CHAPTER-1
INTRODUCTION

1.1 General:

What we have been exercising in our academic or professional carrier are based upon the western origin. Our careerists engineers, architects and planners are convinced of their research and investigations as a matter of disciplines, this is excellent, but we have a sacred duty to formulate a short of technology to fit into our merits.

In keeping this in mind, we tried to develop a short formula to find out moment with the relation of height and shape variations of building.

1.2 Importance of the study:

The importance of the study for engineers are as follows:

- Should consider both wind and earthquake effects for designing the building.
- Should identify which floor govern maximum moment and design accordingly.
- Should understand the risk associated with high rise building.

1.3 OBJECTIVES OF THE STUDY:

To develop an empirical formula by which any engineer in home and abroad can easily find out relations between moment and height of various forms of the building.

1.4 ORGANIZATION OF THE THESIS OR METHODOLOGY:

For the study of this project we chose the following types and shapes of six to ten storied residential building. Load calculation is performed according to code UBC 94. We considered wind load and earthquake load based on 3 zone in Bangladesh.

Type & shape of building

Type-1	**Type-2**
Type=L-48XB-32	Type=L-64XB-48
Type=L-64XB-32	Type=L-80XB-48
Type=L-80XB-32	Type=L-96XB-48

1.5 BACKGROUND:

The history of high rise may be traced back to pyramids of Egypt about 48 stories in height and the tower of Babel.

People did not build tall structure again until the late 1600s, apart from a few roman apartment building of six or seven story tall. Tall building with iron skeletons began to be constructed in 1860s. In 1885 a ten story building was constructed in Chicago by William Le Baron Jenney.

CHAPTER-2
SOFTWARE REVIEW

2.1 What is ETABS (Extended 3D Analysis of Building: System)?

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. The state-of-the-art SAPFIRE 64-bit solver allows extremely large and complex models to be rapidly analyzed, and supports nonlinear modeling techniques such as construction sequencing and time effects (e.g., creep and shrinkage).

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.

2.2 Analysis Software:

There is much finite element software for analyzing structure. ETABS is one of them. Every analysis is this thesis is done by using ETABS 16 package. In the following paragraph we will discuss some of its features.

2.3 History and advantage of ETABS:

Dating back more than 40 years to the original development of TABS, the predecessor of ETABS, it was clearly recognized that buildings constituted a very special class of structures. Early releases of ETABS provided input, output and numerical solution techniques that took into consideration the characteristics unique to building type structures, providing a tool that offered significant savings in time and increased accuracy over general purpose programs.
As computers and computer interfaces evolved, ETABS added computationally complex analytical options such as dynamic nonlinear behavior, and powerful CAD-like drawing tools in a graphical and object-based interface. Although ETABS 2016 looks radically different from its predecessors of 40 years ago, its mission remains the same: to provide the profession with the most efficient and comprehensive software for the analysis and design of buildings. To that end, the current release follows the same philosophical approach put forward by the original programs, namely:

- Most buildings are of straightforward geometry with horizontal beams and vertical columns. Although any building configuration is possible with ETABS, in most cases, a simple grid system defined by horizontal floors and vertical column lines can establish building geometry with minimal effort.
- Many of the floor levels in buildings are similar. This commonality can be used to dramatically reduce modeling and design time.
- The input and output conventions used correspond to common building terminology. With ETABS, the models are defined logically floor-by-floor, column-by-column, bay-by-bay and wall- by-wall and not as a stream of non-descript nodes and elements as in general purpose programs. Thus the structural definition is simple, concise and meaningful.
- In most buildings, the dimensions of the members are large in relation to the bay widths and story heights. Those dimensions have a significant effect on the stiffness of the frame. ETABS corrects for such effects in the formulation of the member stiffness, unlike most general-purpose programs that work on center- line-to-centerline dimensions.
- The results produced by the programs should be in a form directly usable by the engineer. General purpose computer programs produce results in a general form that may need additional processing before they are usable in structural design.

2.4 An Integrated Approach:

ETABS is a completely integrated system. Embedded beneath the simple, intuitive user interface are very powerful numerical methods, design procedures and international design codes, all working from a single comprehensive database. This integration means that you create only one model of the floor systems and the vertical and lateral framing systems to analyze, design, and detail the entire building.

Everything you need is integrated into one versatile analysis and design package with one Windows-based graphical user interface. No external modules are required. The effects on one part of the structure from changes in another part are instantaneous and automatic. The integrated components include:

Drafting for model generation

Seismic and wind load generation

Gravity load distribution for the distribution of vertical loads to columns and beams when plate bending floor elements are not provided as a part of the floor system

Finite element-based linear static and dynamic analysis

Finite element-based nonlinear static and dynamic analysis (available in ETABS Nonlinear & Ultimate versions only)

Output display and report generation

- Steel frame design (column, beam and brace)
- Concrete frame design (column and beam)
- Concrete slab design
- Composite beam design
- Composite column design
- Steel joist design
- Shear wall design
- Steel connection design including column base plates
- Detail schematic drawing generation

2.5 Modeling Features:

The ETABS building is idealized as an assemblage of shell, frame, link, tendon, and joint objects. Those objects are used to represent wall, floor, column, beam, brace, tendon, and link/spring physical members. The basic frame geometry is defined with reference to a simple three- dimensional grid system. With relatively simple modeling techniques, very complex framing situations may be considered. The buildings may be unsymmetrical and non-rectangular in plan. Torsional behavior of the floors and inter story compatibility of the floors are accurately reflected in the results. The solution enforces complete three- dimensional displacement compatibility, making it possible to capture tubular effects associated with the behavior of tall structures having relatively closely spaced columns.

Semi-rigid floor diaphragms may be modeled to capture the effects of in- plane floor deformations. Floor objects may span between adjacent levels to create sloped floors (ramps), which can be useful for modeling parking garage structures. Modeling of partial diaphragms, such as in mezzanines, setbacks, atriums and floor openings, is possible without the use of artificial ("dummy") floors and column lines. It is also possible to model situations with multiple independent diaphragms at each level, allowing the modeling of buildings consisting of several towers rising from a common base.

The column, beam and brace elements may be non-prismatic, and they may have partial fixity at their end connections. They also may have uniform, partial uniform and trapezoidal load patterns, and they may have temperature loads. The effects of the finite dimensions of the beams and columns on the stiffness of a frame system are included using end offsets that can be automatically calculated.
The floors and walls can be modeled as membrane elements within plane stiffness only or full shell-type elements, which combine both in- plane and out-of-plane stiffness. Floor and wall members may have uniform and non-uniform load patterns in-plane or out-of-plane, and they may have temperature loads. The column, beam, brace, floor and wall members are all compatible with one another.

2.6 Analysis Features:

Static analyses for user specified vertical and lateral floor or story loads are possible. If floors with out-of-plane bending capability are modeled, vertical loads on the floor are transferred to the beams and columns through bending of the floor elements. Otherwise, vertical loads on the floor are automatically converted to span loads on adjoining beams, or point loads on adjacent columns, thereby automating the tedious task of transferring floor tributary loads to the floor beams without the need to explicitly model the secondary framing.

The program can automatically generate lateral wind and seismic load patterns to meet the requirements of various building codes. Three- dimensional mode shapes and frequencies, modal participation factors, direction factors and participating mass percentages are evaluated using eigenvector or Ritz vector analysis. P-Delta effects may be included with static or dynamic analysis.
Response spectrum analysis, linear time history analysis, nonlinear time history analysis, and static nonlinear (pushover) analysis are all possible. The static nonlinear capabilities also allow you to perform incremental construction analysis so that forces that arise as a result of the construction sequence are included.

Results from the various static load cases may be combined with each other or with the results from the dynamic response spectrum or time history analyses.
Output may be viewed graphically, displayed in tabular output, compiled in a report, exported to a database file, or saved in an ASCII file. Types of output include reactions and member forces, mode shapes and participation factors, static and dynamic story displacements and story shears, inter-story drifts and joint displacements, time history traces, and more.
Import and export of data may occur between third-party applications such as Revit and AutoCAD from Autodesk, or with other programs that support the CIS/2 or IFC data models.

ETABS uses the SAPFire™ analysis engine, the state-of-the-art equation solver that powers all of CSI's software. This proprietary solver exploits the latest in numerical technology to provide incredibly rapid solution times and virtually limitless model capacity.

2.7 Design Features:

Design of steel frames, concrete frames, concrete slabs, concrete shear walls, composite beams, composite columns, and steel joists can be performed based on a variety of US and International design codes. Flexural, shear and deflection checks may all be performed depending upon the material and member type. Steel and concrete frame members may be optimized from auto select lists, and concrete sections are designed using reinforcing bar sizes chosen from US or International standards. Concrete slab design may be done using either design strips, or be based on the finite element method, and may include the effects of post-tensioning. Steel connection design automates the review of beam-beam and beam-column connections based on user specified bolt and shear plate preferences. Steel base plate design verifies the size, thickness, and anchorage of the connection.

2.8 Detailing Features:

Schematic construction drawings showing floor framing, column schedules, beam elevations and sections, steel connection schedules, and concrete shear wall reinforcing may be produced. Concrete reinforcement of beams, columns, and walls may be selected based on user-defined rules. Any number of drawings may be created, containing general notes, plan views, sections, elevations, tables, and schedules. Drawings may be printed directly from ETABS or exported to DXF or DWG files for fur- the refinement.

CHAPTER-3
STRUCTURAL MODELING AND ANALYSIS

3.1 Introduction:

To present the procedure of analysis and design of the RCC structures is consider a standard grid of 16'x16' and taken different shape from six to ten stored residential building. Dead load, Live load, Vertical load, Lateral load, Wind load, Seismic load are taken on the basis of contemporary trend performing by designers.

Given:

Material Properties:

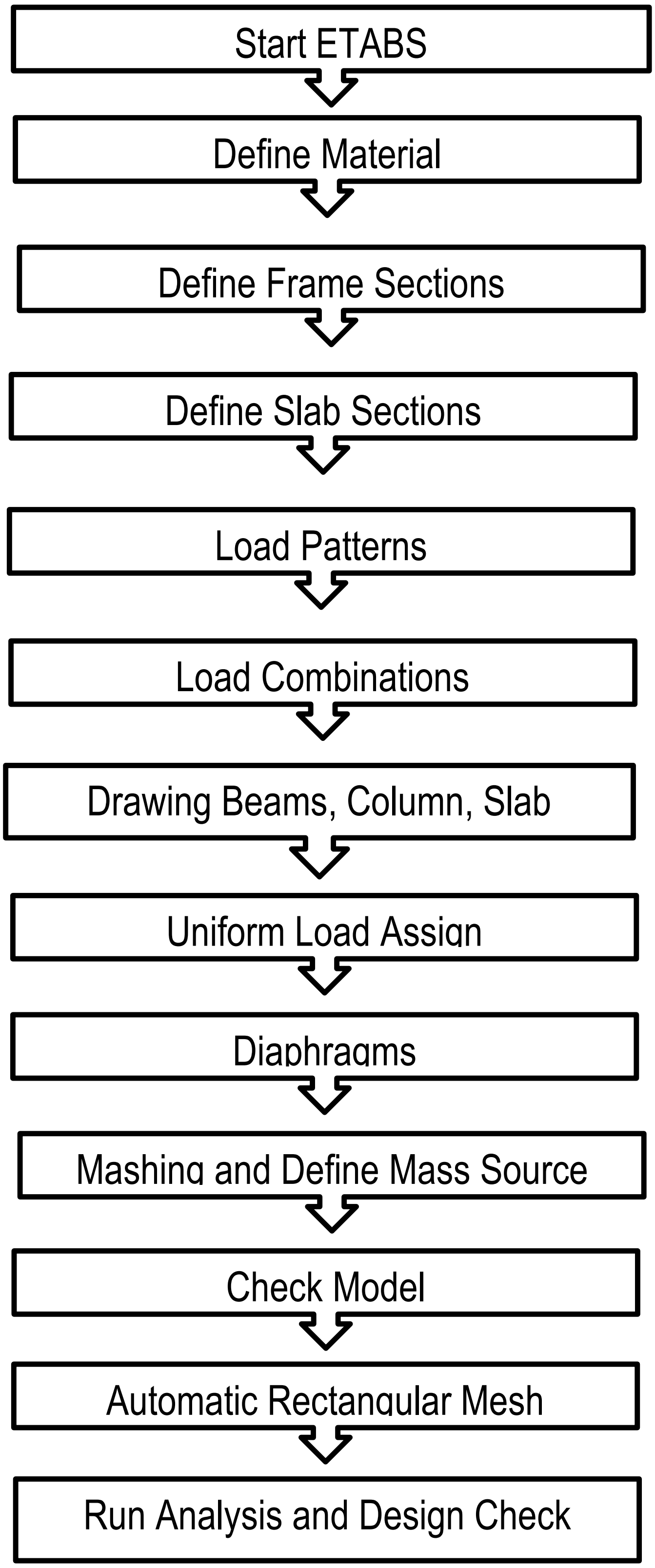
Concrete Compressive strength, f'c = 4 ksi
Yield Strength of Rebar, fy = 72.5ksi (500Mpa)
Yield Strength of Shear Rebar, fy=40 ksi

Load:
Live Load= 40 psf
Partition Wall=35 psf
Floor Finish=25 psf

Beam and Column size:

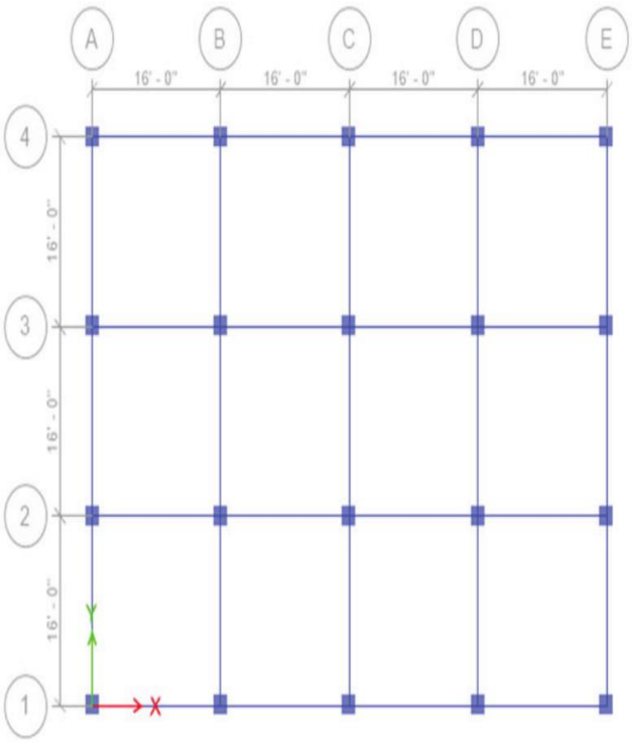
Column=20"x20"
Beam=12"x20"
Beam=12"x21"
All Slab 6" Thickness

3.1.1 Methodology flow Diagram:



3.1.2 Plan:

Beam Column Layout (PLAN-XY)



Material Properties:

Concrete Compressive strength, f'c = 4 ksi
Yield Strength of Rebar, fy = 72.5ksi (500Mpa)
Yield Strength of Shear Rebar, fy=40 ksi

Beam and Column size:
Column=20"x20"
Beam =12"x20"
Beam =12"x21"
All Slab 6"

Load Patterns:

Dead: All the self wt of drawn members.
Live: 40 psf on floor and roof slab,
FF: Floor Finish 25 psf on all slabs
PW: 35 psf on all floor slabs
500 plf on all beams

Load Combinations
(a) 1.4xDead Loads
(b) 1.2xDead Loads + 1.6xLive Loads`

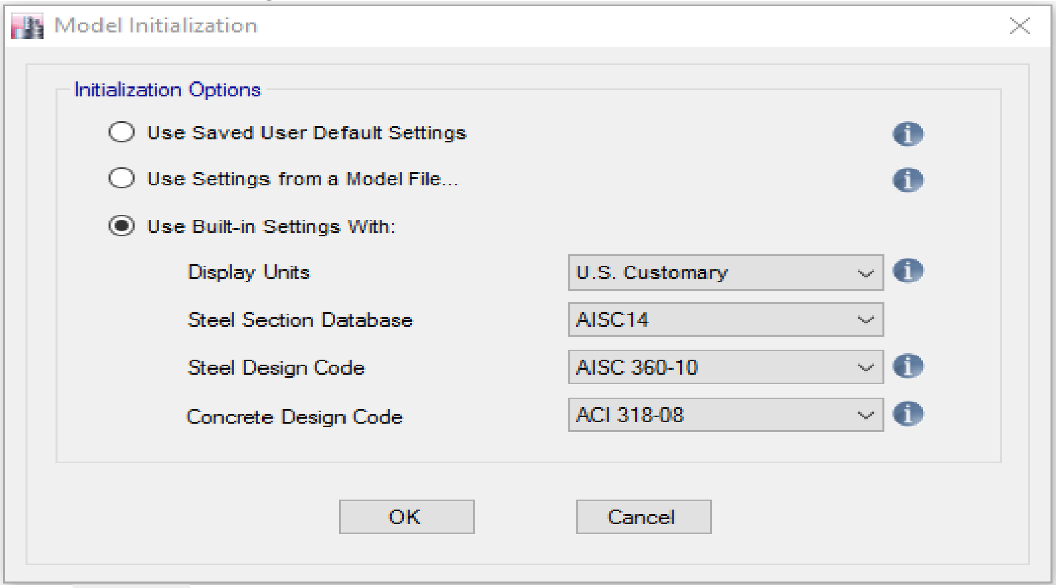
Step	**Action**

3.1.3 **Start ETABS 2016:**

Menu Command: **File>New Model.**

Click on "Use Built-in Settings With:" radio button

Set **Concrete Design Code** to **ACI 318-08**



Click "OK"

New Model Quick Templates window appears

From **New Model Quick Templetes** window

Click on "Custom Grid Spacing" radio button

Click on "Edit Grid Data..." button

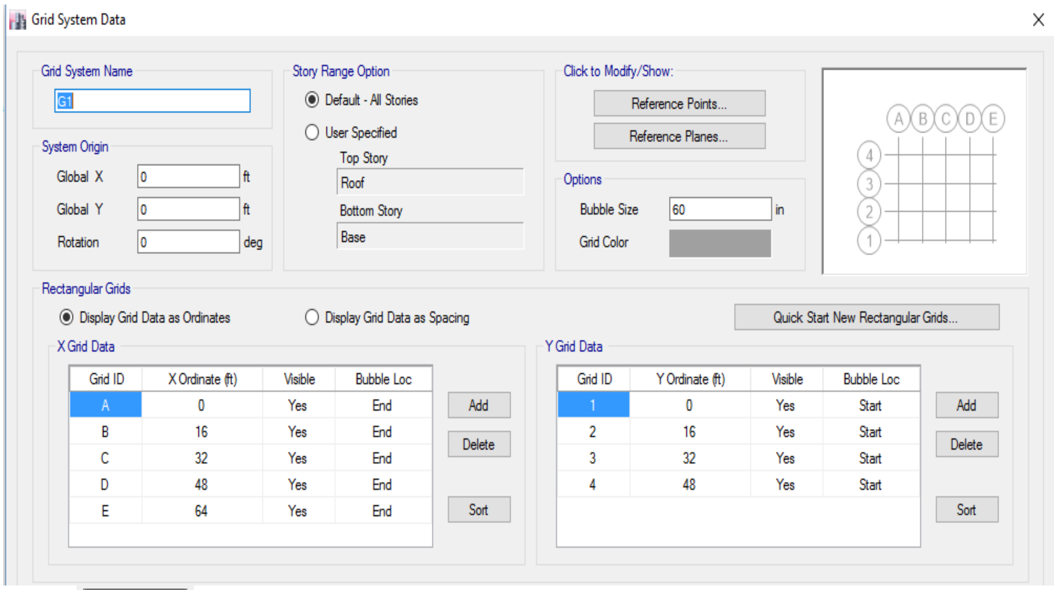
Grid System Data window appears

Click on "Display Grid Data as Spacing" radio button

Click "Add" button to add an extra grid (Grid E) in X

Set the **X Grid Data** and **Y Grid Data** as follows

X Grid Data			**Y Grid Data**	
Grid ID	X Spacing (ft)		Grid ID	Y Spacing (ft)
A	16’		1	16’
B	16’		2	16’
C	16’		3	16’
D	16’		4	0
E	0			



Click 

Brings back to ***New Model Quick Templates window***

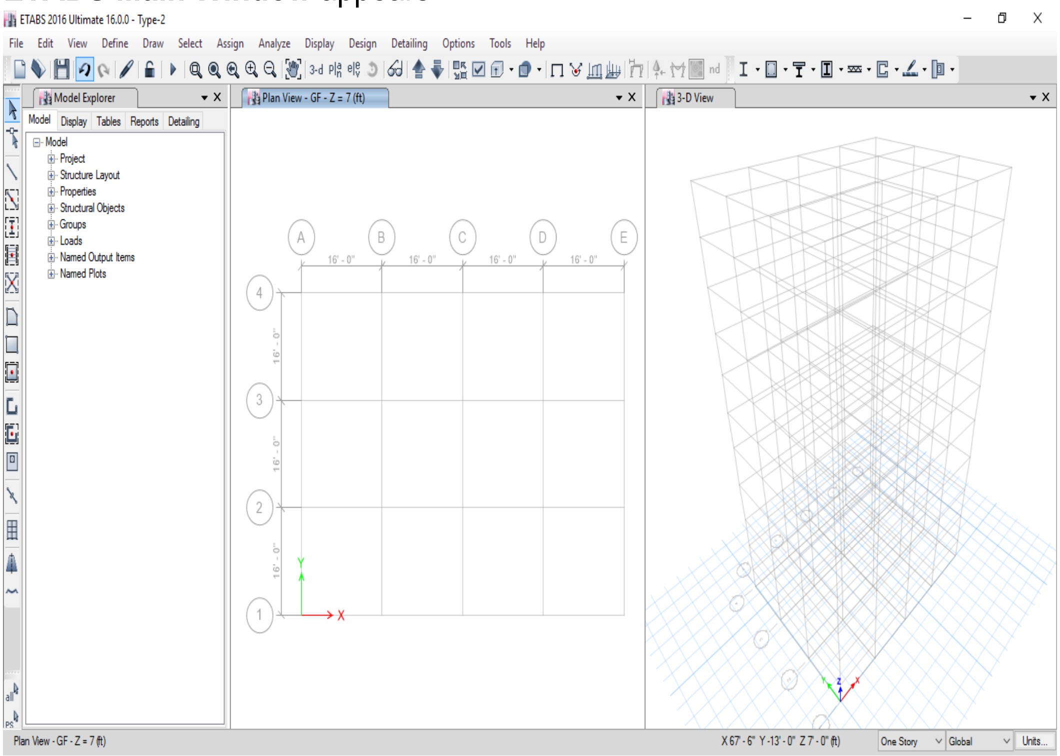
Set*Simple Story Data* as below

Number of Stories	11	
Typical Story Height	10	ft
Bottom Story Height	7	ft

Click 

then **Click** 

ETABS Main Window appears



3.2.1 Define Material Properties of 4 ksi Concrete:

Menu Command: **Define>Material Properties…**

Define Materials Window appears

Click [Add New Material...]

Add New Property Window appears

Select from the dropdown list

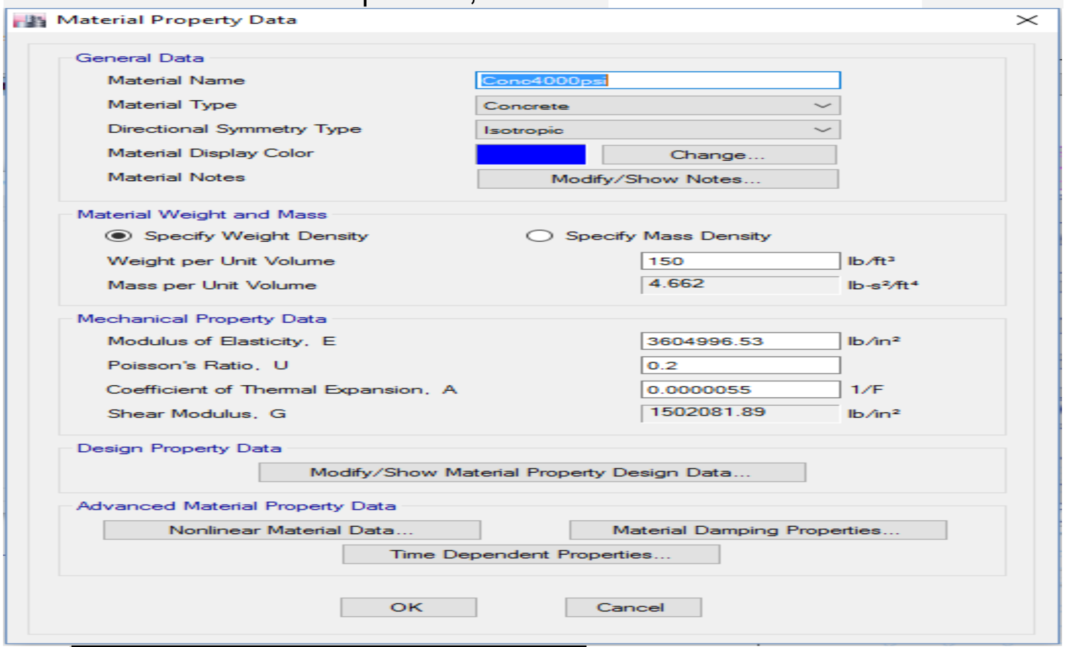
Region	User
Material Type	Concrete

Click [OK]

Material Property Data Window appears

Set Material Property Data window as follows

Material Name	Conc4000psi	
Weight per Unit Volume	150	lb/ft³
Modulus of Elasticity, E	57000*4000^.5	lb/in²
Poisson's Ratio, U	0.2	
Coefficient of Thermal Expansion, A	5.5E-6	1/F



Click [Modify/Show Material Property Design Data...]

Material Property Design Data Window appears

Set Specified Concrete Compressive Strength, f'c | 4000 | lb/in²

Click [OK]

Returns to **Material Property Data** Window

Click [OK]

Returns to **Define Materials Window**with a new matrial in the list

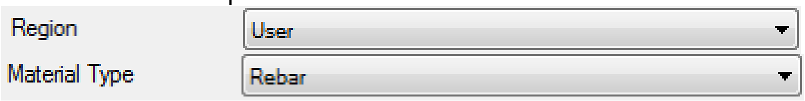
3.2.2 Define Material Properties of 72.5ksi Reinforcement (Rebar):

From the **Define Materials Window**

Click [Add New Material...]

Add New Property Window appears

Select from the dropdown list

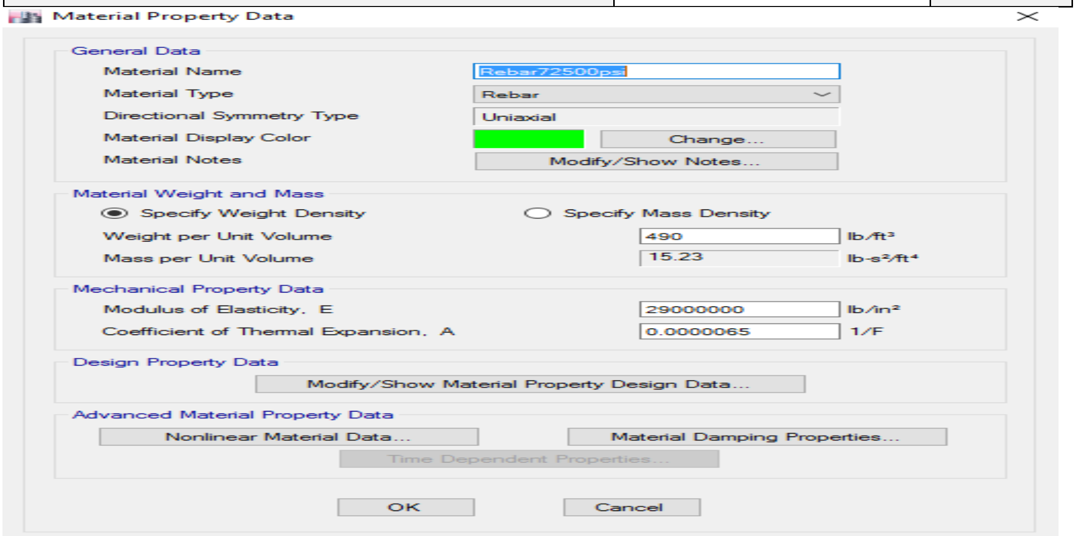


Click OK

Material Property Data Window appears

Set Material Property Data window as follows

Material Name	Rebar72500psi	
Weight per Unit Volume	490	lb/ft^3
Modulus of Elasticity, E	29E6	lb/in^2
Coefficient of Thermal Expansion, A	6.5E-6	1/F



Click Modify/Show Material Property Design Data...

Material Property Design Data Window appears

Set*Design Properties for Rebar Materials* as follows

Minimum Yield Strength, Fy	72500	lb/in^2
Minimum Tensile Strength, Fu	83375	lb/in^2
Expected Yield Strength, Fye	1.1*72500	lb/in^2
Expected Tensile Strength, Fue	1.1*83375	lb/in^2

Click OK

Returns to **Material Property Data** Window

Click OK

Returns to **Define Materials Window**with a new matrial in the list

3.2.3 Define Material Properties of 40ksi Reinforcement (Rebar):

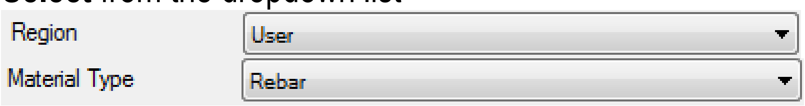
Follow the same procedure as above..

From the**Define Materials Window**

Click Add New Material...

Add New Property Window appears

Select from the dropdown list

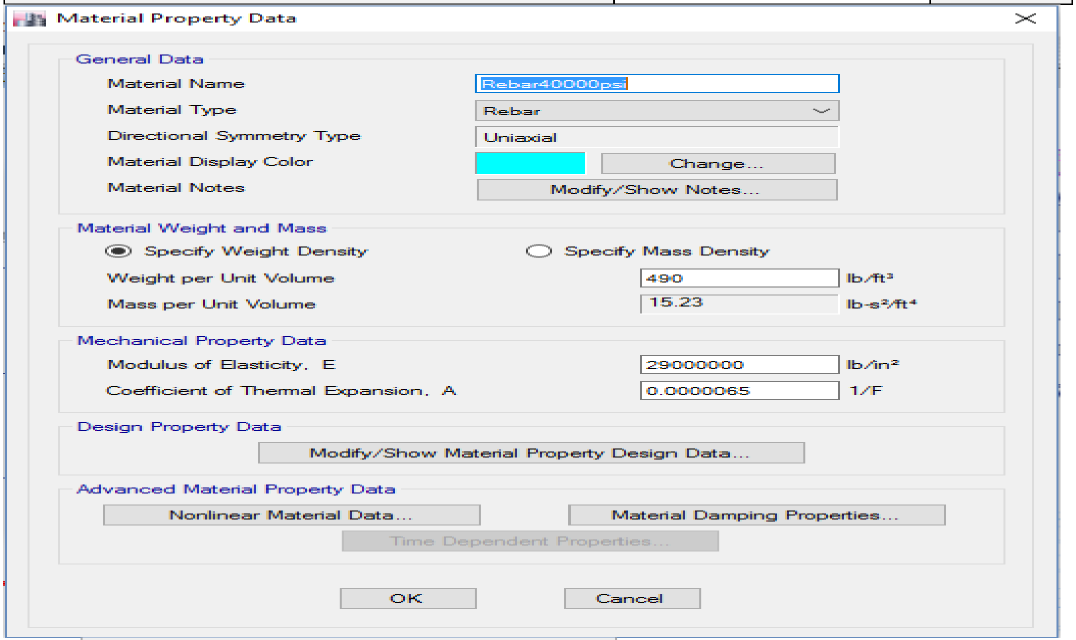


Click OK

Material Property Data Window appears

Set Material Property Data window as follows

Material Name	Rebar40000psi	
Weight per Unit Volume	490	lb/ft^3
Modulus of Elasticity, E	29E6	lb/in^2
Coefficient of Thermal Expansion, A	6.5E-6	1/F



Click Modify/Show Material Property Design Data...

Material Property Design Data Window appears

Set*Design Properties for Rebar Materials*as follows

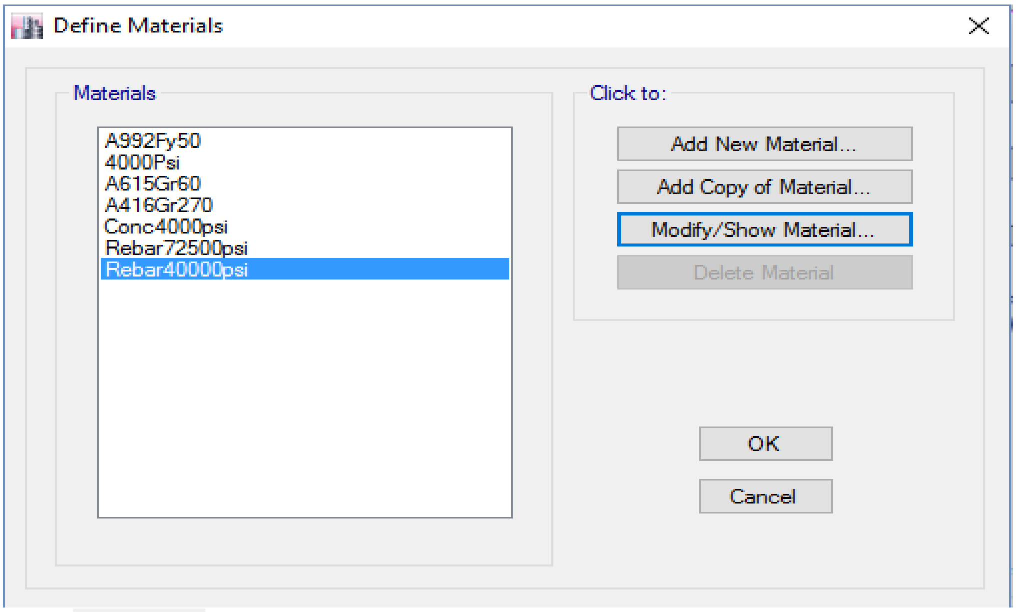
Minimum Yield Strength, Fy	40000	lb/in^2
Minimum Tensile Strength, Fu	60000	lb/in^2
Expected Yield Strength, Fye	1.1*40000	lb/in^2
Expected Tensile Strength, Fue	1.1*60000	lb/in^2

Click OK

Returns to **Material Property Data** Window

Click OK

Returns to **Define Materials Window**with a new matrial in the list



Click OK

Returns to **Main** Window

3.3.1 Define Frame Sections: Column 20"x20" with 8 Rebars:

Menu Command: **Define>Section Properties>Frame Sections…**

Click Delete Multiple Properties...

Delete Multiple Frame Section Properties Window appears

Select all the Frame Sections (Click the first item holding SHIFT key and Click the last item or simply click, hold and drag)

Click Delete Selected Frame Sections

Again Select all Frame Sections (Click the first item holding SHIFT key and Click the last item or simply click, hold and drag)

Click Delete Selected Frame Sections

Atleast one frame section must be present. Hence a **massege box** appears.

Click OK

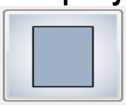
Returns to **Delete Multiple Frame Section Properties Window**

Click OK

Retuns to **Frame Properties Window**

Click Add New Property...

Frame Property Shape Type Window appears

Click  Concrete Rectangular button

Frame Section Property Data Window appears

Set **General Data** and **Section Dimensions** as follows

Property Name	Col20"x20"	
Material	Conc4000psi	
Depth	20	in
Width	20	in

Click [Modify/Show Rebar...]

Frame Section Property Reinforcement Data Window appear

Set the window as follows

Rebar Material

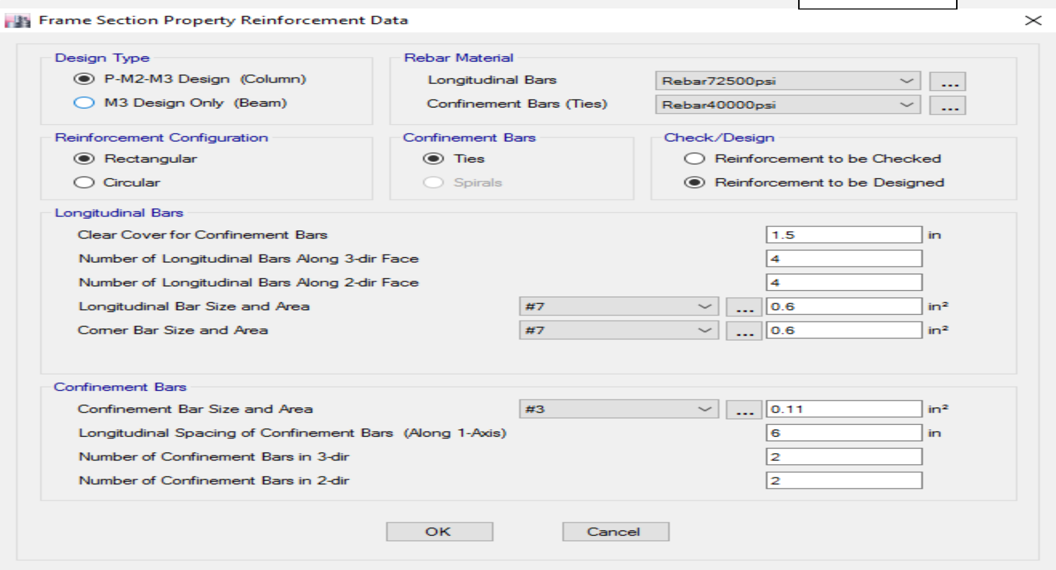
Longitudinal Bars	Rebar72500psi
Confinement Bars (Ties)	Rebar40000psi

Longitudinal Bars

Clear Cover for Confinement Bars	1.5	in
Number of Longitudinal Bars Along 3-dir Face	4	
Number of Longitudinal Bars Along 2-dir Face	4	
Longitudinal Bar Size and Area	#7	
Corner Bar Size and Area	#7	

Confinement Bars

Confinement Bar Size and Area	#3	
Longitudinal Spacing of Confinement Bars	6	in
Number of Confinement Bars in 3-dir	2	
Number of Confinement Bars in 2-dir	2	



Click [OK]

Retuns to **Frame Section Property Data Window**

Click [OK]

Retuns to **Frame Properties Windowwith** a new item

Select W10x12 and **Click** [Delete Property]

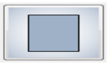
Click [Yes]

3.3.2 Define Frame Sections:Beam 12”x20”

From **Frame Properties Window**

Click [Add New Property...]

Frame Property Shape Type Window appears

Click  Concrete Rectangular button

Frame Section Property Data Window appears

Set **General Data** and **Section Dimensions** as follows

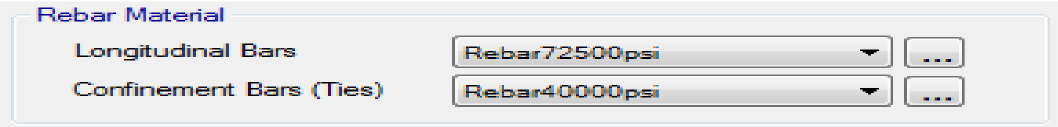
Property Name	Beam12”x20”	
Material	Conc4000psi	
Depth	20	in
Width	12	in

Click Modify/Show Rebar...

Frame Section Property Reinforcement Data Window appear

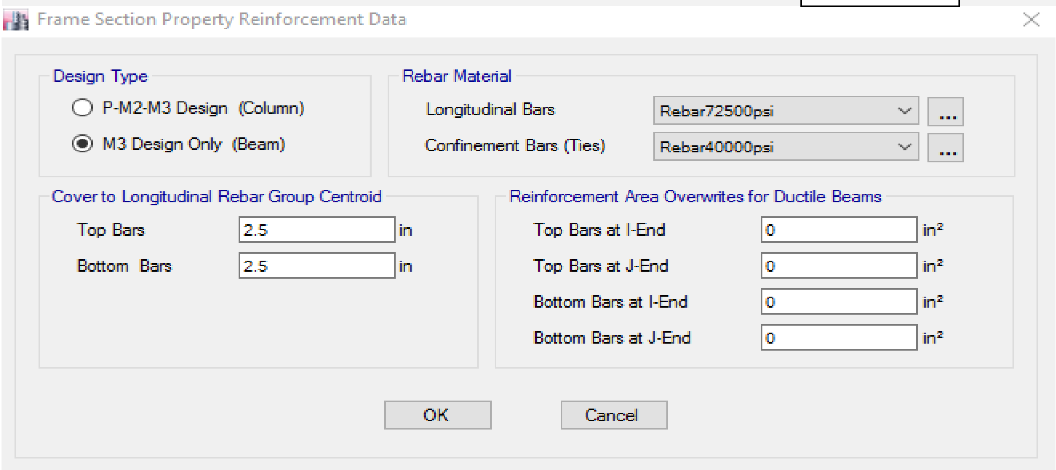
Click M3 Design Only (Beam) radio button

SetRebar Material as below



Set *Cover to Longitudianl Rebar Group Centroid* as below

Top Bars	2.5	in
Bottom Bars	2.5	in



Click OK

Retuns to **Frame Section Property Data Window**

Click OK

Retuns to **Frame Properties Window** with a new item

3.3.3 Define Frame Sections: Beam 12”x21”

From **Frame Properties Window**

Select Beam12x20

Click Add Copy of Property...

Frame Section Property Data Window appears

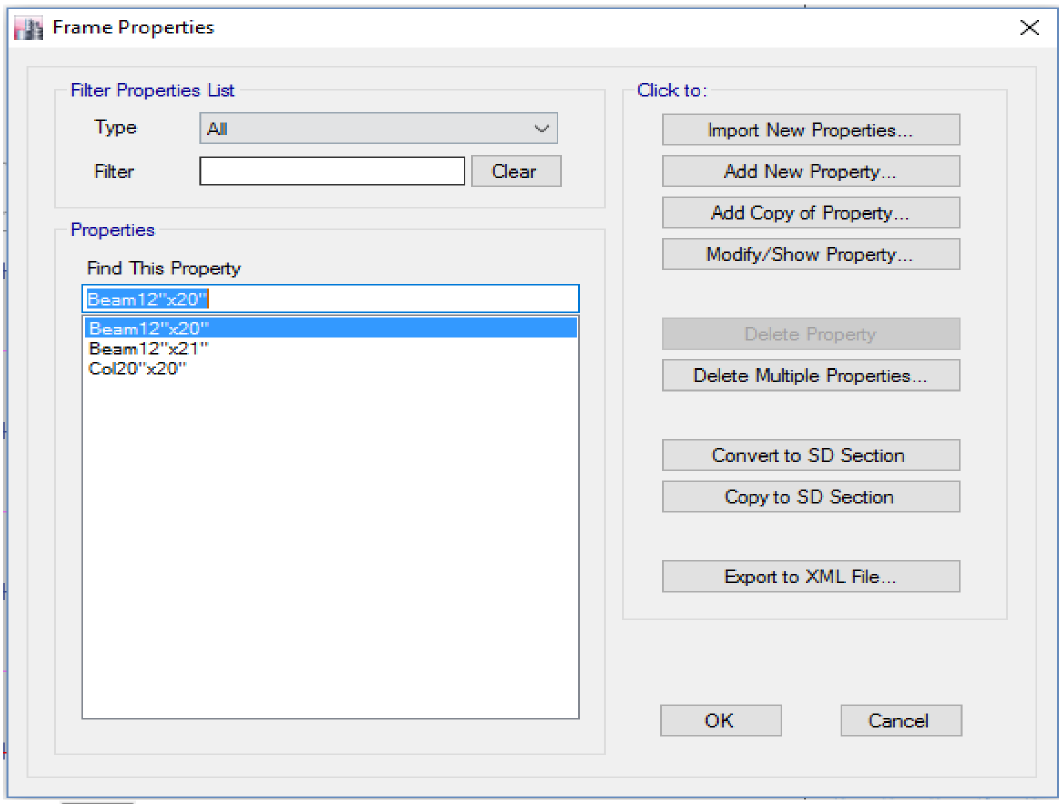
Set **General Data** and **Section Dimensions** as follows

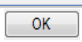
Property Name	Beam12x21	
Material	Conc4000psi	
Depth	21	in
Width	12	in

Click 

Retuns to **Frame Properties Window**with a new item

At last I make this Column and Beam



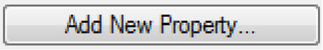
Click 

Returns to **main window**

3.3.4 Define Slab Sections: 6" thick floor and roof slab:

Menu Command: **Define>Section Properties>Slab Sections…**

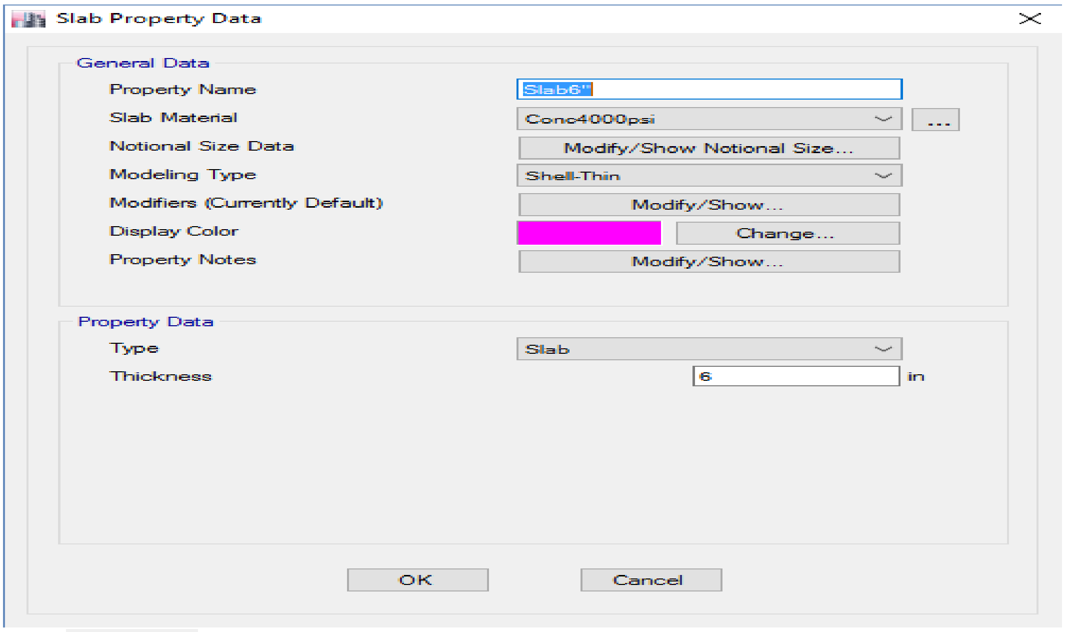
Slab Properties Window appears

Click 

Slab Property Data Window appears

Set **General Data** and **Property Data** as follows

Property Name	Slab6"	
Material	Conc4000psi	
Type	Slab	
Thickness	6	in



Click 

Returns to **Slab Properties** Window

Click 

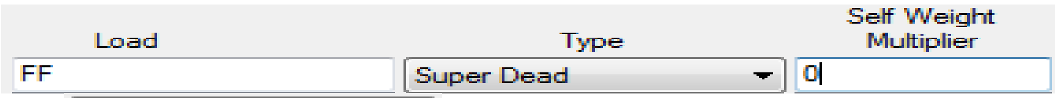
Returns to **ETABS main** Window

3.4.1 Define: Load Patterns (Dead, Live, FF, PW)

Menu Command: **Define>Load Patterns…**

Define Load Patterns Window appears

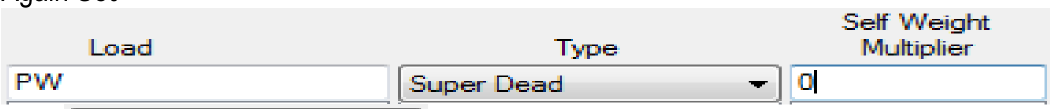
Set



Click 

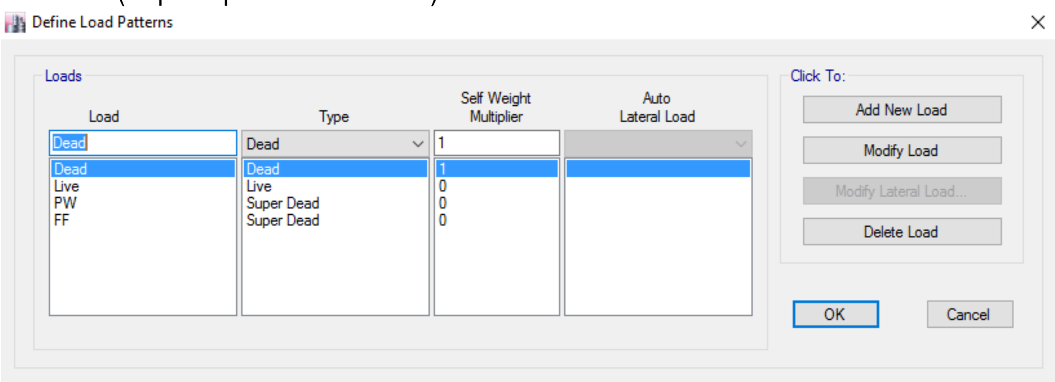
Adds FF(Superimposed Dead Load) Load Pattern

Again **Set**



Click 

Adds PW(Superimposed Dead Load) Load Pattern



Click 

Returns to **ETABS main** Window

3.4.2 Define: Load Combinations:

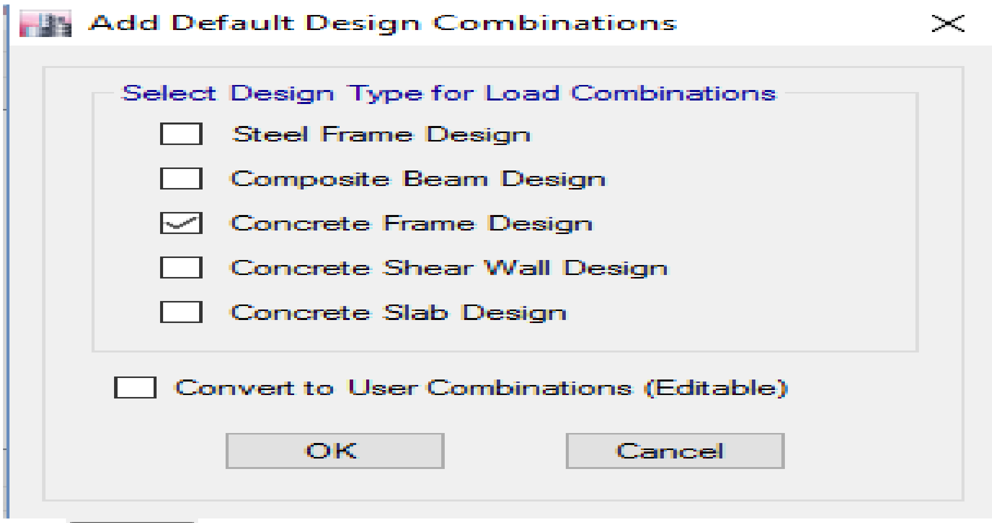
Menu Command: **Define>Load Combinations…**

Load Combination Window appears

Click Add Default Design Combos...

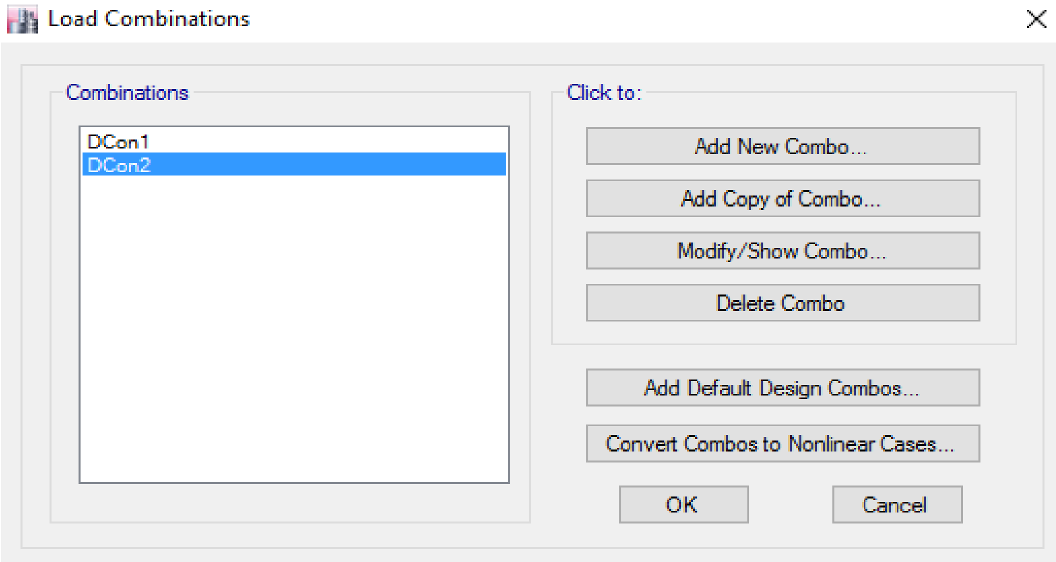
Add Default Design Combinations Window appears

Click ☐ Concrete Frame Design



Click OK

Returns to **Load Combinations** Window with 2 combinations



Click OK

Returns to **ETABS main** Window

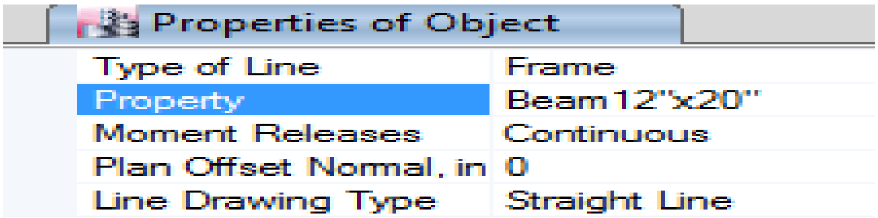
3.5.1 Drawing all Beams:

Menu Command: Draw>Draw Beam/Column/Brace Objects> Draw Beam/Column/Brace (Plan/Elev,3D)

Properties of Object window appear on left bottom

Set Property as follows from the drop-down list

Property	Beam12"x20" Beam12"x21" Col20"x20"



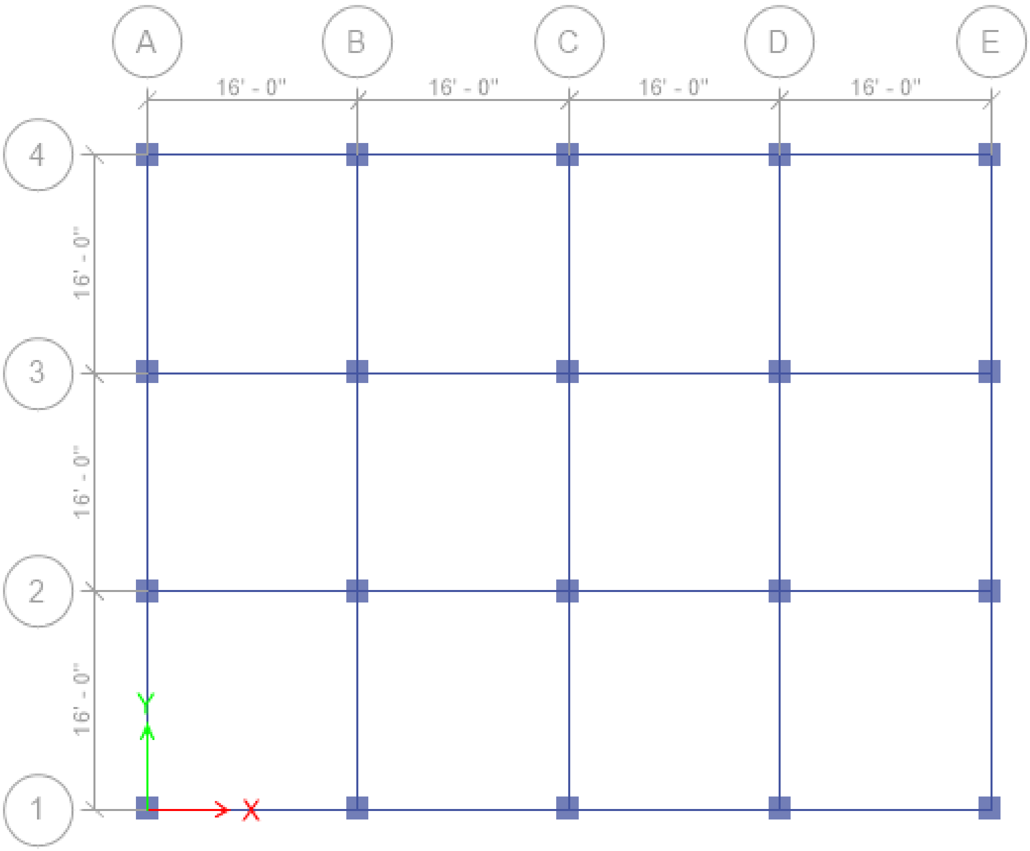
Set Plan Drawing Mode to Similar stories:
Select One Stories from the drop-down list at bottom right corner

To Draw Beam:
Menu Command: Draw>Draw Line Object>Create Line in Region or at Clicks.

Set "Properties of Object" Beam 12”x20” and draw the beams like plan.

3.5.2 Draw Column :

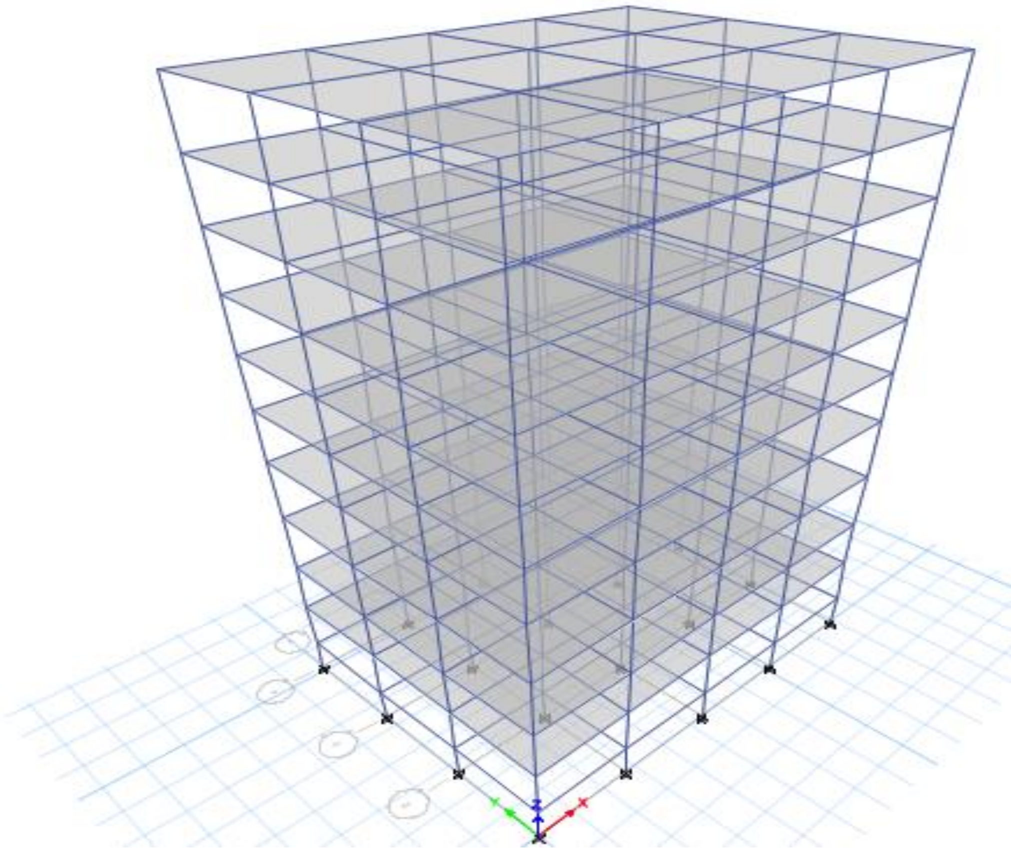
Draw Section: Set "All Stories" First.
Menu Command: Drow> Draw line object in Region or at click
Set "Properties of Object"
Col20"x20" And draw the Column.



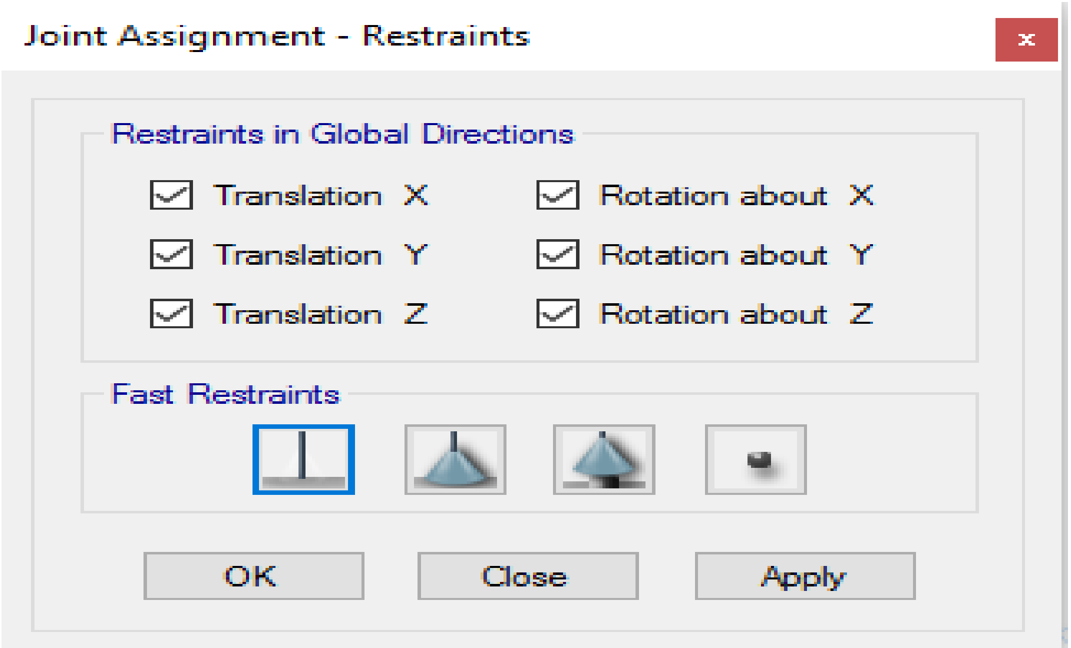
3.5.3 **Draw Floor Slab:**

Draw Section: Set "Similar Stories"
Menu Command: Draw→Draw area Object→Draw Areas
Set "Properties of Object" Slab 6”
Then draw the slab.

Now all slab are drawn:



From the plan view go to the base and select all points: At first Select everything Base
Menu Command →Assign→Joint/Points→ Restraints
Select "Fixed Support" then click Apply-Ok

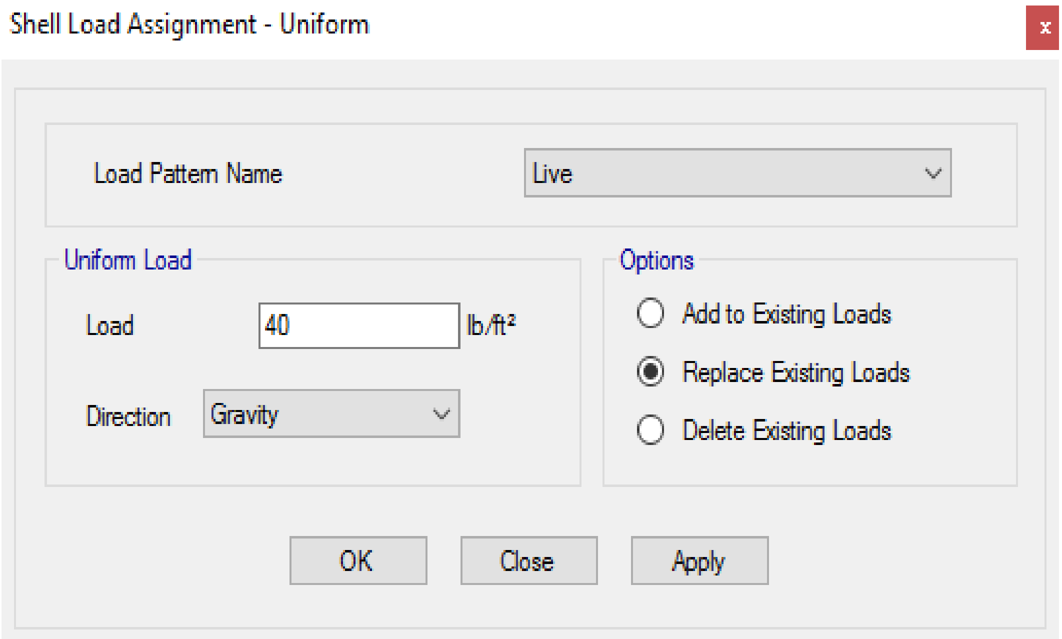


3.6.1 Uniform Load Assign:

Menu Command: Select→By wall/slab/deck sections>select slab 6" then click ok.

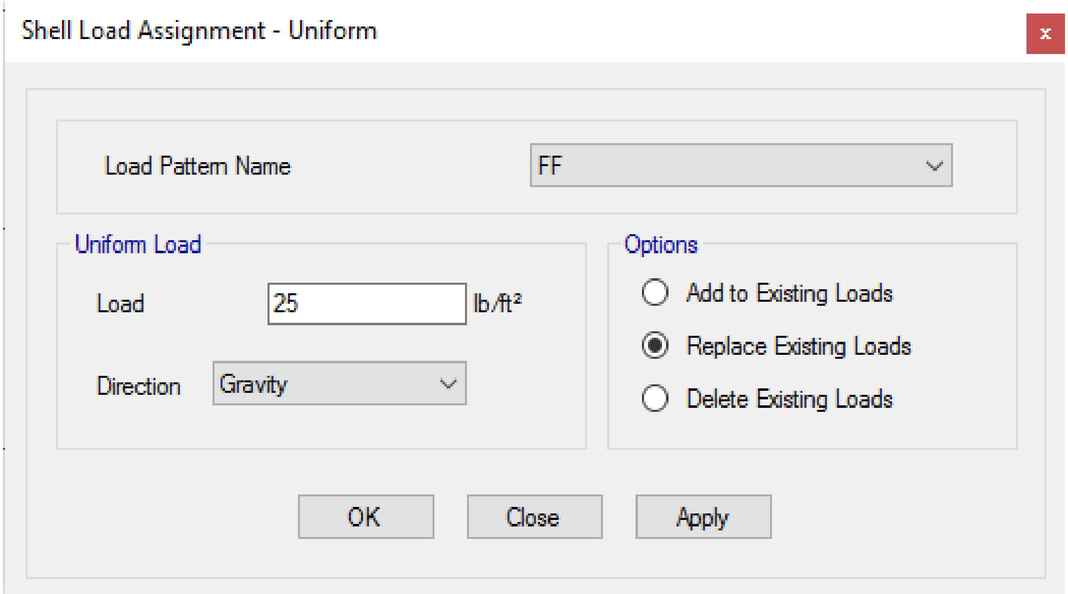
All floor slab has been selected.

Now, Menu Command: Assign→Shell/area loads→Uniform
Set, Load Case Name-Live Load 40 Then click Ok.



Click on previous selection.

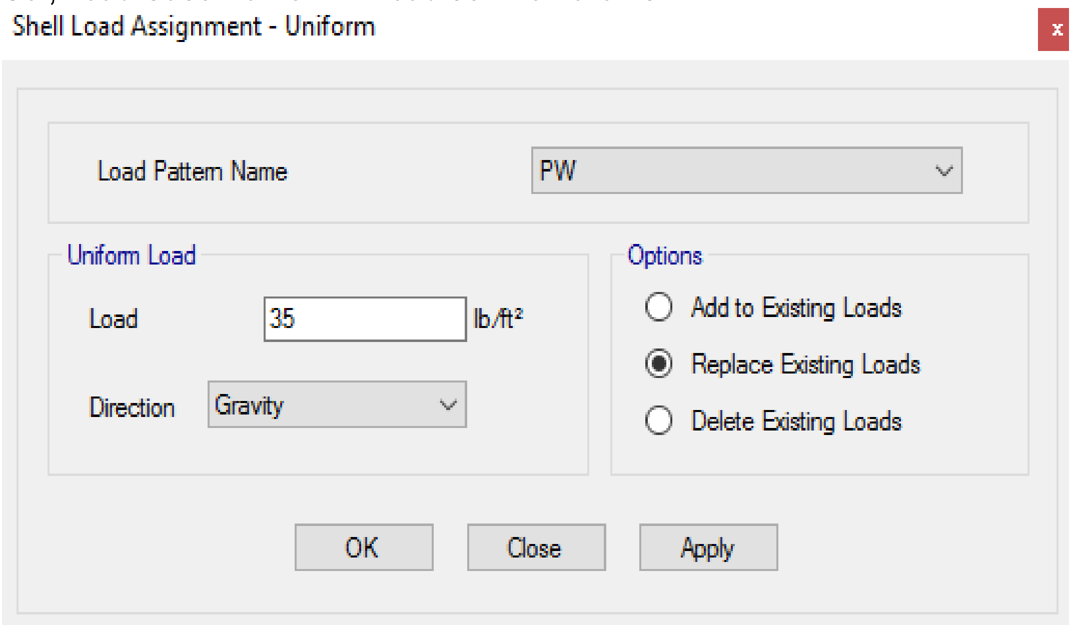
Menu Command: Assign→Shell/area loads→Uniform
Set, Load Case Name-FF Load 25 Then click Ok.



Click on previous selection

Menu Command: Assign→Shell/area loads→Uniform

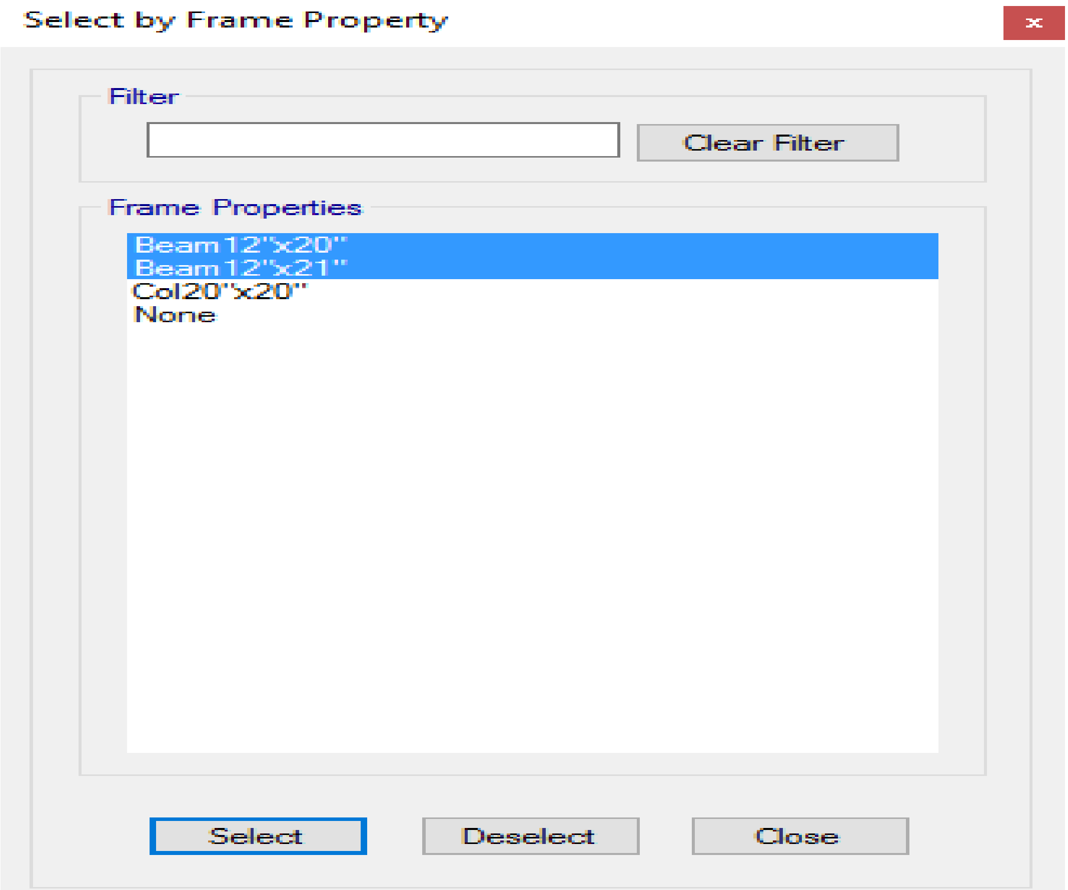
Set, Load Case Name-PW Load 35 Then click Ok.



Now all slab load has been assigned.

Now Select Frame property:

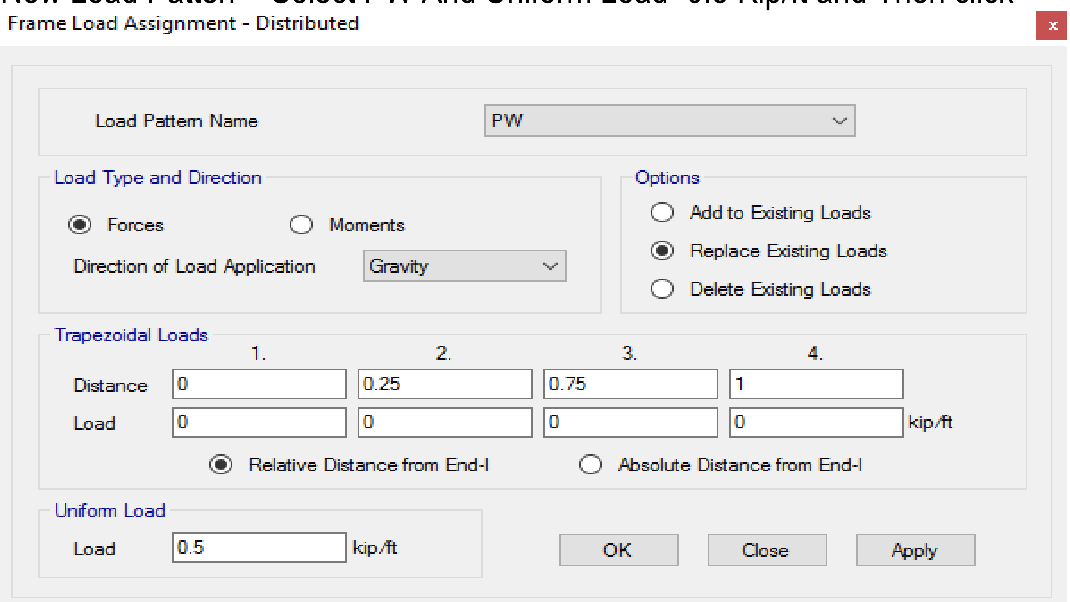
Menu Command: Select →Select→Properties→Frame Sections and Select Beam



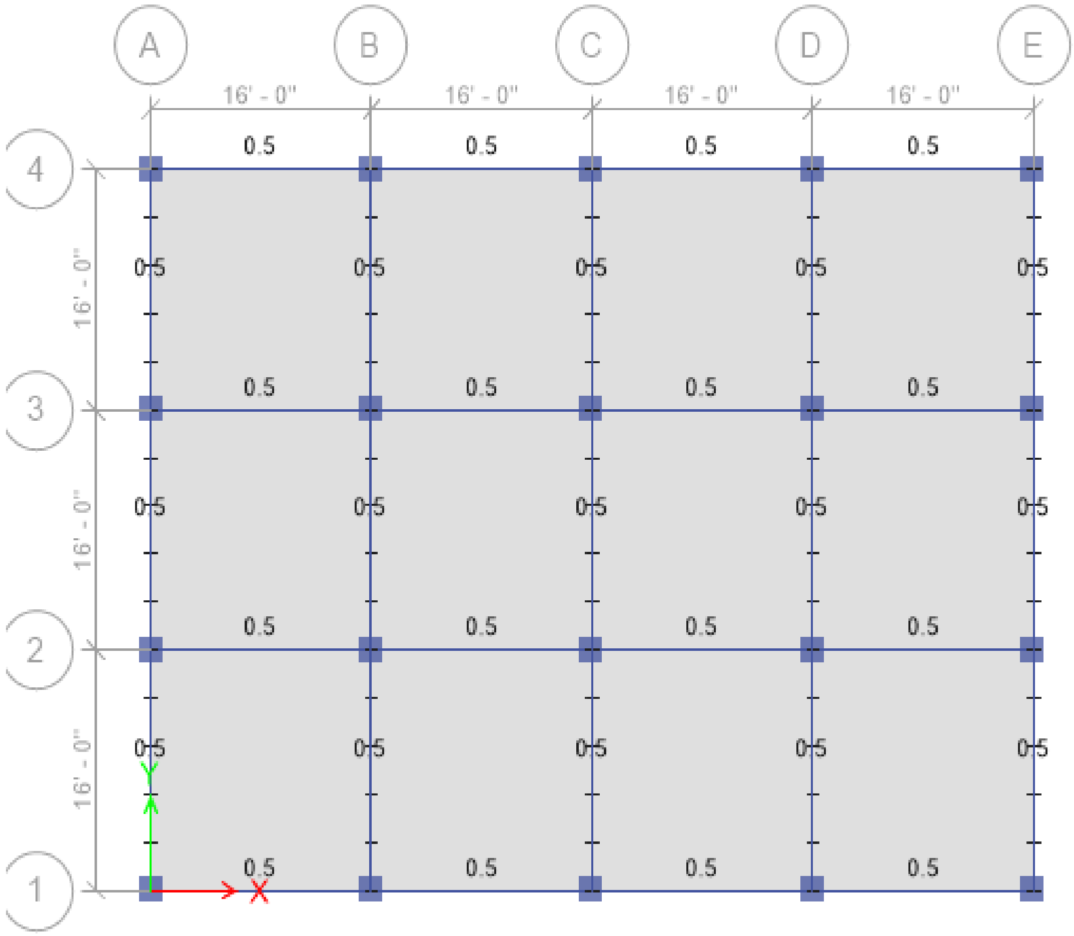
3.6.2 Distributed Frame Loads Assign:

Menu Command: Assign→Frame Loads→Distributed

Now Load Patten = Select PW And Uniform Load=0.5 Kip/ft and Then click



Now click Apply then Ok



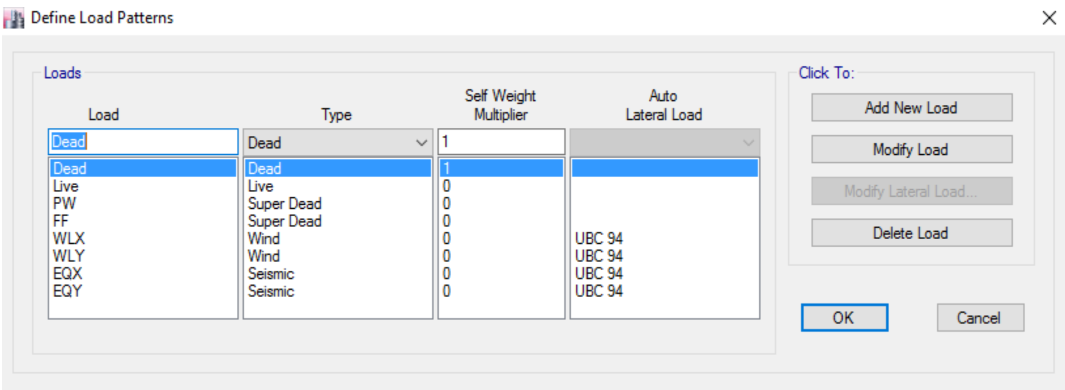
3.6.3 Define Static Load Case:

Then Menu Command : Define> load Patterns:
To set wind load For X Axis: Load-WLX, Type-Wind, Self weight multiplier-0, Auto lateral load-UBC94 Now click Add New Load.

To set wind load For Y Axis : Load-WLY, Type-Wind, Self weight multiplier-0, Auto lateral load-UBC94 Now click Add New Load

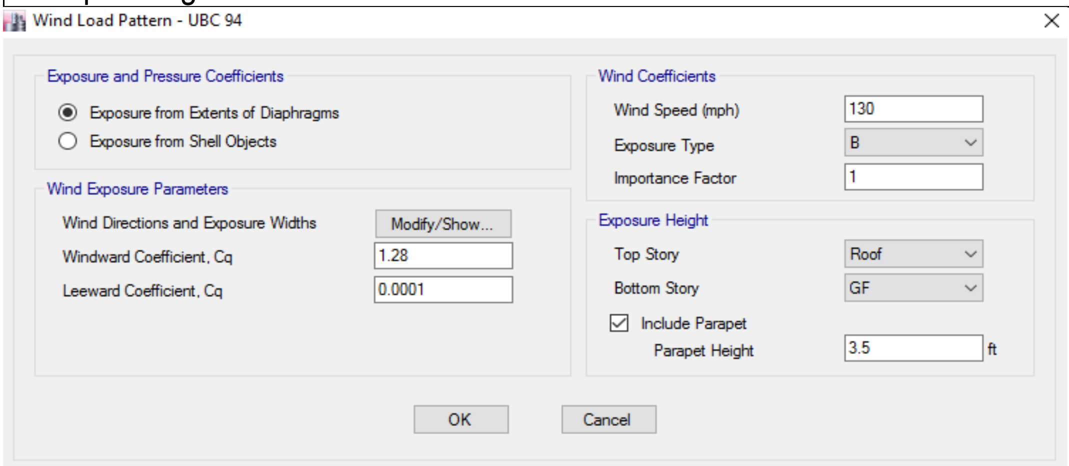
To set Earthquake load For X Axis: Load-EQX, Type-Seismic, Self weight multiplier-0, Auto lateral load-UBC94 Now click Add New Load

To set Earthquake load For Y Axis: Load-EQY, Type-Seismic, Self weight multiplier-0, Auto lateral load-UBC94 Now click Add New Load

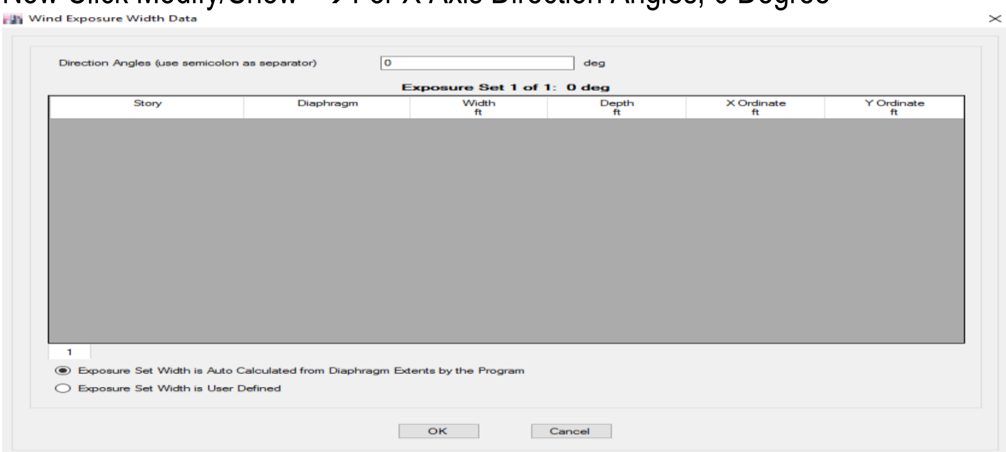


For WLX Click modify lateral load options→

Windward Coefficient ,Cq or Cp=1.28
Leeward Coefficient, Cq=0.0001
Wind Speed (mph)=130
Exposure Type=B
Importance Factor=1
Parapet Height=3.5 ft



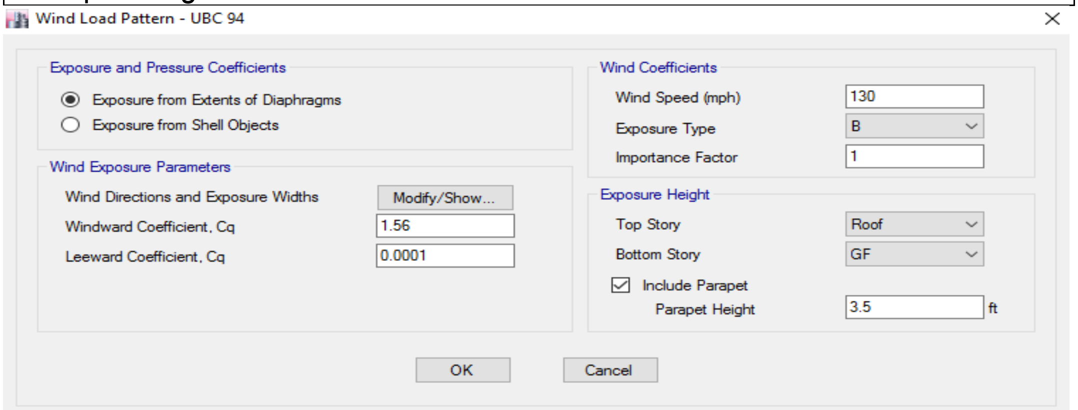
Now Click Modify/Show--→For X Axis Direction Angles, 0 Degree



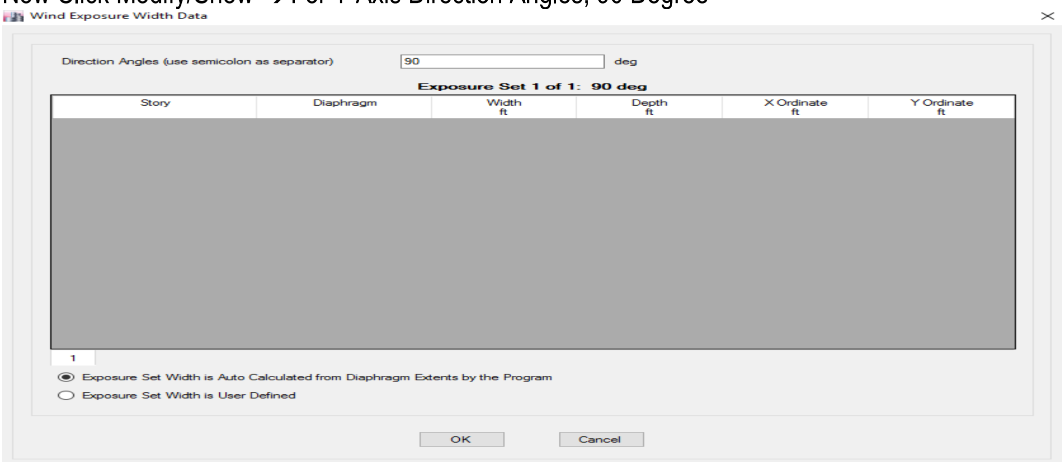
Click Ok and again Click Ok

For WLY Click modify lateral load options:

Windward Coefficient ,Cq or Cp=1.56
Leeward Coefficient, Cq=0.0001
Wind Speed (mph)=130
Exposure Type=B
Importance Factor=1
Parapet Height=3.5 ft



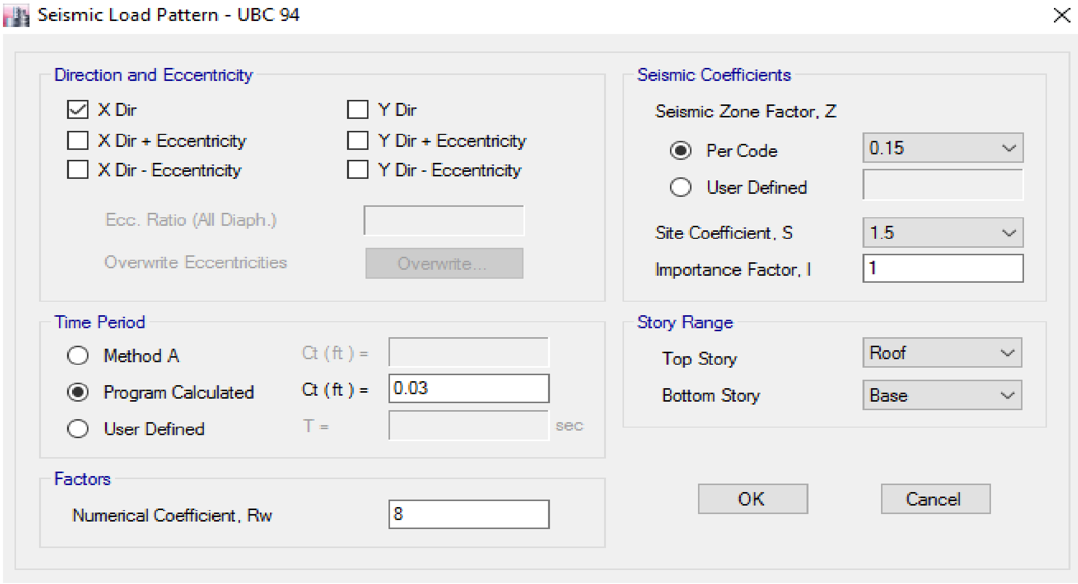
Now Click Modify/Show-→For Y Axis Direction Angles, 90 Degree



Click ok and again Click ok

For EQX Click modify lateral load options→

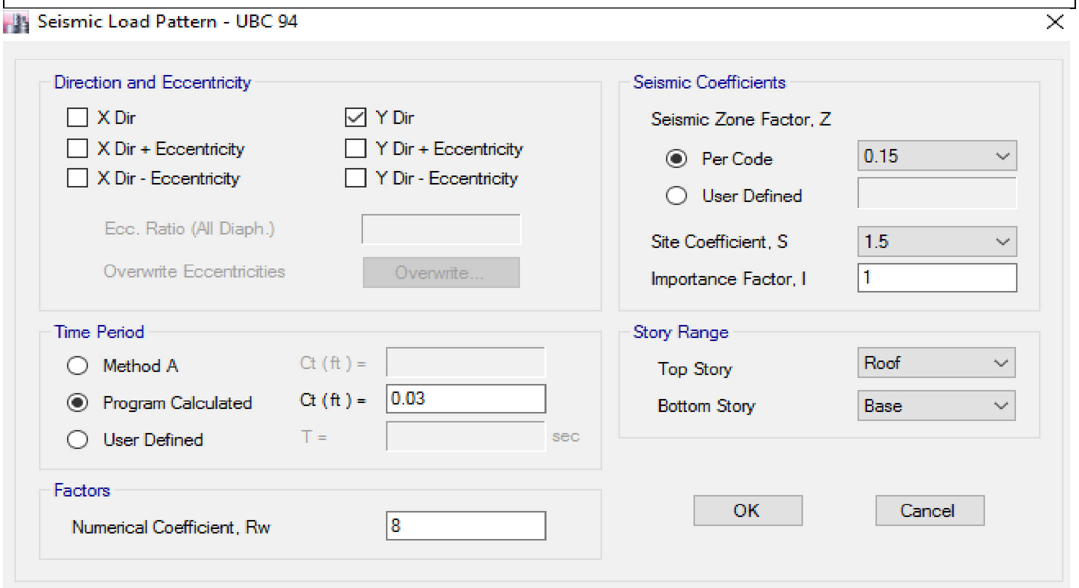
Direction and Eccentricity→Only select X Dir
Select ◉ Program Calculated And c_t=0.03
Per code=0.15
Site Coefficient, S=1.5
Importance Factor,I=1
Numerical Coefficient,Rw=8
Story Range : Top Story= Roof Bottom Story= Base



Click ok

For EQY Click modify lateral load options→

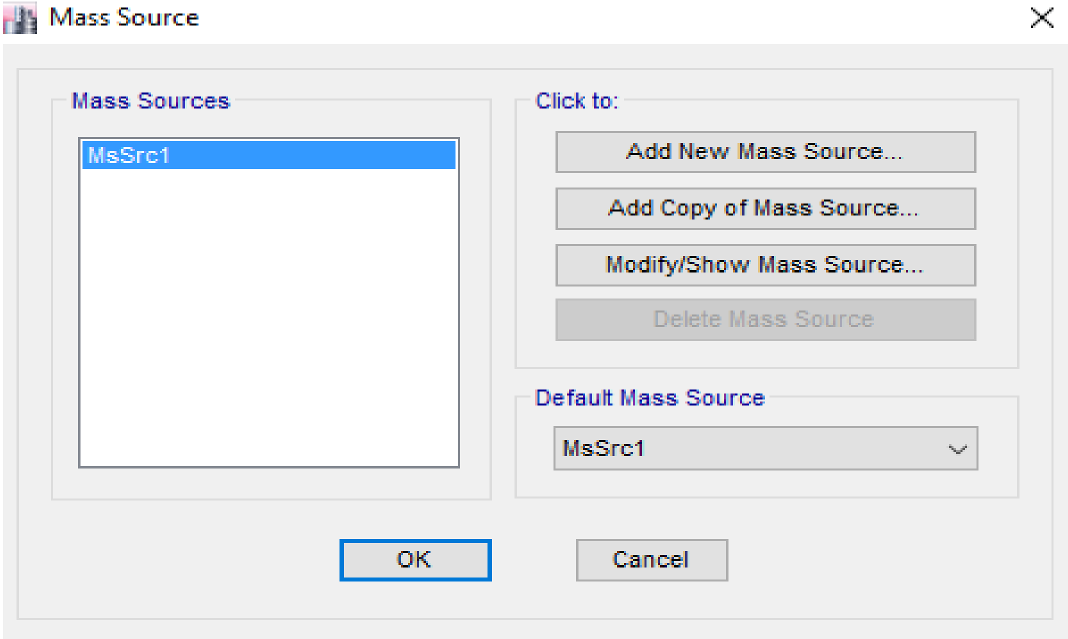
Direction and Eccentricity→Only select Y Dir
Select ◉ Program Calculated And c_t=0.03
Per code=0.15
Site Coefficient, S=1.5
Importance Factor,I=1
Numerical Coefficient,Rw=8
Story Range : Top Story= Roof Bottom Story= Base



Click ok

Returns to main window

Then Menu Command : Define → Mass source



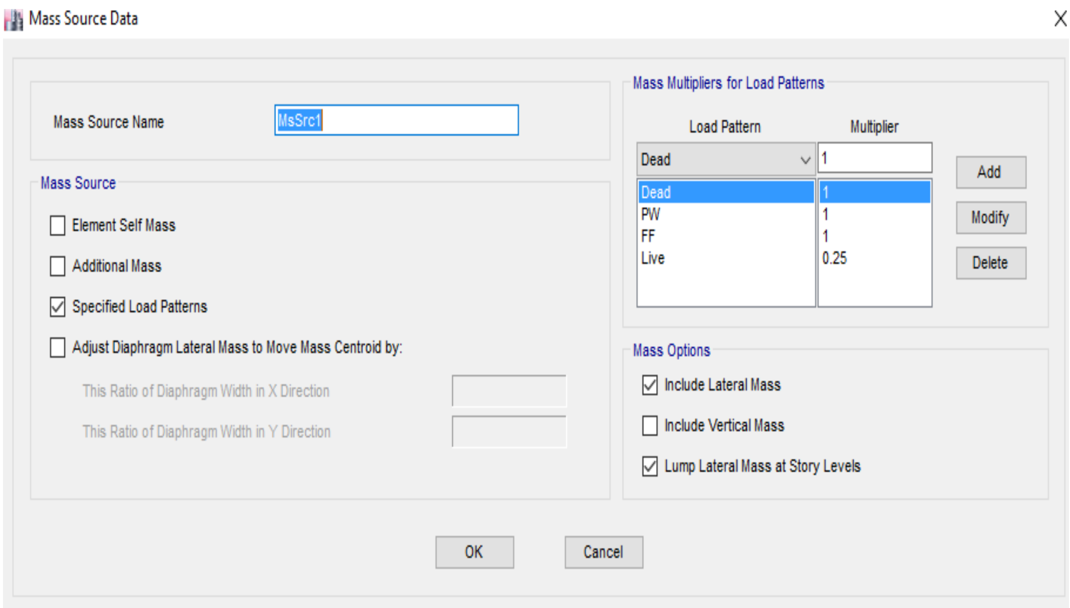
3.7.1 Mashing and Define Mass Source:

Now Click Modify/Show Mass Source

Mass Source →Select only Specified Load patterns

Mass Multiples For load patterns

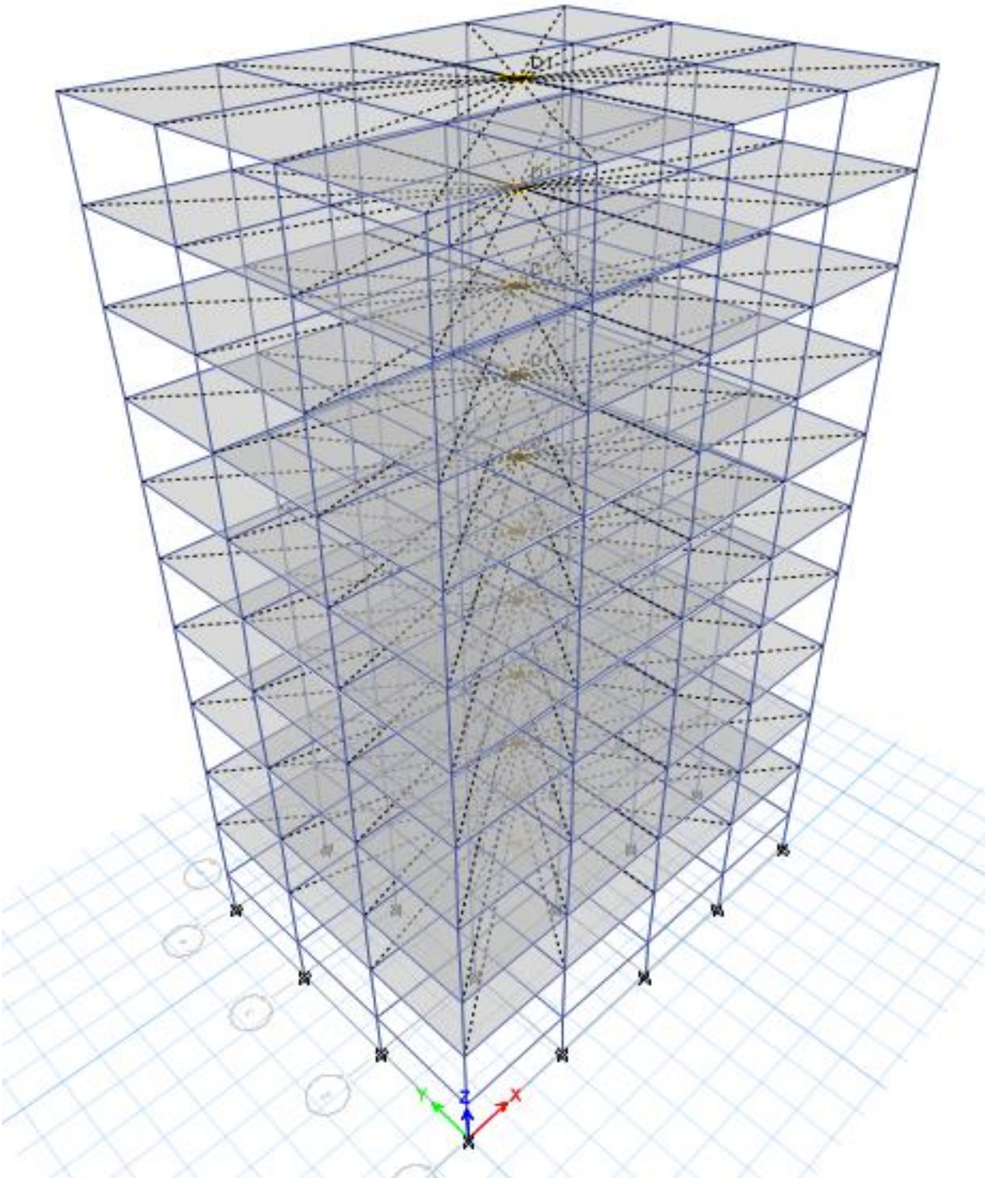
Dead x1 Click Add, Live x 0.25 Click Add, PW x1 Click Add ,FFx1 Click Add



Click ok

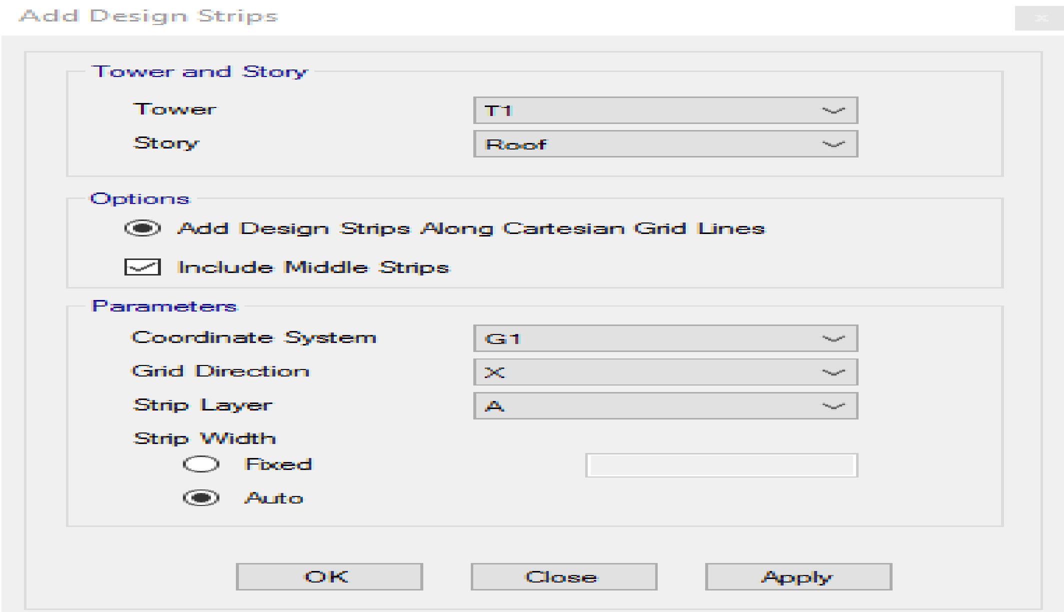
3.7.2 Diaphragms:

Then Menu Command : All Slab Select →Assign→ Shell →Diaphragms→ Click

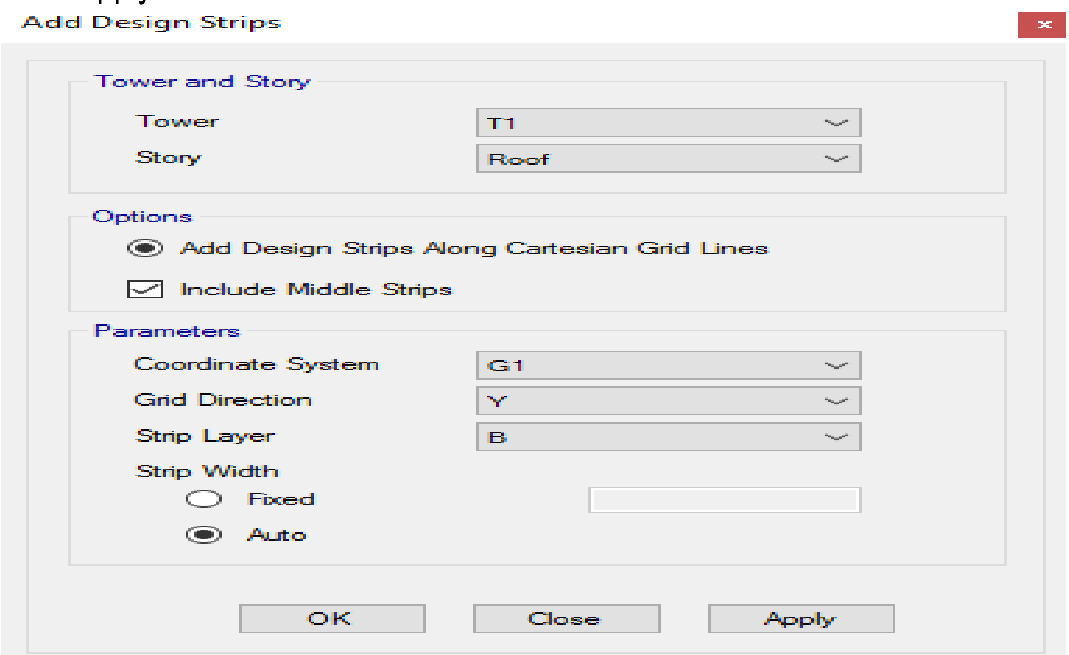


3.7.3 Design Stripe:

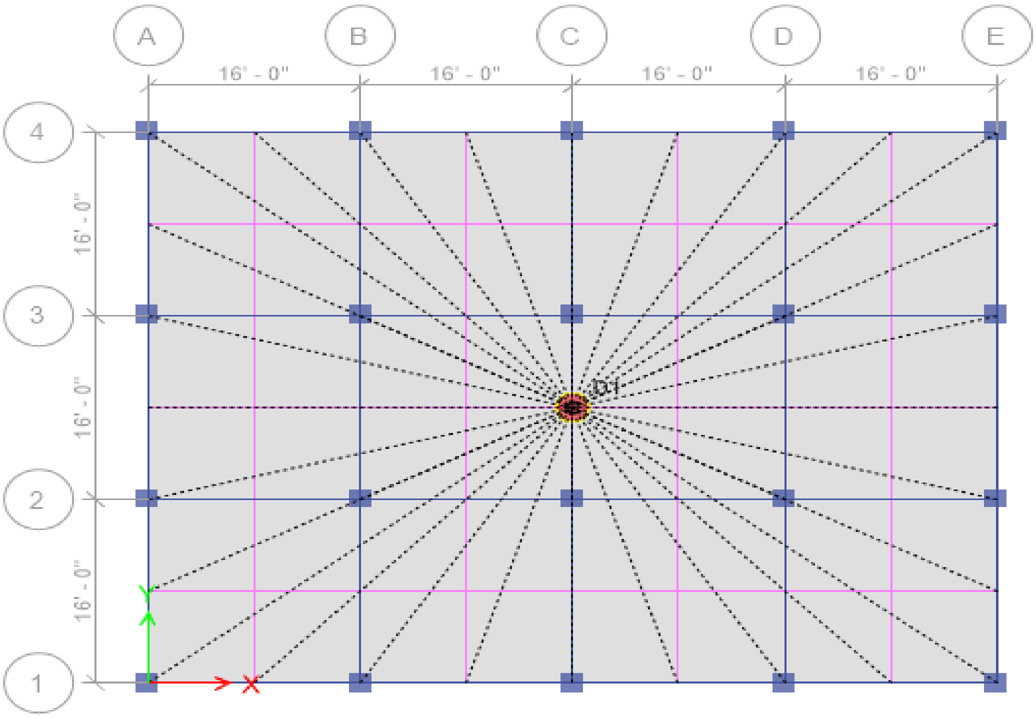
Then Menu Command : Edit→Add/Edit Design Strips →Add Design Strips
Now , Click include Middle Strips
Grid Direction=X
Strip Layer=A
Click Apply Then Ok



Then Menu Command : Edit→Add/Edit Design Strips →Add Design Strips
Now , Click include Middle Strips
Grid Direction=Y
Strip Layer=B
Click Apply then Ok

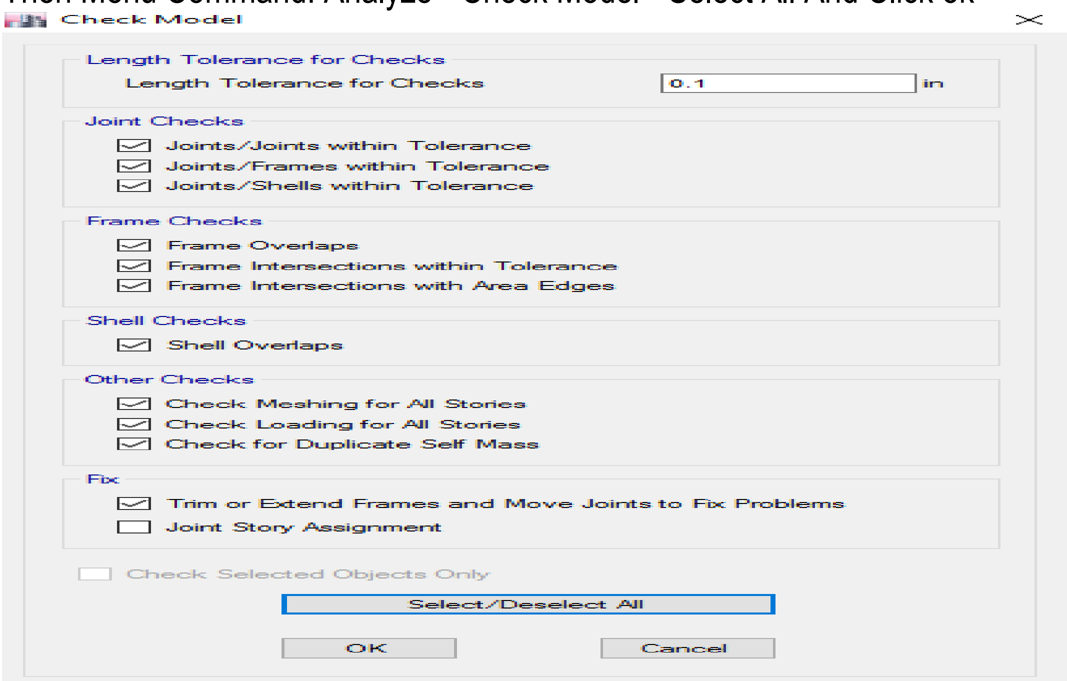


At Last The Diaphragms ===➔

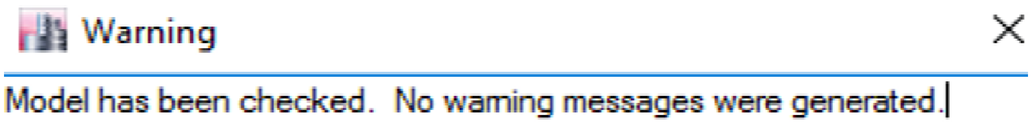


3.7.4 Check Model:

Then Menu Command: Analyze->Check Model->Select All And Click ok



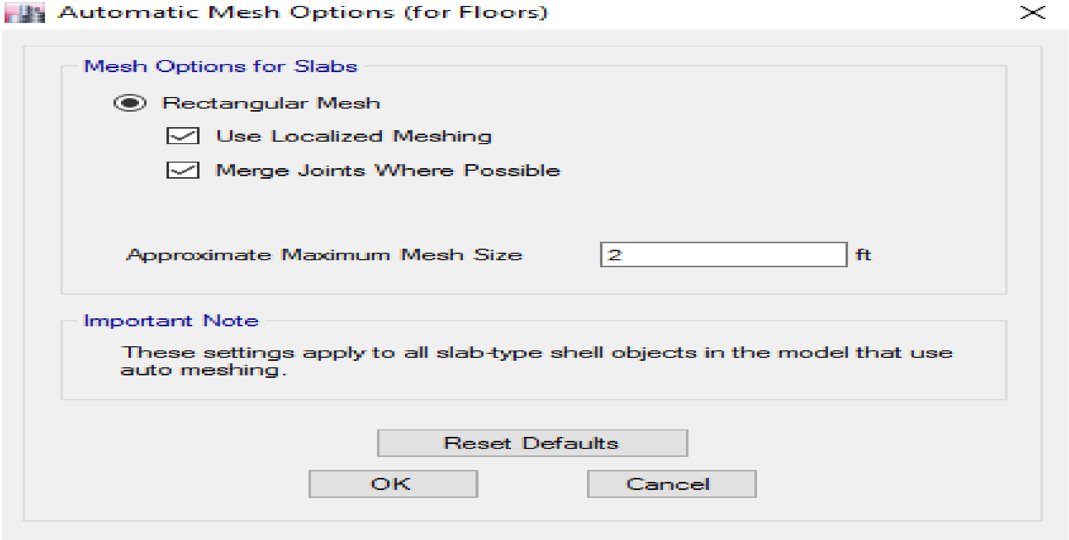
No warning messages were generated.



3.7.5 Automatic Rectangular Mesh Setting For Floors:

Menu Command: Analyze→Automatic Rectangular Mesh Setting For Floors → Then

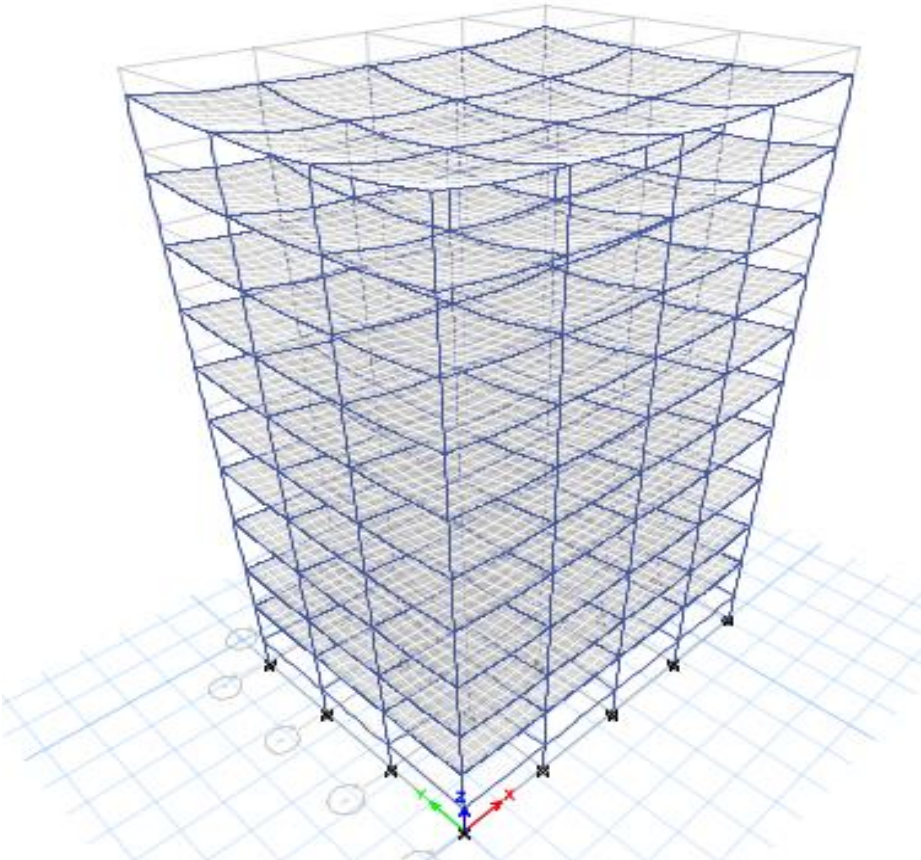
Approximate Mesh Size =2 ft Click ok



3.8.1 Run Analysis:

Then Menu Command: Analyze--> Run Analysis

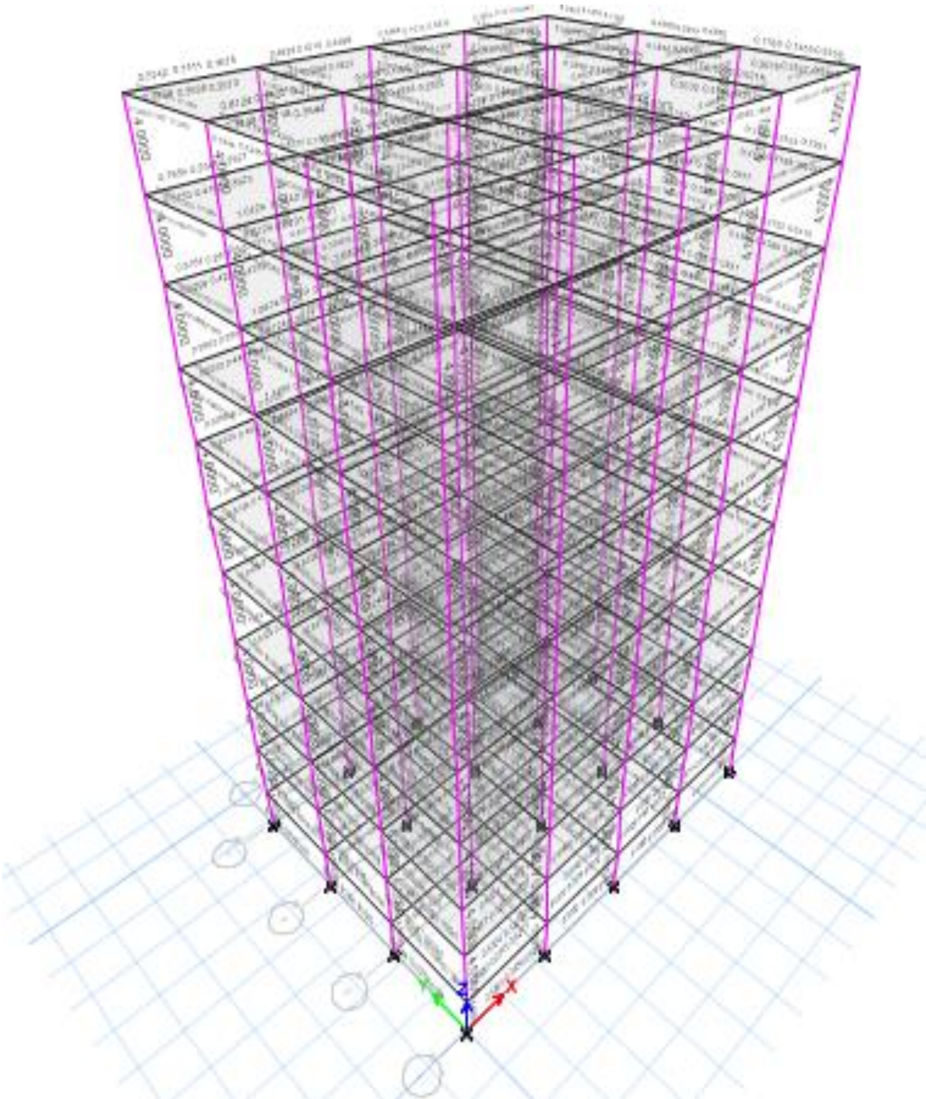
After Analysis:nalysis:



3.8.2 Design Check:

Datiels of Analysis: Menu Command :Design→Concrete Frame Design→Start Design Check:

For Details:



Chapter-04
Load On Building

4.1 WIND LOAD CALCULATION USING BNBC 1993:

Table 1: Exposure Category as per BNBC 1993 and UBC 1991 and afterward

BNBC 1993	UBC 1991 and afterward
Exposure A: Urban and sub-urban areas, industrial areas, wooded areas, hilly or other terrain covering at least 20 per cent of the area with obstructions of 6 meters or more in height and extending from the site at least 500 meters or 10 times the height of the structure, whichever is greater.	**Exposure B:** It has terrain with buildings, forest or surface irregularities 20 feet (6 meter) or more in height covering at least 20 percent of the ground level area extending 1 mile (1.61 km) or more from the site.
Exposure B: Open terrain with scattered obstructions having heights generally less than 10m extending 800 m or more from the site in any full quadrant. This category includes air fields, open park lands, sparsely built-up outskirts of towns, flat open country and grasslands.	**Exposure C:** It has terrain that is flat and generally open, extending ½ mile (0.81 km) or more from the site in any full quadrant.
Exposure C: Flat and unobstructed open terrain, coastal areas and riversides facing large bodies of water, over 1.5 km or more in width. Exposure C extends inland from the shoreline 400 m or 10 times the height of structure, whichever is greater.	**Exposure D:** It represents the most severe exposure in areas with basic wind speeds of 80 miles per hour (mph) (129 km/h) or greater and has terrain that is flat and unobstructed facing large bodies of water over 1 mile (1.61 km) or more in width relative to any quadrant of the building site. Exposure D extends inland from the shoreline ¼ mile (0.40 km) or 10 times the building height, whichever is greater.

Note: Exposure A, B and C in BNBC is similar to Exposure B, C and D in UBC respectively

Table 2: Design Wind Pressure as per BNBC and UBC

BNBC 1993	UBC 1991 and afterward
where velocity-to-pressure conversion coefficient = 47.2x10^{-6} when velocity in km/h and pressure is in kN/m^2 = 0.00256 when velocity in mph and pressure is in lb/ft^2 structure importance coefficient as given in Table 3 combined height and exposure coefficient as given in Table 4 basic wind speed obtained from Table 5 or Figure 1 or site specified value.	where combined height, exposure and gust factor coefficient pressure coefficient for the structure or portion of structure under consideration as given in wind stagnation pressure at the standard height of 33 feet = when velocity in mph and is in lb/ft^2 basic wind speed
where gust coefficient as given in Table 4 pressure coefficient to be used for determination of wind loads on buildings and structures as set forth in sec **Error! Reference source not found.**	Importance factor. Structure importance is categorized in four categories and importance factors vary from 1.00 to 1.15. Low risk structure category is not included. Later wind importance factor is defined as and miscellaneous structure category included.

Table 3 Structure Importance Categories and Coefficients C_I (BNBC 1993: Table 6.1.1 and Table 6.2.9)

Structure Importance Category	Occupancy Type or Functions of Structure	Structure Importance Coefficients, C_I
I) Essential Facilities	Hospital and other medical facilities having surgery and emergency treatment area.	1.25
	Fire and police stations.	
	Tanks or other structures containing, housing or supporting water or other fire-suppression materials or equipment required for the protection of essential or hazardous facilities, or special occupancy structures.	
	Emergency vehicle shelters and garages.	
	Structures and equipment in emergency-preparedness centers, including cyclone and flood shelters.	
	Standby power-generating equipment for essential facilities.	
	Structures and equipment in government communication centers and other facilities required for emergency response.	
II) Hazardous Facilities	Structures housing, supporting or containing sufficient quantities of toxic or explosive substances to be dangerous to the safety of the general public if released.	1.25
III) Special Occupancy Structures	Covered structures whose primary occupancy is public assembly with capacity > 300 persons.	1.00
	Buildings for schools through secondary or day-care centers with capacity > 250 students.	
	patients not included above.	
	Jails and detention facilities.	
	All structures with occupancy > 5,000 persons.	
	Structures and equipment in power-generating stations and other public utility facilities not included above, and required for continued operation.	
IV) Standard Occupancy Structures	All structures having occupancies or functions not listed above.	1.00
V) Low Risk Structures	Buildings and Structures that exhibit a low risk to human life and property in the event of failure, such as agricultural buildings, minor storage facilities, temporary facilities, construction facilities, and boundary walls.	0.80

Table 4: Combined Height and Exposure Coefficient, C_Z and Gust Coefficient, C_G

Height above ground level, z (m)	Height above ground level, z (ft)	Coefficient, *Cz* (1) for exposure category			Coefficient, C_G (1) for exposure category			Combined Coefficient (1)(2) for exposure category		
		A	B	C	A	B	C	A	B	C
0	0	0.368	0.801	1.196	1.654	1.321	1.154	0.609	1.058	1.380
4.5	14.76	0.368	0.801	1.196	1.654	1.321	1.154	0.609	1.058	1.380
6	19.68	0.415	0.866	1.263	1.592	1.294	1.140	0.661	1.121	1.440
9	29.52	0.497	0.972	1.37	1.511	1.258	1.121	0.751	1.223	1.536
12	39.36	0.565	1.055	1.451	1.457	1.233	1.107	0.823	1.301	1.606
15	49.2	0.624	1.125	1.517	1.418	1.215	1.097	0.885	1.367	1.664
18	59.04	0.677	1.185	1.573	1.388	1.201	1.089	0.940	1.423	1.713
21	68.88	0.725	1.238	1.623	1.363	1.189	1.082	0.988	1.472	1.756
24	78.72	0.769	1.286	1.667	1.342	1.178	1.077	1.032	1.515	1.795
27	88.56	0.81	1.33	1.706	1.324	1.17	1.072	1.072	1.556	1.829
30	98.4	0.849	1.371	1.743	1.309	1.162	1.067	1.111	1.593	1.860
35	114.8	0.909	1.433	1.797	1.287	1.151	1.061	1.170	1.649	1.907
40	131.2	0.965	1.488	1.846	1.268	1.141	1.055	1.224	1.698	1.948
45	147.6	1.017	1.539	1.89	1.252	1.133	1.051	1.273	1.744	1.986
50	164	1.065	1.586	1.93	1.238	1.126	1.046	1.318	1.786	2.019
60	196.8	1.155	1.671	2.002	1.215	1.114	1.039	1.403	1.861	2.080
70	229.6	1.237	1.746	2.065	1.196	1.103	1.033	1.479	1.926	2.133
80	262.4	1.313	1.814	2.12	1.18	1.095	1.028	1.549	1.986	2.179
90	295.2	1.383	1.876	2.171	1.166	1.087	1.024	1.613	2.039	2.223
100	328	1.45	1.934	2.217	1.154	1.081	1.020	1.673	2.091	2.261
110	360.8	1.513	1.987	2.26	1.114	1.075	1.016	1.685	2.136	2.296
120	393.6	1.572	2.037	2.299	1.134	1.07	1.013	1.783	2.180	2.329
130	426.4	1.629	2.084	2.337	1.126	1.065	1.010	1.834	2.219	2.360
140	459.2	1.684	2.129	2.371	1.118	1.061	1.008	1.883	2.259	2.390
150	492	1.736	2.171	2.404	1.111	1.057	1.005	1.929	2.295	2.416
160	524.8	1.787	2.212	2.436	1.104	1.053	1.003	1.973	2.329	2.443
170	557.6	1.835	2.25	2.465	1.098	1.049	1.001	2.015	2.360	2.467
180	590.4	1.883	2.287	2.494	1.092	1.046	1.000	2.056	2.392	2.494
190	623.2	1.928	2.323	2.521	1.087	1.043	1.000	2.096	2.423	2.521
200	656	1.973	2.357	2.547	1.082	1.04	1.000	2.135	2.451	2.547
220	721.6	2.058	2.422	2.596	1.073	1.035	1.000	2.208	2.507	2.596
240	787.2	2.139	2.483	2.641	1.065	1.03	1.000	2.278	2.557	2.641
260	852.8	2.217	2.541	2.684	1.058	1.026	1.000	2.346	2.607	2.684
280	918.4	2.91	2.595	2.724	1.051	1.022	1.000	3.058	2.652	2.724
300	984	2.362	2.647	2.762	1.045	1.018	1.000	2.468	2.695	2.762

(1)Linear interpolation is acceptable for intermediate values of z.

(2) Combined coefficient which is the same as C_e in UBC 1991 and afterward

Table 5: Basic Wind Speeds for Selected Locations in Bangladesh (BNBC 1993: Table 6.2.8)

Location	Basic Wind Speed (km/h)	Basic Wind Speed (mph)	Location	Basic Wind Speed (km/h)	Basic Wind Speed (mph)
Angarpota	150	93	Lalmonirhat	204	127
Bagerhat	252	157	Madaripur	220	137
Bandarban	200	124	Magura	208	129
Barguna	260	162	Manikganj	185	115
Barisal	256	159	Meherpur	185	115
Bhola	225	140	Maheshkhali	260	162
Bogra	198	123	Moulvibazar	168	104
Brahmanbaria	180	112	Munshiganj	184	114
Chandpur	160	99	Mymensingh	217	135
Chapai Nawabganj	130	81	Naogaon	175	109
Chittagong	260	162	Narail	222	138
Chuadanga	198	123	Narayanganj	195	121
Comilla	196	122	Narsinghdi	190	118
Cox’s Bazar	260	162	Natore	198	123
Dahagram	150	93	Netrokona	210	130
Dhaka	210	130	Nilphamari	140	87
Dinajpur	130	81	Noakhali	184	114
Faridpur	202	126	Pabna	202	126
Feni	205	127	Panchagarh	130	81
Gaibandha	210	130	Patuakhali	260	162
Gazipur	215	134	Pirojpur	260	162
Gopalganj	242	150	Rajbari	188	117
Habiganj	172	107	Rajshahi	155	96
Hatiya	260	162	Rangamati	180	112
Ishurdi	225	140	Rangpur	209	130
Joypurhat	180	112	Satkhira	183	114
Jamalpur	180	112	Shariatpur	198	123
Jessore	205	127	Sherpur	200	124
Jhalakati	260	162	Sirajganj	160	99
Jhenaidah	208	129	Srimangal	160	99
Khagrachhari	180	112	St. Martin’s Island	260	162
Khulna	238	148	Sunamganj	195	121
Kutubdia	260	162	Sylhet	195	121
Kishoreganj	207	129	Sandwip	260	162
Kurigram	210	130	Tangail	160	99
Kushtia	215	134	Teknaf	260	162
Lakshmipur	162	101	Thakurgaon	130	81

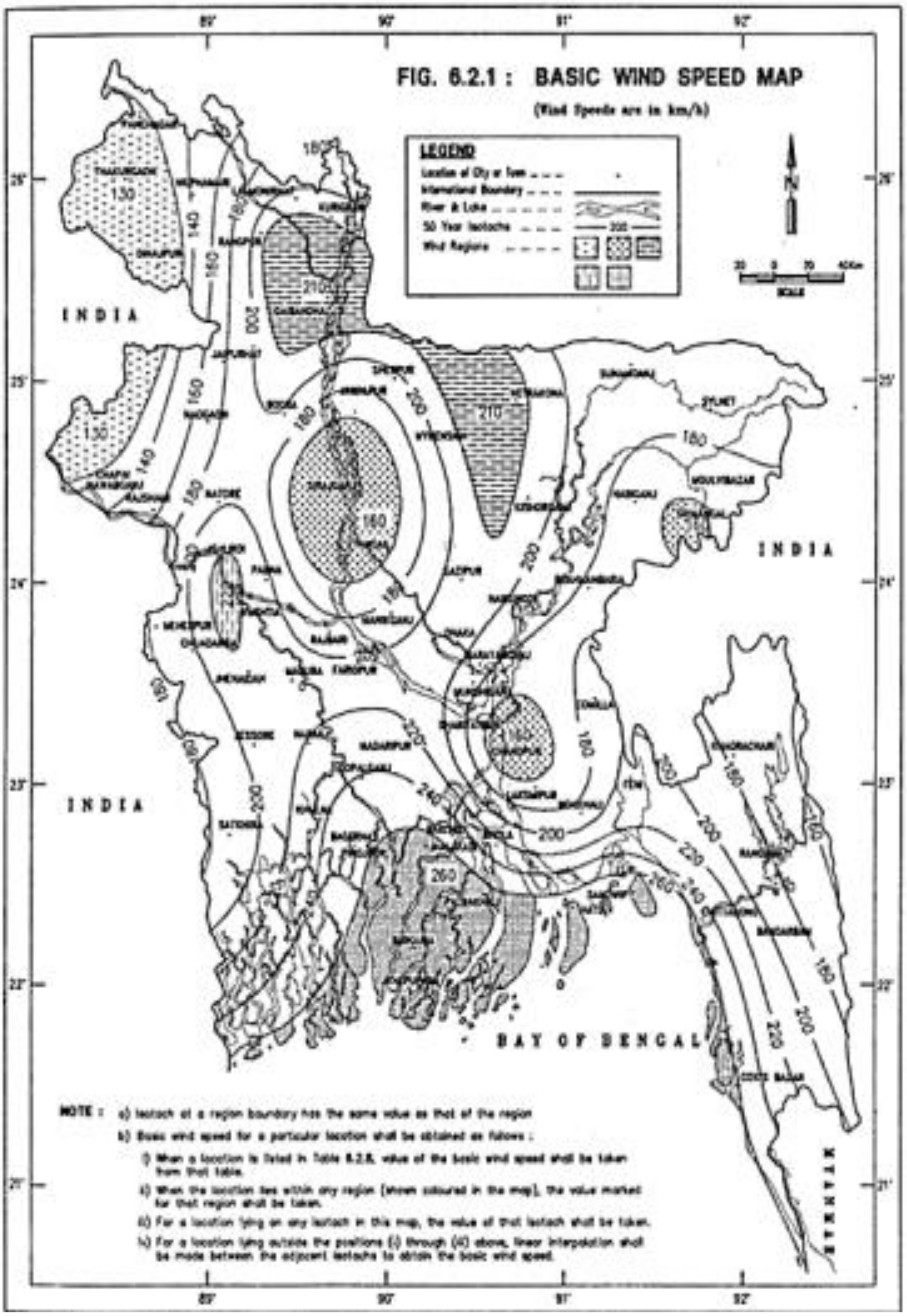


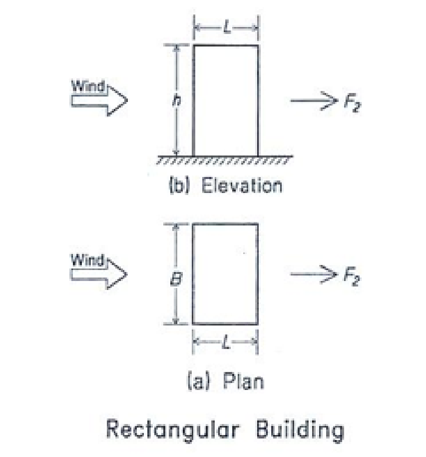
FIG. 6.2.1 : BASIC WIND SPEED MAP
(Wind Speeds are in km/h)
LEGEND
INDIA
INDIA
INDIA
BAY OF BENGAL
130
140
160
180
200
210
220
240
260
NOTE : a) Isotach at a region boundary has the same value as that of the region
b) Basic wind speed for a particular location shall be obtained as follows :
i) When a location is listed in Table 6.2.8, value of the basic wind speed shall be taken from that table.
ii) When the location lies within any region (shown coloured in the map), the value marked for that region shall be taken.
iii) For a location lying on any isotach in this map, the value of that isotach shall be taken.
iv) For a location lying outside the positions (i) through (iii) above, linear interpolation shall be made between the adjacent isotachs to obtain the basic wind speed.

Table 6: Overall Pressure Coefficients, $C_{p(2)}$ for Rectangular Buildings with Flat Roofs (BNBC 1993: Table 6.2.15(1))

h/B	*L/B*					
	0.1	0.5	0.65	1.0	2.0	≥ 3.0
≤0.5	1.40	1.45	1.55	1.40	1.15	1.10
10.0	1.55	1.85	2.00	1.70	1.30	1.15
20.0	1.80	2.25	2.55	2.00	1.40	1.20
≥40.0	1.95	2.50	2.80	2.20	1.60	1.25

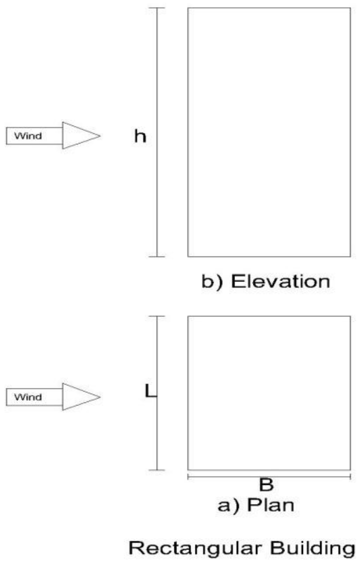
(1) These coefficients are to be used with Method-2 given in BNBC Sec 2.4.6.6a (ii). Use $C_p = \pm 0.7$ for roof in all cases.

(2) Linear interpolation may be made for intermediate values of *h/B and L/B*.

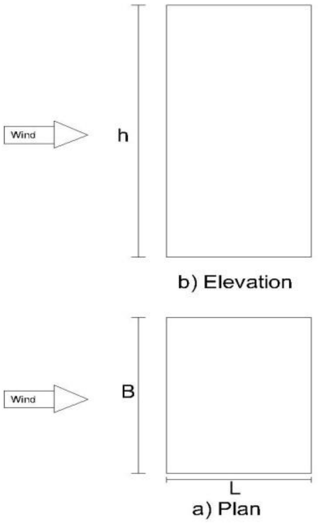


Interpolation for C_p Value:

WLX			
INPUT			
L	64	ft	
B	48	ft	
h	111	ft	
Output			
L/B	1.33		
h/B	2.31		
Cpy			
Manual Interpolation Table For Check			
h/B	L/B		
	0.65	1.33	1
0.5	1.55	1.25714286	1.4
2.31		1.28712406	
10	2	1.41428571	1.7



WLY			
INPUT			
L	48	ft	
B	64	ft	
h	111	ft	
Output			
L/B	0.75		
h/B	1.73		
Cpy			
Manual Interpolation Table For Check			
h/B	L/B		
	0.65	0.75	1
0.5	1.55	1.50714286	1.4
1.73		1.56004464	
10	2	1.91428571	1.7



Rectangular Building

4.2 EARTHQUAKE LOAD CANCULATION:

Equivalent Static Force Method

This method may be used for calculation of seismic lateral forces for all structures specified in Sec 2.5.5.1(a)

2.5.6.1 Design Base Shear : The total design base shear in a given direction shall be determined from the following relation :

$$V = \frac{ZIC}{R} W \qquad (2.5.1)$$

where, Z = Seismic zone coefficient given in Table 6.2.22
I = Structure importance coefficient given in Table 6.2.23
R = Response modification coefficient for structural systems given in Table 6.2.24 W
= The total seismic dead load defined in Sec 2.5.5.2
C = Numerical coefficient given by the relation :

$$C = \frac{1.25S}{T^{2/3}} \le 2.75 \qquad (2.5.2)$$

S = Site coefficient for soil characteristics as provided in Table 6.2.25
T = Fundamental period of vibration in seconds, of the structure for the direction under consideration as determined by the provisions of Sec 2.5.6.2.

The value of C need not exceed 2.75 and this value may be used for any structure without regard to soil type or structure period. Except for those requirements where Code prescribed forces are scaled up by 0.375R, the minimum value of the ratio C/R shall be 0.075.

Table 6.2.22
Seismic Zone Coefficients, Z

Table 6.2.23
Structure Importance Coefficients I, I'

2.5.6.2 Structure Period : The value of the fundamental period, T of the structure shall be determined from one of the following methods :

a) **Method A** : For all buildings the value of T may be approximated by the following formula :

$$T = C_t (h_n)^{3/4} \qquad (2.5.3)$$

where, C_t = 0.083 for steel moment resisting frames {0.034 when height in ft}
= 0.073 for reinforced concrete moment resisting frames, and eccentric braced steel frames {**0.030** when height in ft}
= 0.049 for all other structural systems {0.020 when height in ft}

h_n = Height in metres above the base to level n.

SEISMIC WEIGHT

Seismic weight, *W*, is the total dead load of a building or a structure, including partition walls, and applicable portions of other imposed loads listed below:

a) For live load up to and including 3 kN/m^2, a minimum of 25% of the live load shall be applicable.

b) For live load above 3 kN/m^2, a minimum of 50% of the live load shall be applicable.

c) Total weight (100%) of permanent heavy equipment or retained liquid or any imposed load sustained in nature shall be included.

Where the probable imposed loads (mass) at the time of earthquake are more correctly assessed, the designer may go for higher percentage of live load.

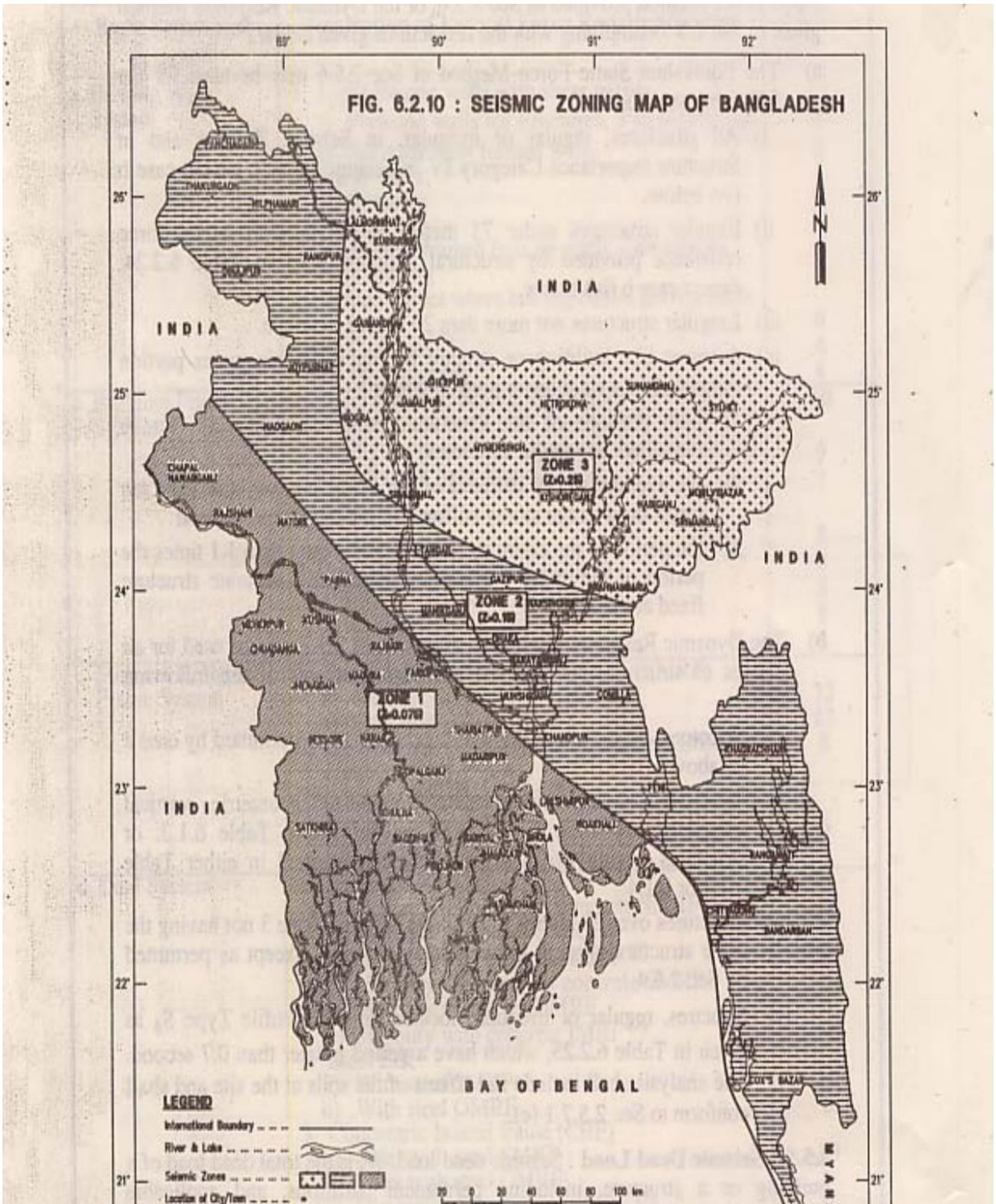


FIG. 6.2.10 : SEISMIC ZONING MAP OF BANGLADESH

Table 6.2.24
Response Modification Coefficient for Structural Systems,

Basic Structural System(1)	Description of Lateral Force Resisting System	R (2)
a. Bearing Wall System	1. Light framed walls with shear panels	
	i) Plywood walls for structures, 3 storeys or less	8
	ii) All other light framed walls	6
	2. Shear walls	
	i) Concrete	6
	ii) Masonry	6
	3. Light steel framed bearing walls with tension only bracing	4
	4. Braced frames where bracing carries gravity loads	
	i) Steel	6
	ii) Concrete (3)	4
	iii) Heavy timber	4
b. Building Frame System	1. Steel eccentric braced frame (EBF)	10
	2. Light framed walls with shear panels	
	i) Plywood walls for structures 3-storeys or less	9
	ii) All other light framed walls	7
	3. Shear walls	
	i) Concrete	8
	ii) Masonry	8
	4. Concentric braced frames (CBF)	
	i) Steel	8
	ii) Concrete (3)	8
	iii) Heavy timber	8
c. Moment Resisting Frame System	1. Special moment resisting frames (SMRF)	
	i) Steel	12
	ii) Concrete	12
	2. Intermediate moment resisting frames (IMRF), concrete (4)	8
	3. Ordinary moment resisting frames (OMRF)	
	i) Steel	6
	ii) Concrete (5)	5
d. Dual System	1. Shear walls	
	i) Concrete with steel or concrete SMRF	12
	ii) Concrete with steel OMRF	6
	iii) Concrete with concrete IMRF (4)	9
	iv) Masonry with steel or concrete SMRF	8
	v) Masonry with steel OMRF	6
	vi) Masonry with concrete IMRF (3)	7
	2. Steel EBF	
	i) With steel SMRF	12
	ii) With steel OMRF	6
	3. Concentric braced frame (CBF)	
	i) Steel with steel SMRF	10
	ii) Steel with steel OMRF	6
	iii) Concrete with concrete SMRF (3)	9
	iv) Concrete with concrete IMRF (3)	6
e. Special Structural Systems	See Sec 1.3.2, 1.3.3, 1.3.5	

Notes:

(1) Basic Structural Systems are defined in Sec 1.3.2, Chapter 1.
(2) See Sec 2.5.6.6 for combination of structural systems, and Sec 1.3.5 for system limitations.
(3) Prohibited in Seismic Zone 3.
(4) Prohibited in Seismic Zone 3 except as permitted in Sec 2.5.9.3.
(5) Prohibited in Seismic Zones 2 and 3. Sec 1.7.2.6.

Table 6.2.25

Site Coefficient, S for Seismic Lateral Forces (1)

Site Soil Characteristics		Coefficient, S
Type	Description	
S1	A soil profile with either : a) A rock-like material characterized by a shear-wave velocity greater than 762 m/s or by other suitable means of classification, or b) Stiff or dense soil condition where the soil depth is less than 61 metres	1.0
S_2	A soil profile with dense or stiff soil conditions, where the soil depth exceeds 61 metres	1.2
S3	A soil profile 21 metres or more in depth and containing more than 6 metres of soft to medium stiff clay but not more than 12 metres of soft clay	1.5
S_4	A soil profile containing more than 12 metres of soft clay characterized by a shear wave velocity less than 152 m/s	2.0

Note : (1) The site coefficient shall be established from properly substantiated geotechnical data. In locations where the soil properties are not known in sufficient detail to determine the soil profile type, soil profile S3 shall be used. Soil profile S4 need not be assumed unless the building official determines that soil profile S4 may be present at the site, or in the event that soil profile S4 is established by geotechnical data.

2.5.6.3 Vertical Distribution of Lateral Forces : In the absence of a more rigorous procedure, the total lateral force, which is the base shear V, shall be distributed along the height of the structure in accordance with Eq (2.5.6), (2.5.7) and (2.5.8):

$$V = F_t + \sum_{i=1}^{n} F_i \qquad (2.5.6)$$

where, F_i = Lateral force applied at storey level -i and

F_t = Concentrated lateral force considered at the top of the building in addition to the force F_n.

The concentrated force, F_t acting at the top of the building shall be determined as follows:

$$F_t = 0.07\,TV \le 0.25\,V \qquad \text{when } T \ge 0.7 \text{ second} \qquad (2.5.7a)$$

$$F_t = 0.0 \qquad \text{when } T \le 0.7 \text{ second} \qquad (2.5.7b)$$

The remaining portion of the base shear (V-F_t), shall be distributed over the height of the building, including level-n, according to the relation :

$$Fx = \frac{(V - F_t) w_x h_x}{\sum_{i=1}^{n} w_i h_i} \qquad \textbf{(2.5.8)}$$

At each storey level-x, the force F_x shall be applied over the area of the building in proportion to the mass distribution at that level.

CHAPTER-05
RESULT AND DISCUSSIONS

5.1 Data analysis:

5.1.1 Finding Maximum Moment Value:

After checking deferent floor from analysis we found maximum moment on beam at:

Beam Element Details (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (in)	LLRF	Type
Floor2	B15	163	Beam12"x20"	DCon6	10	192	1	Sway Special

Design Moment and Flexural Reinforcement for Moment, M_{u3}

	Design -Moment kip-ft	Design +Moment kip-ft	-Moment Rebar in²	+Moment Rebar in²	Minimum Rebar in²	Required Rebar in²
Top (+2 Axis)	-215.7726		2.6146	0	0.5793	2.6146
Bottom (-2 Axis)		107.8863	0	1.2078	0.5793	1.2078

From above procedure we collect / found max moment with respect to grid type & level which is put on the graph as bellow:

5.1.2 Grid Type:

Type-1	Type-2
Type=L-48XB-32	Type=L-64XB-48
Type=L-64XB-32	Type=L-80XB-48
Type=L-80XB-32	Type=L-96XB-48

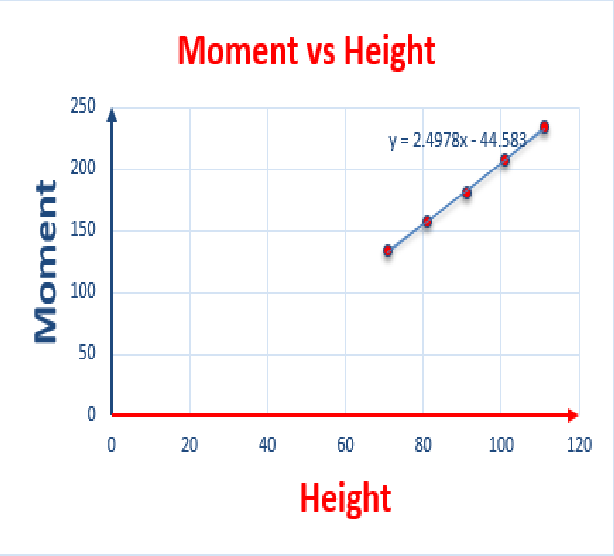
5.1.3 Graphs:

Graph is prepared with the relation of moment.

Subject: Drawing Graph (Moment & L/B Ratio, Height Variable)

L= 48 Feet	**Ratio = 1.5**
B= 32 Feet	

Height (Variable)	Moment	L/B Ratio
71	133.7917	1.5
81	157.3412	1.5
91	181.4188	1.5
101	207.3381	1.5
111	233.6817	1.5
X	Y	

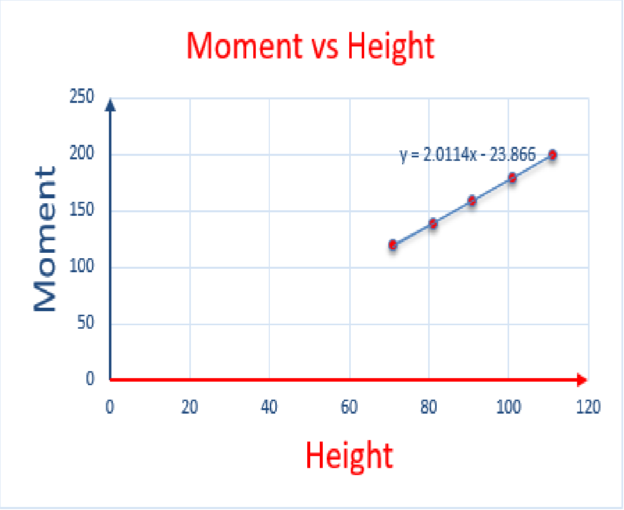


m=2.4978
C=-44.583

Subject: Drawing Graph (Moment & L/B Ratio, Height Variable)

L= 64 Feet	**Ratio = 2.00**
B= 32 Feet	

Height (Variable)	Moment	L/B Ratio
71	119.3194	2.00
81	138.8041	2.00
91	158.9158	2.00
101	179.0526	2.00
111	199.765	2.00
X	Y	



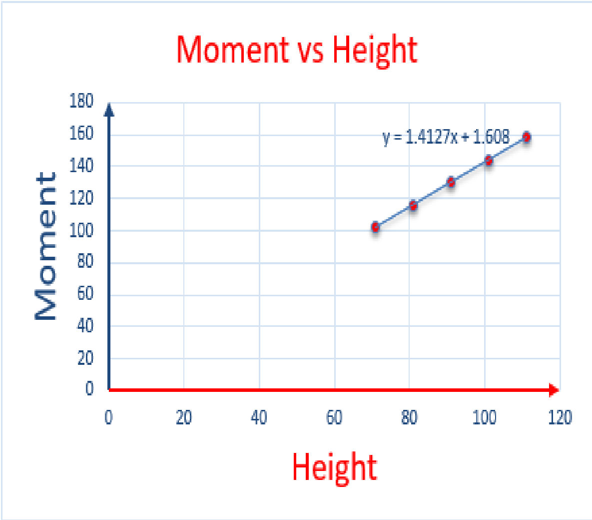
m=2.0114
C=-23.866

Subject: Drawing Graph (Moment & L/B Ratio, Height Variable)

L= 80 Feet	**Ratio = 2.5**
B= 32 Feet	

Height (Variable)	Moment	L/B Ratio
71	101.8553	2.50
81	115.9662	2.50
91	130.3551	2.50
101	144.3194	2.50
111	158.3126	2.50
X	**Y**	

m=1.4127
C=1.608

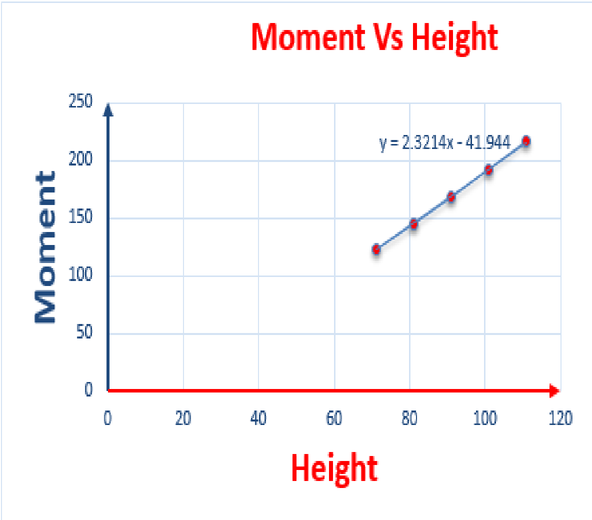


Subject: Drawing Graph (Moment & L/B Ratio, Height Variable)

L= 64 Feet	**Ratio = 1.33**
B= 48 Feet	

Height (Variable)	Moment	L/B Ratio
71	123.9093	1.33
81	145.4292	1.33
91	168.2449	1.33
101	192.4438	1.33
111	216.4696	1.33
X	**Y**	

m=2.3214
C=-41.944

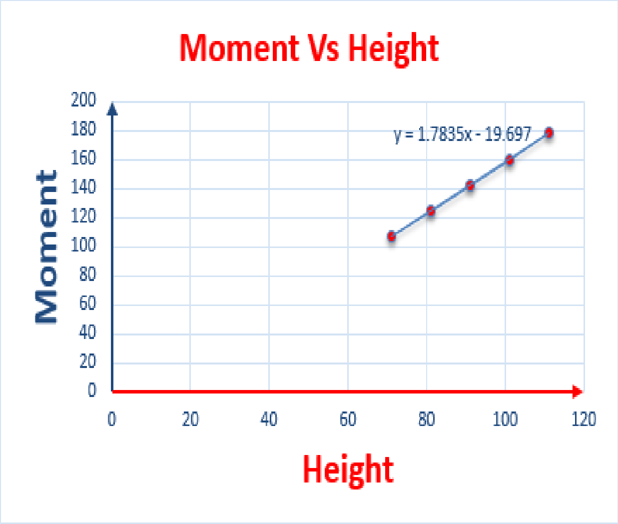


Subject: Drawing Graph (Moment & L/B Ratio, Height Variable)

L= 80 Feet	**Ratio = 1.67**
B= 48 Feet	

Height (Variable)	Moment	L/B Ratio
71	107.4904	1.67
81	124.4688	1.67
91	142.1489	1.67
101	159.9639	1.67
111	178.9154	1.67
X	**Y**	

m=1.7835
C=-19.697

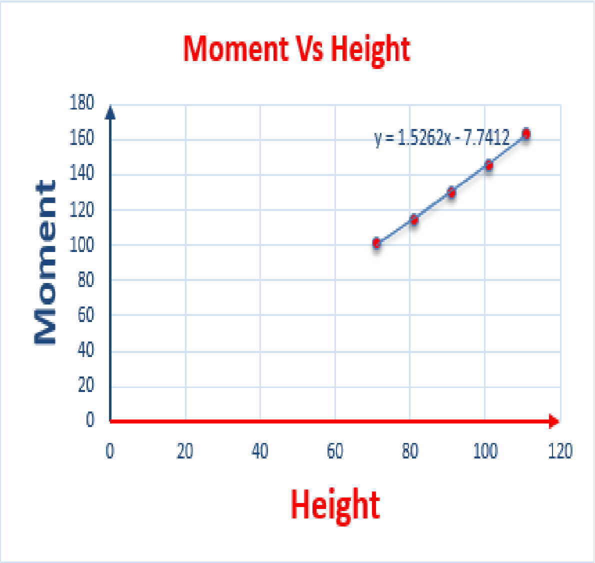


Subject: Drawing Graph (Moment & L/B Ratio, Height Variable)

L= 96 Feet	**Ratio = 2.00**
B= 48 Feet	

Height (Variable)	Moment	L/B Ratio
71	101.746	2
81	115.0202	2
91	130.434	2
101	145.867	2
111	162.6307	2
X	**Y**	

m=1.5262
C=-7.7412



5.1.4 Three Seismic Zone of Bangladesh:

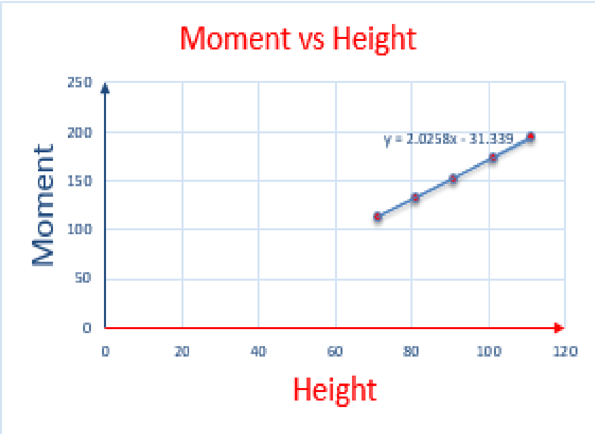
For Zone 1: (High Risk) Sylhet

Subject: Drawing Graph (Moment & L/B Ratio, Height Variable)

L= 64 Feet	Ratio = 1.33
B= 48 Feet	

Height (Variable)	Moment	L/B Ratio
71	113.3629	1.33
81	132.1956	1.33
91	152.1245	1.33
101	173.2304	1.33
111	194.1364	1.33
X	Y	

m=2.0258
C=-31.339



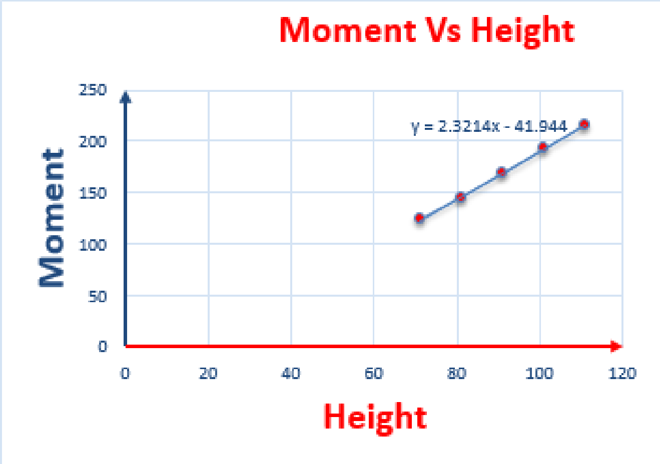
For Zone 2: (Moderate Risk) Dhaka

Subject: Drawing Graph (Moment & L/B Ratio, Height Variable)

L= 64 Feet	**Ratio = 1.33**
B= 48 Feet	

Height (Variable)	Moment	L/B Ratio
71	123.9093	1.33
81	145.4292	1.33
91	168.2449	1.33
101	192.4438	1.33
111	216.4696	1.33
X	Y	

m=2.3214
C=-41.944



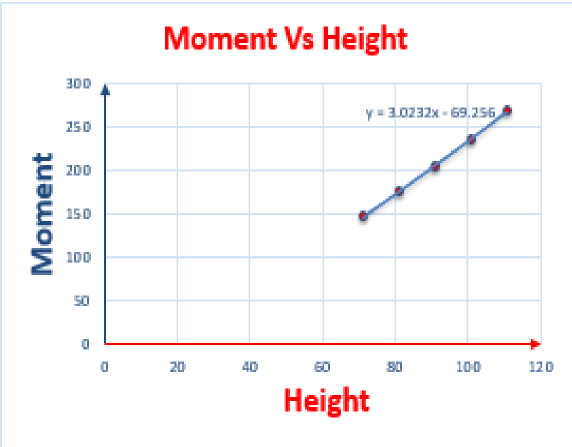
For Zone 3: (Low Risk) Khulna

Subject: Drawing Graph (Moment & L/B Ratio, Height Variable)

L= 64 Feet	Ratio = 1.33
B= 48 Feet	

Height (Variable)	Moment	L/B Ratio
71	147.2709	1.33
81	174.7434	1.33
91	203.9539	1.33
101	235.004	1.33
111	268.3003	1.33
X	Y	

m=3.0232
C=-69.256



Remarks:

We chose 3 Locations Dhaka, Khulna and Sylhet of 3 separate Zones to assign lateral loads (both wind and seismic loads) to perform analysis of our project. But it is mentionable that for different Zones, Moment variations also different.

5.2 Result:

Y=mx+C ---------------------------------(1)
nY=nmx+nc------------------------------(2) [Multiply By n]
$\sum$Y=m$\sum$x+nC---------------------------(3)
$\sum$xY=m$\sum x^2$+C$\sum$x----------------------(4) [Multiply By x]

x(Height) ft	x^2(Height) ft^2	Y(Moment) kip-ft	xY (kip-ft^2)
71	5041	123.9093	8797.5603
81	6561	145.4292	11779.7652
91	8281	168.2449	15310.2859
101	10201	192.4438	19436.8238
111	12321	216.4696	24028.1256
$\sum$x=455	$\sum x^2$=42405	$\sum$Y=846.4968	$\sum$xY=79352.5608

Now, Putting the value in 3 & 4 No. Equation:
846.4968=m*455+5*C [Where n=5]
79352.5608=m*42405+C*455

So, m=2.3214 [By Using Calculator]
C=-41.944

Y=mx+C
Y=2.3214*101+(-41.944) [when, x=101 ft]
=192.5174 kip-ft (Equation Proved)

Moment Variation Follows a Straight Line.

6.1 Conclusions:

- Through this analysis it has been found that lateral loads (Wind, Earthquake) have considerable effect to grate extent in the design of a high rise building frame.
- For analysis the selected building frame we have used ETABS software. Which is the most common and accurate analysis procedure now a days.
- We found maximum moment on beam at 2^{nd} and 3^{rd} floor (Maximum Cases).

6.2 FURTHER STUDIES:

From the above study the following recommendation can made for further study:

- The analysis can be performed by varying the number of story, height and number of spans of the building.
- The analysis involves finite element techniques with relatively coarse mesh. So accuracy of the result can be improved through using fine mesh.
- This study can be compared between other approximate methods.

References:

- Class Note of Computer Aided Analysis and Design of Structures, Sonargaon University, (SU), Dhaka, Bangladesh.
- Manzur-su.webs.com
- Using Software ETABS-16
- ETABS Tutorials, YouTube.
- "Building Code Requirement for Reinforcement Concrete" ACI Publication 318-08 American Concrete Institute.
- "Seismic Zoning Map of Bangladesh.
- Code UBC-94.