

SAP2000

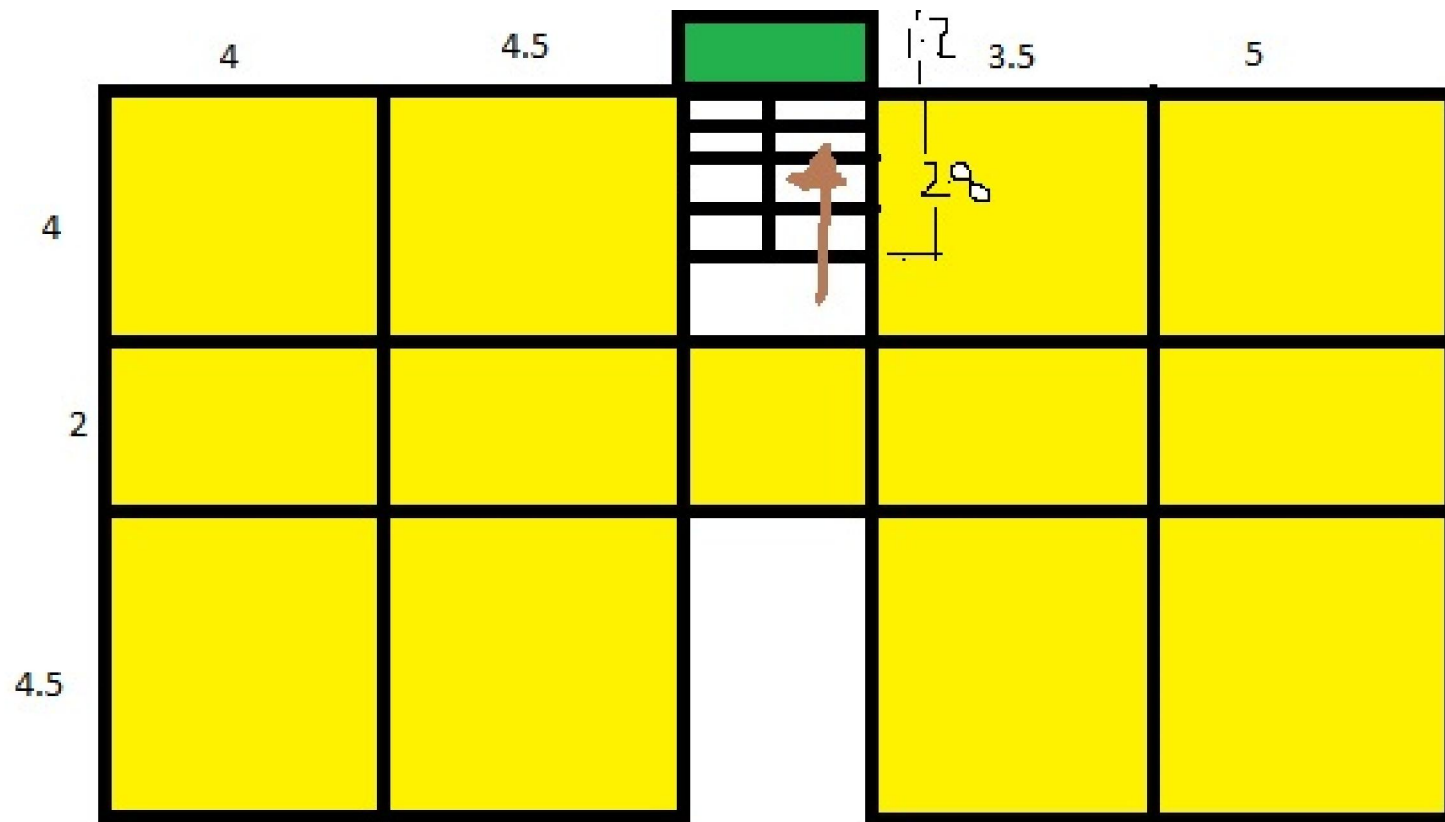
By Biruk Gezahegn

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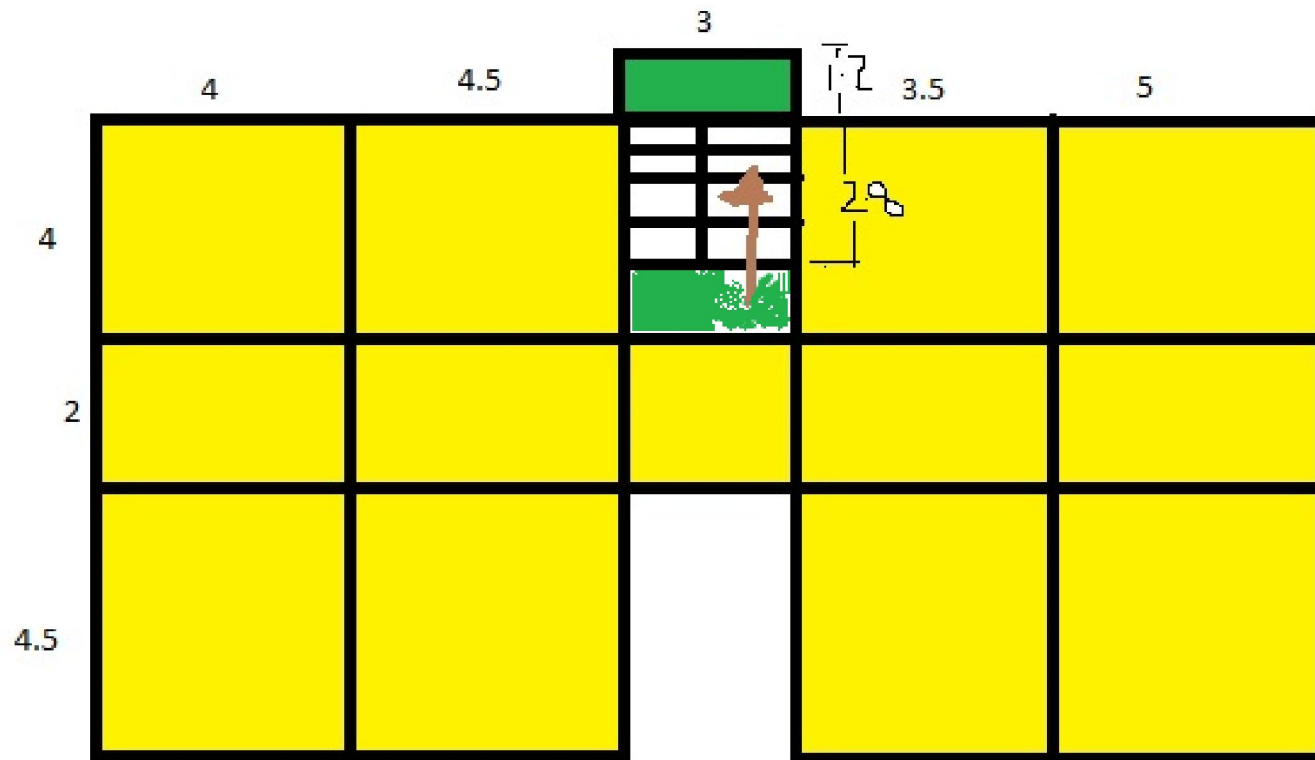
Email-birukgeza@gmail.com

Concrete Frame Building Analysis and Design

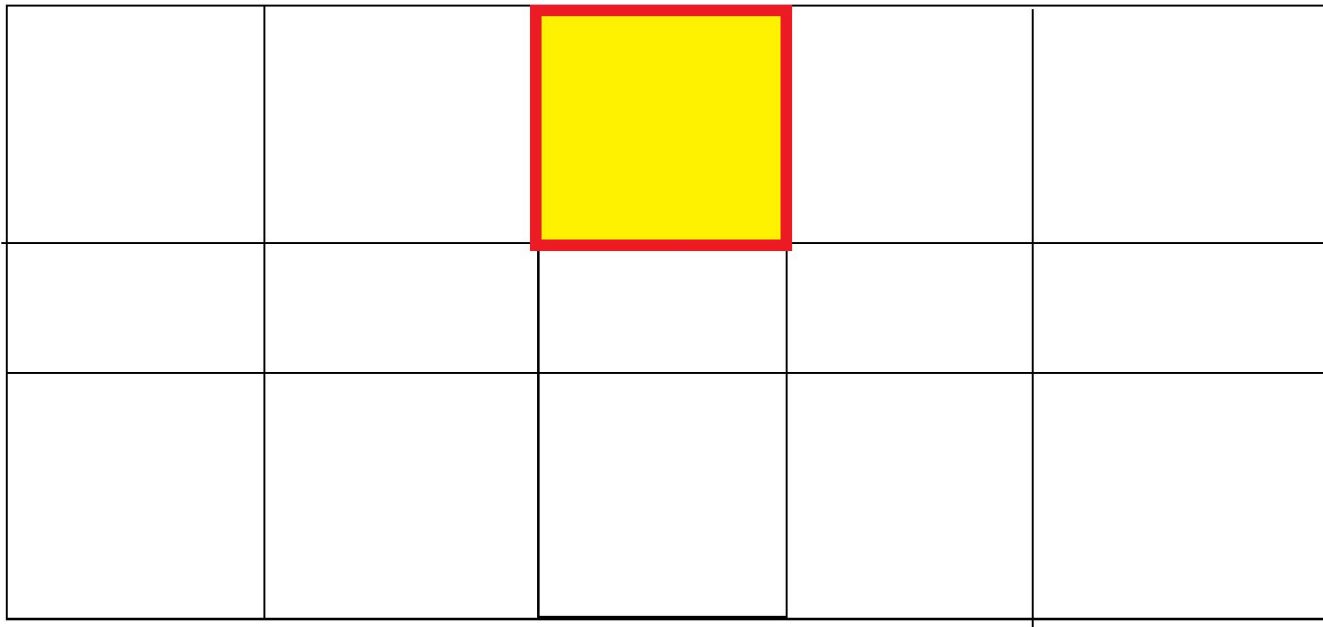
- Ground Floor Plan



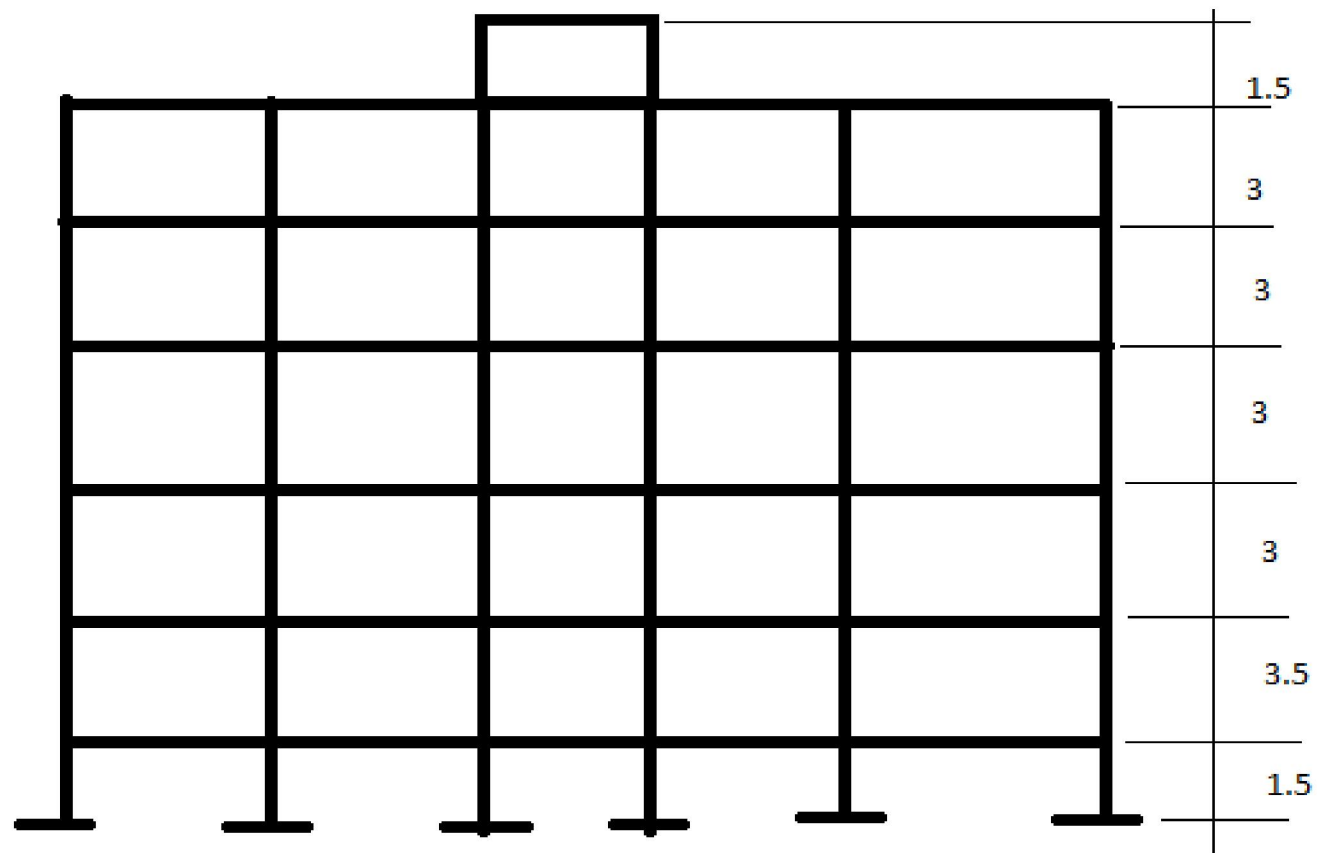
Typical floor plan



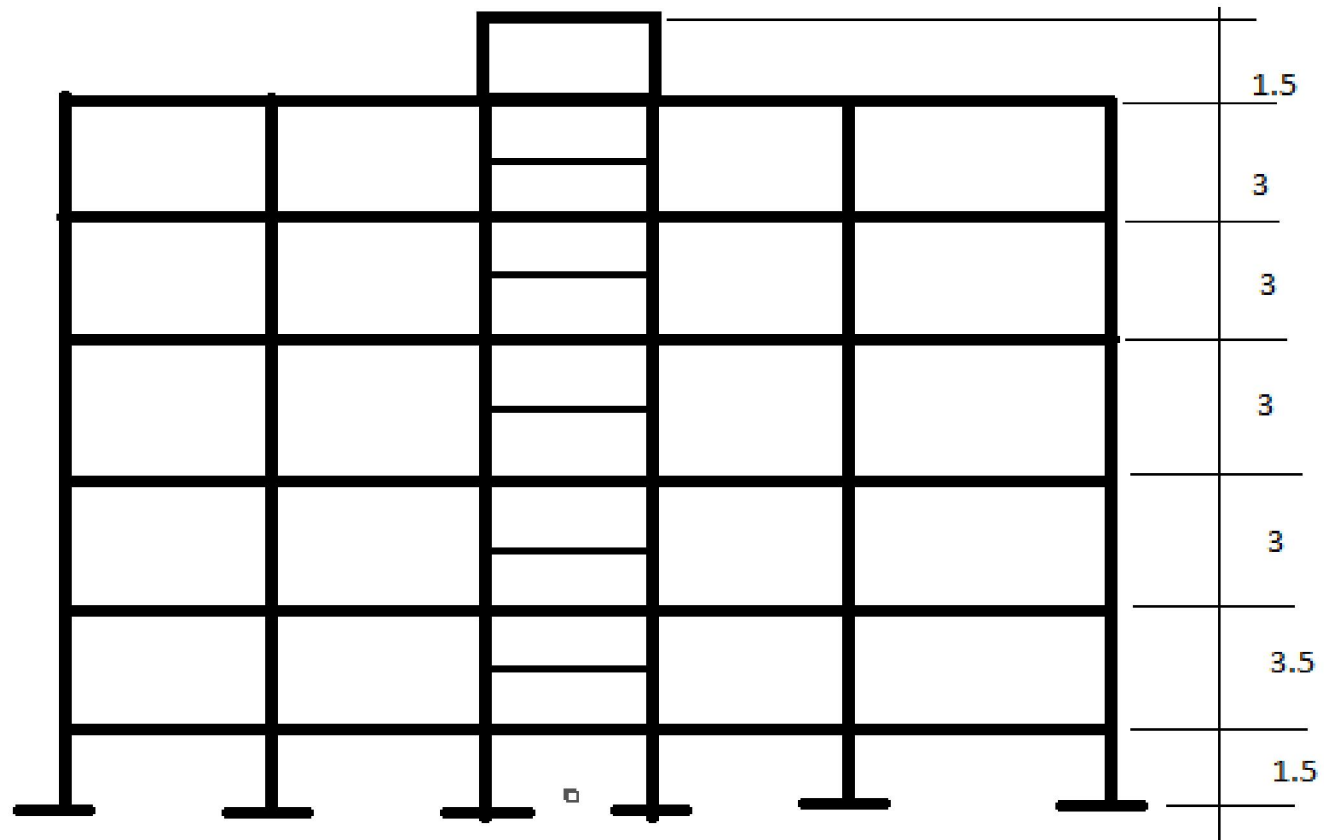
Water tank plan



Front Elevation



Rear View



Material Data

Concrete

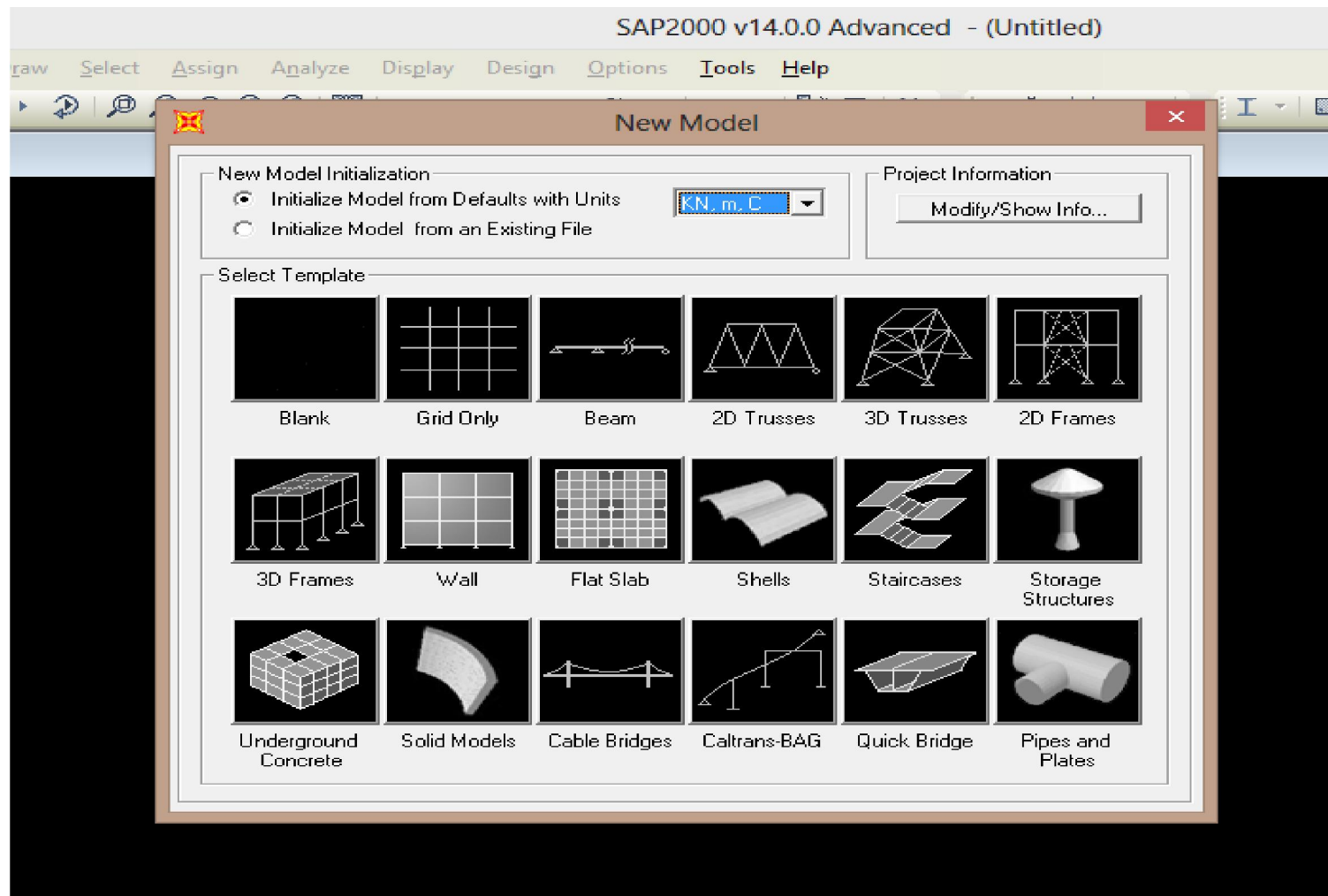
- C-25
- $F_{cu}=25\text{MPa}$
- $F_{ck}(f_c)=0.8*f_{cu}$

Rebar

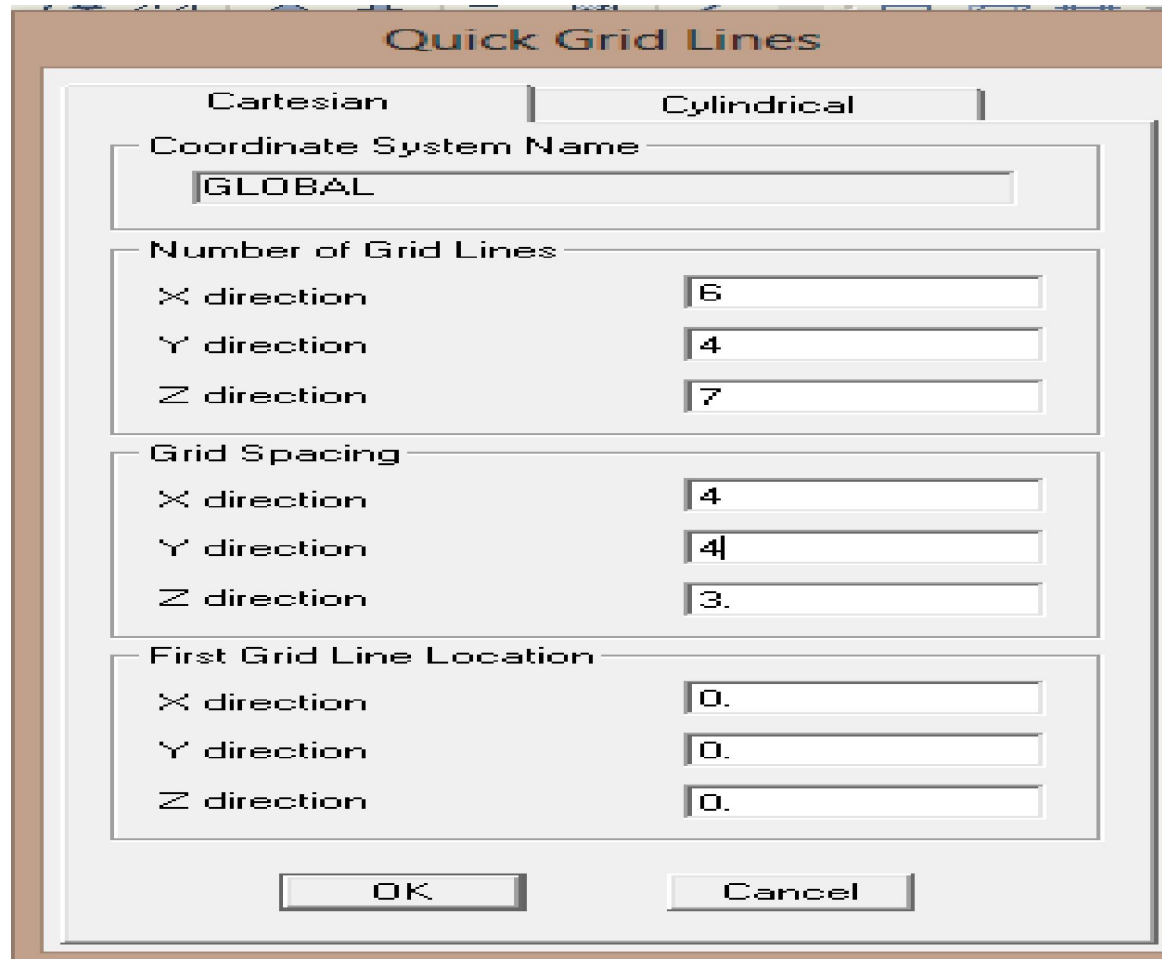
- S-400 for longitudinal rebar
- S-300 for shear rebar

1. Open SAP2000

File---New model



Click grid only and adjust no. of grid line and grid spacing



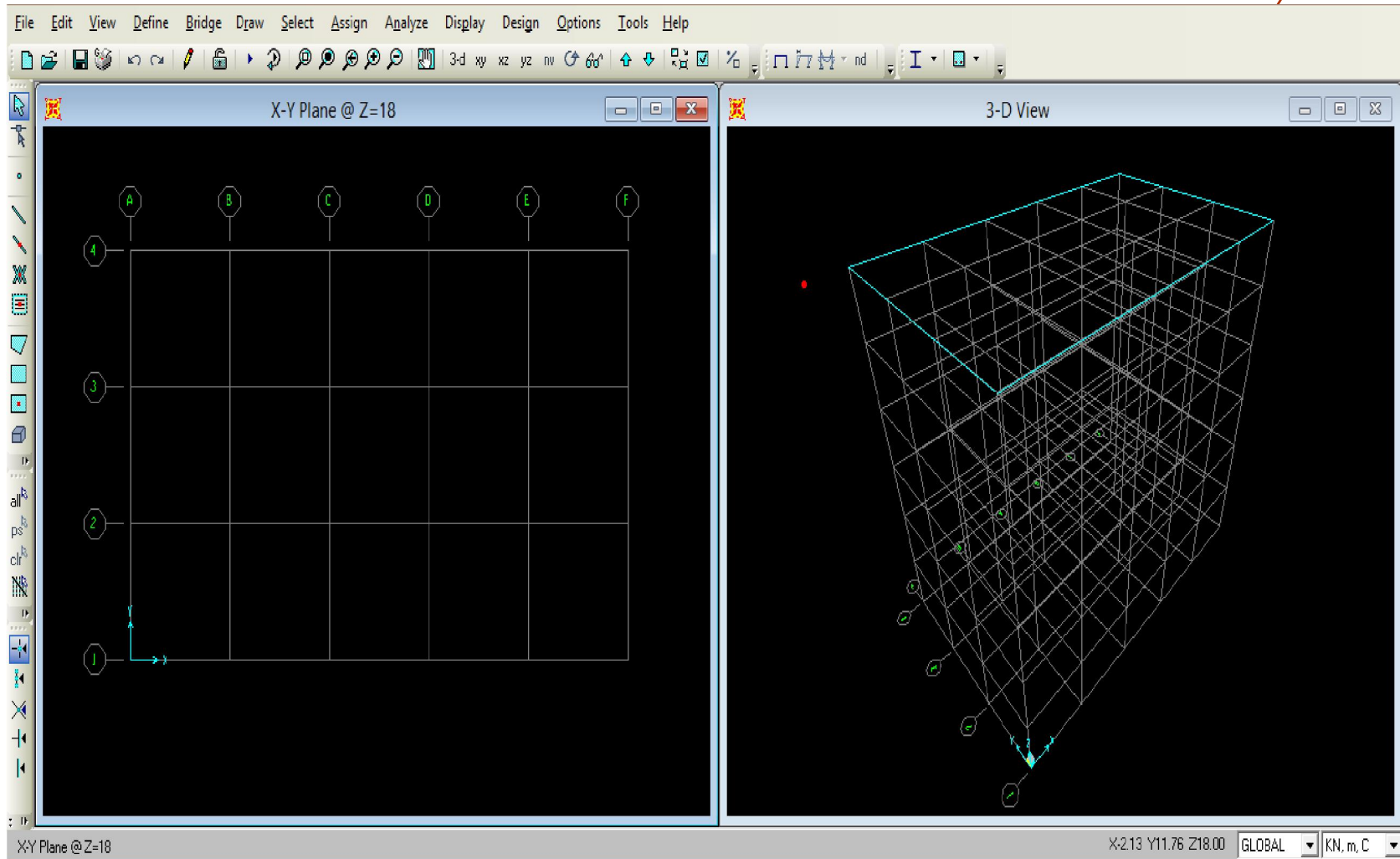
The image shows a 'Quick Grid Lines' dialog box with a title bar. It contains two tabs: 'Cartesian' (selected) and 'Cylindrical'. The dialog is organized into four sections, each with a label and a group box containing three input fields for X, Y, and Z directions.

Section	X direction	Y direction	Z direction
Coordinate System Name	GLOBAL		
Number of Grid Lines	6	4	7
Grid Spacing	4	4	3.
First Grid Line Location	0.	0.	0.

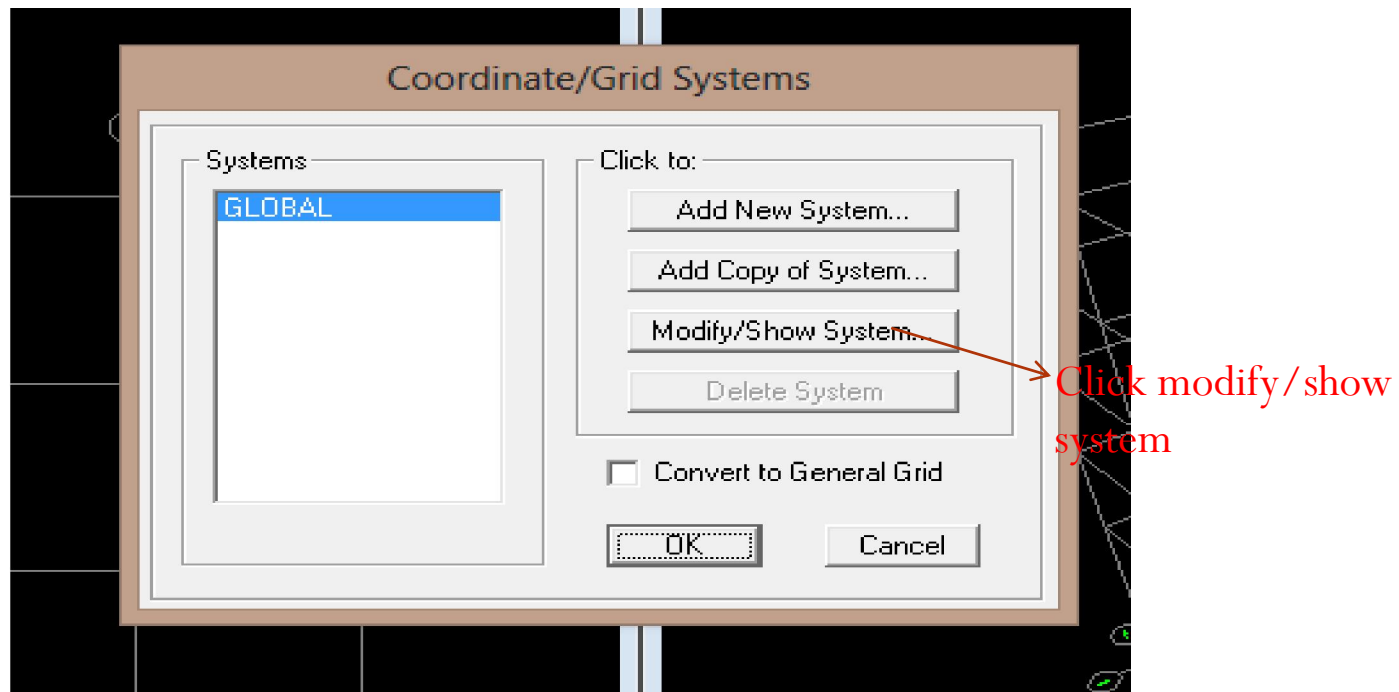
At the bottom of the dialog are 'OK' and 'Cancel' buttons.

Click ok

Your window should look like this



Edit grid data





Define Grid System Data



Edit Format

System Name

GLOBAL

Units

KN, m, C

Grid Lines

Quick Start...

X Grid Data

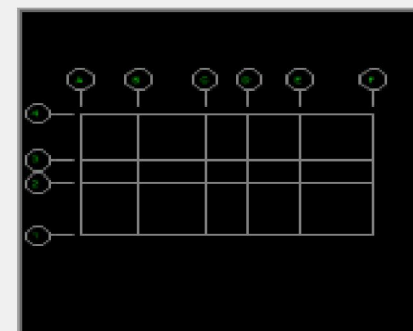
	Grid ID	Ordinate	Line Type	Visibility	Bubble Loc.	Bubble Loc.
1	A	0	Primary	Show	End	
2	B	4	Primary	Show	End	
3	C	8.5	Primary	Show	End	
4	D	11.5	Primary	Show	End	
5	E	15	Primary	Show	End	
6	F	20	Primary	Show	End	
7						
8						

Y Grid Data

	Grid ID	Ordinate	Line Type	Visibility	Bubble Loc.	Bubble Loc.
1	1	0	Primary	Show	Start	
2	2	4.5	Primary	Show	Start	
3	3	6.5	Primary	Show	Start	
4	4	10.5	Primary	Show	Start	
5						
6						
7						
8						

Z Grid Data

	Grid ID	Ordinate	Line Type	Visibility	Bubble Loc.	
1	Z1	-1.5	Primary	Show	End	
2	Z2	0	Primary	Show	End	
3	Z3	3.5	Primary	Show	End	
4	Z4	6.5	Primary	Show	End	
5	Z5	9.5	Primary	Show	End	
6	Z6	12.5	Primary	Show	End	
7	Z7	15.5	Primary	Show	End	
8		17	Secondary	Show	End	



Display Grids as

☒ Ordinates ☐ Spacing

☐ Hide All Grid Lines

☐ Glue to Grid Lines

Bubble Size 0.875

Reset to Default Color

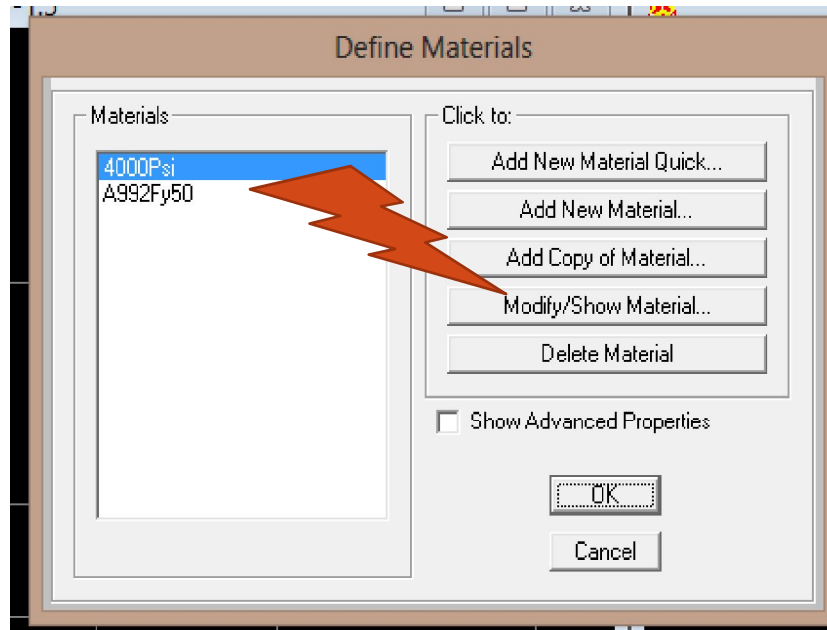
Reorder Ordinates

After editing click ok!

OK

Cancel

Define materials



Edit material property and click
ok!

Material Property Data

General Data

Material Name and Display Color: C-25

Material Type: Concrete

Material Notes: Modify/Show Notes...

Weight and Mass

Weight per Unit Volume: 25

Mass per Unit Volume: 2.5493

Units: KN, m, C

Isotropic Property Data

Modulus of Elasticity, E: 29E6

Poisson's Ratio, U: 0.2

Coefficient of Thermal Expansion, A: 9.900E-06

Shear Modulus, G: 12083333

Other Properties for Concrete Materials

Specified Concrete Compressive Strength, f'c: 20000

☐ Lightweight Concrete

Shear Strength Reduction Factor:

☐ Switch To Advanced Property Display

OK Cancel

Define Materials

Materials

C-25
A992Fy50

Click to:

Add New Material Quick...

Add New Material...

Add Copy of Material...

Modify/Show Material...

Delete Material

☐ Show Advanced Properties

OK

Cancel

After editing material property
click ok!

Material Property Data

General Data

Material Name and Display Color

S-400

Material Type

Rebar

Material Notes

Modify/Show Notes...

Weight and Mass

Weight per Unit Volume

77

Mass per Unit Volume

7.8518

Units

KN, m, C

Isotropic Property Data

Modulus of Elasticity, E

200E6

Poisson's Ratio, U

0.3

Coefficient of Thermal Expansion, A

1.170E-05

Shear Modulus, G

76923077

Other Properties for Rebar Materials

Minimum Yield Stress, Fy

400000

Minimum Tensile Stress, Fu

347826.086

Expected Yield Stress, Fye

400000

Expected Tensile Stress, Fue

347826.086

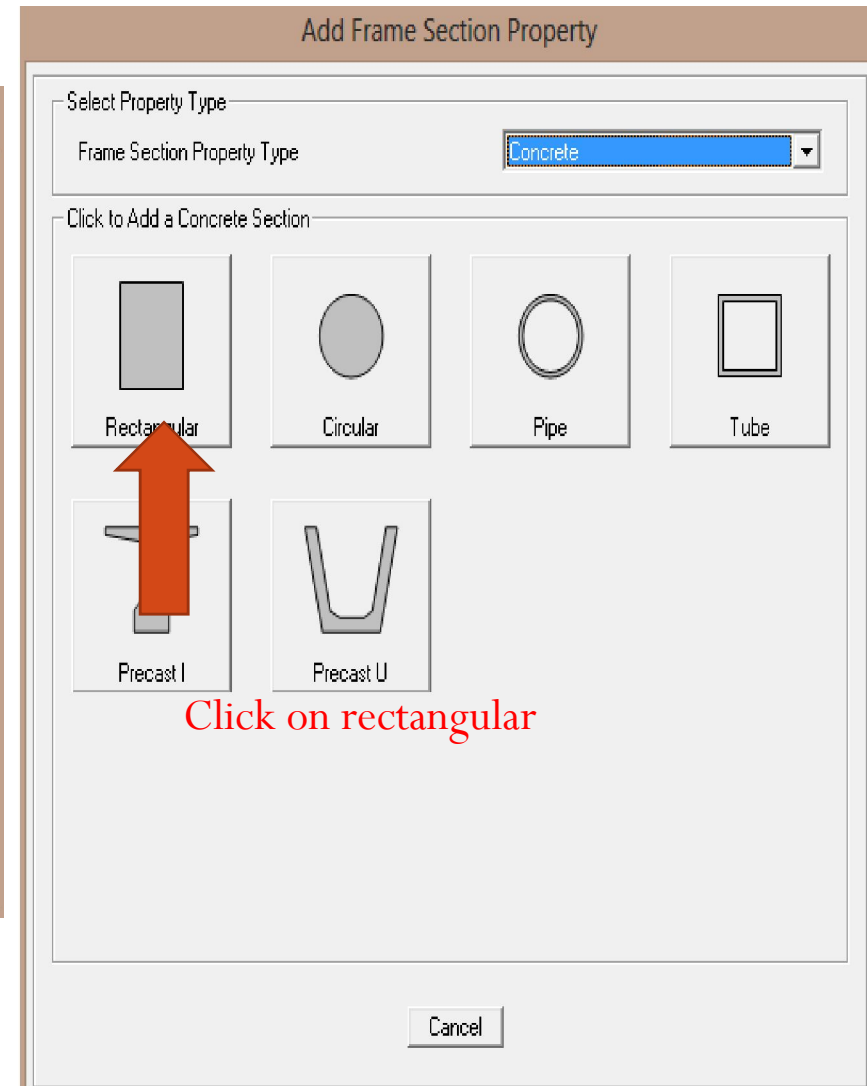
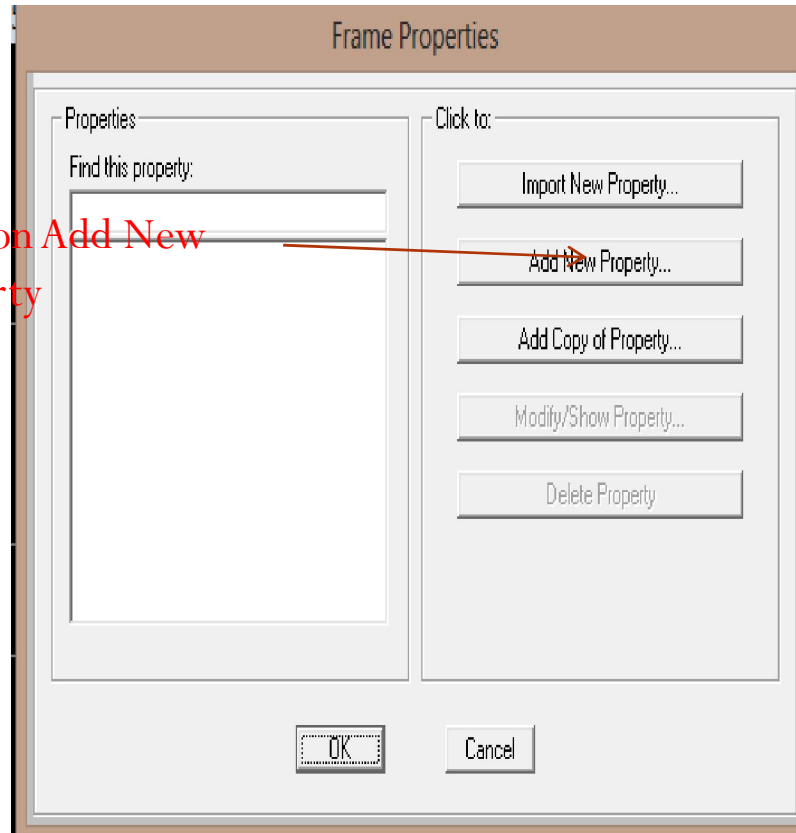
☐ Switch To Advanced Property Display

OK

Cancel

Define → section properties → frame sections

Click on Add New Property



Column Sections

Rectangular Section

Section Name FC

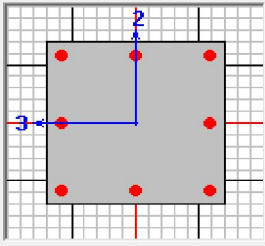
Section Notes

Properties **Property Modifiers** **Material** + C-25

Dimensions

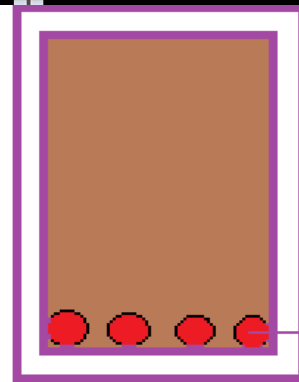
Depth (t3) 0.5

Width (t2) 0.5



Display Color 

Click on conc.
reinforcement



Reinforcement Data

Rebar Material

Longitudinal Bars + S-400

Confinement Bars (Ties) + S-400

Design Type

☒ Column (P-M2-M3 Design)

☐ Beam (M3 Design Only)

Reinforcement Configuration

☒ Rectangular

☐ Circular

Confinement Bars

☒ Ties

☐ Spiral

Longitudinal Bars - Rectangular Configuration

Clear Cover for Confinement Bars 0.043

Number of Longit Bars Along 3-dir Face 3

Number of Longit Bars Along 2-dir Face 3

Longitudinal Bar Size + #9

Confinement Bars

Confinement Bar Size + #4

Longitudinal Spacing of Confinement Bars 0.15

Number of Confinement Bars in 3-dir 3

Number of Confinement Bars in 2-dir 3

Check/Design

☐ Reinforcement to be Checked

☒ Reinforcement to be Designed

Cover to rebar center
 $= d20/2 + 8 + 25 = 43\text{mm}$

Add copy of property

Frame Properties

Properties

Find this property:

TFC
FC
TFC

Click to:

Import New Property...
Add New Property...
Add Copy of Property...
Show Property...
Delete Property

OK Cancel

Rectangular Section

Section Name: TFC

Section Notes: Modify/Show Notes...

Properties: Section Properties...

Property Modifiers: Set Modifiers...

Material: + C-25

Dimensions:

Depth (t3): 0.4

Width (t2): 0.4

Concrete Reinforcement...

Display Color: ☒

OK Cancel

Rectangular Section

Section Name

RC

Section Notes

Modify/Show Notes...

Properties

Section Properties...

Property Modifiers

Set Modifiers...

Material

+ C-25

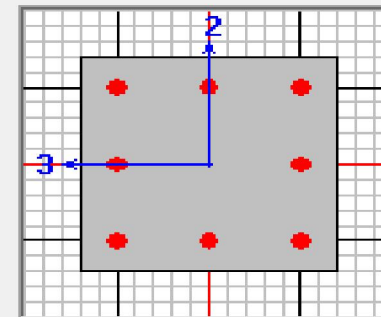
Dimensions

Depth (t3)

0.3

Width (t2)

0.3



Display Color



Concrete Reinforcement...

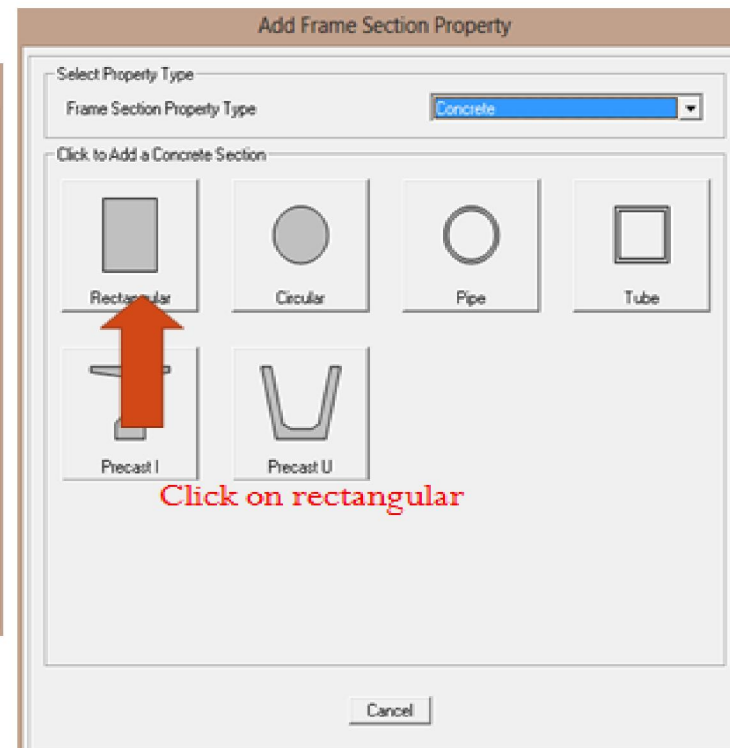
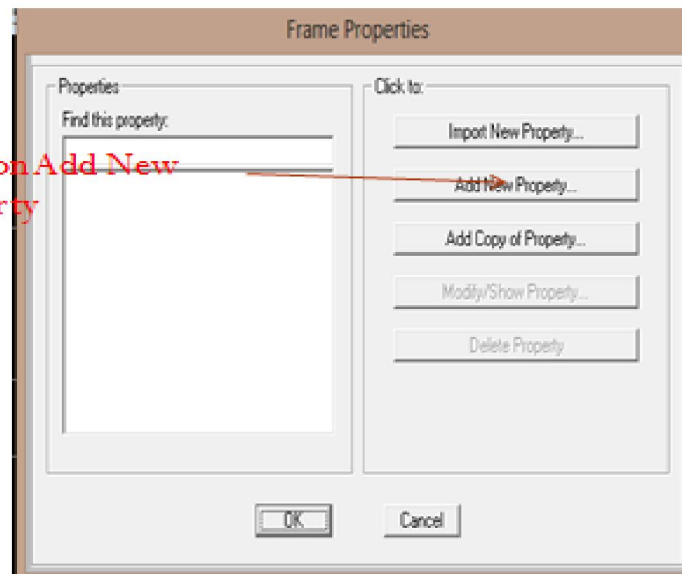
OK

Cancel

Beam sections

Define → section properties → frame sections

Click on Add New Property



Rectangular Section

Section Name

GB

Section Notes

Modify/Show Notes...

Properties

Section Properties...

Property Modifiers

Set Modifiers...

Material

+ C-25

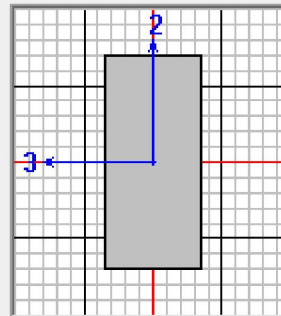
Dimensions

Depth (t3)

0.4

Width (t2)

0.3



Display Color



Click on conc.
reinforcement

Concrete Reinforcement...

OK

Cancel

Reinforcement Data

Rebar Material

Longitudinal Bars



S-400



Confinement Bars (Ties)



S-400



Design Type

☐ Column (P-M2-M3 Design)

☒ Beam (M3 Design Only)

Concrete Cover to Longitudinal Rebar Center

Top

0.04

Bottom

0.04

Reinforcement Overrides for Ductile Beams

Left

Right

Top

0.

0.

Bottom

0.

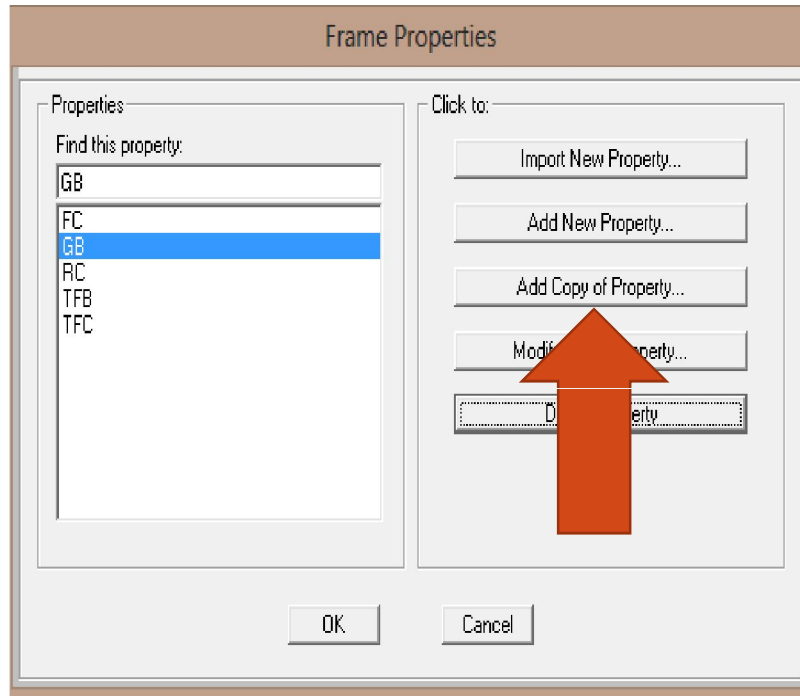
0.

OK

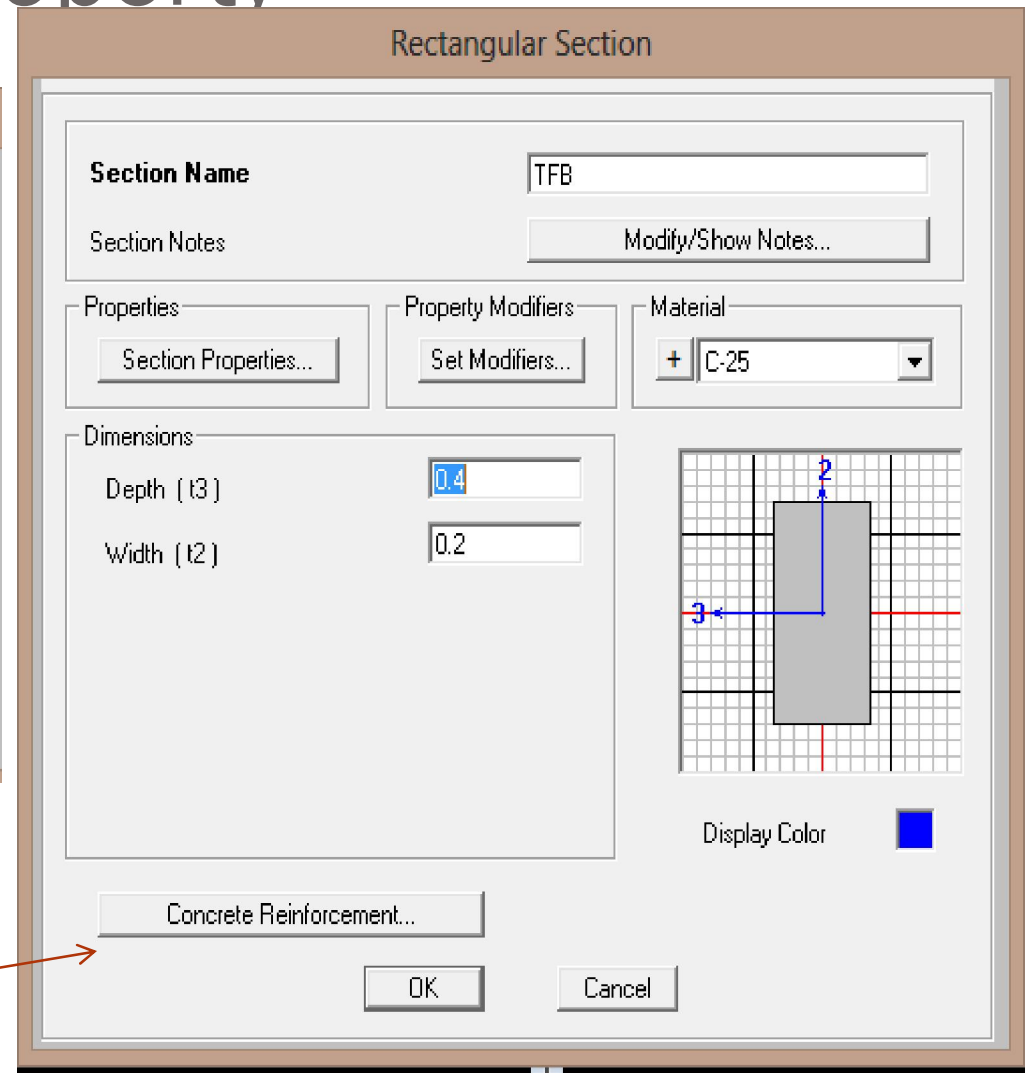
Cancel

Note: Make sure design type is
Beam!

Add copy of property



If you use add copy of property, you don't have to edit conc. Reinforcement!



Rectangular Section

Section Name

TTB

Section Notes

Modify/Show Notes...

Properties

Section Properties...

Property Modifiers

Set Modifiers...

Material

+ C-25

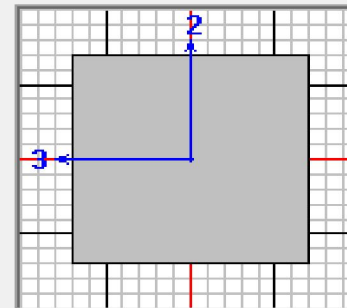
Dimensions

Depth (t3)

.3

Width (t2)

.2



Display Color

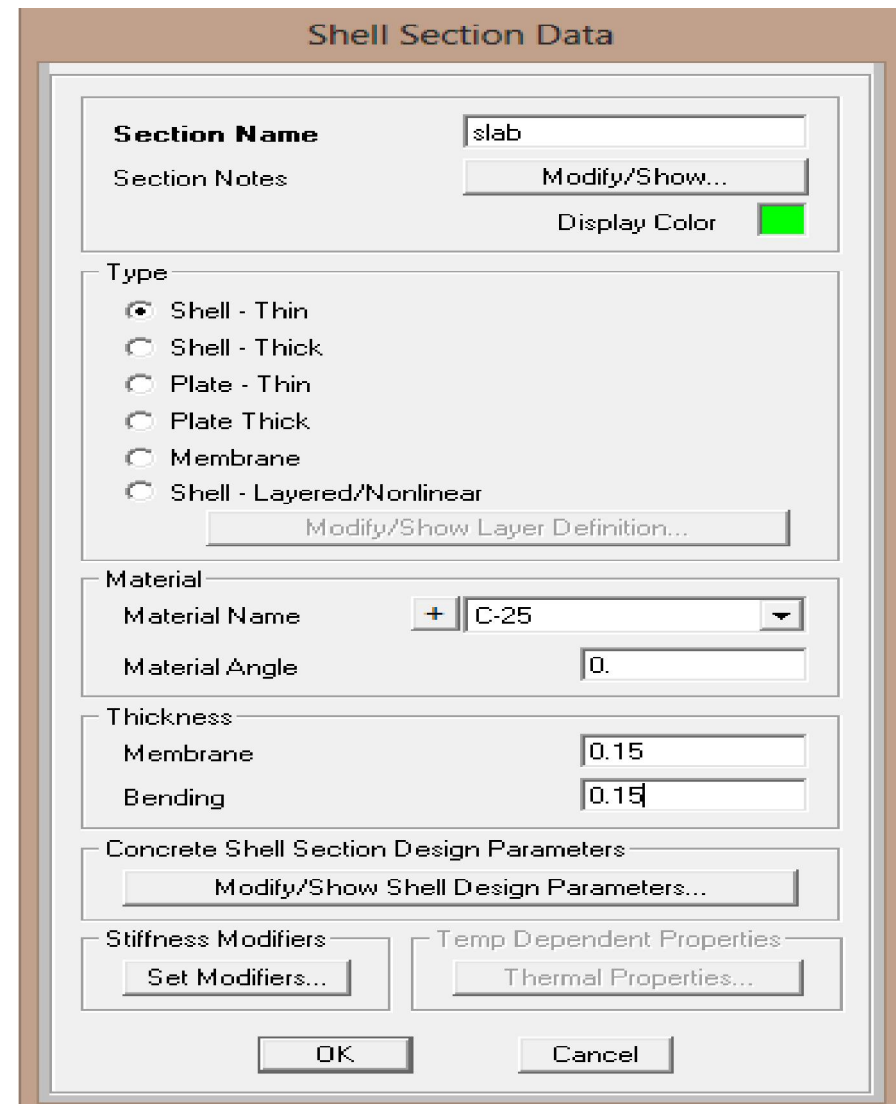
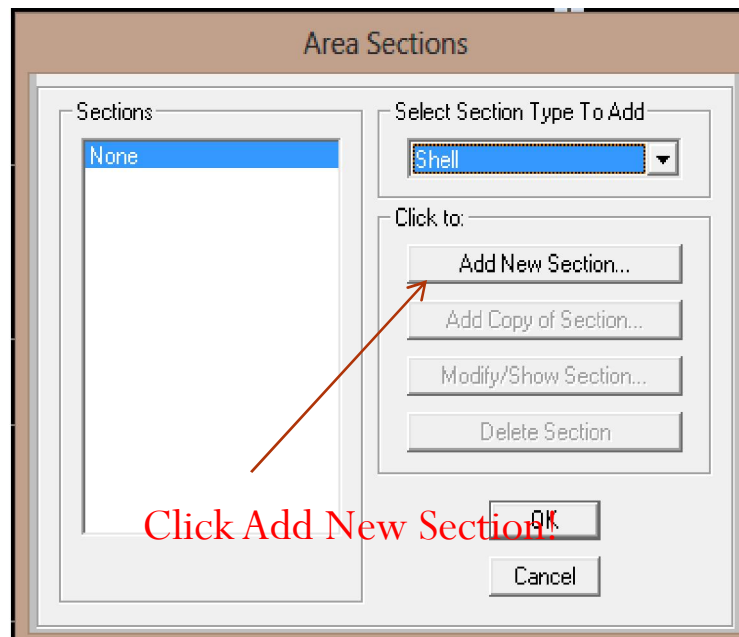


Concrete Reinforcement...

OK

Cancel

Define ➡ section property ➡ area section



Define → Load Pattern

Define Load Patterns

Load Patterns

Load Pattern Name	Type	Self Weight Multiplier	Auto Lateral Load Pattern
EQ(Y-)	QUAKE	0	Eurocode8 2004
DEAD	DEAD	1	
LL	LIVE	0	
EQ(X+)	QUAKE	0	Eurocode8 2004
EQ(X-)	QUAKE	0	Eurocode8 2004
EQ(Y+)	QUAKE	0	Eurocode8 2004
EQ(Y-)	QUAKE	0	Eurocode8 2004

Click To:

Add New Load Pattern

Modify Load Pattern

Modify Lateral Load Pattern...

Delete Load Pattern

Show Load Pattern Notes...

OK

Cancel

Modify lateral load pattern

Define Load Patterns

Load Patterns

Load Pattern Name	Type	Self Weight Multiplier	Auto Lateral Load Pattern
EQ(X+)	QUAKE	0	Eurocode8 2004
DEAD	DEAD	1	
LL	LIVE	0	
EQ(X+)	QUAKE	0	Eurocode8 2004
EQ(X-)	QUAKE		
EQ(Y+)	QUAKE		
EQ(Y-)	QUAKE		

Click To:

- Add New Load Pattern
- Modify Load Pattern
- Modify Lateral Load Pattern...

Click on EQ(X+) and click

2004 Eurocode8 Seismic Load Pattern

Load Direction and Diaphragm Eccentricity

- ☒ Global X Direction
- ☐ Global Y Direction

Ecc. Ratio (All Diaph.)

Override Diaph. Eccen.

Time Period

- ☐ Approximate
- ☒ Program Calc
- ☐ User Defined

Lateral Load Elevation Range

- ☐ Program Calculated
- ☒ User Specified

Max Z

Min Z

Parameters

Ground Acceleration, a_g

Spectrum Type

Ground Type

Lower Bound Factor, Beta

Behavior Factor, q

Correction Factor, Lambda

Define Load Patterns

Load Patterns

Load Pattern Name	Type	Self Weight Multiplier	Auto Lateral Load Pattern
EQ(X-)	QUAKE	0	Eurocode8 2004
DEAD	DEAD	1	
LL	LIVE	0	
EQ(X+)	QUAKE	0	Eurocode8 2004
EQ(X-)	QUAKE	0	Eurocode8 2004
EQ(Y+)	QUAKE	0	Eurocode8 2004
EQ(Y-)	QUAKE	0	Eurocode8 2004

Click To:

Add New Load Pattern

Modify Load Pattern

Modify Lateral Load Pattern...

Delete Load Pattern

Show Load Pattern Notes...

2004 Eurocode8 Seismic Load Pattern

Load Direction and Diaphragm Eccentricity

☒ Global X Direction

☐ Global Y Direction

Ecc. Ratio (All Diaph.)

Override Diaph. Eccen.

Time Period

☐ Approximate Ct (m)

☒ Program Calc

☐ User Defined T =

Lateral Load Elevation Range

☐ Program Calculated

☒ User Specified

Max Z

Min Z

Parameters

Ground Acceleration, ag

Spectrum Type

Ground Type

Lower Bound Factor, Beta

Behavior Factor, q

Correction Factor, Lambda

Click EQ(X-) and
click

Don't Forget!!

Define Load Patterns

Load Patterns

Load Pattern Name	Type	Self Weight Multiplier	Auto Lateral Load Pattern
EQ(Y+)	QUAKE	0	Eurocode8 2004
DEAD	DEAD	1	
LL	LIVE	0	
EQ(X+)	QUAKE	0	Eurocode8 2004
EQ(X-)	QUAKE	0	Eurocode8 2004
EQ(Y+)	QUAKE	0	Eurocode8 2004
EQ(Y-)	QUAKE	0	Eurocode8 2004

Click To:

Add New Load Pattern

Modify Load Pattern

Modify Lateral Load Pattern...

Delete Load Pattern

Show Load Pattern Notes...

Click EQ(Y+) and click

2004 Eurocode8 Seismic Load Pattern

Load Direction and Diaphragm Eccentricity

☐ Global X Direction
☒ Global Y Direction

Ecc. Ratio (All Diaph.)

Override Diaph. Eccen.

Time Period

☐ Approximate Ct (m)
☒ Program Calc
☐ User Defined T =

Lateral Load Elevation Range

☐ Program Calculated
☒ User Specified

Max Z
Min Z

Parameters

Ground Acceleration, a_g

Spectrum Type

Ground Type

Lower Bound Factor, Beta

Behavior Factor, q

Correction Factor, Lambda

Define Load Patterns

Load Pattern Name	Type	Self Weight Multiplier	Auto Lateral Load Pattern
EQ(Y-)	QUAKE	0	Eurocode8 2004
DEAD	DEAD	1	
LL	LIVE	0	
EQ(X+)	QUAKE	0	Eurocode8 2004
EQ(X-)	QUAKE	0	Eurocode8 2004
EQ(Y+)	QUAKE	0	Eurocode8 2004
EQ(Y-)	QUAKE	0	Eurocode8 2004

Click To:

Add New Load Pattern

Modify Load Pattern

Modify Lateral Load Pattern...

Delete Load Pattern

Click EQ(Y-) and click

Don't forget(-0.05)!

2004 Eurocode8 Seismic Load Pattern

Load Direction and Diaphragm Eccentricity

☐ Global X Direction

☒ Global Y Direction

Ecc. Ratio (All Diaph.)

Override Diaph. Eccen.

Time Period

☐ Approximate

☒ Program Calc

☐ User Defined

Lateral Load Elevation Range

☐ Program Calculated

☒ User Specified

Max Z

Min Z

Parameters

Ground Acceleration, a_g

Spectrum Type

Ground Type

Lower Bound Factor, Beta

Behavior Factor, q

Correction Factor, Lambda

Define → Load Combination

The image shows two overlapping software dialog boxes. The background box is titled 'Define Load Combinations' and contains a list box on the left and a 'Click to:' section with buttons: 'Add New Combo...', 'Add Copy of Combo...', 'Modify/Show Combo...', 'Delete Combo', 'Add Default Design Combos...', and 'Convert Combos to Nonlinear Cases...'. The foreground box is titled 'Load Combination Data' and contains fields for 'Load Combination Name' (COMB1), 'Notes', 'Load Combination Type' (Linear Add), and 'Options' (Convert to User Load Combo, Create Nonlinear Load Case from Load Combo). It also features a table titled 'Define Combination of Load Case Results' with columns 'Load Case Name', 'Load Case Type', and 'Scale Factor'. The table contains three rows: 'LL', 'DEAD', and 'LL', all with 'Linear Static' type and '1' scale factor. The third row is highlighted in blue. Red arrows and text provide instructions: 'Click add new combo..' points to the 'Add New Combo...' button, and 'Edit and click Ok!' points to the 'LL' row in the table.

Define Load Combinations

Load Combinations

Click to:

- Add New Combo...
- Add Copy of Combo...
- Modify/Show Combo...
- Delete Combo
- Add Default Design Combos...
- Convert Combos to Nonlinear Cases...

OK Cancel

Load Combination Data

Load Combination Name (User-Generated) COMB1

Notes Modify/Show Notes...

Load Combination Type Linear Add

Options

Convert to User Load Combo Create Nonlinear Load Case from Load Combo

Define Combination of Load Case Results

Load Case Name	Load Case Type	Scale Factor
LL	Linear Static	1
DEAD	Linear Static	1
LL	Linear Static	1

Add Modify Delete

OK Cancel

Click add new combo..

Edit and click Ok!

Define Load Combinations

Load Combinations

COMB1

Click to:

Add New Combo...

Add Copy of Combo...

Modify/Show Combo...

Delete Combo

Again click..

Load Combination Data

Load Combination Name (User-Generated)

COMB2

Notes

Modify/Show Notes...

Load Combination Type

Linear Add

Options

Convert to User Load Combo

Create Nonlinear Load Case from Load Combo

Define Combination of Load Case Results

Load Case Name	Load Case Type	Scale Factor
LL	Linear Static	1.6
DEAD	Linear Static	1.3
LL	Linear Static	1.6

Add

Modify

Delete

OK

Cancel

Define Load Combinations

Load Combinations

COMB1
COMB2



Click to:

Add New Combo...

Add Copy of Combo...

Modify/Show Combo...

Delete Combo

Add D...

Convert Co...

Load Combination Data

Load Combination Name (User-Generated)

COMB3

Notes

Modify/Show Notes...

Load Combination Type

Linear Add

Options

Convert to User Load Combo

Create Nonlinear Load Case from Load Combo

Define Combination of Load Case Results

Load Case Name	Load Case Type	Scale Factor
EQ(X+)	Linear Static	1
COMB2	Combination	0.75
EQ(X+)	Linear Static	1

Add

Modify

Delete

OK

Cancel

Define Load Combinations

Load Combinations

COMB1
COMB2
COMB3



Click to:

Add New Combo...

Add Copy of Combo...

Modify/Show Combo...

Delete Combo

Add Default De

Convert Combos to

OK

Cancel

Load Combination Data

Load Combination Name (User-Generated)

COMB4

Notes

Modify/Show Notes...

Load Combination Type

Linear Add

Options

Convert to User Load Combo

Create Nonlinear Load Case from Load Combo

Define Combination of Load Case Results

Load Case Name	Load Case Type	Scale Factor
EQ(X+)	Linear Static	-1
COMB2	Combination	0.75
EQ(X+)	Linear Static	-1

Add

Modify

Delete

OK

Cancel

Define Load Combinations

Load Combinations

COMB1
COMB2
COMB3
COMB4

↑

↓

Click to:

Add New Combo...

Add Copy of Combo...

Modify/Show Combo...

Delete Combo

Load Combination Data

Load Combination Name (User-Generated)

COMB5

Notes

Modify/Show Notes...

Load Combination Type

Linear Add

Options

Convert to User Load Combo

Create Nonlinear Load Case from Load Combo

Define Combination of Load Case Results

Load Case Name	Load Case Type	Scale Factor
EQ(X-)	Linear Static	1
COMB2	Combination	0.75
EQ(X-)	Linear Static	1

Add

Modify

Delete

OK

Cancel

Define Load Combinations

Load Combinations

- COMB1
- COMB2
- COMB3
- COMB4
- COMB5

Click to:

Add New Combo...

Add Copy of Combo...

Modify/Show Combo...

Delete Combo

Add Default Des

Convert Combos to

OK

Cancel

Load Combination Data

Load Combination Name (User-Generated)

Notes

Load Combination Type

Options

Define Combination of Load Case Results

Load Case Name	Load Case Type	Scale Factor
EQ(X-)	Linear Static	-1
COMB2	Combination	0.75
EQ(X-)	Linear Static	-1

Define Load Combinations

Load Combinations

COMB1
COMB2
COMB3
COMB4
COMB5
COMB6



Click to:

Add New Combo...

Add Copy of Combo...

Modify/Show Combo...

Delete Combo

Load Combination Data

Load Combination Name (User-Generated)

COMB7

Notes

Modify/Show Notes...

Load Combination Type

Linear Add

Options

Convert to User Load Combo

Create Nonlinear Load Case from Load Combo

Define Combination of Load Case Results

Load Case Name	Load Case Type	Scale Factor
EQ(Y+)	Linear Static	1
COMB2	Combination	0.75
EQ(Y+)	Linear Static	1

Add

Modify

Delete

OK

Cancel

Define Load Combinations

Load Combinations

COMB1
COMB2
COMB3
COMB4
COMB5
COMB6
COMB7



Click to:

Add New Combo...

Add Copy of Combo...

Modify/Show Combo...

Delete Combo...

Add Default Design

Convert Combos to Nonlinear

OK

Cancel

Load Combination Data

Load Combination Name (User-Generated)

COMB8

Notes

Modify/Show Notes...

Load Combination Type

Linear Add

Options

Convert to User Load Combo

Create Nonlinear Load Case from Load Combo

Define Combination of Load Case Results

Load Case Name	Load Case Type	Scale Factor
EQ(Y+)	Linear Static	-1
COMB2	Combination	0.75
EQ(Y+)	Linear Static	-1

Add

Modify

Delete

OK

Cancel

Load Combination Data

Load Combination Name (User-Generated)

COMB9

Notes

Modify/Show Notes...

Load Combination Type

Linear Add

Options

Convert to User Load Combo

Create Nonlinear Load Case from Load Combo

Define Combination of Load Case Results

Load Case Name	Load Case Type	Scale Factor
EQ(Y-)	Linear Static	1
COMB2	Combination	0.75
EQ(Y-)	Linear Static	1

Add

Modify

Delete

OK

Cancel

Load Combination Data

Load Combination Name (User-Generated)

COMB10

Notes

Modify/Show Notes...

Load Combination Type

Linear Add

Options

Convert to User Load Combo

Create Nonlinear Load Case from Load Combo

Define Combination of Load Case Results

Load Case Name	Load Case Type	Scale Factor
EQ(Y-)	Linear Static	-1
COMB2	Combination	0.75
EQ(Y-)	Linear Static	-1

Add

Modify

Delete

OK

Cancel

Load Combination Data

Load Combination Name (User-Generated)

COMB11

Notes

Modify/Show Notes...

Load Combination Type

Envelope

Options

Convert to User Load Combo

Create Nonlinear Load Case from Load Combo

Define Combination of Load Case Results

Load Case Name	Load Case Type	Scale Factor
COMB10	Combination	1
COMB1	Combination	1
COMB2	Combination	1
COMB3	Combination	1
COMB4	Combination	1
COMB5	Combination	1
COMB6	Combination	1
COMB7	Combination	1
COMB8	Combination	1
COMB9	Combination	1
COMB10	Combination	1

Add

Modify

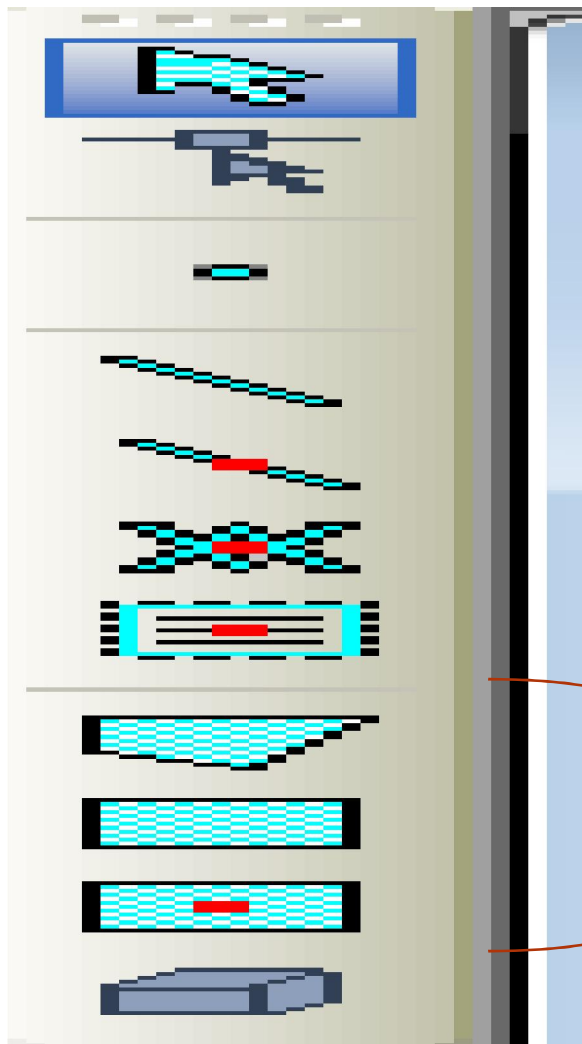
Delete

Delete

OK

Cancel

Drawing the building



Set select mode

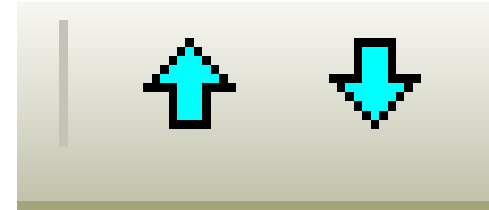
Reshape element

Draw special joint

Draw frame(beam or column)

Quick draw frame

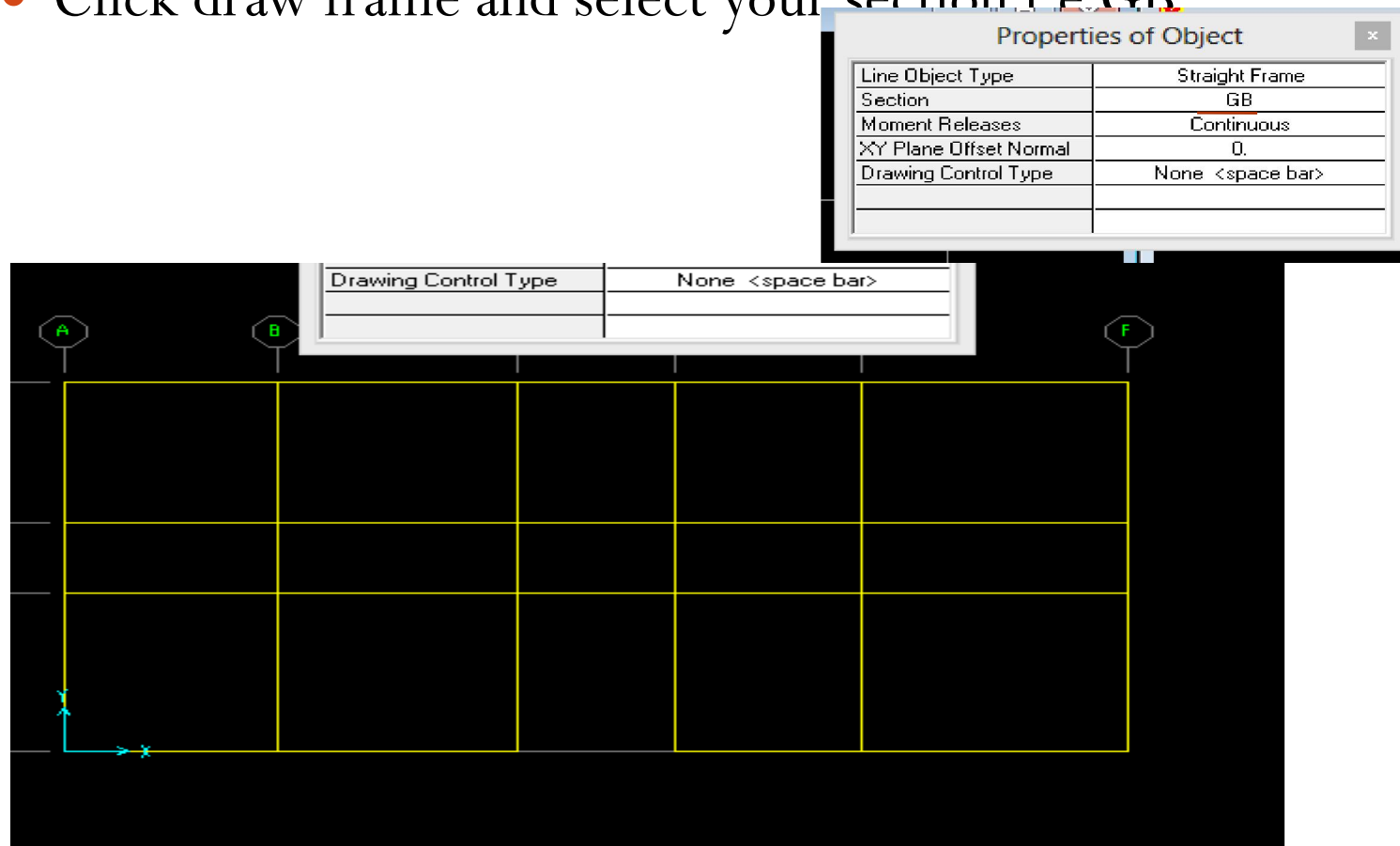
To draw slab, wall or any areal object



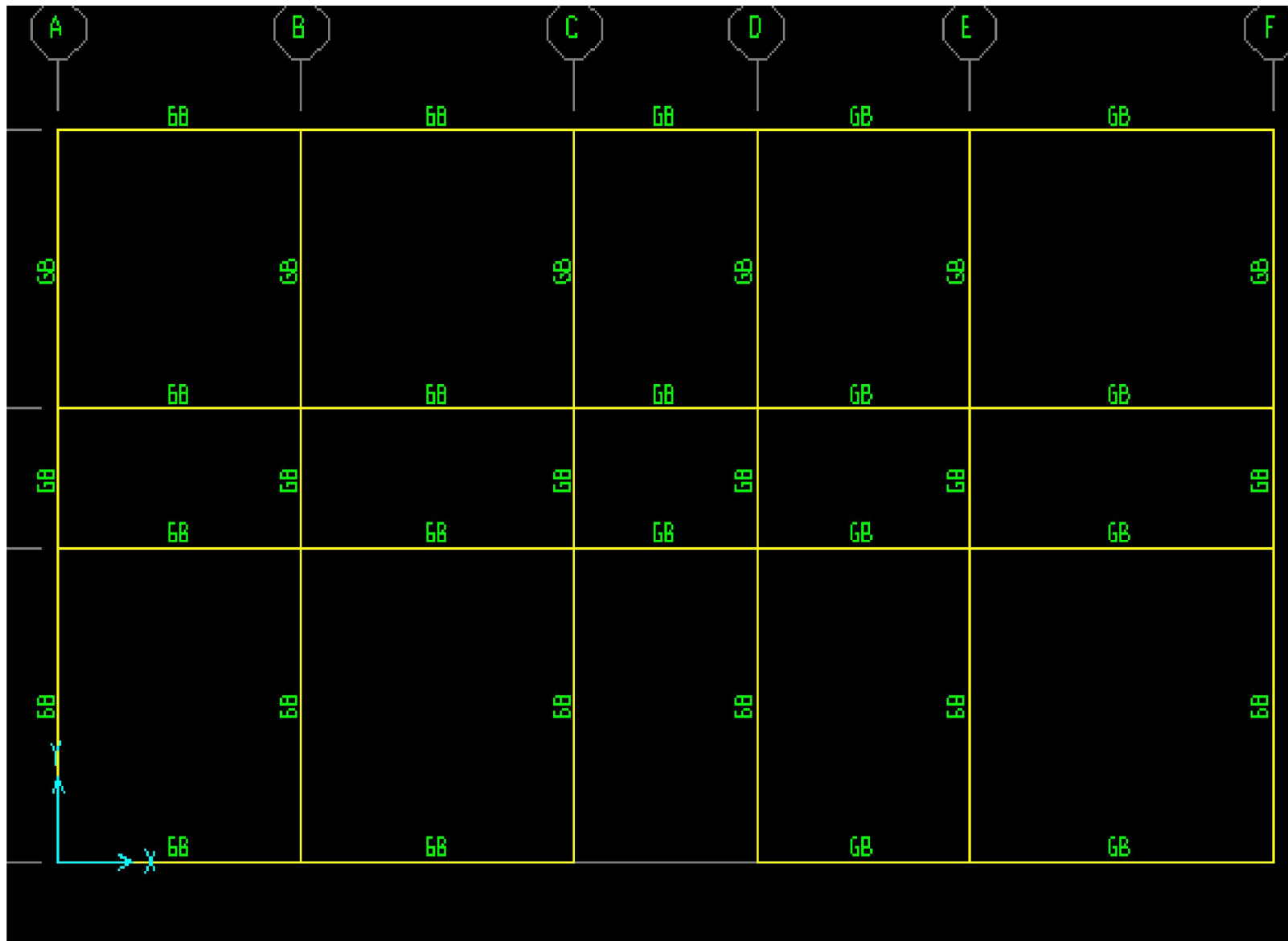
Move UP.....DOWN

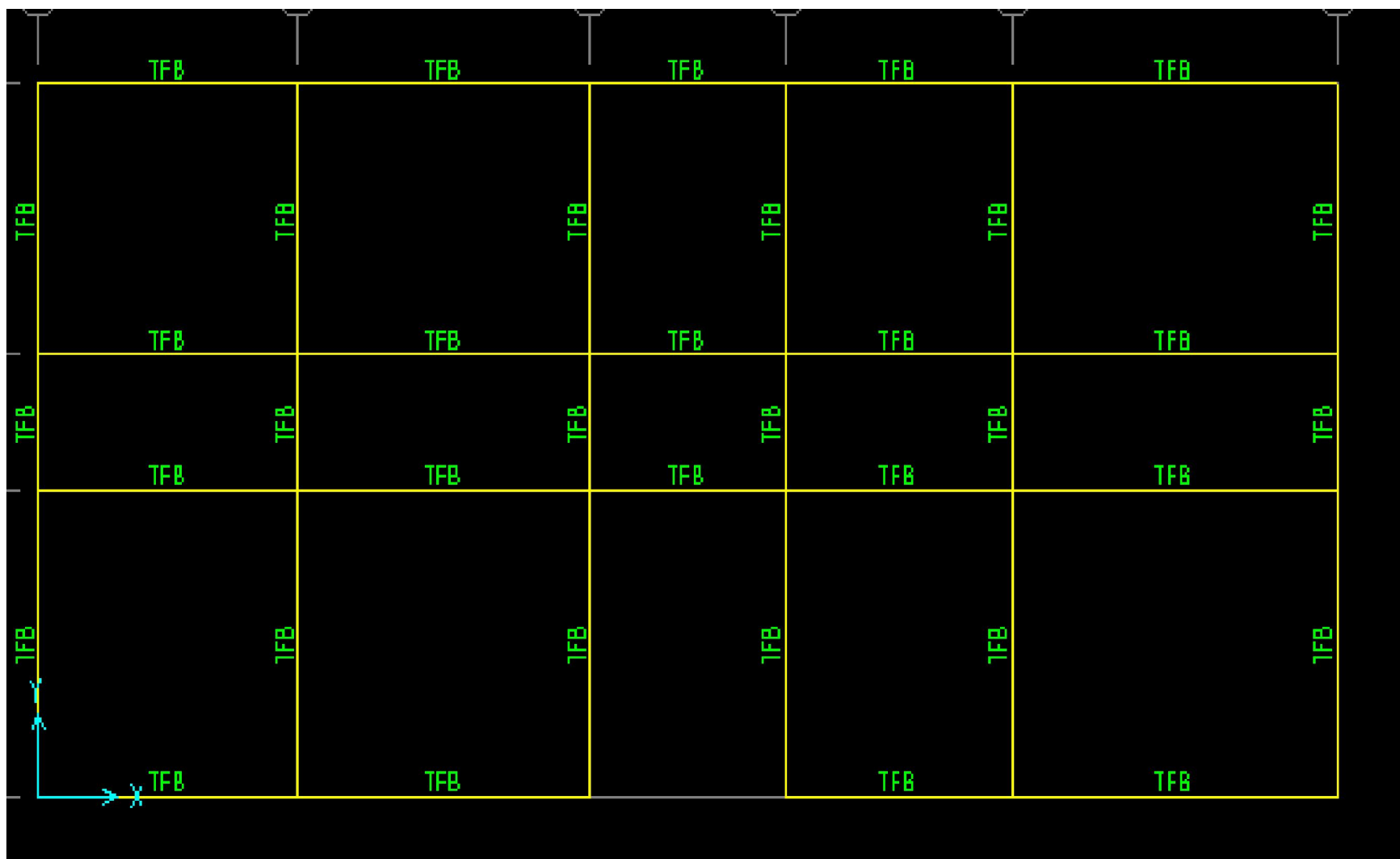
Draw beams

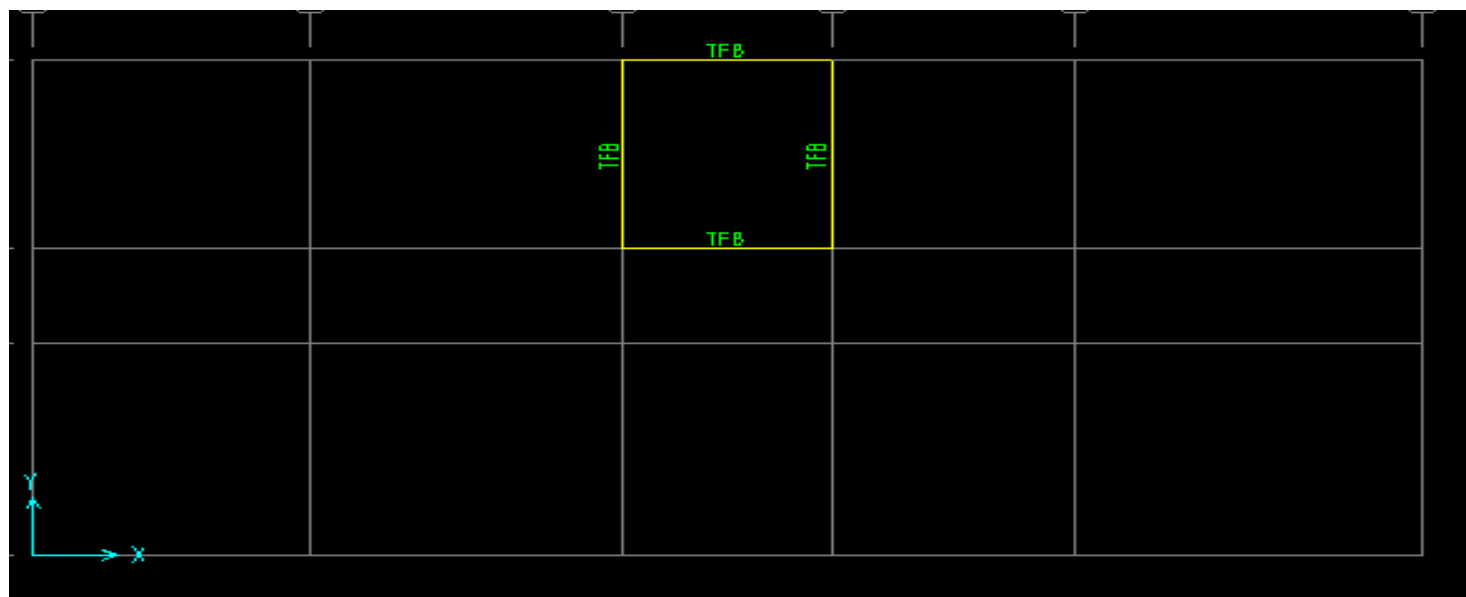
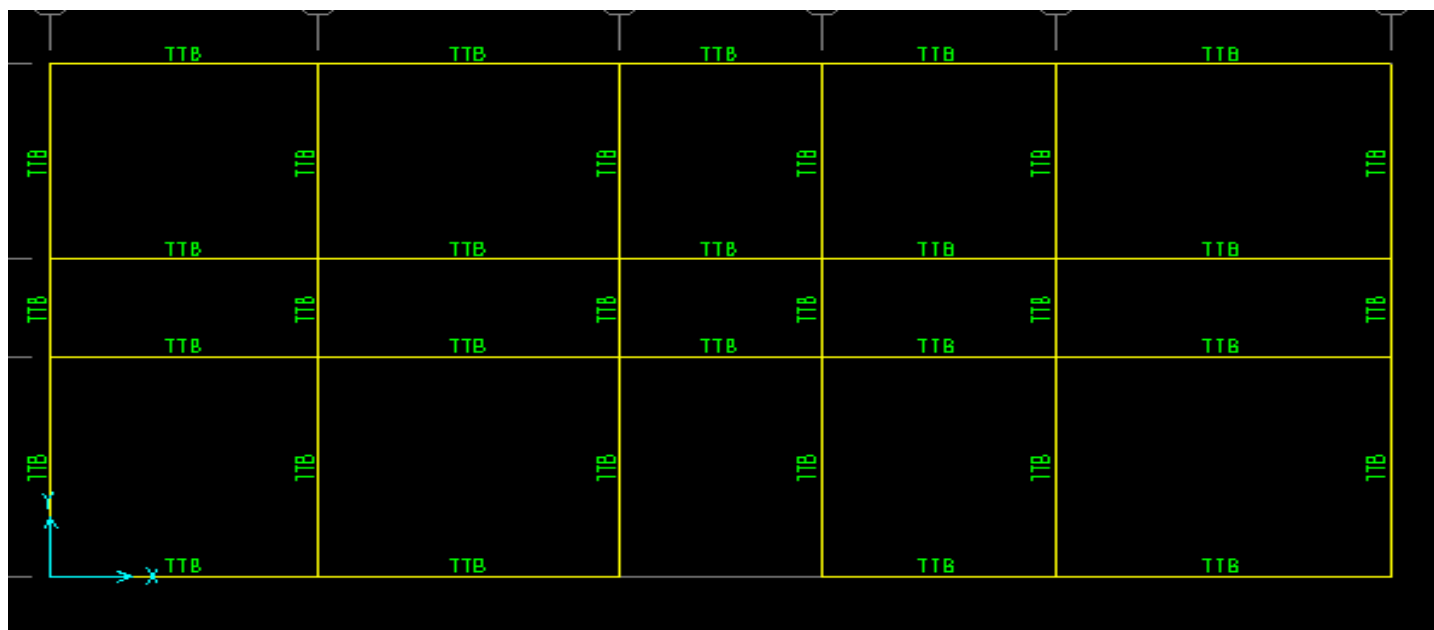
- Place your XY plane @ $Z=0$
- Click draw frame and select your section, i.e. GB



- In the same manner draw all the beams except roof column using section “TFB”
- Draw the roof beam using “TTB”



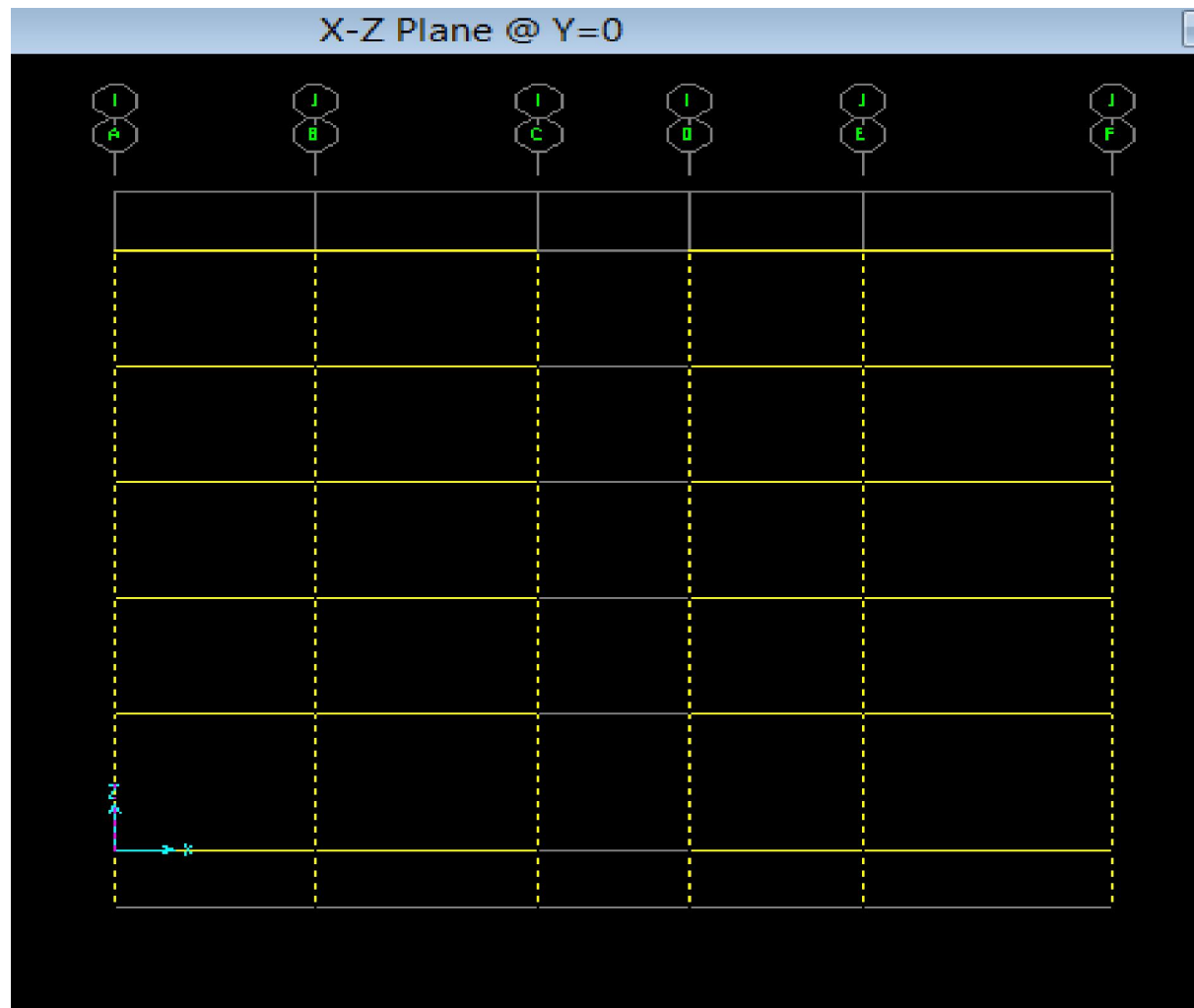




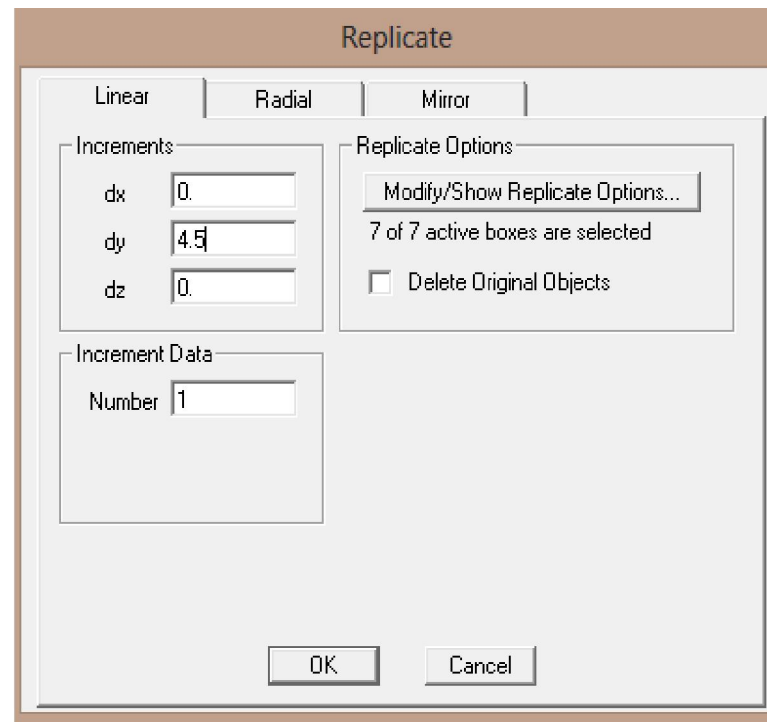
Draw columns

- Make your 2D view in XZ plane
- Use “FC” from $Z=-1.5$ to 0
- Use “TFC” from $Z=0$ to 12.5
- Use “RC” from $Z=12.5$ to 15.5

Select the columns only



Edit → Replicate



The image shows a 'Replicate' dialog box with a brown title bar. It contains three tabs: 'Linear', 'Radial', and 'Mirror'. The 'Linear' tab is selected. Inside the dialog, there are three sections: 'Increments' with input fields for dx (0), dy (4.5), and dz (0); 'Increment Data' with a 'Number' field set to 1; and 'Replicate Options' which includes a 'Modify/Show Replicate Options...' button, the text '7 of 7 active boxes are selected', and an unchecked checkbox for 'Delete Original Objects'. 'OK' and 'Cancel' buttons are at the bottom.

Replicate

Linear Radial Mirror

Increments

dx 0

dy 4.5

dz 0

Increment Data

Number 1

Replicate Options

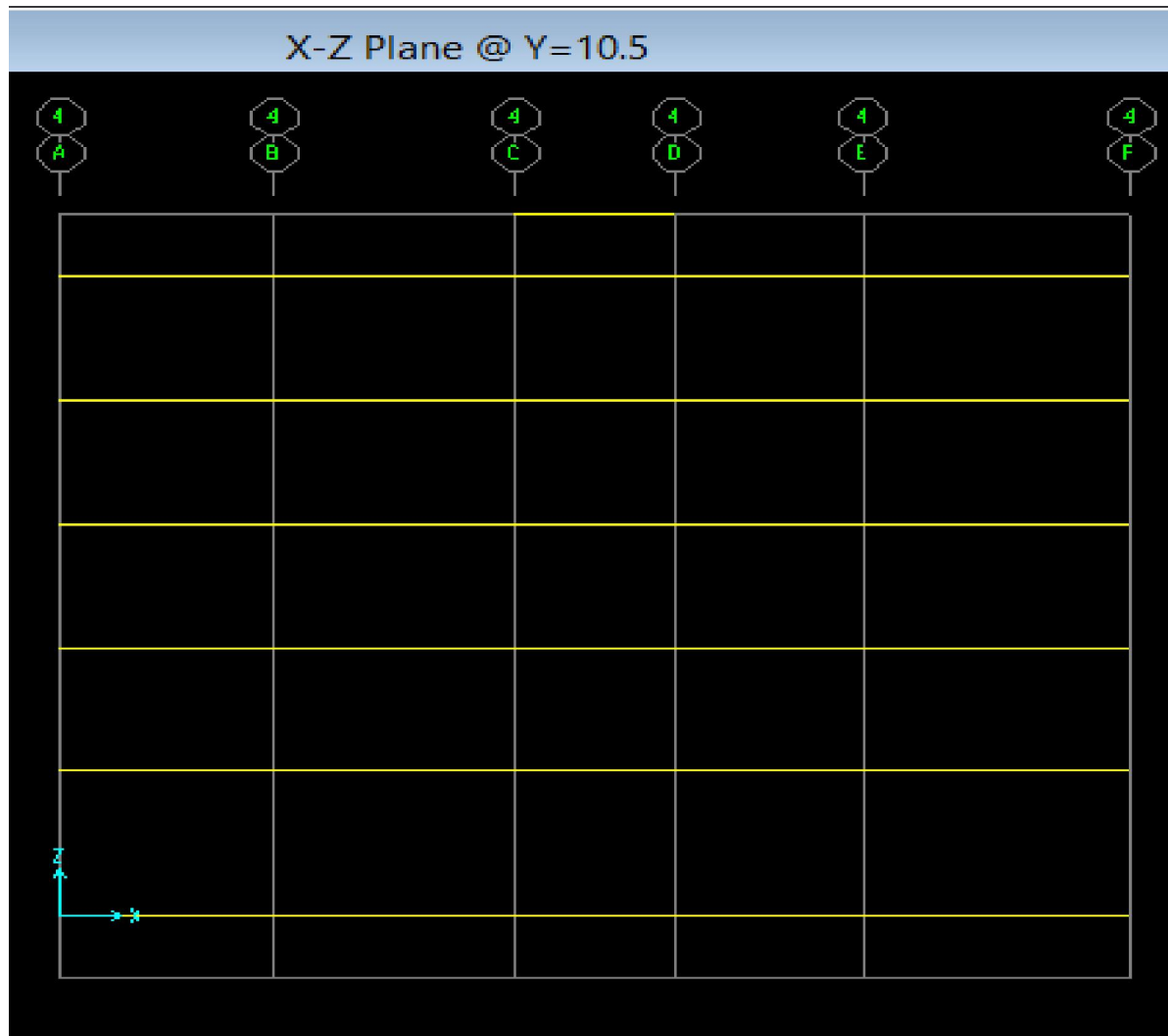
Modify/Show Replicate Options...

7 of 7 active boxes are selected

☐ Delete Original Objects

OK Cancel

- Set your XZ plane @ $Y=10.5$

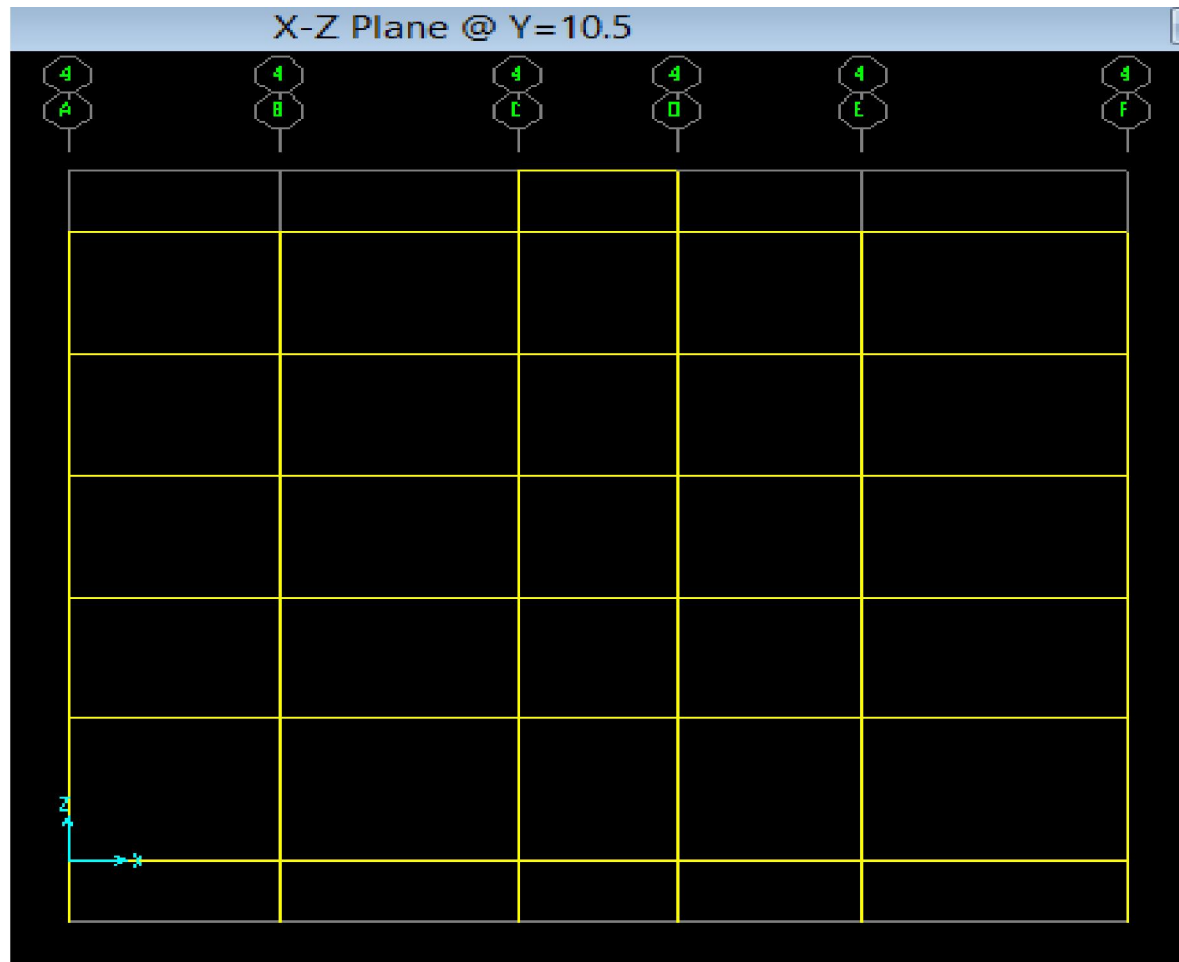


- Draw the columns

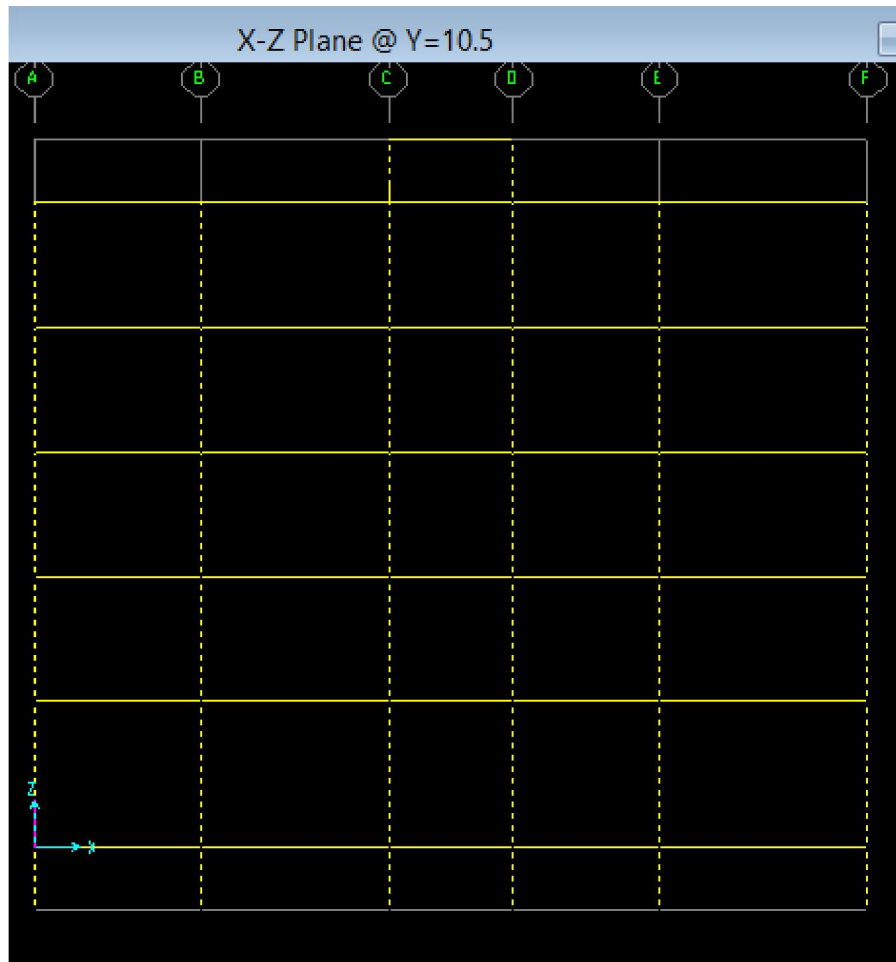
Use “FC” from $Z=-1.5$ to 0

Use “TFC” from $Z=0$ to 12.5

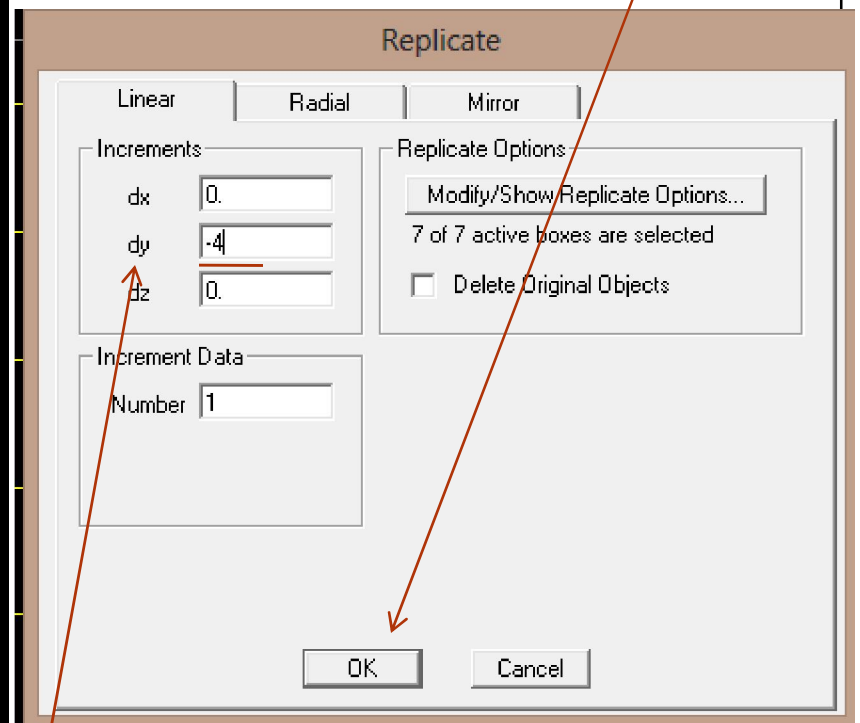
Use “RC” from $Z=12.5$ to 15.5



Select the columns only using box selection

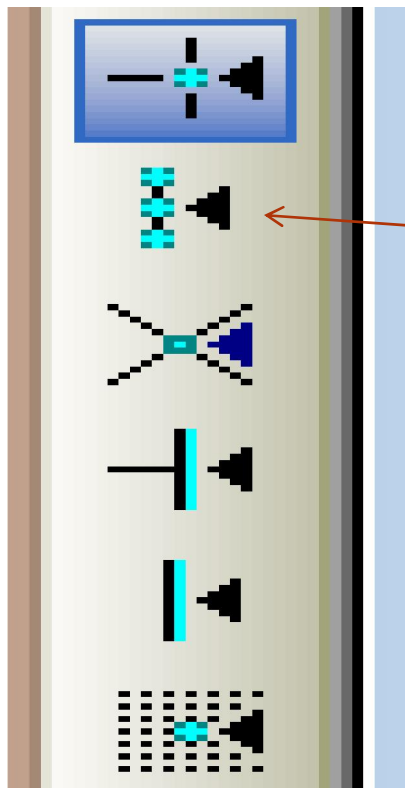


After selecting, Edit → replicate



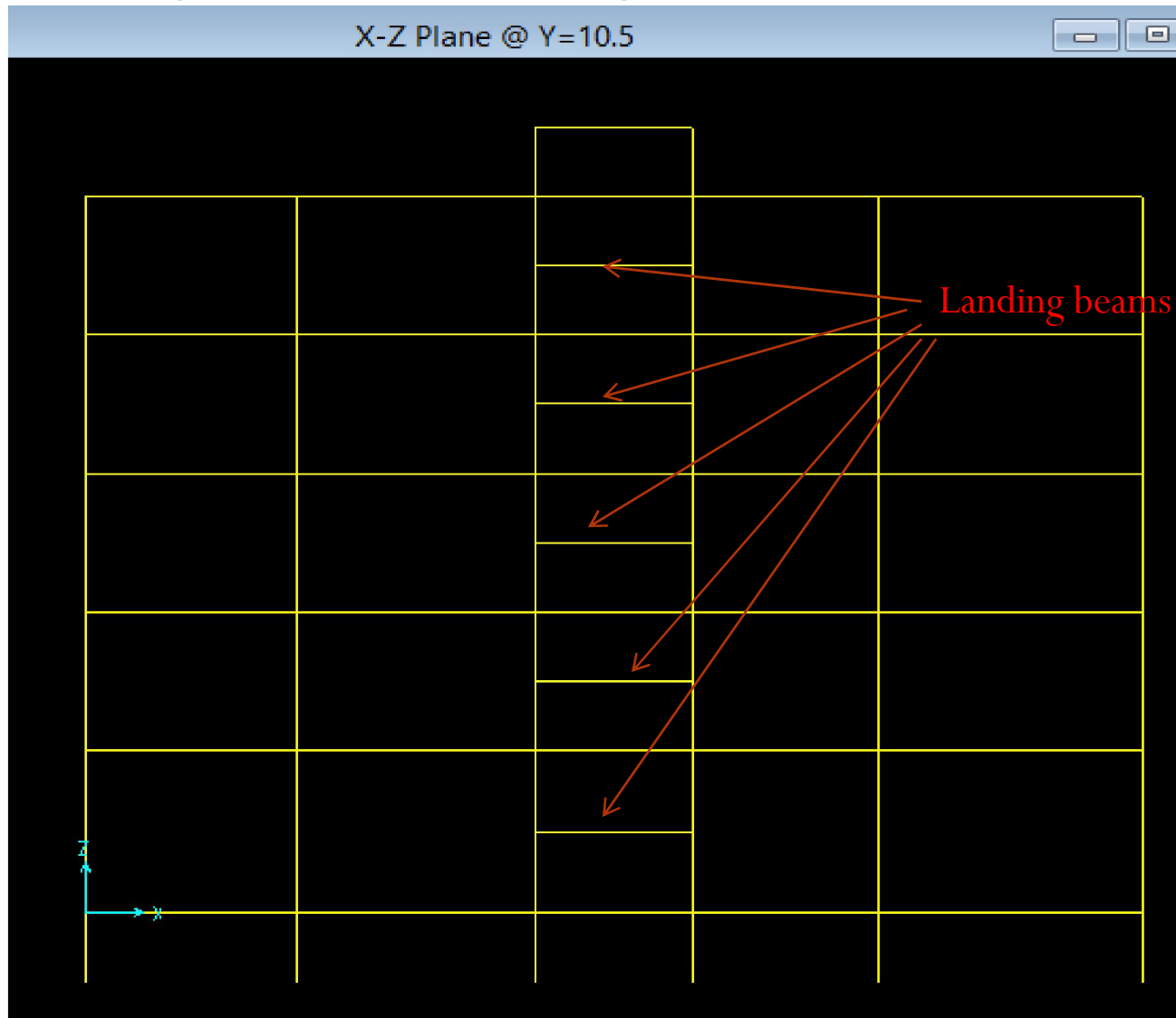
Don't forget to type -4!

- Draw landing beam
- Set your XZ plane @Y=10.5
- Snapping toolbar



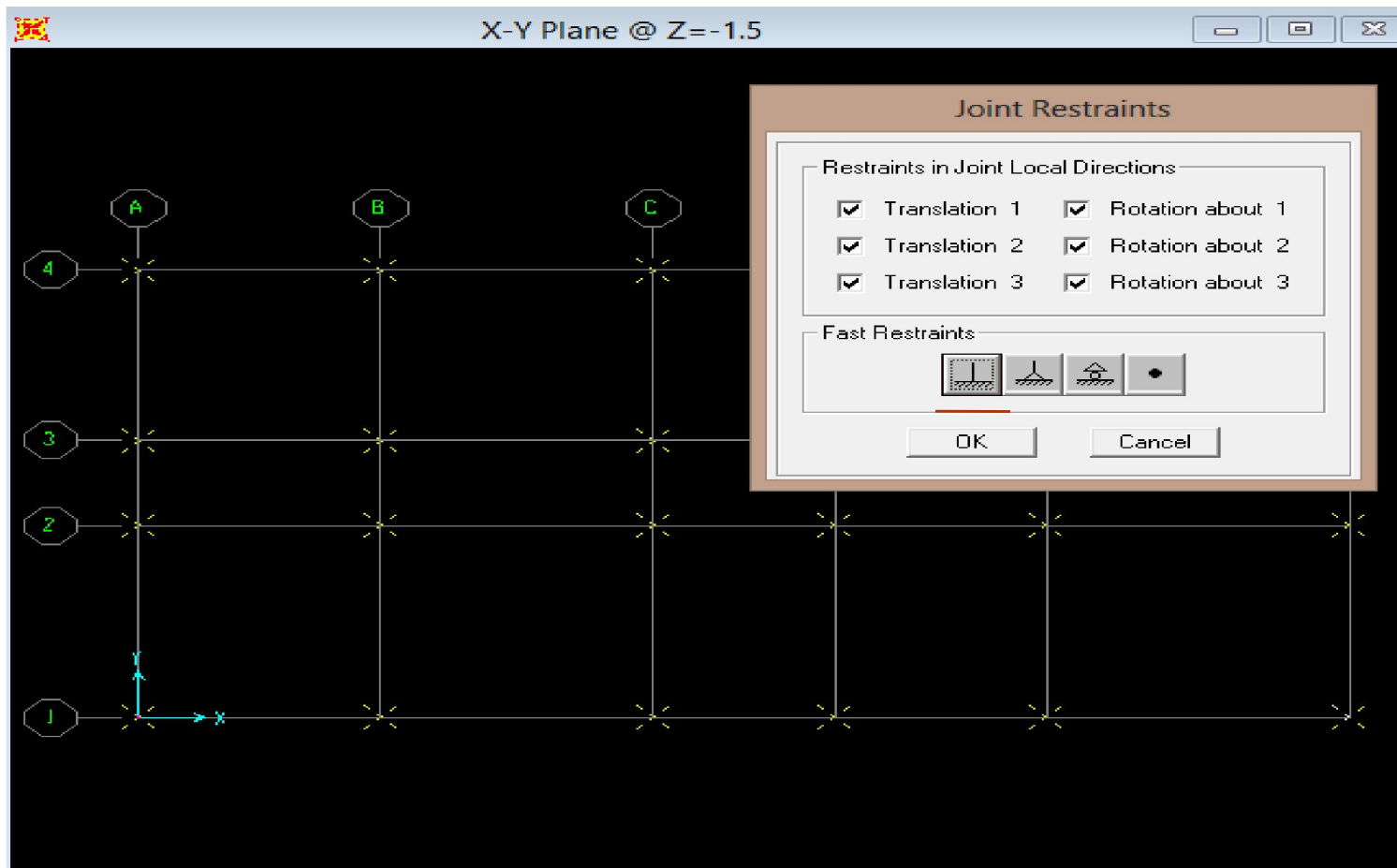
Click 'ends and mid points'

- Using 'TFB' draw landing beams



Set your XY plane @Z=-1.5

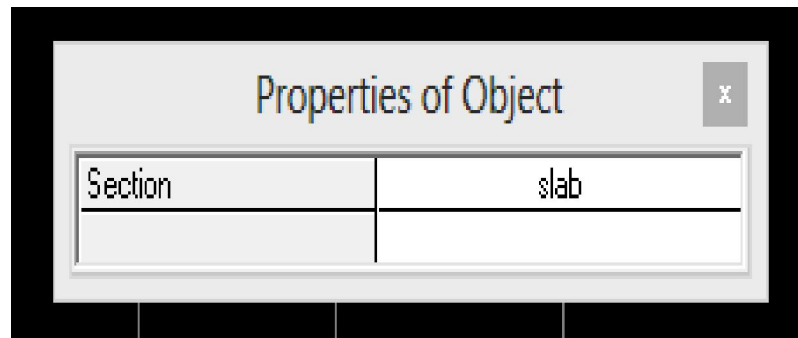
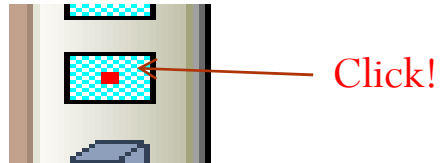
- Select the entire area using box selection
- Assign → Joint → Restraint



Draw Slab

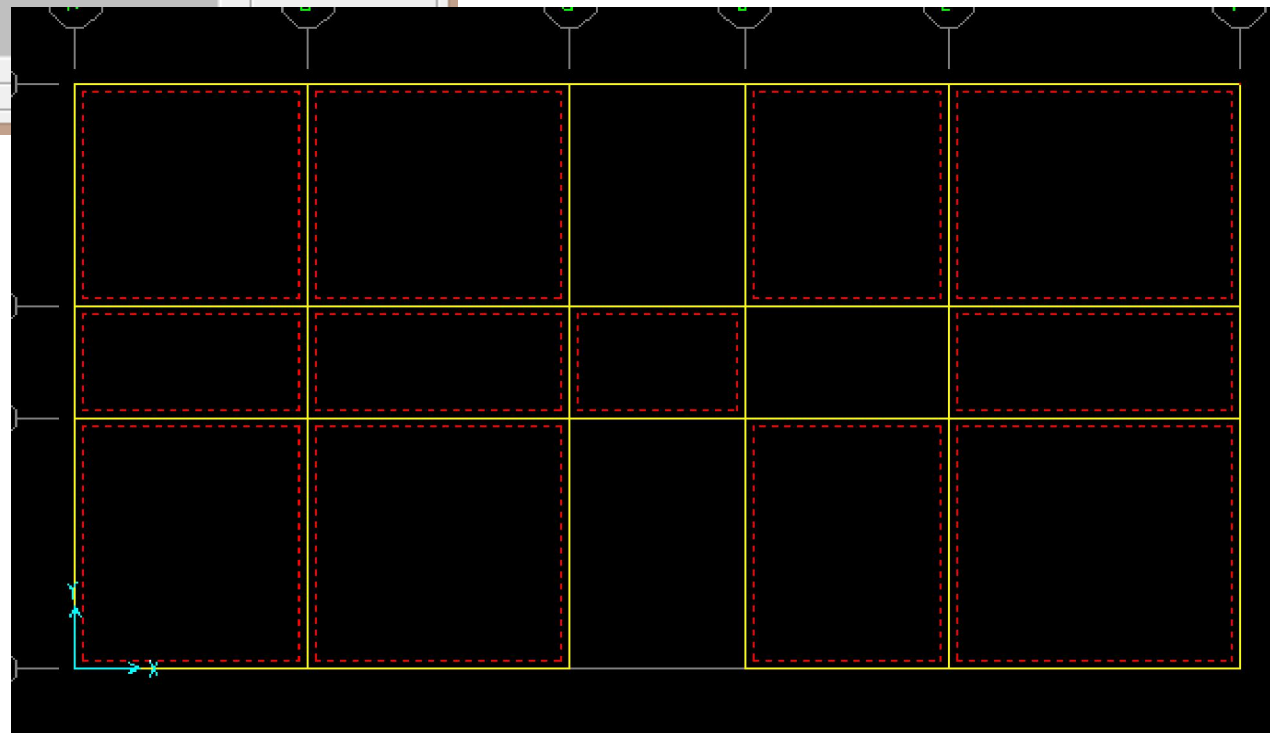
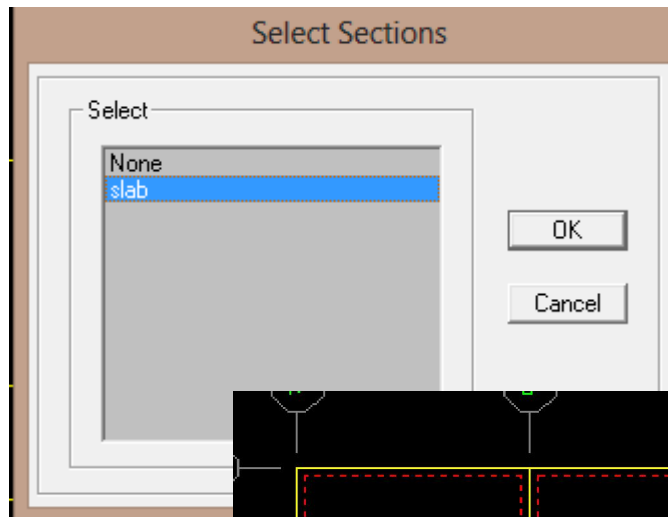
- Set your XY plane @ $Z=3.5$

- Draw using...

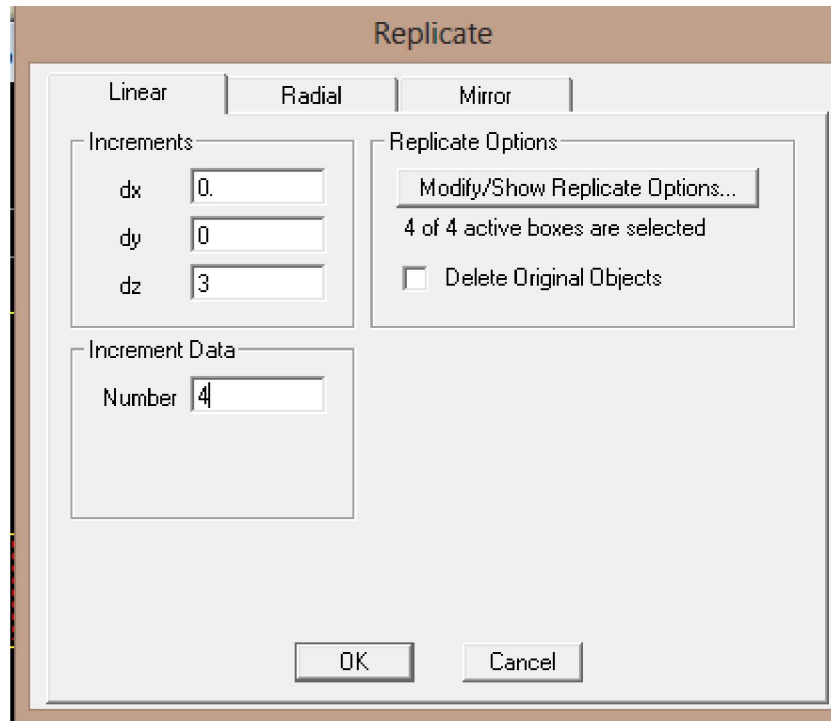


Click inside each slab area except
at stair location

- Select → Select → Properties → Area sections



- Edit → Replicate



Set your XY plane @Z=17 and draw the water storage slab(refer back to floor plan)

- View ➡ Set display option

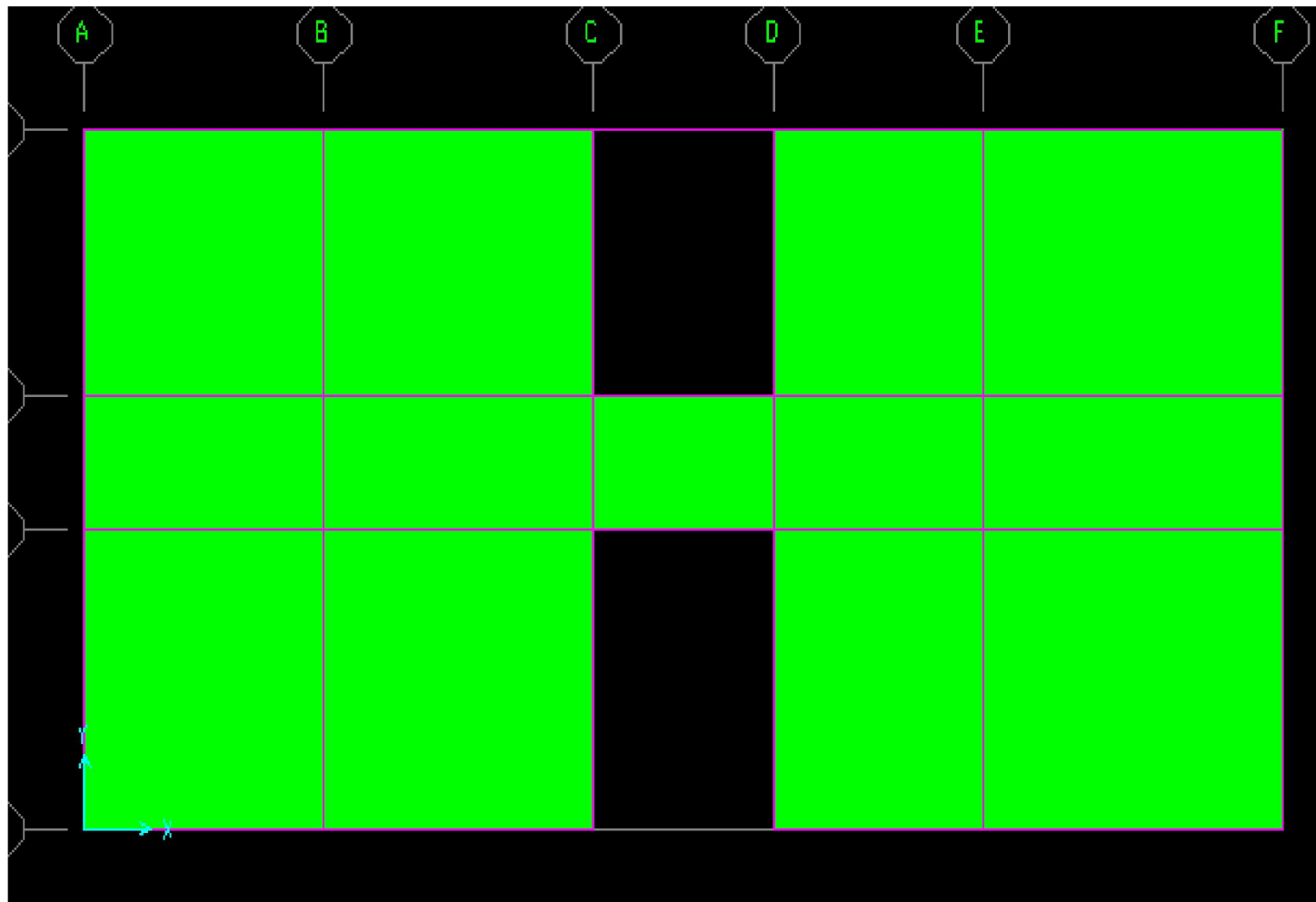
Display Options For Active Window

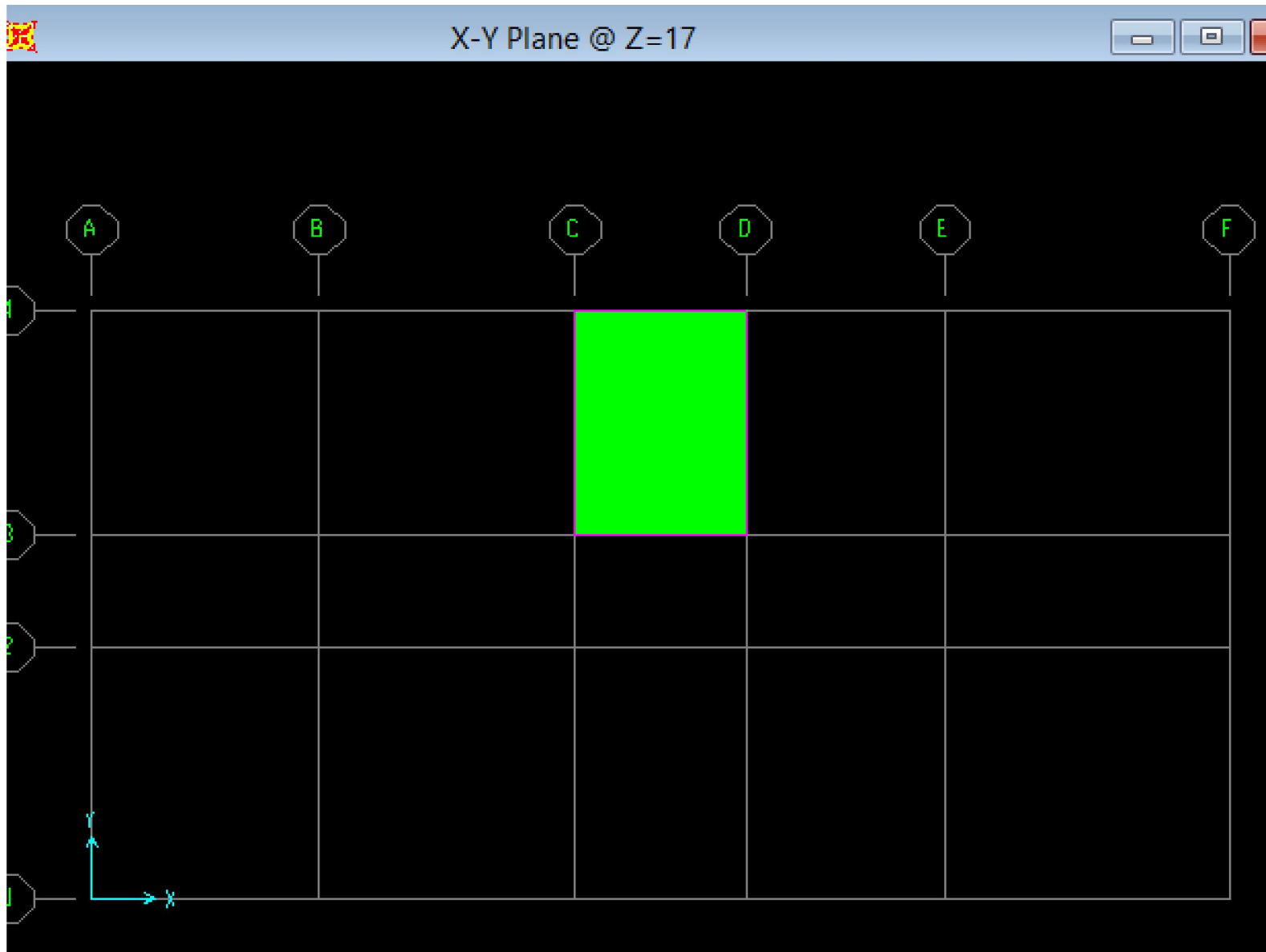
Joints ☐ Labels ☒ Restraints ☒ Springs ☐ Local Axes ☒ Invisible ☐ Not in View	Frames/Cables/Tendons ☐ Labels ☐ Sections ☐ Releases ☐ Local Axes ☐ Frames Not in View ☐ Cables Not in View ☐ Tendons Not in View	General ☐ Shrink Objects ☐ Extrude View ☒ Fill Objects ☒ Show Edges ☒ Show Ref. Lines ☐ Show Bounding Boxes	View by Colors of ☐ Objects ☒ Sections ☐ Materials ☐ Color Printer ☐ White Background, Black Objects ☐ Selected Groups Select Groups...
Areas ☐ Labels ☐ Sections ☐ Local Axes ☐ Not in View	Solids ☐ Labels ☐ Sections ☐ Local Axes ☐ Not in View	Links ☐ Labels ☐ Properties ☐ Local Axes ☐ Not in View	Miscellaneous ☐ Show Analysis Model (If Available) ☐ Show Joints Only For Objects In View

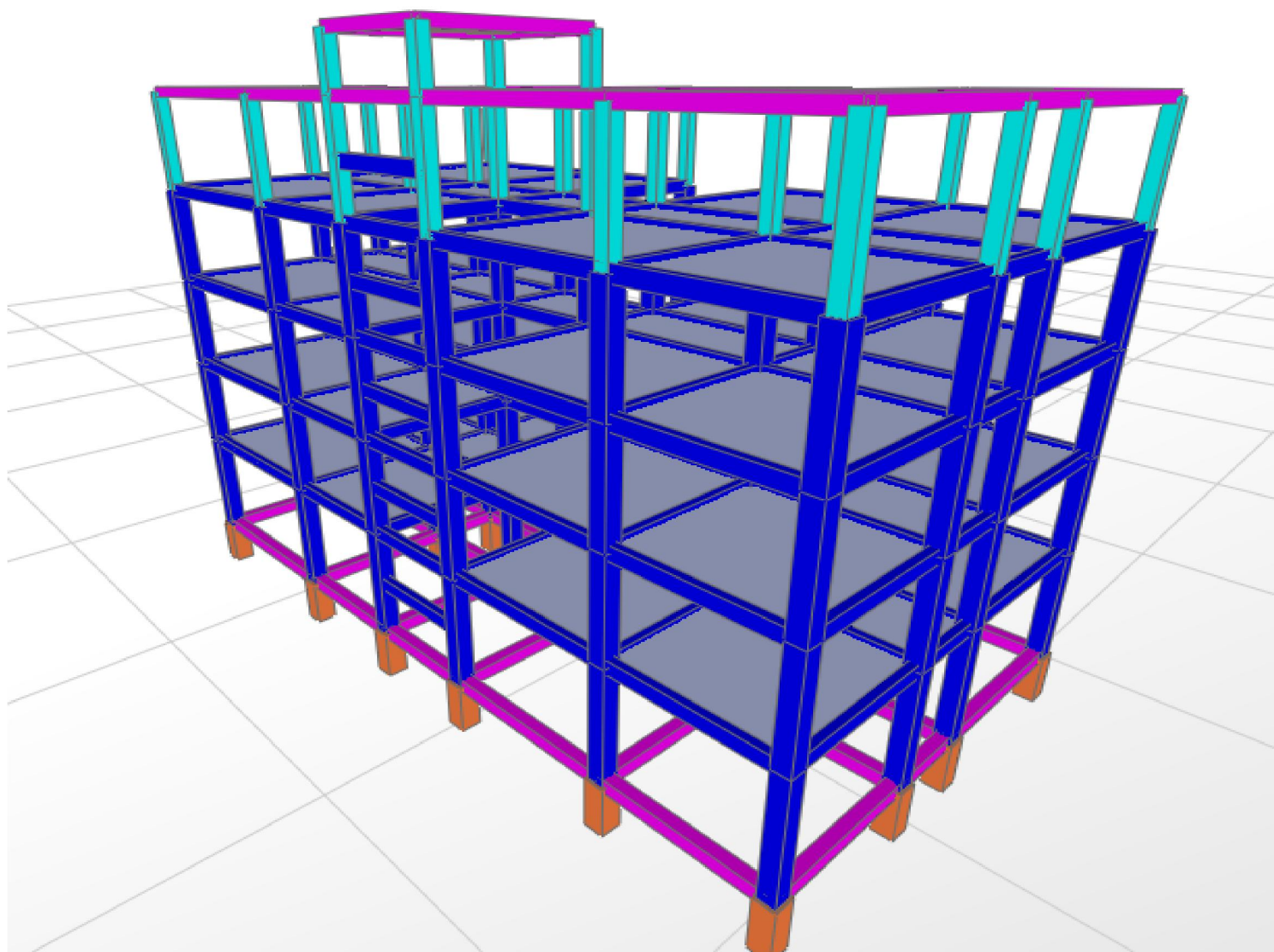
☒

Check the above

Typical floor



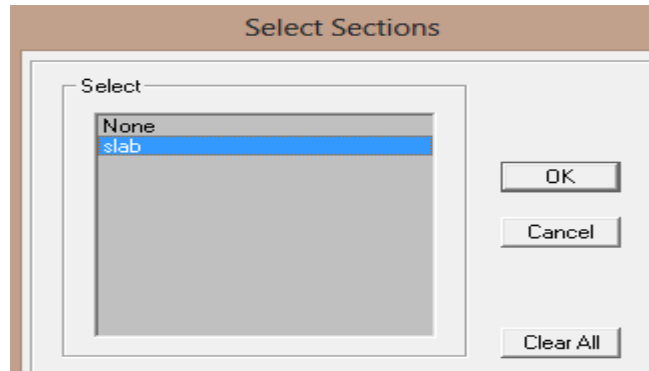




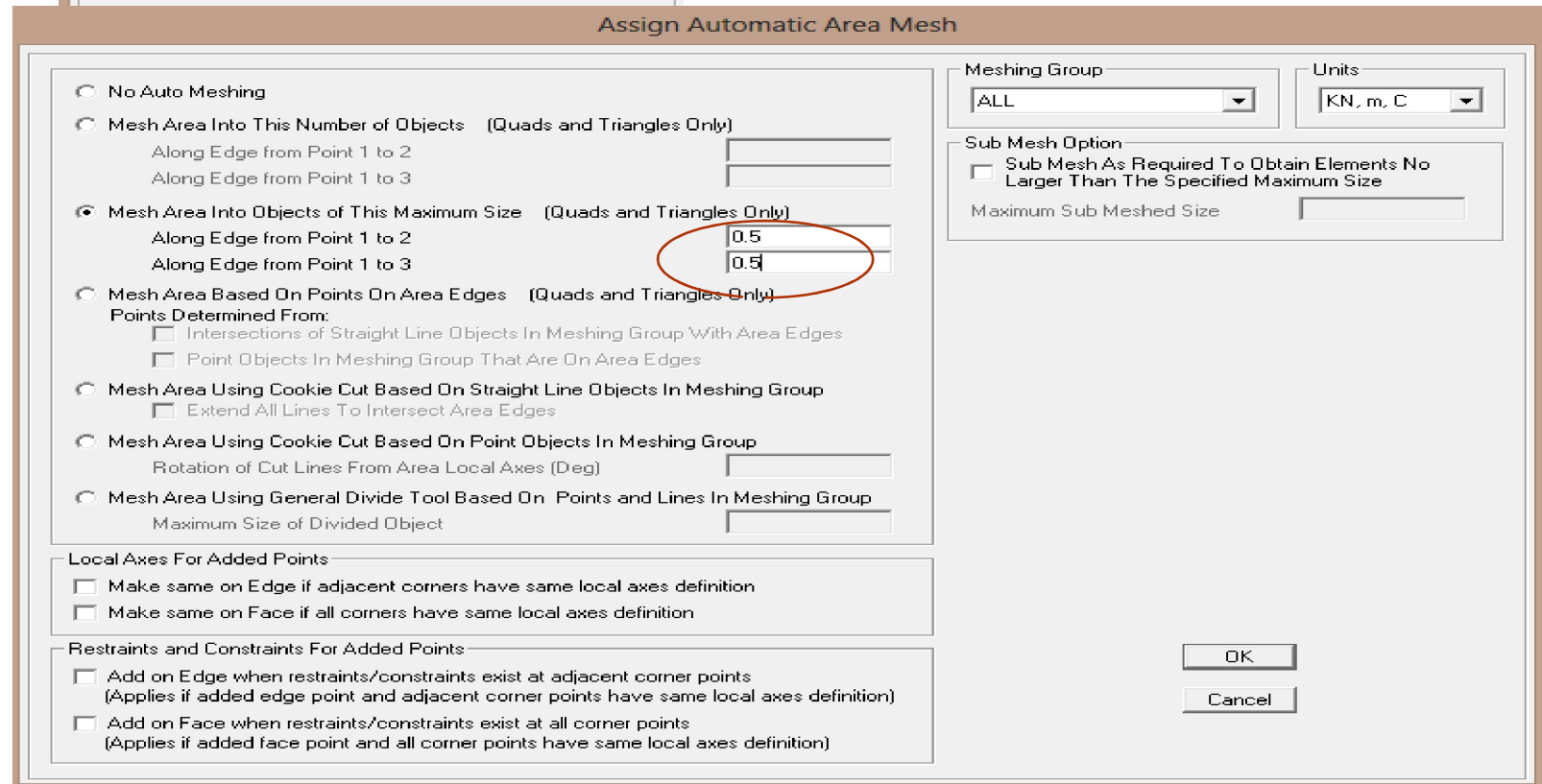
Loads

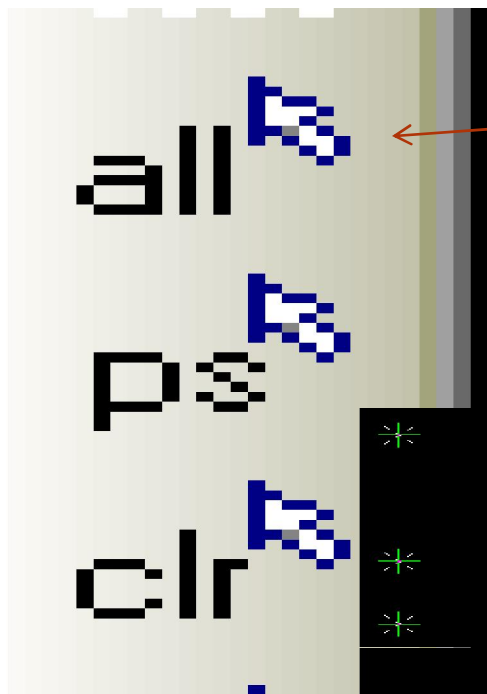
- On Beams
 - $DL = 10.5 \text{ kN/m}$
- On TTB $DL = 5 \text{ kN/m}^2$
- On Slab
 - $DL = 2 \text{ kN/m}^2$
 - $LL = 2 \text{ kN/m}^2$ on water tank slab $= 8 \text{ kN/m}^2$
- On the landing beam
 - $DL = 8 \text{ kN/m}$

- Select → Select → Properties → Area Section



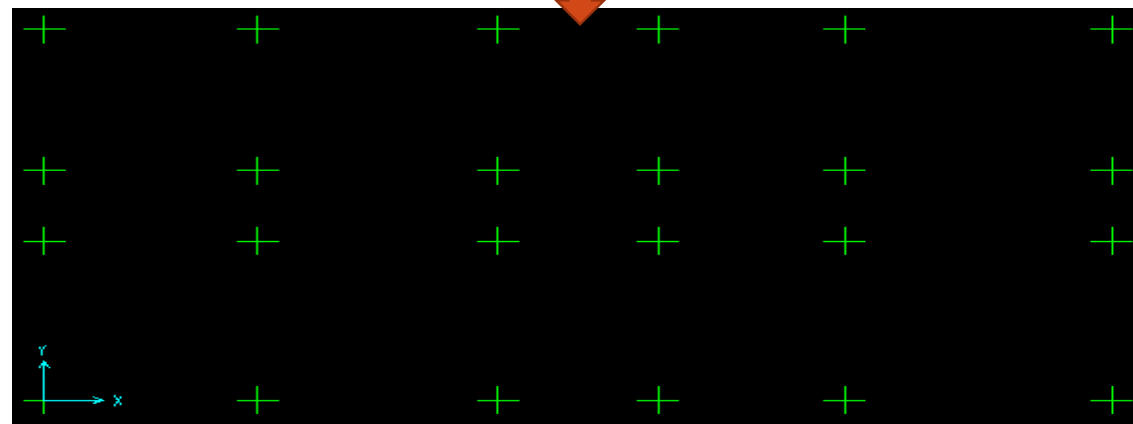
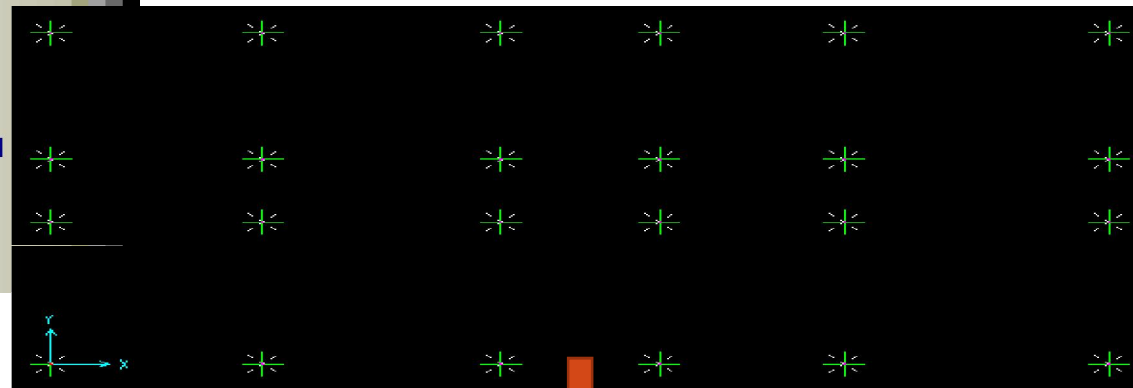
Assign → Area → Automatic Area Mesh



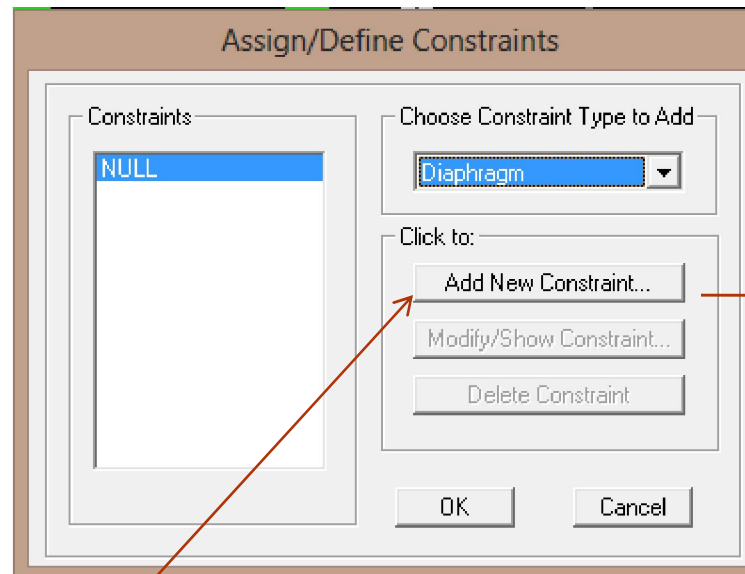


Select all

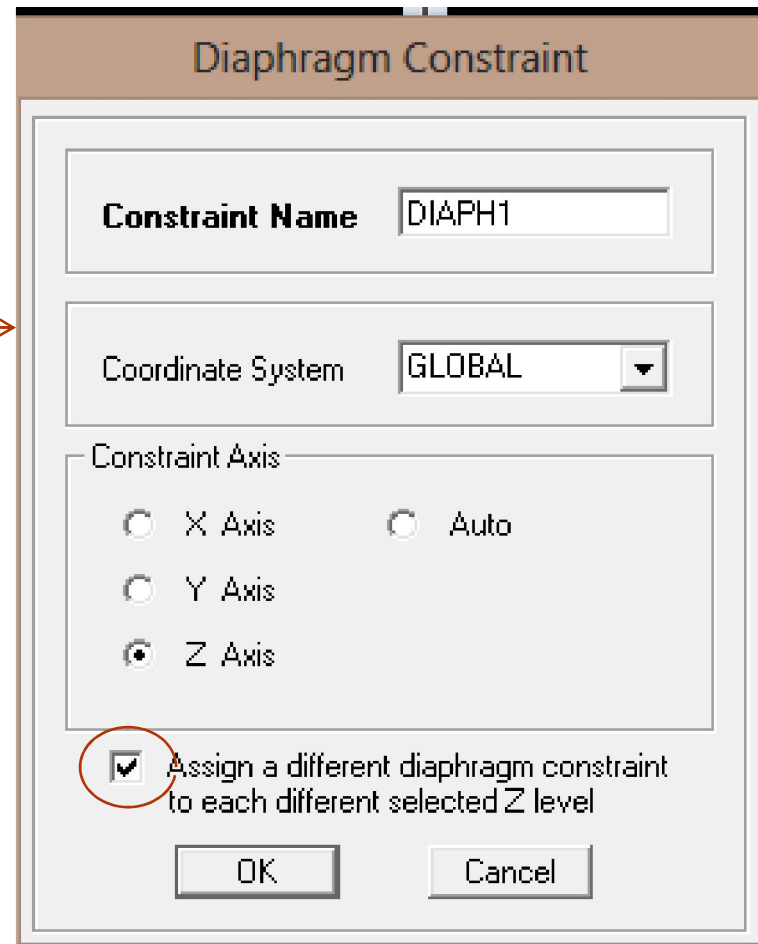
Set your XY plane @Z=-1.5 and
deselect supports!



- Assign → Joint → Constraint

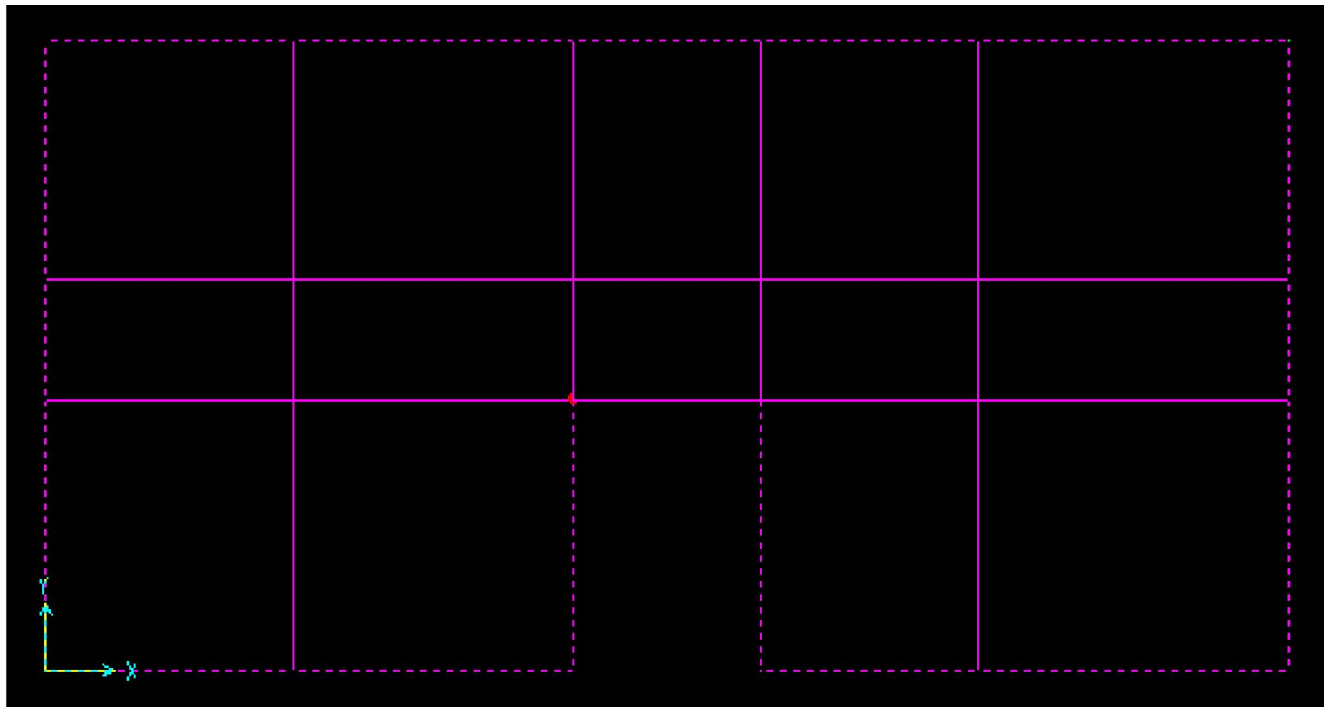


Click after changing constraint type in to 'Diaphragm'!



Assign Loads

- Set your XY plane @Z=15.5 and select the exterior beams



- Assign ➡ Frame Loads ➡ Distributed

Frame Distributed Loads

Load Pattern Name: DEAD

Units: KN, m, C

Load Type and Direction:
☒ Forces ☐ Moments
Coord Sys: GLOBAL
Direction: Gravity

Options:
☐ Add to Existing Loads
☒ Replace Existing Loads
☐ Delete Existing Loads

Trapezoidal Loads

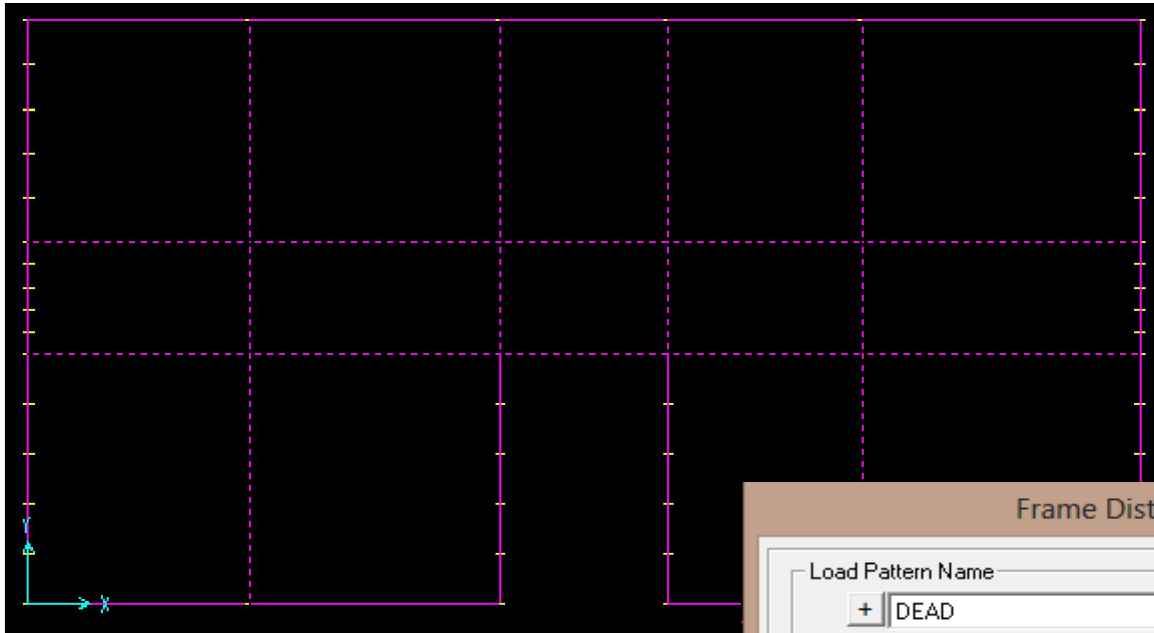
	1.	2.	3.	4.
Distance	0.	0.25	0.75	1.
Load	0.	0.	0.	0.

☒ Relative Distance from End-I ☐ Absolute Distance from End-I

Uniform Load:
Load: 5

OK Cancel

- Again select the interior beams and assign a DL of 3.4KN/m



Frame Distributed Loads

Load Pattern Name: Units:

Load Type and Direction:
☒ Forces ☐ Moments
Coord Sys:
Direction:

Options:
☐ Add to Existing Loads
☒ Replace Existing Loads
☐ Delete Existing Loads

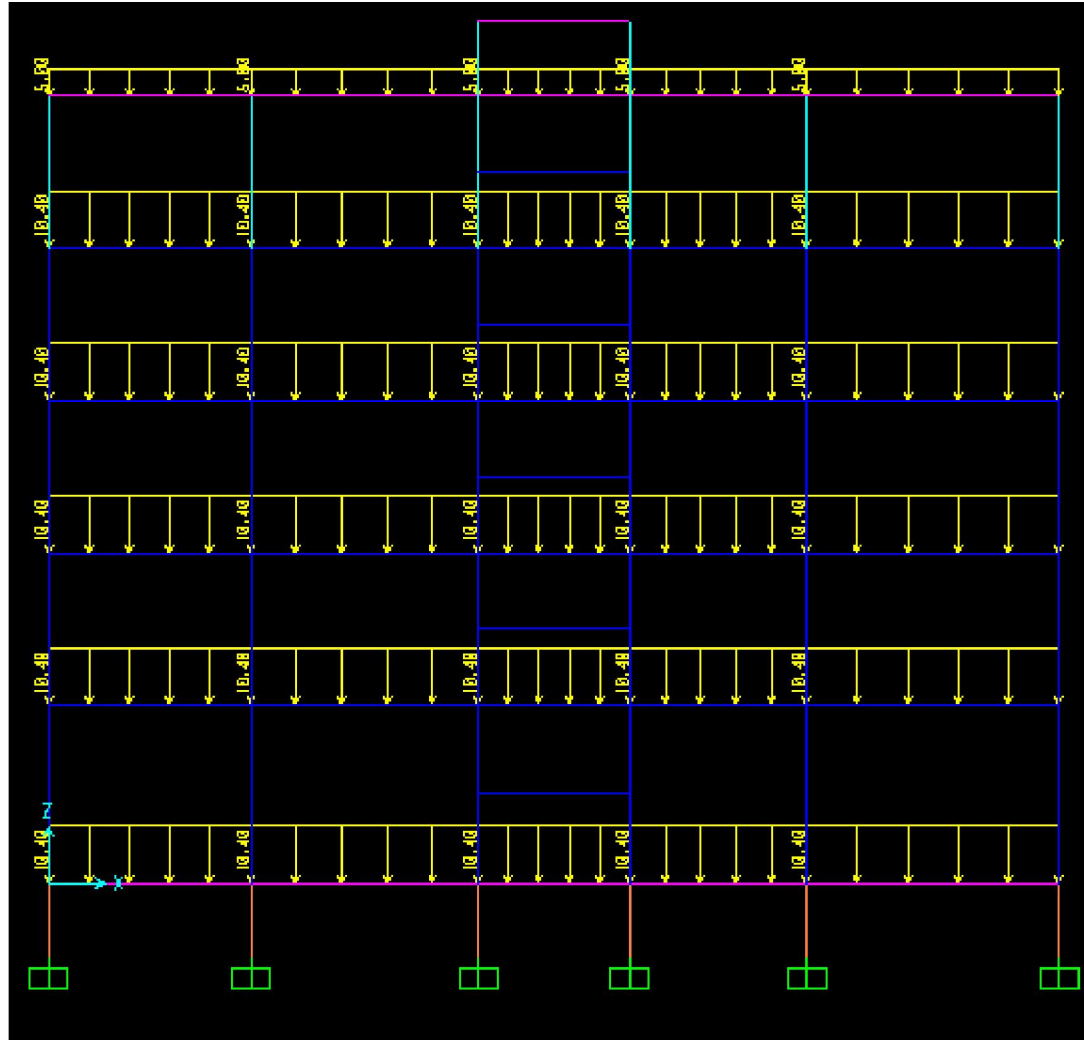
Trapezoidal Loads:

	1.	2.	3.	4.
Distance	0.	0.25	0.75	1.
Load	0.	0.	0.	0.

☒ Relative Distance from End-I ☐ Absolute Distance from End-I

Uniform Load:
Load:

- Assign a DL of 10.4KN/m for all exterior beams and 3.4KN/m for Interior Beams



Assign → Area Loads → Uniform(shell)

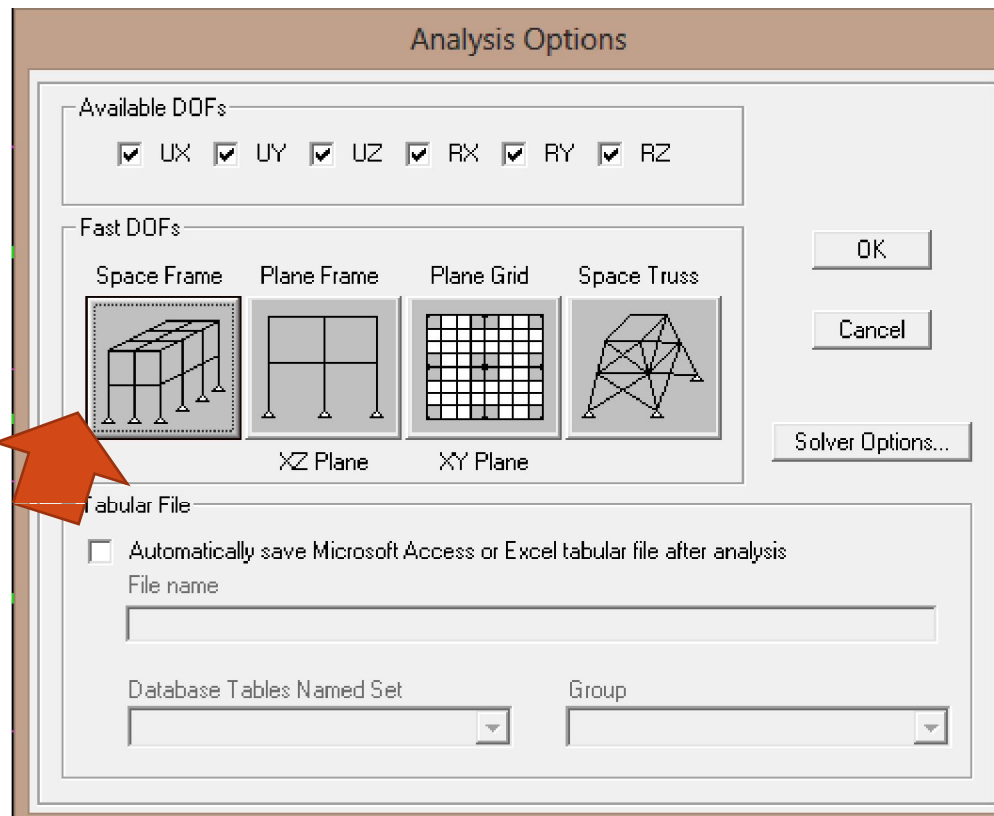
Area Uniform Loads

Load Pattern Name + DEAD		Units KN, m, C
Uniform Load Load: 2		Options ☐ Add to Existing Loads ☒ Replace Existing Loads ☐ Delete Existing Loads
Coord System: GLOBAL		
Direction: Gravity		
OK		Cancel

Area Uniform Loads

Load Pattern Name + LL		Units KN, m, C
Uniform Load Load: 2		Options ☐ Add to Existing Loads ☒ Replace Existing Loads ☐ Delete Existing Loads
Coord System: GLOBAL		
Direction: Gravity		
OK		Cancel

- Analyze → Set analysis option



- Analyze ➡ Run analysis

Set Load Cases to Run

Case Name	Type	Status	Action
DEAD	Linear Static	Not Run	Run
MODAL	Modal	Not Run	Do Not Run
LL	Linear Static	Not Run	Run
EQ(X+)	Linear Static	Not Run	Run
EQ(X-)	Linear Static	Not Run	Run
EQ(Y+)	Linear Static	Not Run	Run
EQ(Y-)	Linear Static	Not Run	Run

Click to:

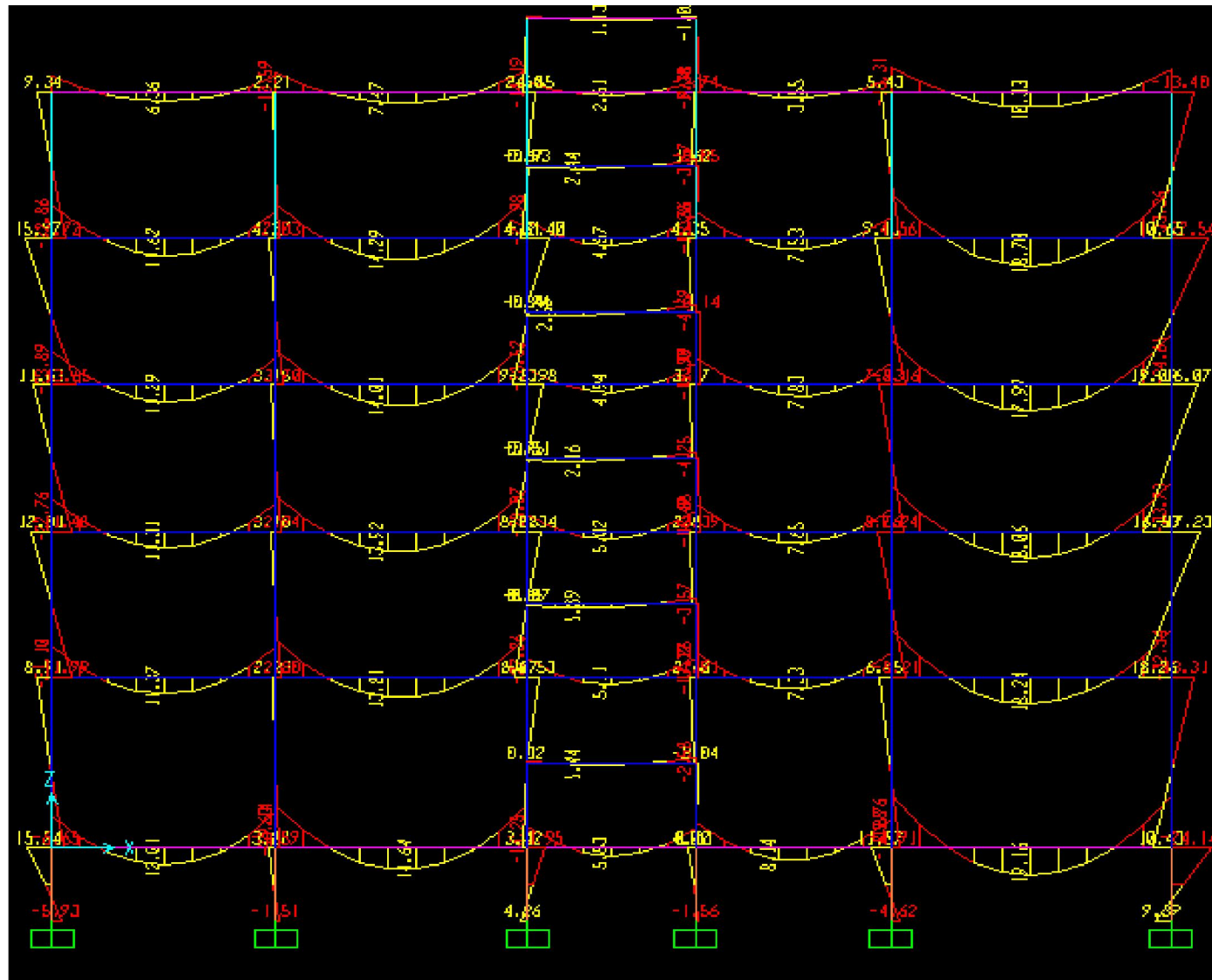
Analysis Monitor Options

☐ Always Show

☐ Never Show

☒ Show After seconds

☐ Model-Alive



Design

- Design Concrete Frame Design View/Revise
Preferences

Concrete Frame Design Preferences for Eurocode 2-2004

	Item	Value
1	Design Code	Eurocode 2-2004
2	Country	CEN Default
3	Combinations Equation	Eq. 6.10
4	Second Order Method	Nominal Stiffness
5	Time History Design	Envelopes
6	Number of Interaction Curves	24
7	Number of Interaction Points	11
8	Consider Minimum Eccentricity	Yes
9	Theta0 (ratio)	5.000E-03
10	GammaS (steel)	1.15
11	GammaC (concrete)	1.5
12	AlphaCC (compression)	1.
13	AlphaCT (tension)	1.
14	AlphaLCC (lightweight compression)	0.85
15	AlphaLCT (lightweight tension)	0.85
16	Pattern Live Load Factor	0.75
17	Utilization Factor Limit	0.95

Item Description
The selected design code.
Subsequent design is based on this selected code.

Explanation of Color Coding for Values
Blue: Default Value
Black: Not a Default Value
Red: Value that has changed during the current session

Set To Default Values
All Items Selected Items

Reset To Previous Values
All Items Selected Items

OK Cancel

- Design ➡ Concrete Frame Design ➡ Select Design Combo..

Design Load Combinations Selection

Load Combinations for Design

Select Type of Design Load Combination

Load Combination Type: Strength

Select Load Combinations

List of Load Combinations

Design Load Combinations

COMB1
COMB10
COMB11
COMB2
COMB3
COMB4
COMB5
COMB6
COMB7
COMB8

Buttons: Add ->, <- Remove, Show...

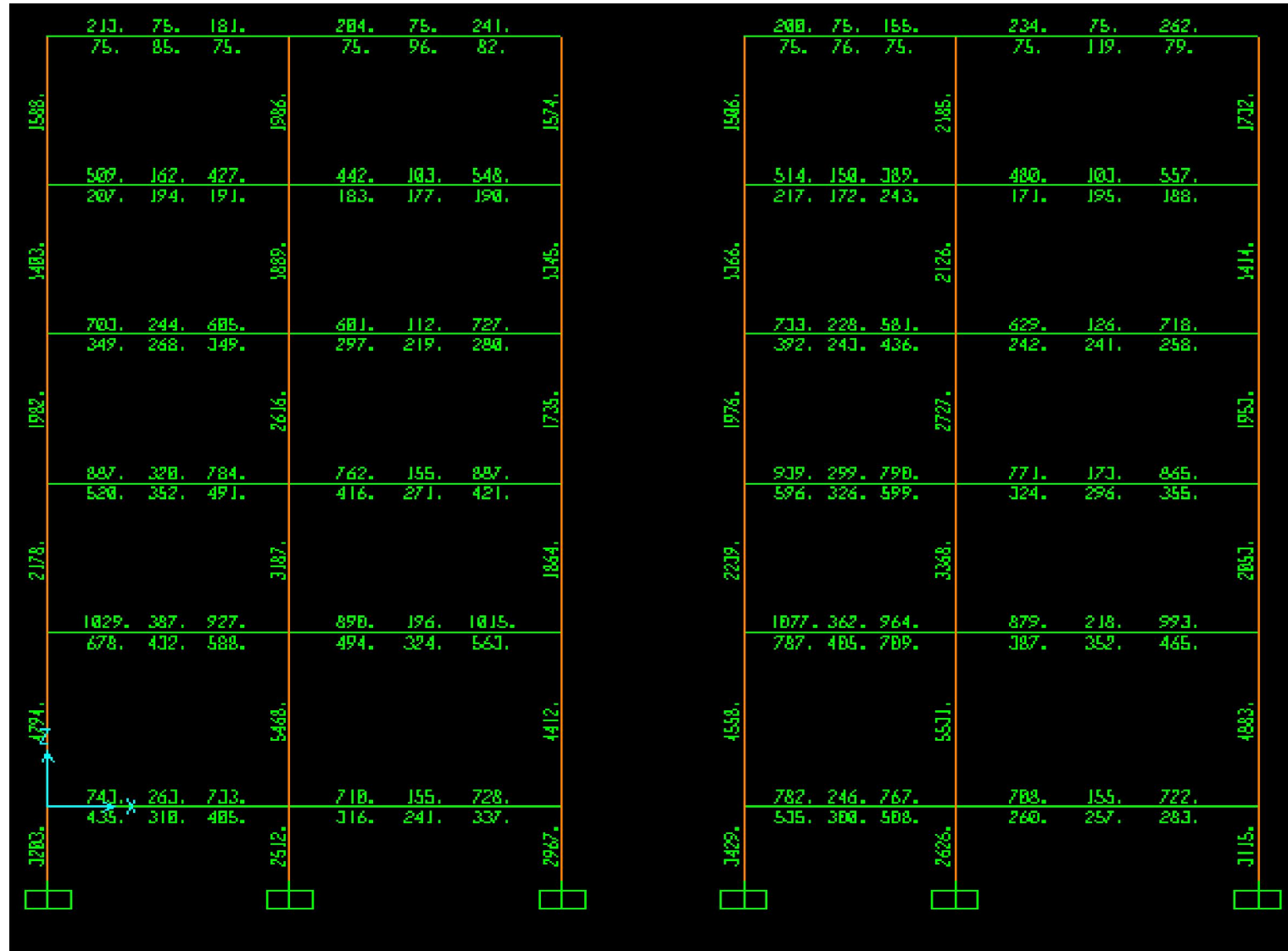
Automatic Design Load Combinations

☐ Automatically Generate Code-Based Design Load Combinations

Set Automatic Design Load Combination Data...

OK Cancel

- Design → Concrete Frame Design → Start Design

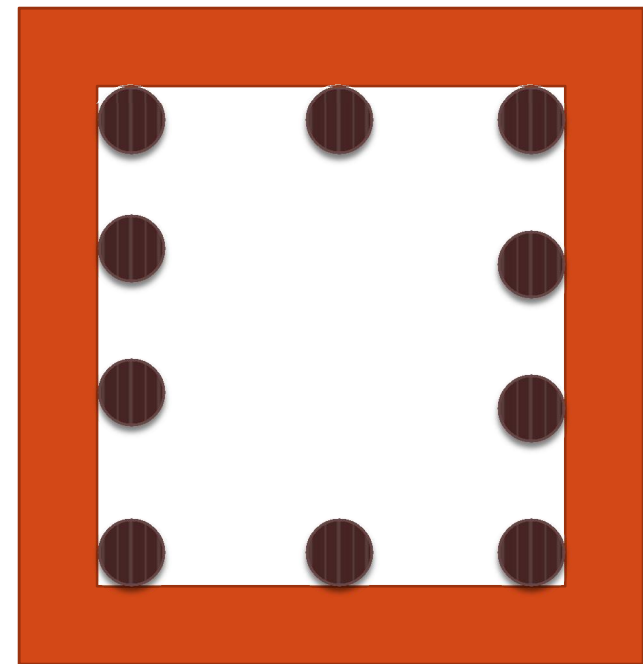
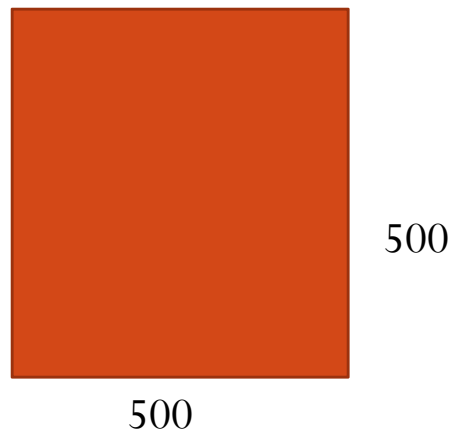
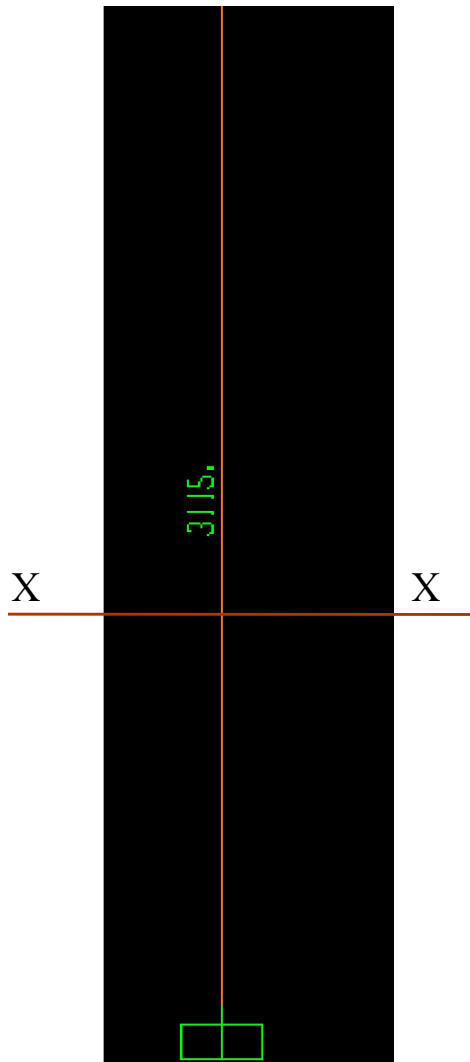


- For Example(For column)

$$A_{s,min}=0.008*500*500=2000\text{mm}^2 > 3115\text{mm}^2 \dots \text{ok!}$$

$$\text{No. of Bar}=3115/314=10$$

Use 10Ø20



- For Beam

Flexural			CCC
708.	155.	722.	
260.	257.	283.	

Shear			
0.488	0.268	0.485	

Top bar = $722 / 154 = 5$use 5 ϕ 14

Bottom bar = $283 / 154 = 2$ use 2 ϕ 14

Spacing = $(1000 * 50.4) / 485 = 100$
mm

