very important. They presented a multi-storeyed residential building analysed and designed with lateral loading effect of earthquake using ETABS. This structure is designed as per Indian Codes- IS 1893-part2:2002, IS 456:2000. The analysis was done using the software package ETABS and drawing details in AutoCAD and REVIT. The structural components were designed manually in addition to the software design

Chapter 3

METHODS AND METHODOLOGY

3.1 step 1: ETABS Software:

For nearly thirty years, ETABS has been identified as the industry standard for Building Analysis and Design Software. Today, continuing along with the similar tradition, ETABS has emerged into a quietly developed structure analysis and design program.

ETABS being used as an Engineering software application for multi-storied building structural analysis as well as structural design. Can be evaluated preliminary to advanced systems under either dynamic or static conditions utilizing ETABS

The latest version of ETABS continues in that tradition, incorporating structural element terminology that is used on a daily basis (Columns, Beams, Bracings, Shear Walls etc.), contrary to the common civil engineering programs that use terms such as nodes, members etc. Additionally, it offers many automatic functions for the formation, analysis and design of the structural system in an efficient, fast and easy way. The user can easily create a model, apply any kind of load to it and then take advantage of the superior capabilities of ETABS to perform a state-of-the-art analysis and design.

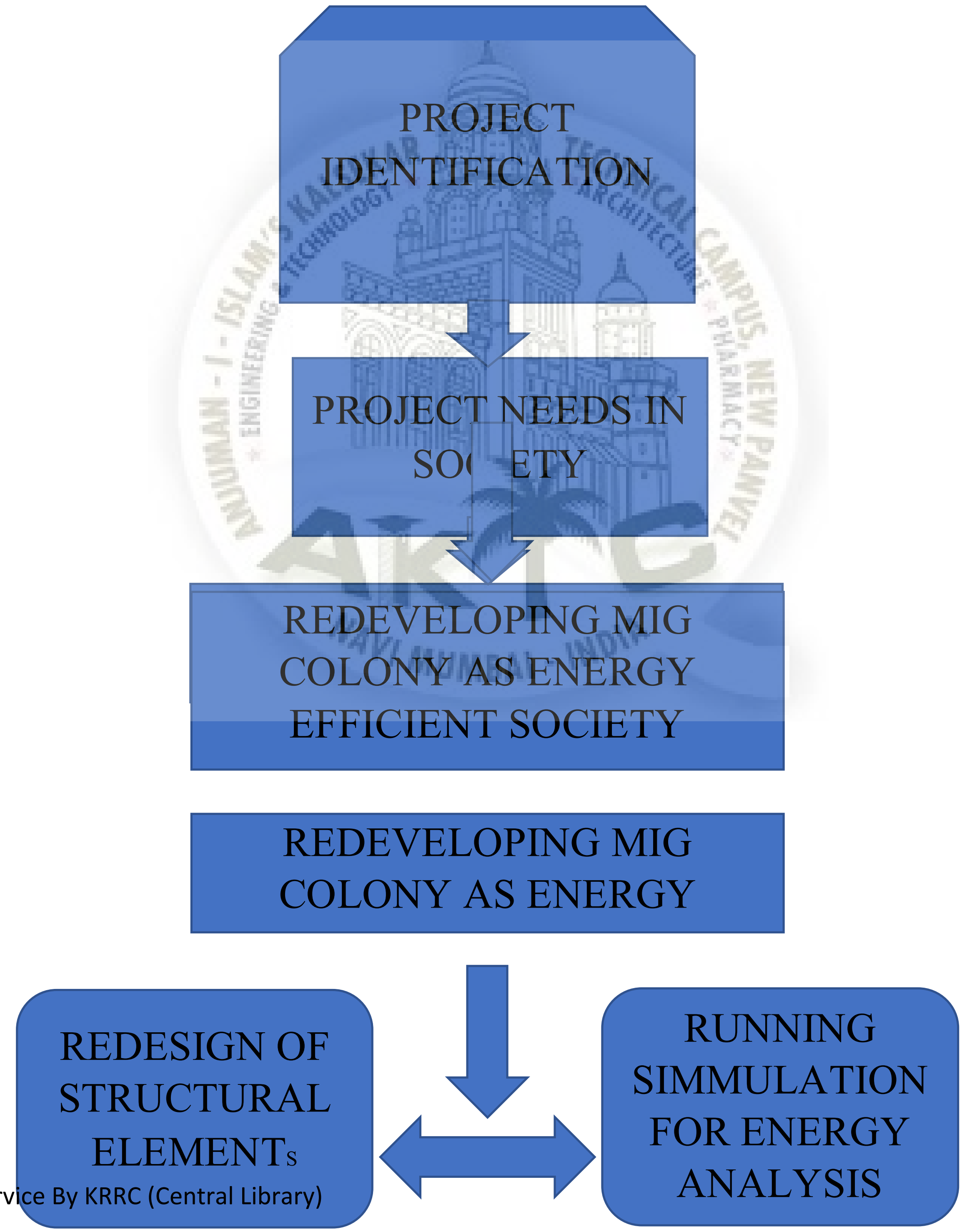
3.2 step 2: Autodesk REVIT (2017)

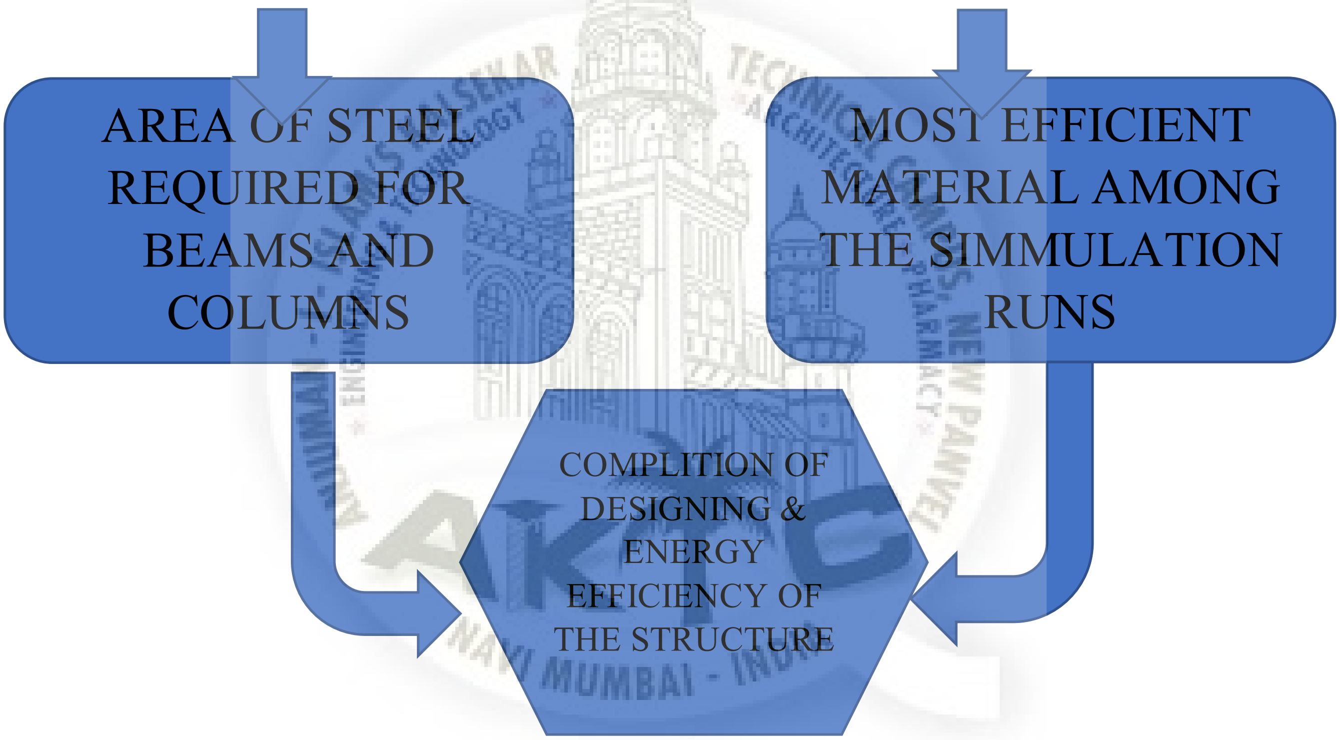
Energy simulation can help you analyse the movement of energy in, out, and through the rooms and volumes in a building model. This information can help designers make better informed, cost-effective decisions that improve the performance and reduce the environmental impact of buildings. Whole building energy simulation measures expected energy use (fuel and electricity) based on the building's geometry, climate, building type, envelope properties, and active systems (HVAC & Lighting). It takes into account the interdependencies of the building as a whole system. To perform whole building energy simulation for your Revit models, use Energy Analysis for Autodesk® Revit®. Use Energy Analysis for Autodesk® Revit® to perform energy simulation for conceptual forms and detailed architectural models created in Revit. Use the simulation results to understand building energy use. Then iterate the designs to improve their sustainability ratings.

The energy model created from the Revit building model can be displayed in Revit, so you can view and validate the energy model used for analysis. The energy model can also be exported to third-party applications for further analysis in a variety of common formats: gbXML, DOE2, and Energy Plus.

3.3 step 3: Flow chart

PROJECT FLOW CHART




AREA OF STEEL REQUIRED FOR BEAMS AND COLUMNS
MOST EFFICIENT MATERIAL AMONG THE SIMMULATION RUNS
COMPLITION OF DESIGNING & ENERGY EFFICIENCY OF THE STRUCTURE

Chapter 4

DATA COLLECTION AND ANALYSIS

The proposed colony has a total of 9 buildings each comprising of G+4(i.e 5) storeys. To redevelop any structure, existing norms of DCR (2034) have to be referred. The DCR (2034) has different sections for different redevelopment projects.

The MIG COLONY was built by MHADA and therefore the rules given in section 33(a) DCR (2034) are to be followed for redevelopment.

The first step done included getting the drawings from the MHADA department of existing society and drawings of buildings. Then the DCR (2034) was referred and the FSI that can be used was known. The section 33(a) says that the total built-up area should be divided into 3 components. Accordingly, how much built up area should be given to MHADA, tenant and developer was computed. After the collecting the required data the Drawings of the new proposed structure were made in AUTO CAD Software as a 2D plan

After the plan was ready the centre to centre line plan of beam was made in the same software

4.1 Analysis using ETABS software:

ETABS offer single face interface to perform: Analysing, Designing and reporting this software will analyse and design the residential building with much ease

There are step by step procedure to be followed for the analysing and designing the structure which has been explained in detail below in a proper sequence

4.1.1 Step 1: Model Initialization

A new model is selected in which model initialization is done (Fig 4.1). Then from the available options, built-in setting with IS 800:2007,IS456:2000 as the design code needs to be selected

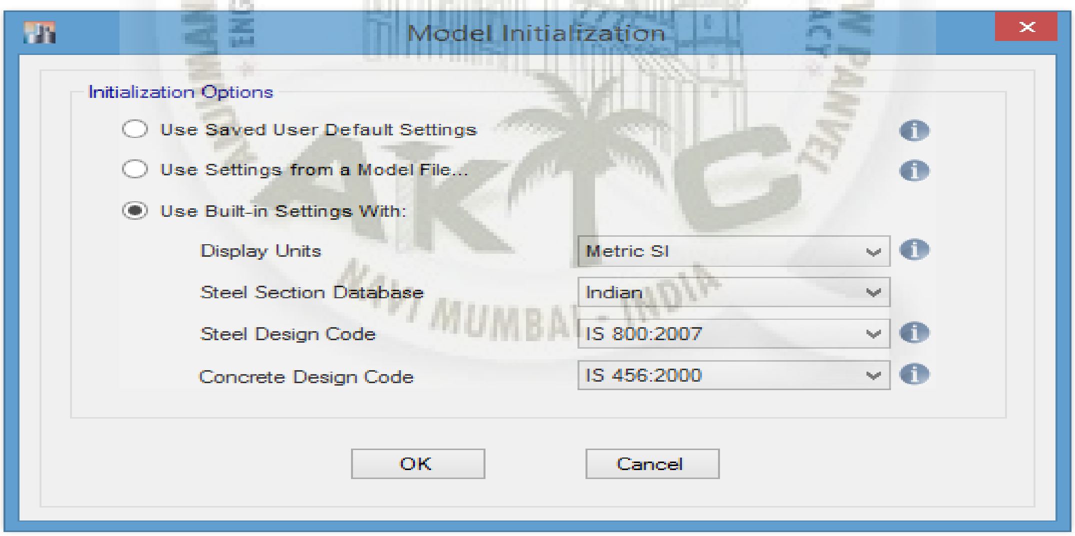


Fig 4.1: Model showing process of initializing in ETABS

4.1.2 Step 2: Grid System Data

The grid system is used to create a grid with the help of the values from the centre to centre line plan of beams from Auto Cad (Fig 4.2)

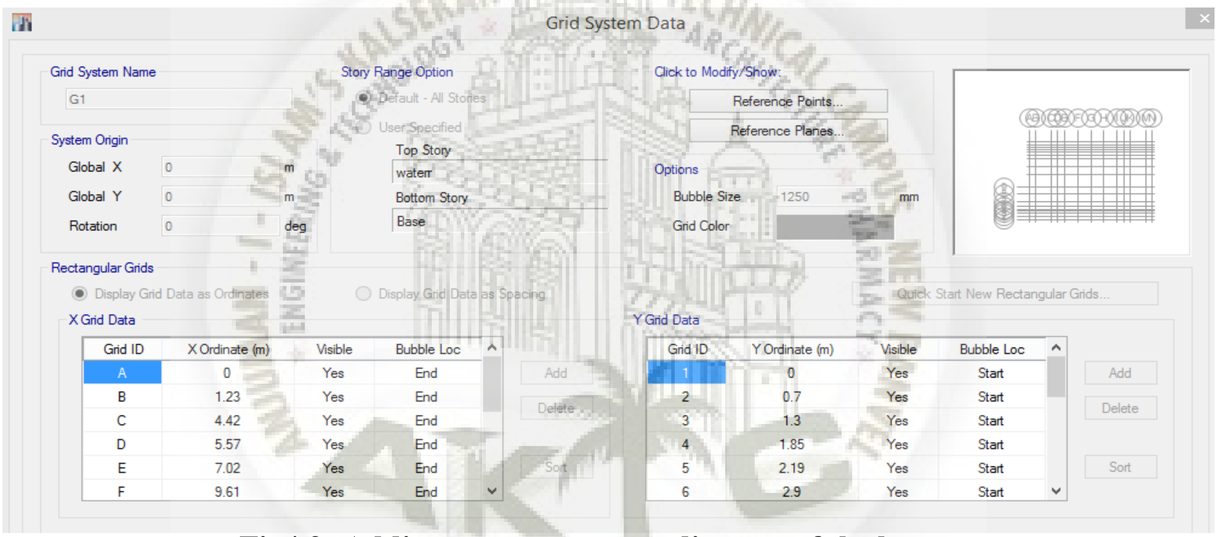


Fig4.2: Adding centre to centre distance of the beams

4.1.3 Step 3: Story editing data

The number of storeys, master storey, story height and the similar storeys is then selected in the story data (Fig 4.3)

Story	Height m	Elevation m	Master Story	Similar To	Splice Story	Splice Height m	Story Color m
waterr	3	27.6	No	None	No	0	
Story9	3	24.6	Yes	None	No	0	
Story8	3	21.6	No	Story9	No	0	
Story7	3	18.6	No	Story9	No	0	
Story6	3	15.6	No	Story9	No	0	
Story5	3	12.6	No	Story9	No	0	
Story4	3	9.6	No	Story9	No	0	
Story3	3	6.6	No	Story9	No	0	
Story2	3	3.6	No	Story9	No	0	
p storey	0.6	0.6	No	None	No	0	
Base		0					

Fig 4.3: Storey editing dialogue box

4.1.4 Step 4: Material defining tab

Defining grade of concrete and rebar is done by defining material as per IS456:2000 (Fig 4.4)

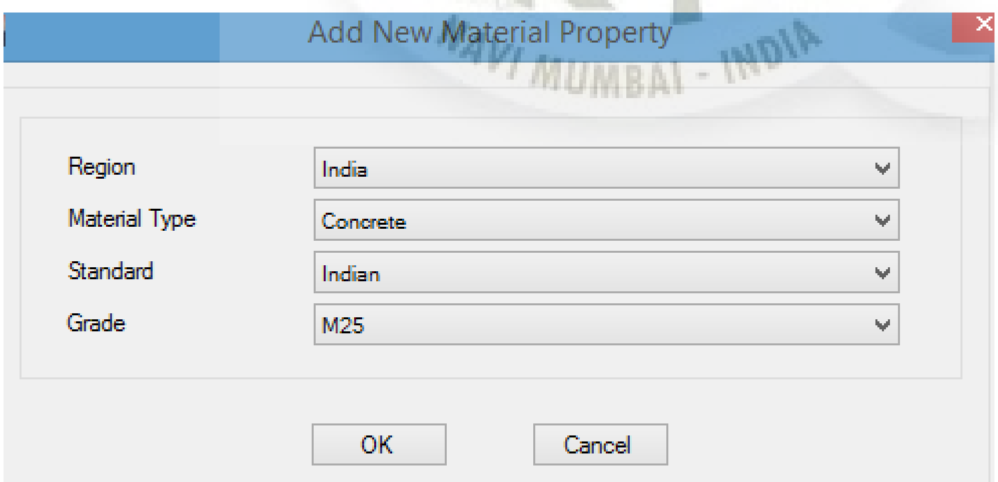


Fig 4.4: Material defining dialogue box

4.1.5 Step 5:Section defining tab

Defining section properties for beans and columns (Fig 4.5 and 4.6)

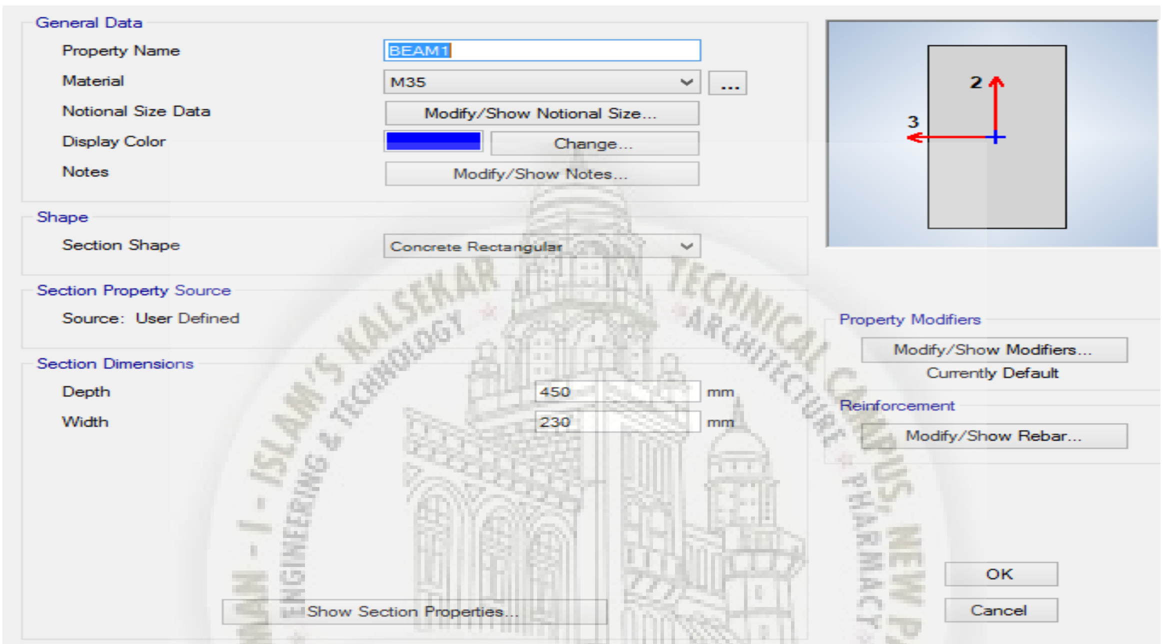


Fig 4.5: beam defining dialogue box

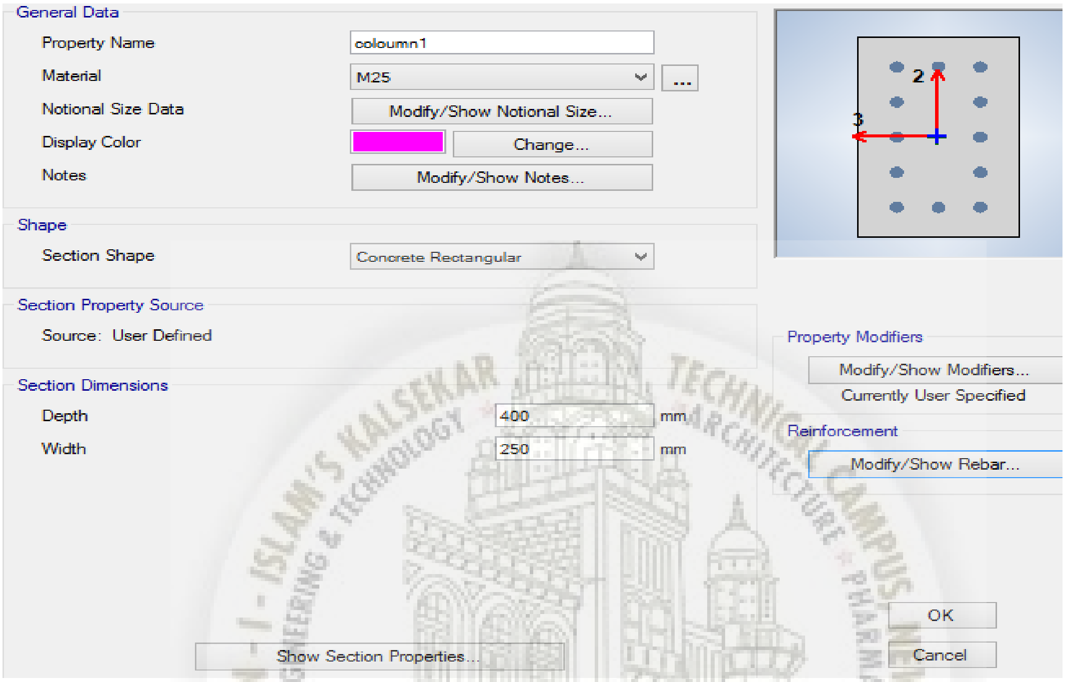


Fig 4.6.: Column defining dialogue box

4.1.6 Step 6:Section defining tab (slab)

Defining of section properties for slab (Fig 4.7)

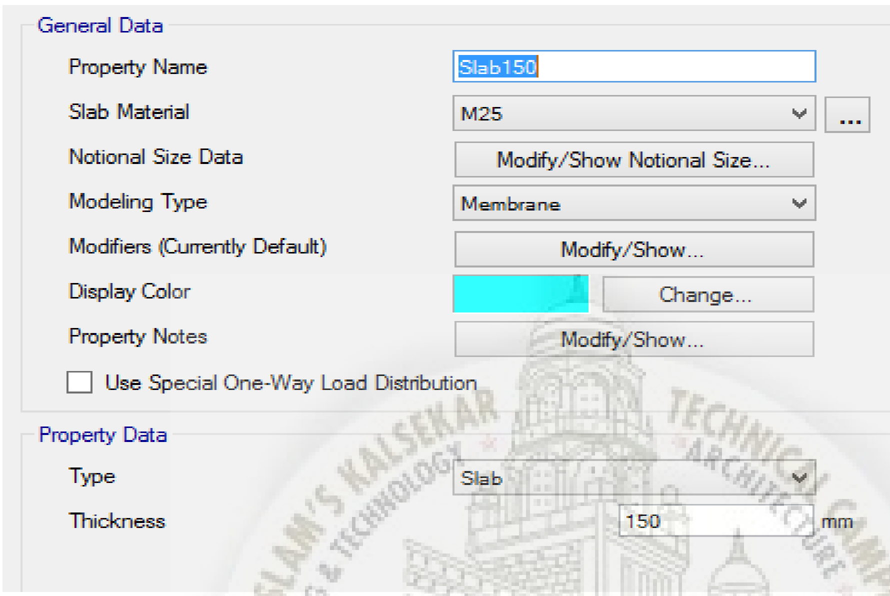


Fig 4.7: slab defining dialogue box

4.1.7 Step 7: Beam assignment on grids

Beams is drawn on the grids as per the drawings (Fig 4.8)

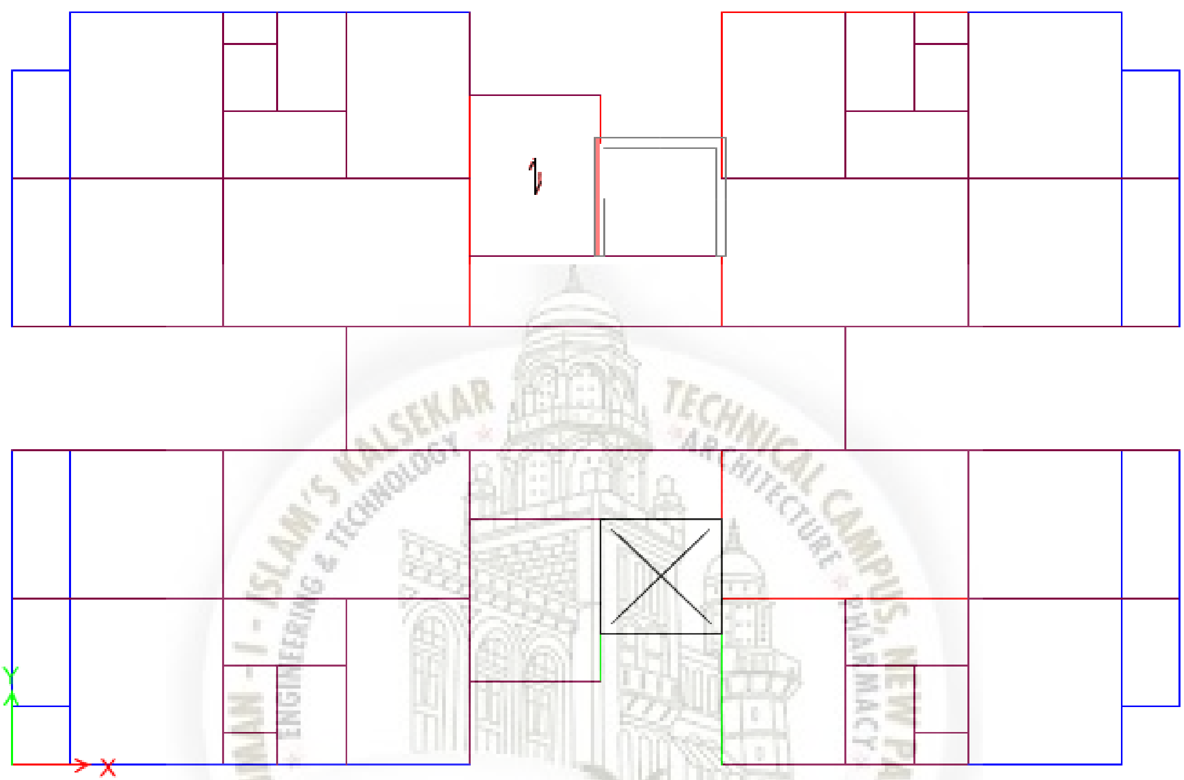


Fig 4.8: Drawing of the beams on the grids

4.1.8 Step 8:Coloumn assignment :

Columns are placed as per drawings (Fig 4.9)

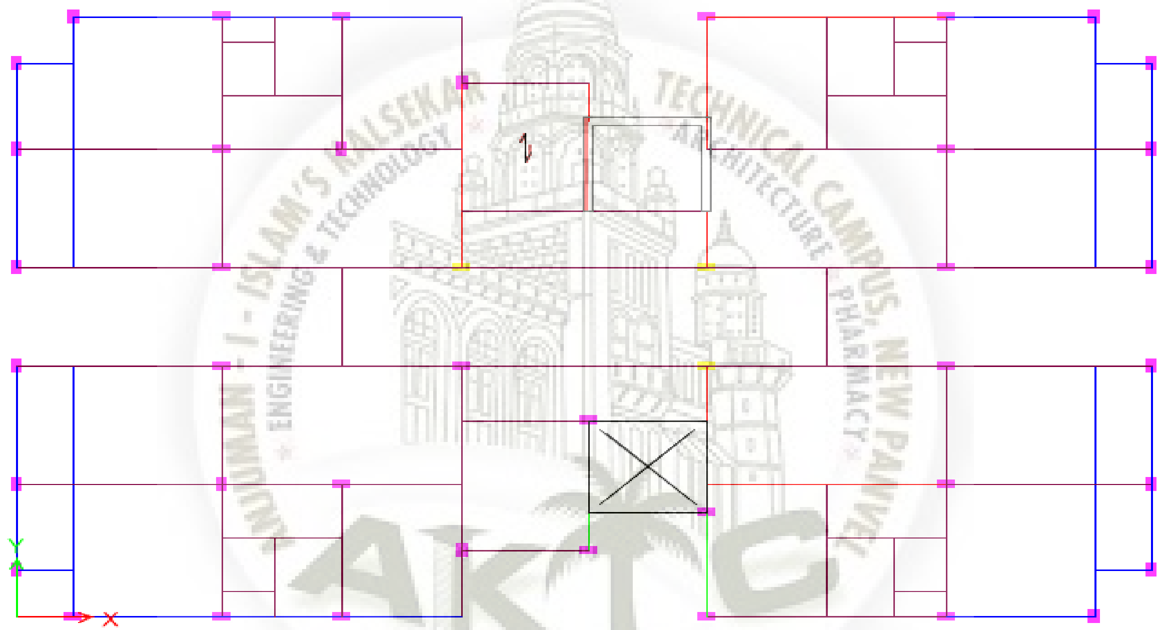


Fig 4.9: Placing of the column on the plan

4.1.9 Step 9: Slab assignment:

Slabs are placed as per the drawings (one way or two way) (Fig 4.10)

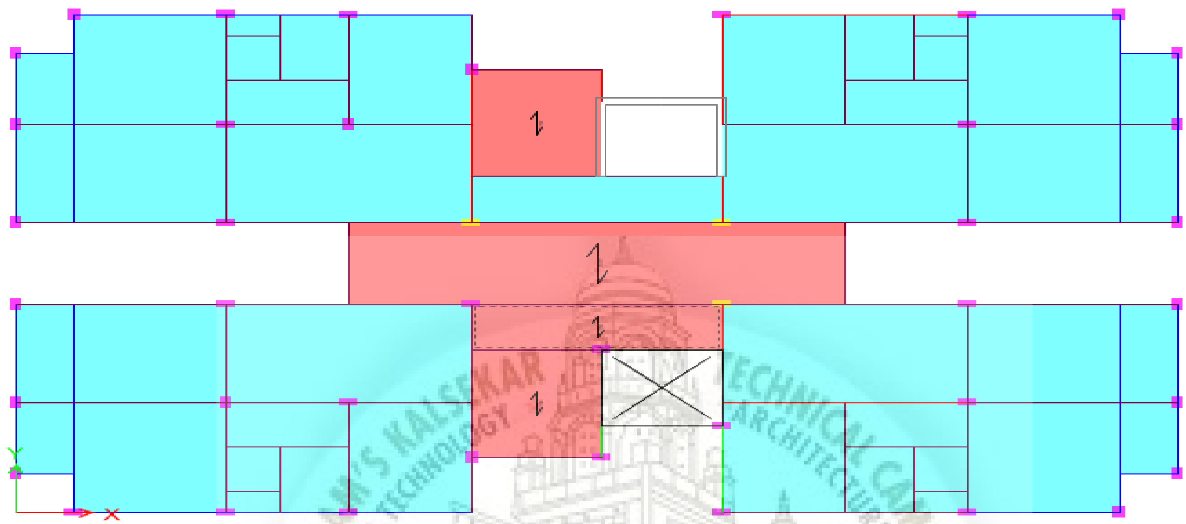


Fig 4.10: Placing the slabs on the plan

4.1.10 Step 10:Load pattern defination

Defining of the load patter is done (live, dead, seismic, masonry) (Fig 4.11)

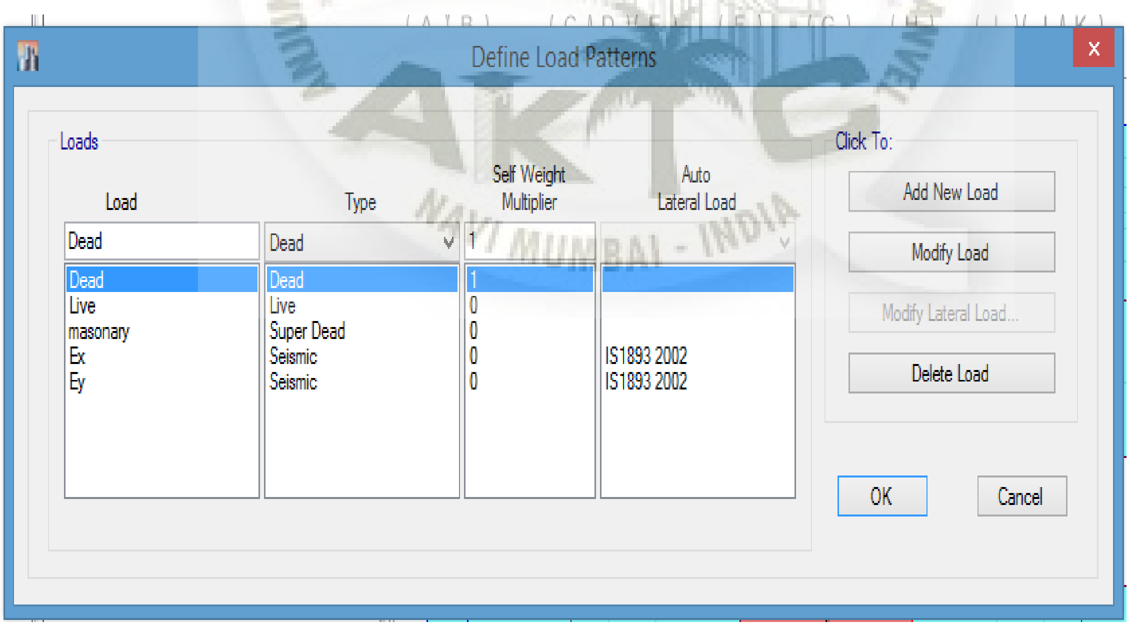


Fig 4.11: load pattern dialogue box

4.1.11 Step 11:Shell load assingment

Assigning of frame loads(distributed) and shell load(uniform) is done (Fig 4.12)

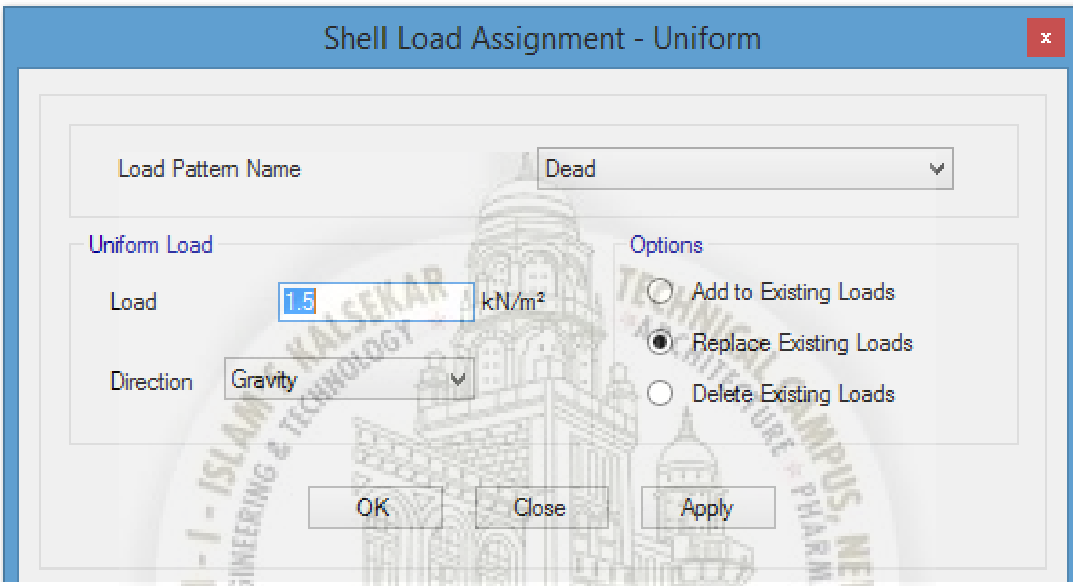


Fig 4.12: Dead and live load assignment dialogue box

4.1.12 Step 12:Defining load combination

Load combination is defined with 9 combination and 1 envelope (Fig 4.13)

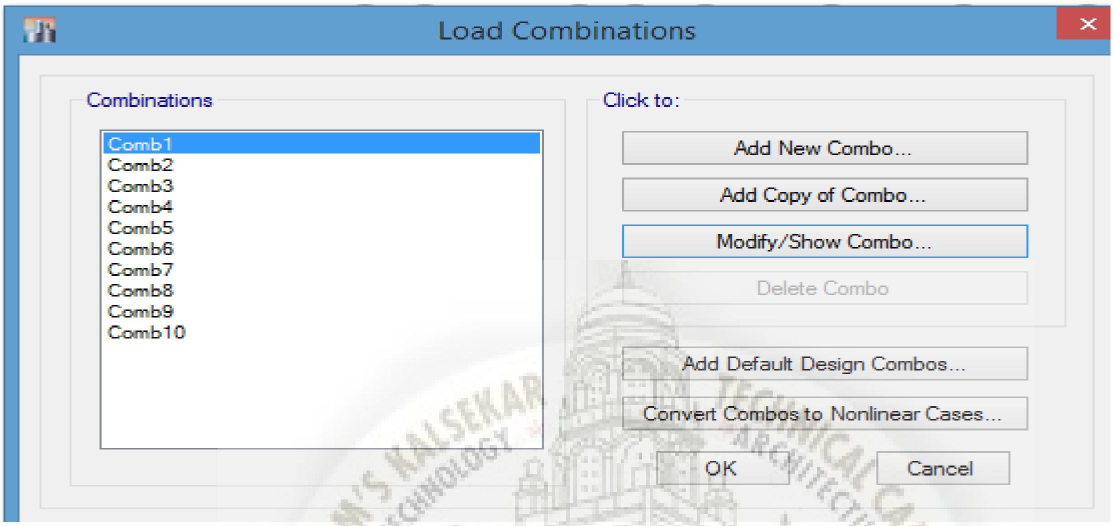


Fig 4.13: Defining load combination dialogue box

4.1.13 Step 13: Check model analysis

After all the above steps analyse check model. After checking model is free from errors or warnings analysis is done on the model (Fig 4.14)

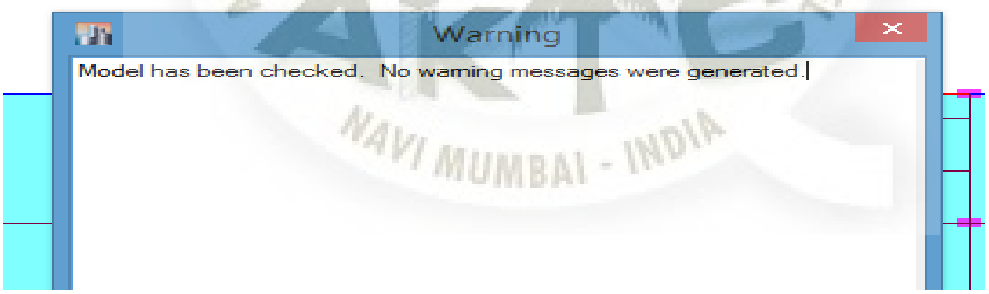


Fig 4.14: Warning box after checking model

4.1.14 Step 14:Base reaction calculation

The analysis gives the reaction on the base which helps the designing of foundation which is done on the Excel sheet.

4.2 Designing using ETABS:

After analysing the structure, designing the beams and columns are done using ETABS as per IS456 2000. Under this head, the elements for bending, shear and torsion are designed. The corresponding area of steel to counter bending, shear and torsion are worked out. Different structural members on different floors may or may not have same design and detailing schedule. (Fig 4.15)

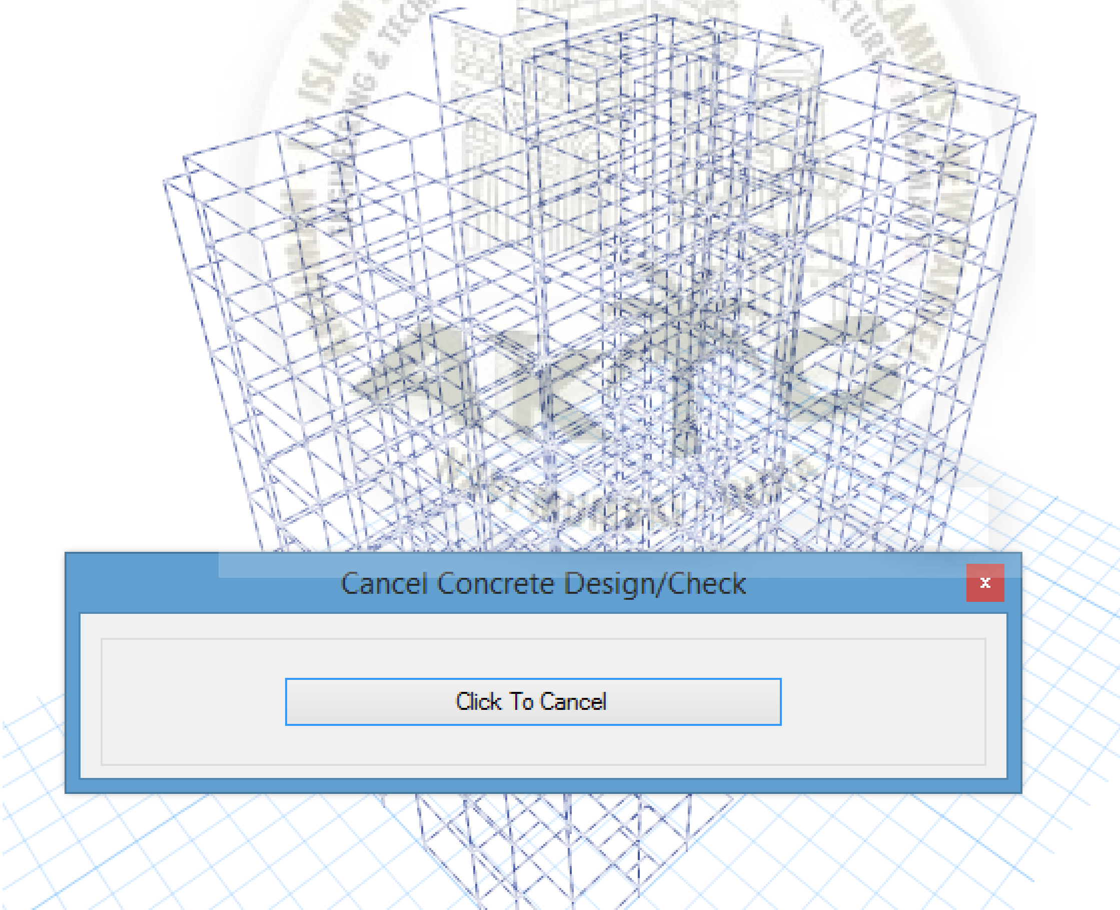


Fig 4.15: Designing of the beams and columns

4.3 Designing of the footings using excel sheets:

4.3.1 step 1: Calculating reinforcement in footings

The reactions are found on the base of the structure after analysis is ran on the ETABS taking this reaction in consideration footing is designed in the excel sheets according to IS 456 2000

4.4: Designing of the slabs manually:

4.4.1 step1: Calculating the area of reinforcement in slabs:

The reinforcement can also be designed in the excel sheets but here the designing is done manually according to IS 456 2000

4.5 Energy Analysis of the Structure (Autodesk REVIT 2017)

4.5Modellingusinf Autodesk REVIT software

This project demonstrate how to create and manage more complex projects using the REVIT software. The software features several analytical tools which is used to measures the environmental impact on our models. Model has to be created in the software to run the energy simulations for different materials

The step by step procedure for modelling in Autodesk REVIT for energy analysis is given below:

4.5.1 Step 1: Importing Autocad drawings
Importing the Auto cad plan of the structure to REVIT
4.5.2 Step 2: level defination tab
Defining the levels: The levels are defined from foundation level from first level to nine level (Fig 4.16)

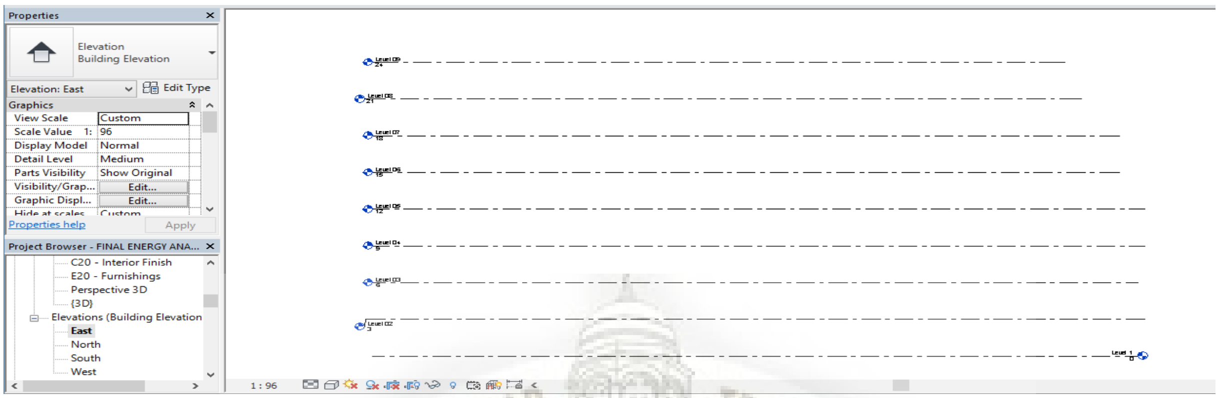


Fig 4.16: Definition of the levels

4.5.3 Step 3: wall type selection

Selecting the type of wall to be used. And the type of material to be used and also defining the thermal properties of the materials to be used (Fig 4.17)

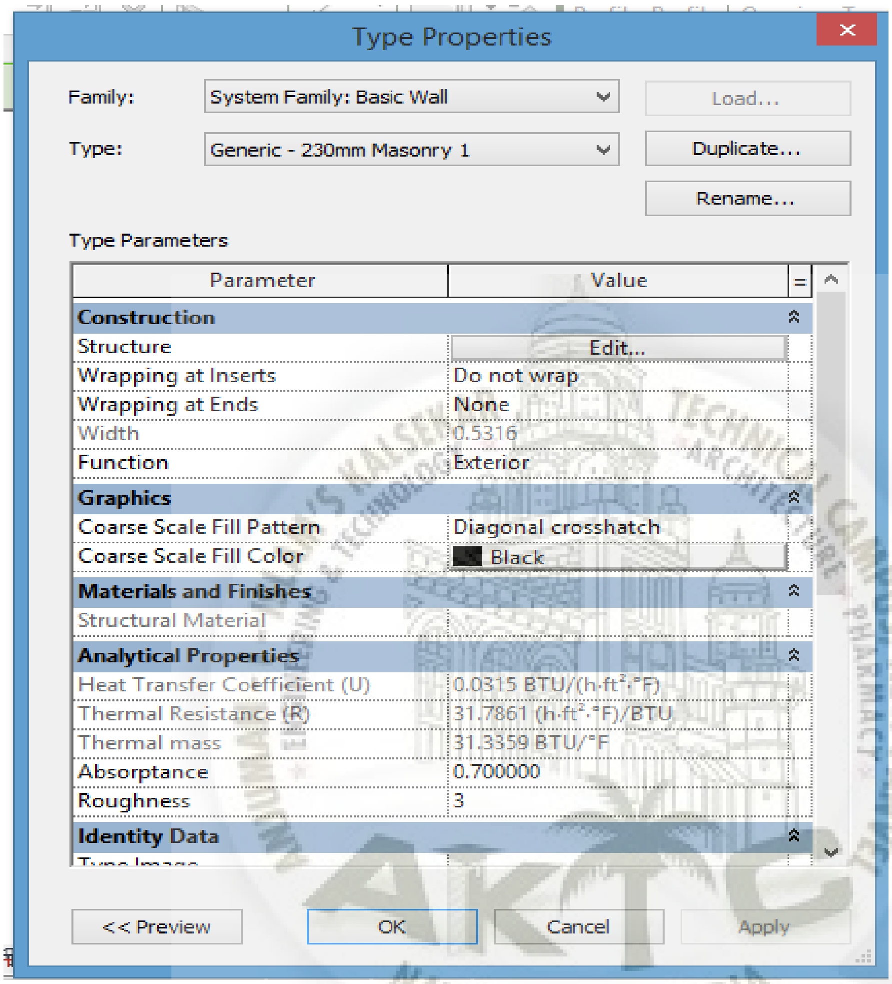


Fig 4.17: Wall defining dialogue box

4.5.4 Step 4: defining walls, doors and floor slab tab.

Defining of the windows, doors, floor slab and the roof slab is done along with material and their thermal properties (Fig 4.18 and 4.19)

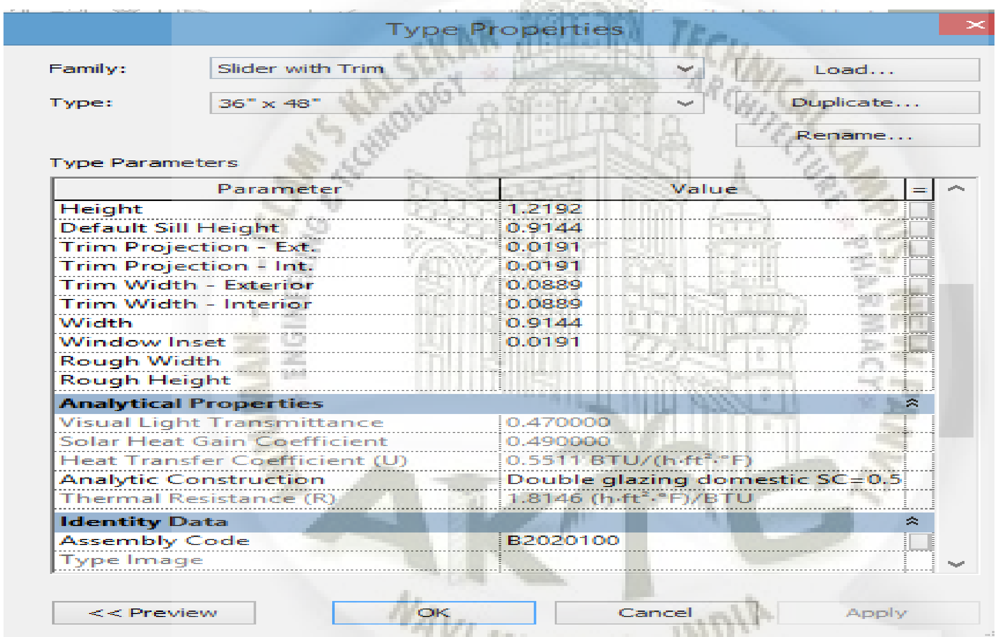


Fig 4.18: window defining dialogue box

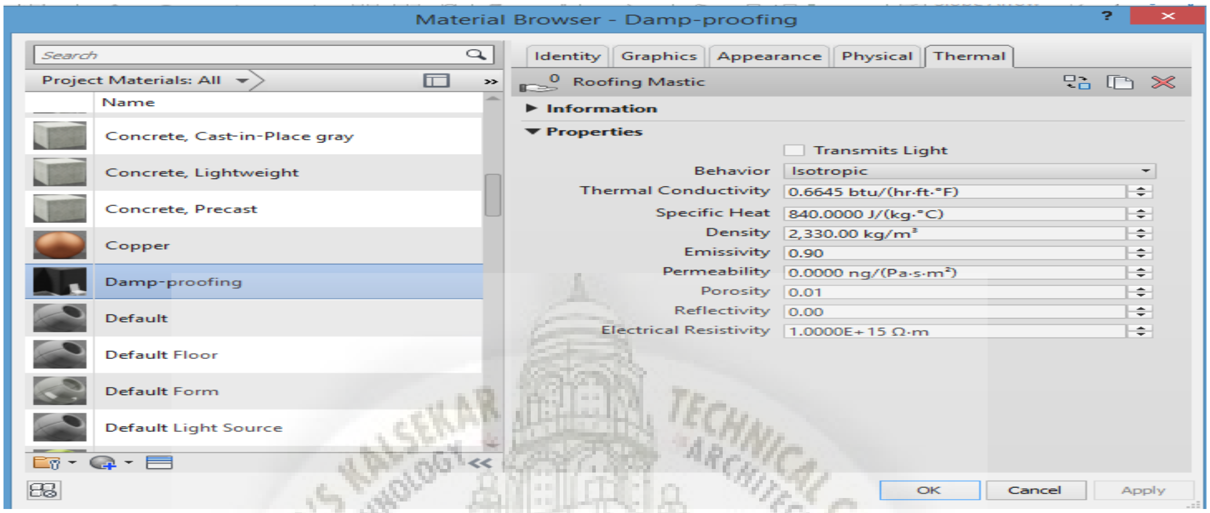


Fig 4.19: thermal properties dialogue box

4.5.5 Step 5: Modelling at first level

Modelling is done on the first level according to the Auto Cad plan. The complete plan of first level is then copied to clipboard and pasted from clipboard on different levels by the aligned at selected level option

4.4.6 Step 6: Providing location of the project

Location of the project is given to the software (calculation of weather conditions) (Fig 4.20)

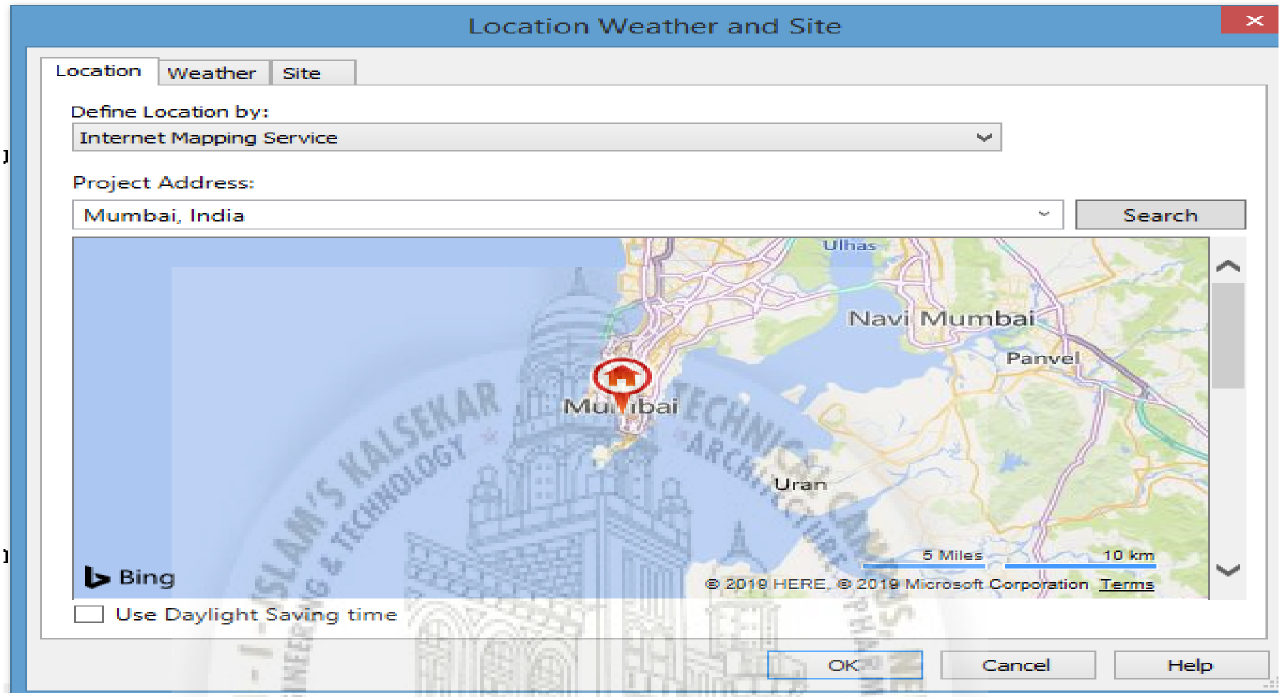


Fig 4.20: Location of the project

4.5.7 Step 7: Energy model created

Energy model is created in the analyse option and the same model is ran for the simulation (Fig 4.21)

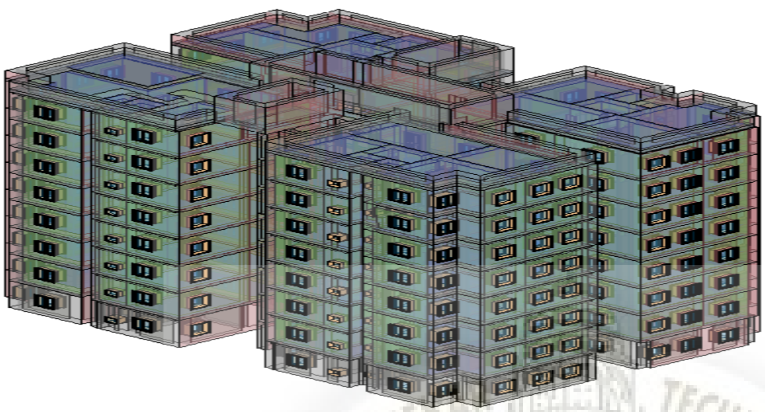
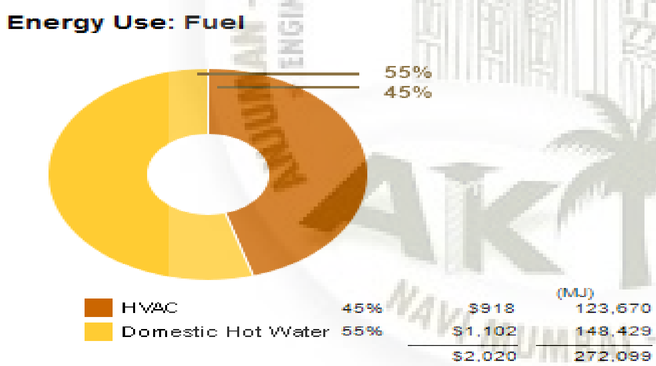


Fig 4.21: Energy model

4.5.8 Step 8: Simulation completed and results generated

After the simulation is completed the software gives the different results for the structure which helps in energy efficiency of the structure (Fig 4.22)



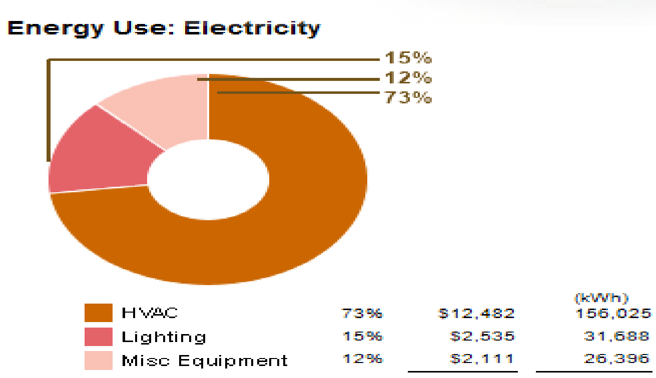


Fig 4.22: Showing electricity and fuel consumption with the respective cost

4.5.9 Step 9: Selection of most efficient result

Energy simulation is then done using different materials and the results of all the simulations is compared and the most efficient materials for us according to our environmental conditions are adopted for the structure

Chapter 5

RESULT AND DISCUSSION

After creating the model in ETABS, detailed analysis and design on the structure is performed. The results focus on area of steel required in the respective structural members (beams, column, shear walls) along with bending moment details, shear force details and deflection in each beam is also obtained.

The model was imported in the REVIT software for the energy simulations by varying different materials to study the energy consumption patterns and hence compare the results.

After reviewing the above three software, conclusions can be drawn that AutoCAD is the most efficient and user-friendly software for planning purpose. ETABS give the user the wide possibilities for designing almost any kind of structure in any region and under various condition. Autodesk REVIT is most comfortable and user-friendly software for 3-D modelling as it is very easy to understand and execute. It also gives the most efficient results of the energy simulations run on the structure

The following are the results generated for the project:

5.1 Step 1: Values of shear force and bending moment

1) The shear force and bending moment is given by the ETABS software (Fig 5.1)

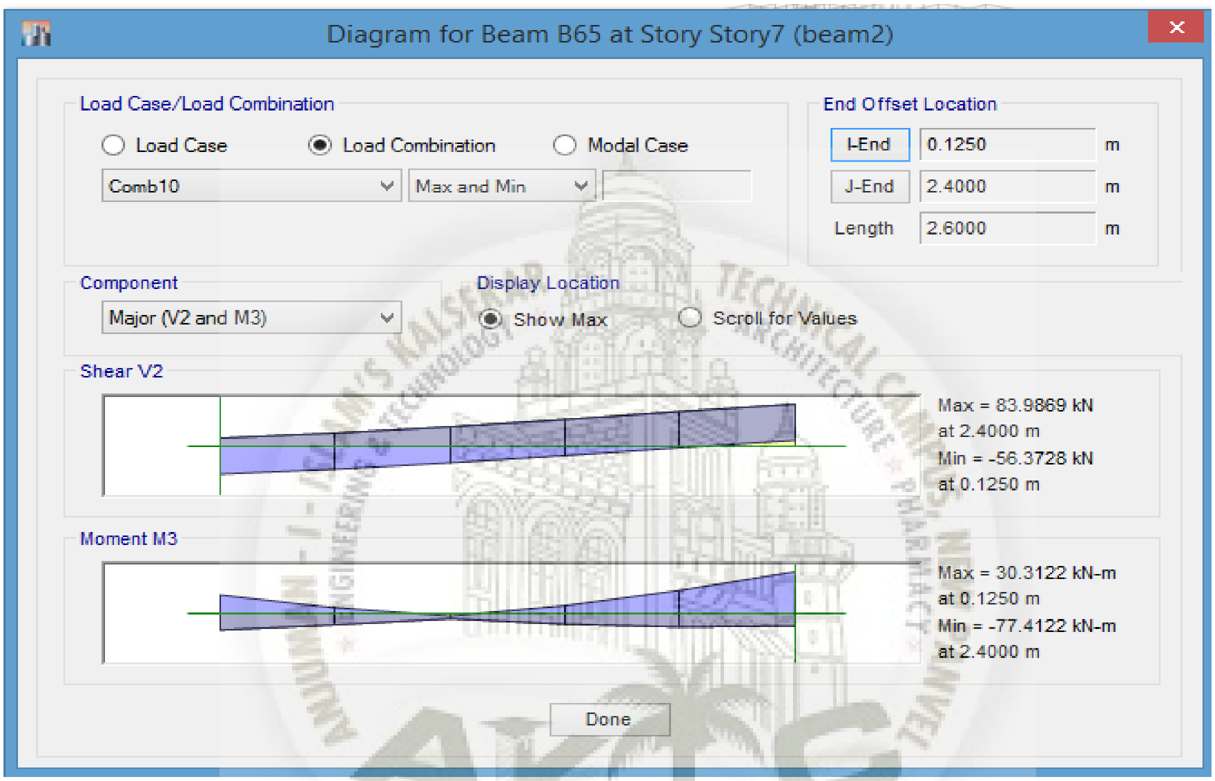


Fig 5.1: bending moment and shear force diagram of beam 65 of storey 7

5.2 Step 2: Reactions obtained on base

The reactions on base are obtained from ETABS for designing of the footings.

5.3 Step 3: Area of steel in beams and column obtained

The design Area of steel in beams and column (Fig 5.2 and 5.3)

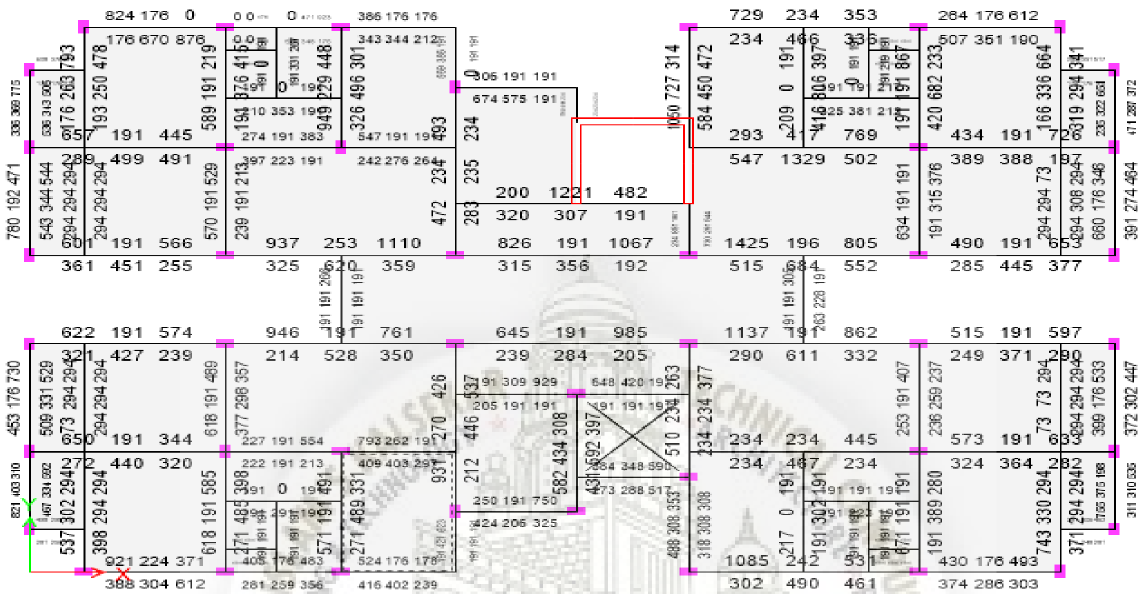
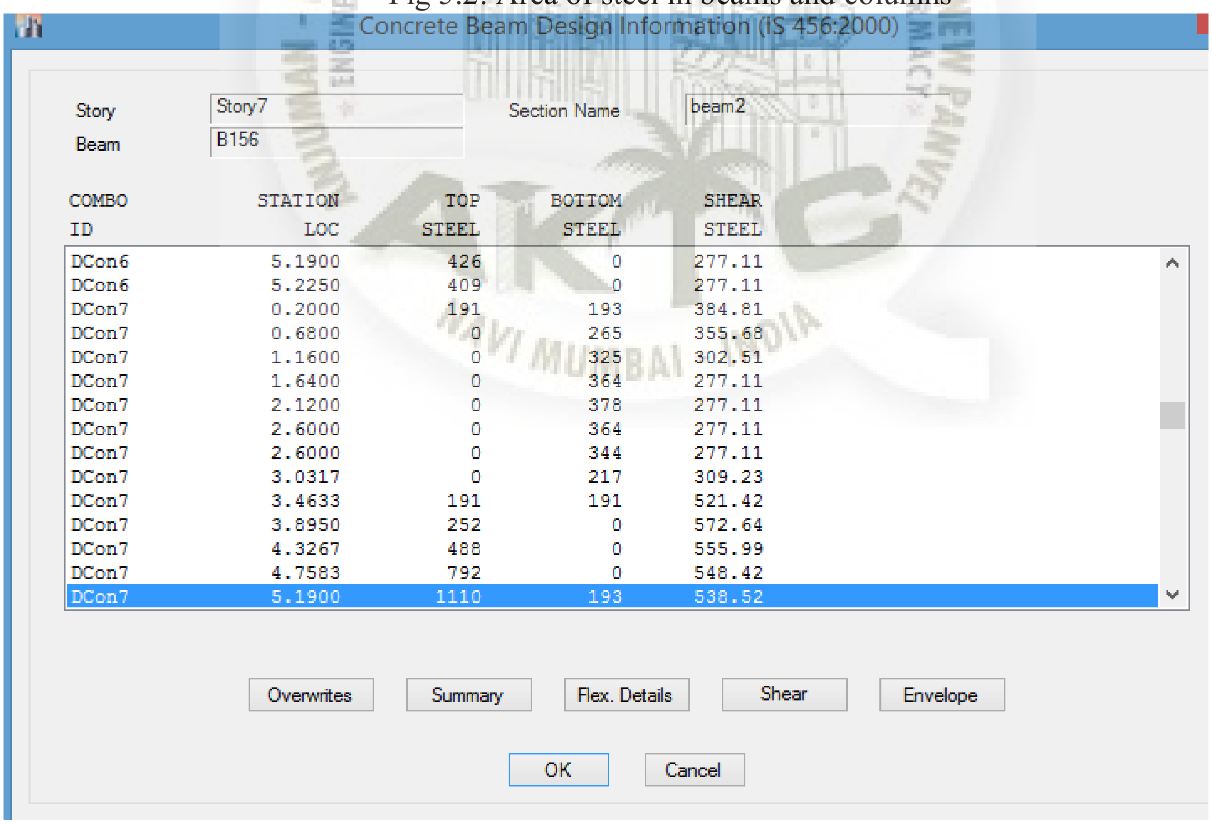


Fig 5.2: Area of steel in beams and columns



Concrete Beam Design Information (IS 456:2000)

Story: Story7 Section Name: beam2
Beam: B156

COMBO ID	STATION LOC	TOP STEEL	BOTTOM STEEL	SHEAR STEEL
DCon6	5.1900	426	0	277.11
DCon6	5.2250	409	0	277.11
DCon7	0.2000	191	193	384.81
DCon7	0.6800	0	265	355.68
DCon7	1.1600	0	325	302.51
DCon7	1.6400	0	364	277.11
DCon7	2.1200	0	378	277.11
DCon7	2.6000	0	364	277.11
DCon7	2.6000	0	344	277.11
DCon7	3.0317	0	217	309.23
DCon7	3.4633	191	191	521.42
DCon7	3.8950	252	0	572.64
DCon7	4.3267	488	0	555.99
DCon7	4.7583	792	0	548.42
DCon7	5.1900	1110	193	538.52

Overwrites Summary Flex. Details Shear Envelope

OK Cancel

Fig 5.3: beam design information

5.4 Step 4: Reinforcement provided in slabs:

Reinforcement provided in the slabs are for one way slab (5.26×1.565)m

Main and distribution steel is 8mmØ @270mmc/c

5.5step 5: Reinforcement provide in staircase

reinforcement provided in staircase (manually)

Number of Riser in each flight = 10 numbers

Number of Tread in each flight= 9 numbers

Floor to floor height = 3 meter

Providing main reinforcement as 10mmØ @ 160mmc/c

Providing distribution steel as 8mmØ @ 160mmc/c

5.6step 6: Reinforcement provide in footing

The design of footings(foundation)

For column 69 and 92:

Providing 12Ø @ 125mm c/c along the width (width=2.0 meter)

Providing 12Ø @ 140mm c/c along the length (length=2.2 meter

5.7step 7: estimated total approximate cost of the construction

Total approximate cost of the construction = ₹ 133 crore

5.8 step 8: Simulations results given by REVIT

The simulations of the energy analysis on the REVIT software using different materials (Fig 4.4,4.5 and 4.6)

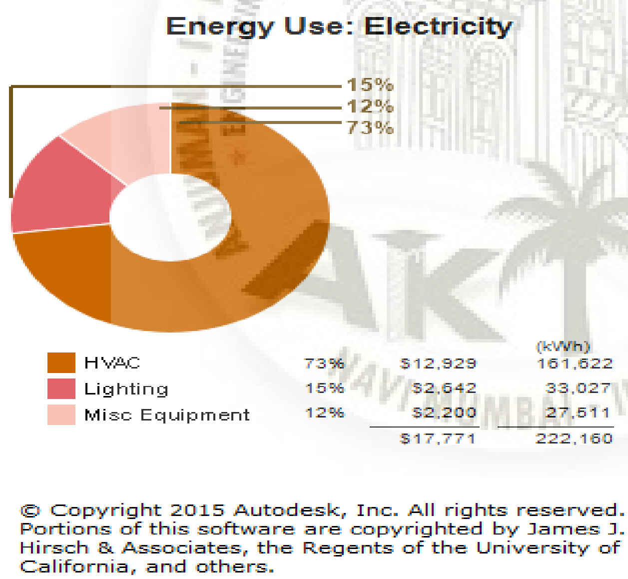


Fig 4.4: Consumption of electricity for materials used in run 1

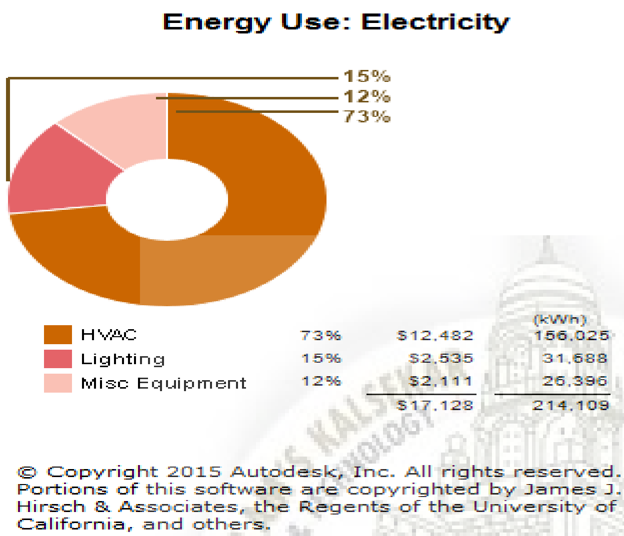


Fig 4.4: Fig 4.4: Consumption of electricity for materials used in run 2

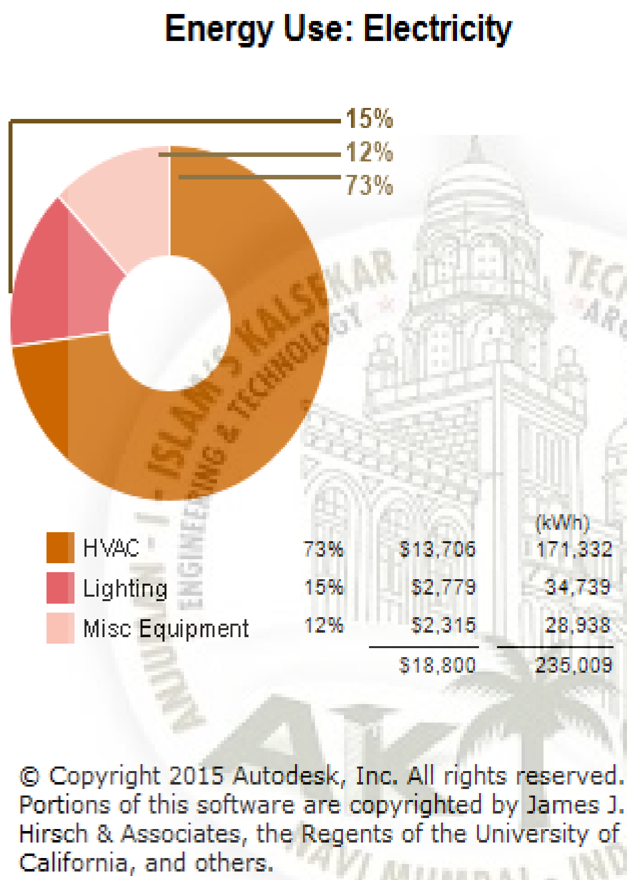


Fig 4.5: Fig 4.4: Consumption of electricity for materials used in run 3

Chapter 6

CONCLUSION AND FUTURE SCOPE

6.1 Conclusions from software analysis:

By the analysis and design of the structure in ETABS software and the energy analysis simulations on the Autodesk REVIT Software following conclusions are obtained:

1) All the criteria of serviceability and strength are satisfied. Therefor the beams, columns and shear walls area designed as per IS456:2000, IS1893 :2002 and IS800:2007 in ETABS software
2) The footings are designed in Excel sheets efficiently
3) The slabs and staircase are designed manually
4) Among all the 3 simulations run in the Autodesk REVIT software with different materials the most efficient material for our structure is acquired by the Software.

5) The total approximate cost of the entire project is also estimated and found to be 133 crores. Although this is more by around 10%, than conventional building, but it would account for considerable savings in life cycle costs.
6) Materials used in run 1 are found to be more efficient than materials in run 2 and run 3, if compared from cost-cutting point of view in operation and maintenance stages of the project.

6.2 Recommedations to the society:

From the data analysed in Chapter 4, and its subsequent results obtained in Chapter 5, it is imperative that the MIG colony in Kurla (W), would not be safe for residents in the near future unless severe structural modifications are done. Then too, the operational costs would be too high and the occupants have to shed a lot of money for maintenance. Therefore, it is proposed that the building shall be redeveloped using the material such as for the walls using the finish1 as common brick, thermal air-rigid insulation, membrane-damp proofing, structure-concrete masonry, finsih2-gypsum, for the windows use the double glazing window of shading coefficient as 0.5 and for the floor using the material of masonry and damp proofing . This green approach would initially cost around 10% more investments, but it will lead to substantial saving in the future, due to reduced O&M cost

6.3 Future Scope:

Due to plaucity of time, this redevelopment project was studied only from the traditional construction point of view, by replacing few conventtional materials. However, there is a lot of scope for achieving reduced energy consumption due to various innovative materials locally and globaaly available. The following four-point objective can take the research forward:

- Replace conventional brickwork for partition walls with thin-walled cement construction using mivan or doka. This woul results in more occupancy space and circulation area. Ultimately, less energy would be required during the functional utility of the building

- Replace conventional materilas by innovative materials and compare results for energy-saving.
- Change the orientation of buiding to suit sun-path and wind-rose diagrams
- Study the effect of increased FSI on health and stability of builldings. If positive results are found, increased FSI can be suggested, especially for redevelopment project.
- Synchronize timeline schedules (4-D), material take-of and cost (5-D), environment and sustainability (6-D) to obtain an efficient BIM model for a project.
- Study the impact of improved facilities management on the life cycle of project

6.4 Summary

This project is an attempt to find out how redevelopment of an MIG colony can be successfully achieved using modern tools for controling the project. Although, there are many limitations w.r.t reach and scope of the project, this study can be a pilot project for many dilapated structures in and around metro cities in India, which were built in different eras, but no longer stand good and need to be effectively redeveloped. The major issue in redevelopment is the resistance from occupants to leave their houses due to unassured patterns of development, However, if such a study is done in more detail, considering minute aspects of he project, and the occupants are shown the long-term benefits and assured time of delivery, redevelopment can be an attractive option for existing and new occupants alike.

Reference

1) Abhishek, Manoj S Kumar, Roopa B , Bhagyashree; Design and Analysis of Residential Building using E-TABS; Guruprasad International Research Journal of Engineering and Technology (IRJET);(2018)

2) Anil Kumar K. Padmanabham; Comparative Studies on Construction Cost of High Raise Buildings (Designed under RC Frame and Shear Wall Systems); International Journal of Science Technology & Engineering;(2017)

3) Chenhui Ni1, Xu Chen, Wanrong Chen, Zhenkun Gan, and Chao Zhang; Research on the Adaptability Design of Residential Buildings Based on the Upside-down System;(2017)

4) D. R. Vaidya, Prof. R. D. Shinde; 3D Modelling and Energy Analysis of a Residential Building using BIM Tools; International Research Journal of Engineering and Technology;(2017)

5) Naga Sai Gopal N. Lingeshwaran; ANALYSIS AND DESIGN OF G+5 RESIDENTIAL BUILDIN G BY USING E-TABSInternational Journal of Civil Engineering and Technology (IJCIET);(2017)

6) Kamar Aljundi , Armando Pinto , Fernanda Rodrigues;Energy analysis using cooperation between bim tools (revit and green building studio) and energy plus; ºCongresso Português de Building Information Modelling;(2016)

7) Lisha, Yixing Deng and Min Ren; Structural reconstruction design and performance simulation analysis of old buildings based on BIM Ren;International Journal of Low-Carbon Technologies; (2018).

8) Vinayak Subhashchandra Pore, Prof. Shruti Wadalkar;Recent Practices of Redevelopment of Housing Societies in the Developing Cities of India;International Journal of Innovative Research in Science, Engineering and Technology;(2017)

9) Venkataraman A., Kannan R.; Whole Building Energy Analysis using BIM; Proceedings of International Conference on Advances in Civil Engineering (AETACE); (2014)