



**Andhra Pradesh State Skill
Development Corporation**



Extended Three-Dimensional Analysis of Building System

ETABS

2D Frame Analysis - II

2D FRAME ANALYSIS-2

Objective

This chapter describes the step by step process of Analysis of 2D Frame with multiple bays in ETABS.

A multiple bay 2D frame contains more than one bay as shown in the following figure
Let's take an example

EXERCISE:

Analyze a 2-D frame as shown in Fig with the following considerations

Material Properties

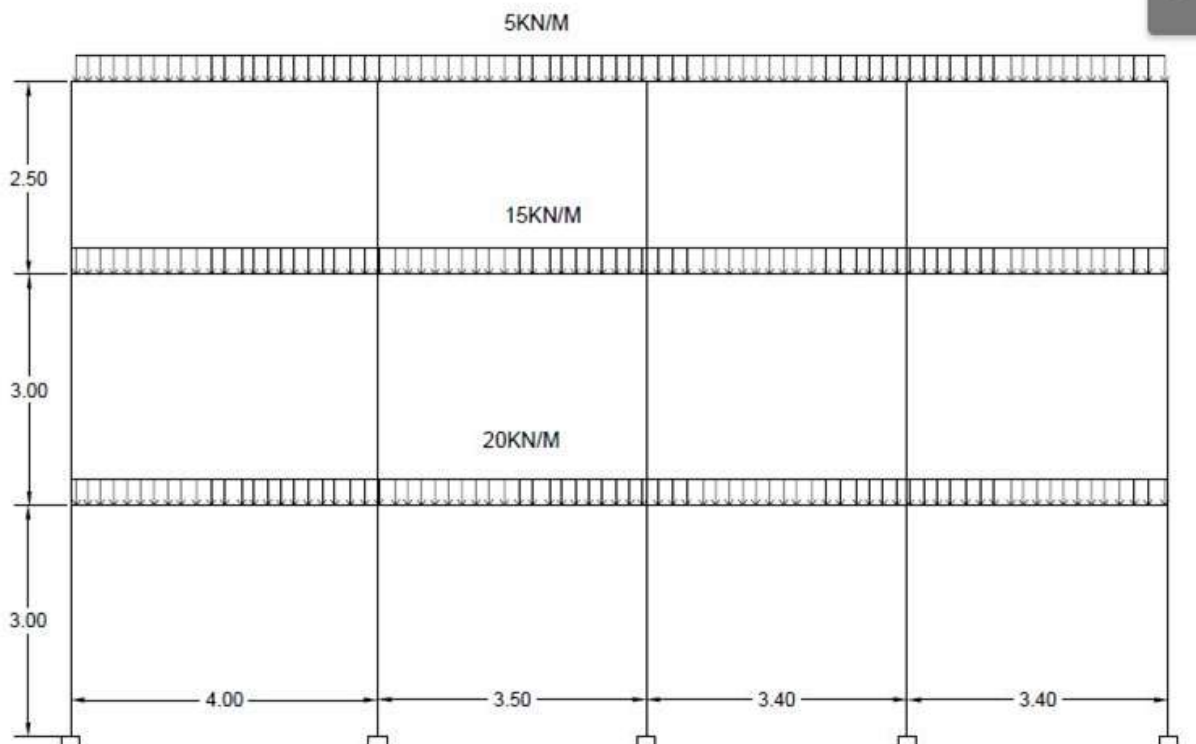
Concrete: M25

Steel: HYSD415

Section Property

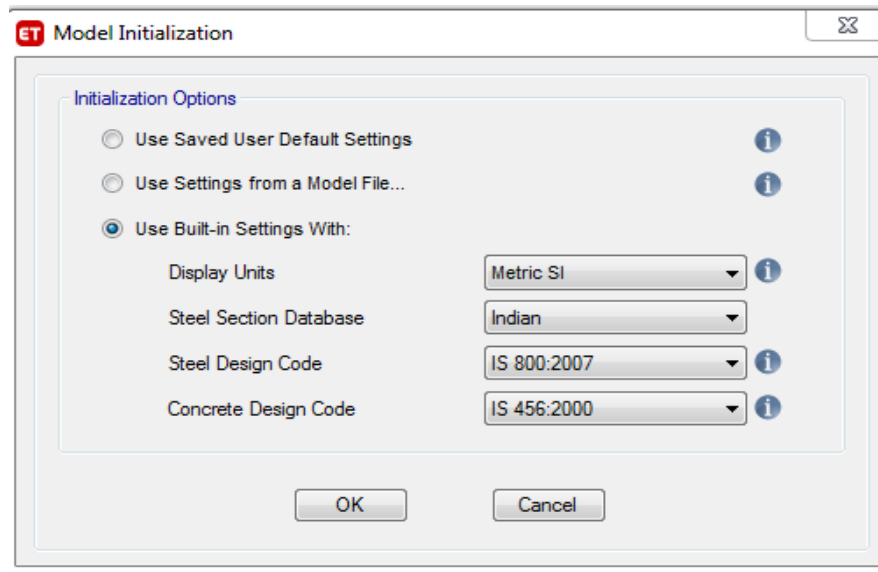
Beam Section: 230mm X 300mm

Column Sections: 300mm X 230mm



Procedure:

1. Create a new model by using **Use Built in Settings with** option from the **Model Initialization** form as shown below and click on **OK**



ET Model Initialization

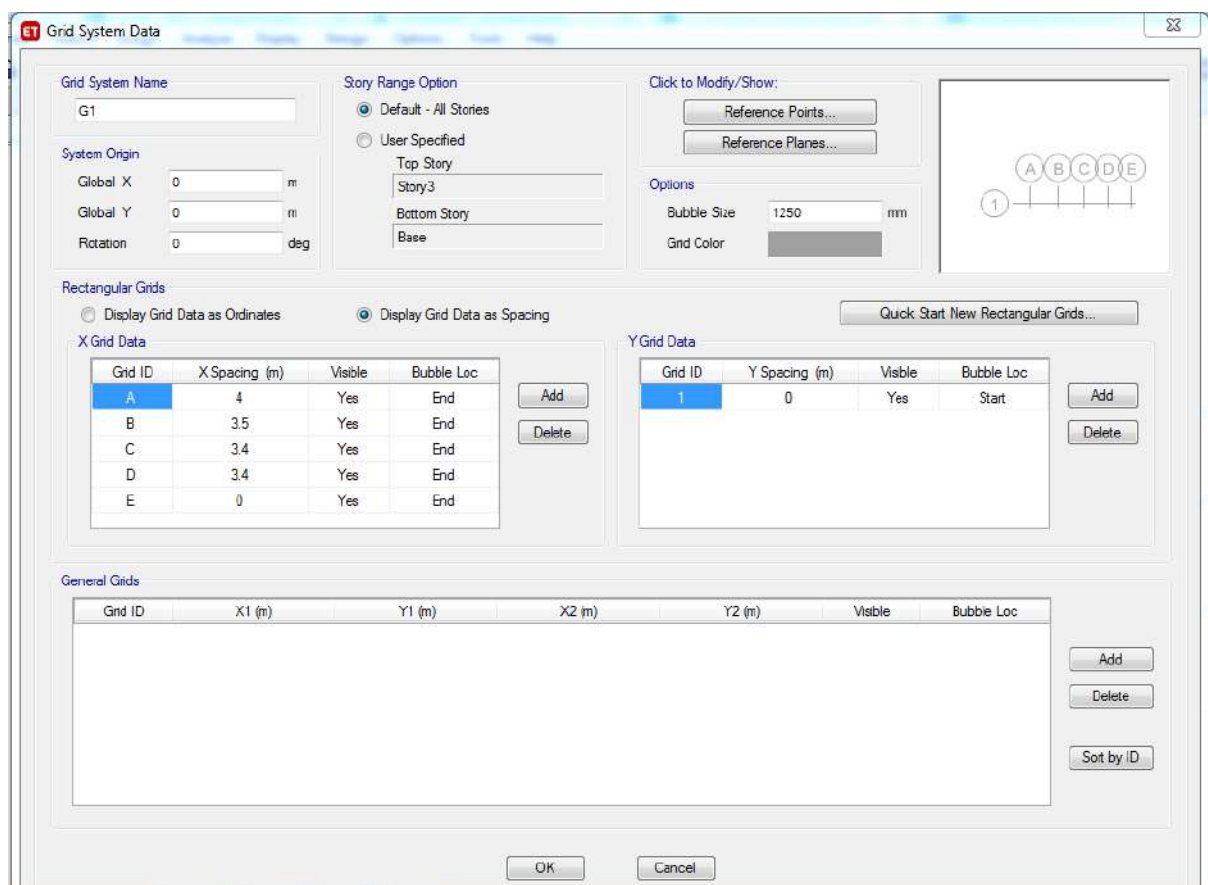
Initialization Options

☐ Use Saved User Default Settings ?
☐ Use Settings from a Model File... ?
☒ Use Built-in Settings With:

Display Units: Metric SI ?
 Steel Section Database: Indian
 Steel Design Code: IS 800:2007 ?
 Concrete Design Code: IS 456:2000 ?

Fig: Model Initialization form

- Specify the grid dimensions as 5-grids along X-axis, 1- grid along Y-axis and then enter spacing's under **Custom Grid Spacing** by clicking on **Edit Grid Data** in the **New Model Quick Templates** form.
- To add the grid click on **Add** and to delete the grid click on **Delete** buttons, enter the spacing's in the spacing column.



ET Grid System Data

Grid System Name: G1

System Origin:
 Global X: 0 m
 Global Y: 0 m
 Rotation: 0 deg

Story Range Option:
☒ Default - All Stories
☐ User Specified
 Top Story: Story3
 Bottom Story:
 Base:

Click to Modify/Show:

Options:
 Bubble Size: 1250 mm
 Grid Color:

Rectangular Grids:
☐ Display Grid Data as Ordinates ☒ Display Grid Data as Spacing

X Grid Data

Grid ID	X Spacing (m)	Visible	Bubble Loc
A	4	Yes	End
B	3.5	Yes	End
C	3.4	Yes	End
D	3.4	Yes	End
E	0	Yes	End

Y Grid Data

Grid ID	Y Spacing (m)	Visible	Bubble Loc
1	0	Yes	Start

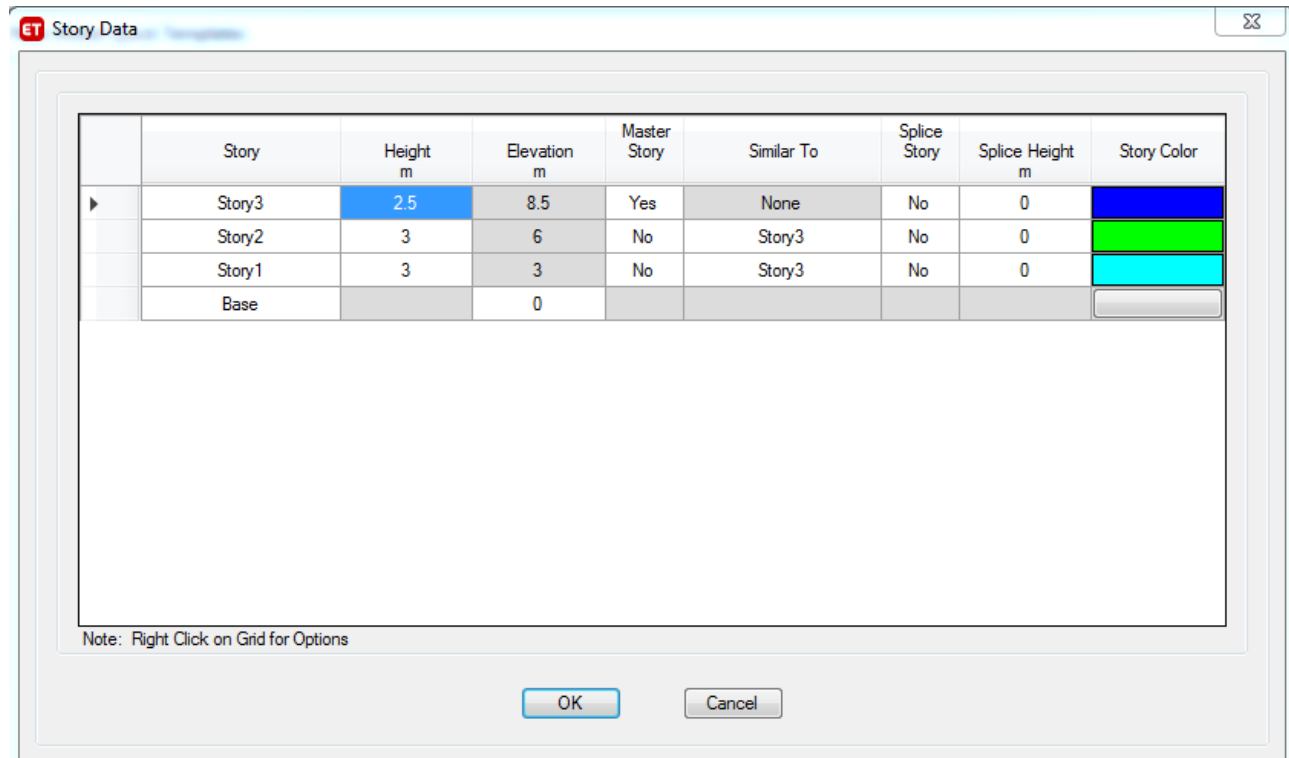
Quick Start New Rectangular Grids...

General Grids

Grid ID	X1 (m)	Y1 (m)	X2 (m)	Y2 (m)	Visible	Bubble Loc

Fig: Grid System Data form

4. Specify the number of stories as 3 under **Simple Story Data** then select **Custom Story Data** and click on **Edit Story Data** to enter the story height.
5. In **Story data** form enter the story heights and then click on **OK**



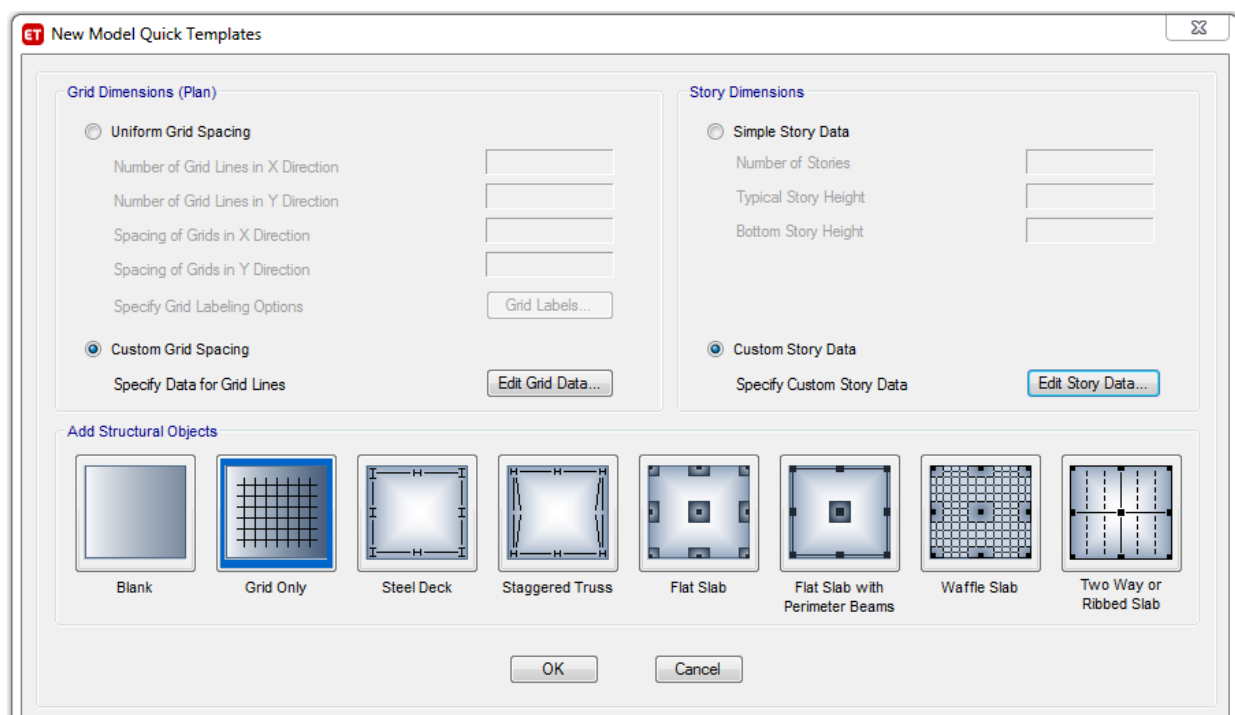
	Story	Height m	Elevation m	Master Story	Similar To	Splice Story	Splice Height m	Story Color
▶	Story3	2.5	8.5	Yes	None	No	0	Blue
	Story2	3	6	No	Story3	No	0	Green
	Story1	3	3	No	Story3	No	0	Cyan
	Base		0					

Note: Right Click on Grid for Options

OK Cancel

Fig: Story Data Form

6. Select **Grid only** template from **Add Structural Template**.



Grid Dimensions (Plan)

☐ Uniform Grid Spacing

Number of Grid Lines in X Direction:

Number of Grid Lines in Y Direction:

Spacing of Grids in X Direction:

Spacing of Grids in Y Direction:

Specify Grid Labeling Options: Grid Labels...

☒ Custom Grid Spacing

Specify Data for Grid Lines: Edit Grid Data...

Story Dimensions

☐ Simple Story Data

Number of Stories:


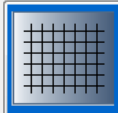
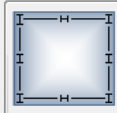
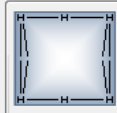

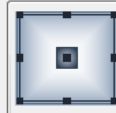
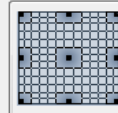
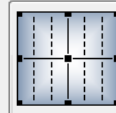
Typical Story Height:

Bottom Story Height:

☒ Custom Story Data

Specify Custom Story Data: Edit Story Data...

Add Structural Objects

 Blank
  Grid Only
  Steel Deck
  Staggered Truss
  Flat Slab
  Flat Slab with Perimeter Beams
  Waffle Slab
  Two Way or Ribbed Slab

OK Cancel

Fig: New Model Quick Templates form

7. By keeping remaining settings as default click **Ok**.
8. Go to **Define menu > Material Properties** , Click on **Add New Material** option and add M25 grade concrete and HYSD415 grade rebar using **Add New Material Property** form.

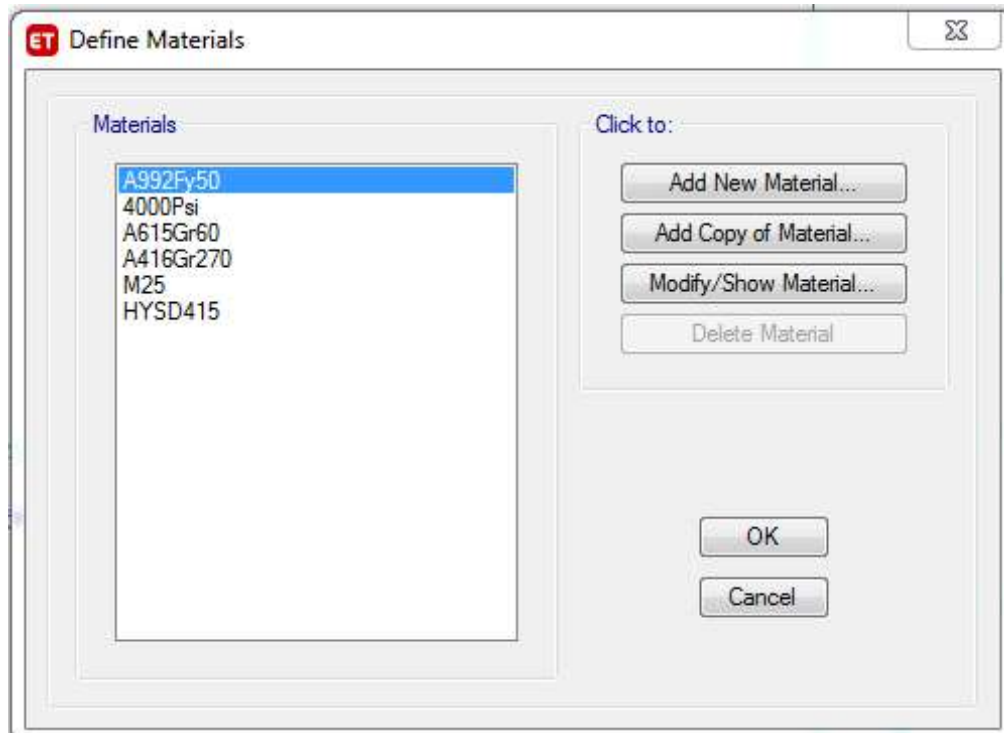
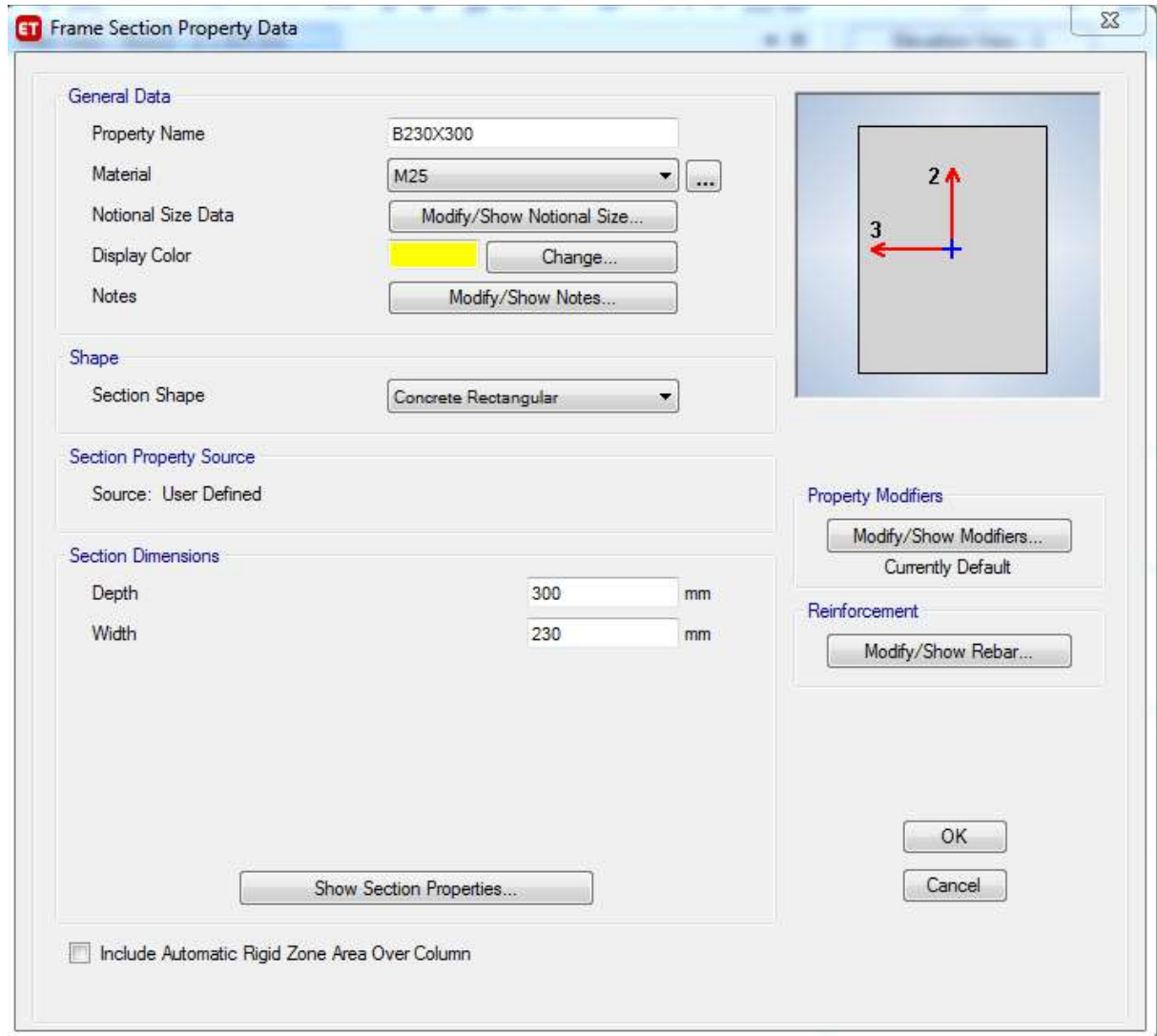


Fig: Define Materials form

9. Go to **Define menu >Section Properties > Frame Sections**, click on **Add New Property** and specify the parameters in **Frame Section Property Data** form as shown in following figures



ET Frame Section Property Data

General Data

Property Name: B230X300

Material: M25

Notional Size Data: Modify/Show Notional Size...

Display Color: Change...

Notes: Modify/Show Notes...

Shape

Section Shape: Concrete Rectangular

Section Property Source

Source: User Defined

Section Dimensions

Depth: 300 mm

Width: 230 mm

Property Modifiers

Modify/Show Modifiers...
Currently Default

Reinforcement

Modify/Show Rebar...

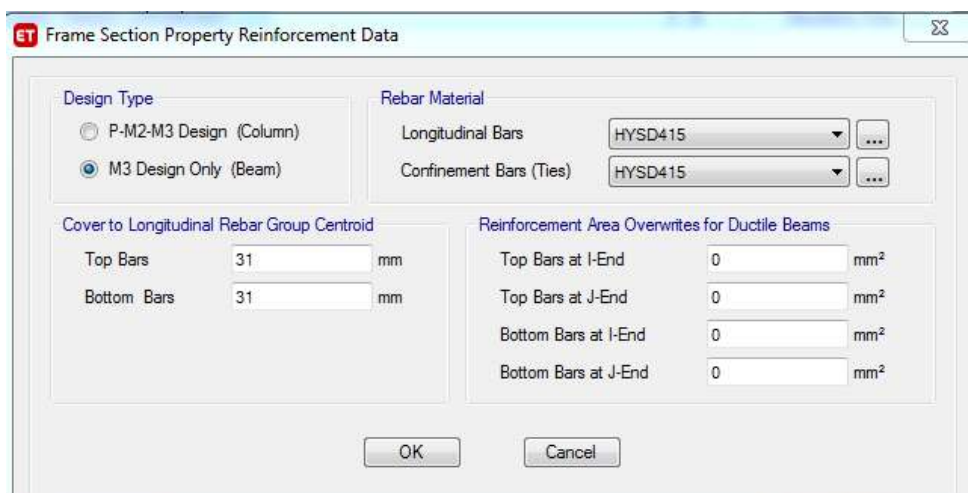
OK Cancel

Show Section Properties...

☐ Include Automatic Rigid Zone Area Over Column

Fig: Frame Section Property Data form (Beam Definition)

- Click on **Modify/Show Rebar** to Specify the design type, rebar materials & cover as per the requirements as shown in following figure



ET Frame Section Property Reinforcement Data

Design Type

☐ P-M2-M3 Design (Column)

☒ M3 Design Only (Beam)

Rebar Material

Longitudinal Bars: HYSD415

Confinement Bars (Ties): HYSD415

Cover to Longitudinal Rebar Group Centroid

Top Bars: 31 mm

Bottom Bars: 31 mm

Reinforcement Area Overwrites for Ductile Beams

Top Bars at I-End: 0 mm²

Top Bars at J-End: 0 mm²

Bottom Bars at I-End: 0 mm²

Bottom Bars at J-End: 0 mm²

OK Cancel

Fig: Frame Section Property Reinforcement Data form (Beam Definition)

Frame Section Property Data

General Data

Property Name: C300X230

Material: M25

Notional Size Data: Modify/Show Notional Size...

Display Color: Change...

Notes: Modify/Show Notes...

Shape

Section Shape: Concrete Rectangular

Section Property Source

Source: User Defined

Section Dimensions

Depth: 300 mm

Width: 230 mm

Property Modifiers

Modify/Show Modifiers...
Currently Default

Reinforcement

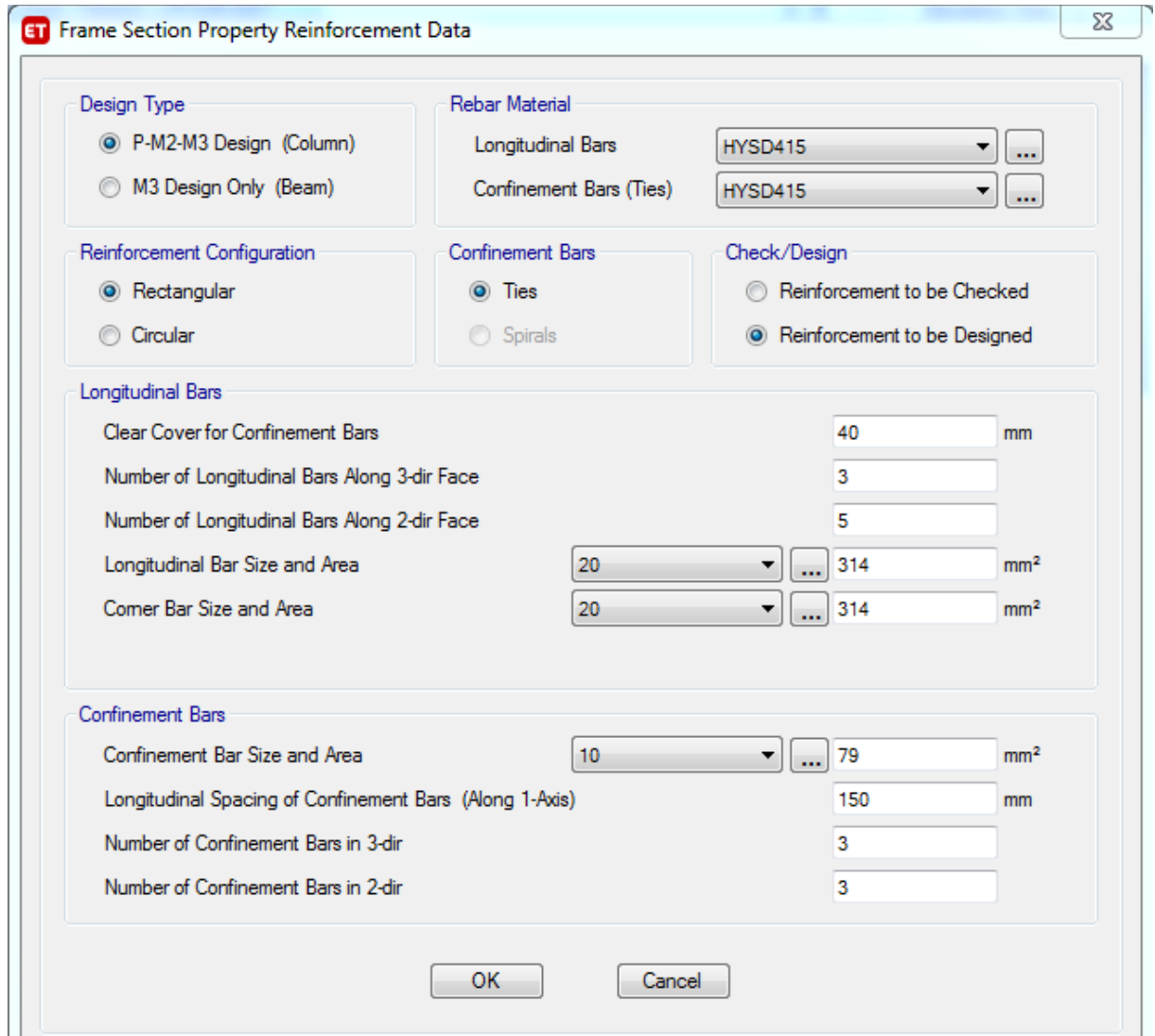
Modify/Show Rebar...

Diagram: A rectangular cross-section diagram showing a grid of reinforcement bars. The top bar is labeled '2' and the left bar is labeled '3'. A red arrow points from the center towards the top bar, and a blue arrow points from the center towards the left bar.

Buttons: Show Section Properties..., OK, Cancel

☐ Include Automatic Rigid Zone Area Over Column

Fig: Frame Section Property Data form (Column Definition)



ET Frame Section Property Reinforcement Data

Design Type

- ☒ P-M2-M3 Design (Column)
- ☐ M3 Design Only (Beam)

Rebar Material

Longitudinal Bars: HYSD415

Confinement Bars (Ties): HYSD415

Reinforcement Configuration

- ☒ Rectangular
- ☐ Circular

Confinement Bars

- ☒ Ties
- ☐ Spirals

Check/Design

- ☐ Reinforcement to be Checked
- ☒ Reinforcement to be Designed

Longitudinal Bars

Clear Cover for Confinement Bars: 40 mm

Number of Longitudinal Bars Along 3-dir Face: 3

Number of Longitudinal Bars Along 2-dir Face: 5

Longitudinal Bar Size and Area: 20 ... 314 mm²

Corner Bar Size and Area: 20 ... 314 mm²

Confinement Bars

Confinement Bar Size and Area: 10 ... 79 mm²

Longitudinal Spacing of Confinement Bars (Along 1-Axis): 150 mm

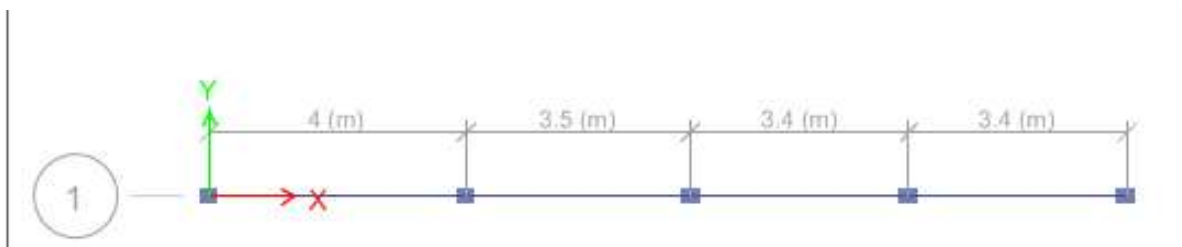
Number of Confinement Bars in 3-dir: 3

Number of Confinement Bars in 2-dir: 3

OK Cancel

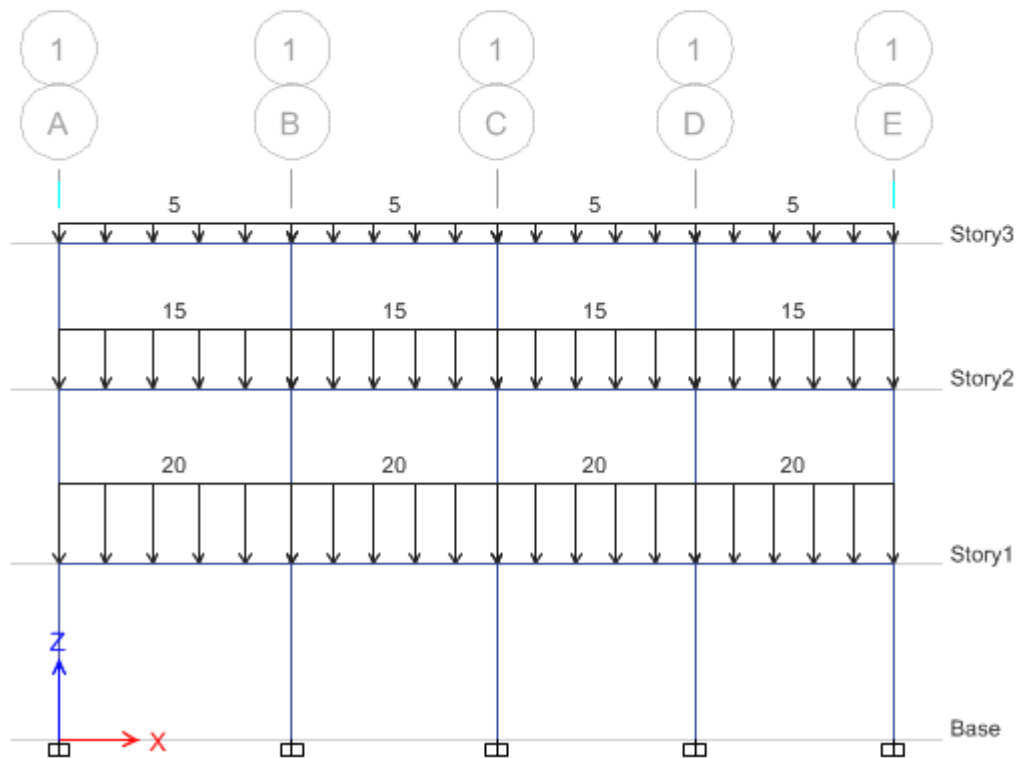
Fig: Frame Section Property Reinforcement Data form (Column Definition)

- Keep the **Story Settings** as **All Stories** and Assign the beam & columns to grid by using either **Draw Beam/Column/brace(Plan,Elev,3D)** or **Quick Draw beam Beams/columns(Plan,Elev,3D)** tool from **Draw** menu.



- Open the plan view of story-1 > change the Story Settings to One Story > Select all beams in Story-1 and assign **UDL** of 20kN/m under Live load pattern using **Frame Loads**, similarly open the plan view of Story-2 > change the Story Settings to One Story > Select all beams in Story-2 and assign **UDL** of 15kN/m using **Frame Loads**. Same process is repeated for the 3rd Story as well.

Elevation View - 1 Frame Span Loads (Live) X



13. To Assign Supports open grid-1 elevation and select the joints at base using windows selection, go to **Assign > Joints > Restraints**, and assign Fixed support to bottom joints.

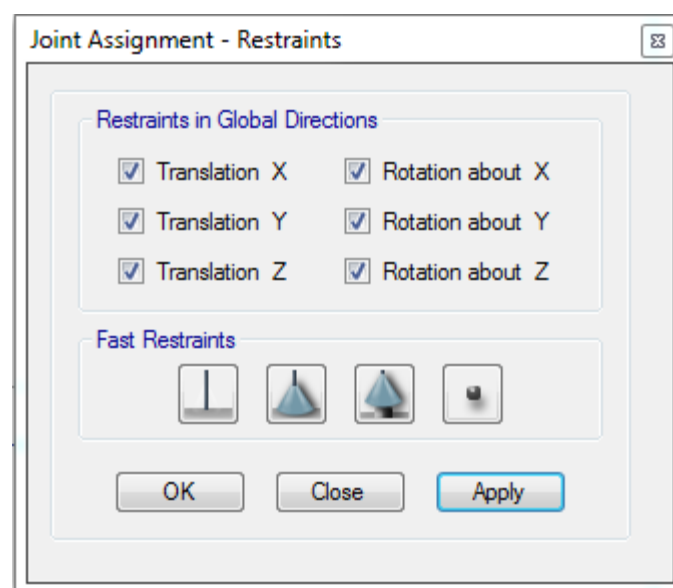
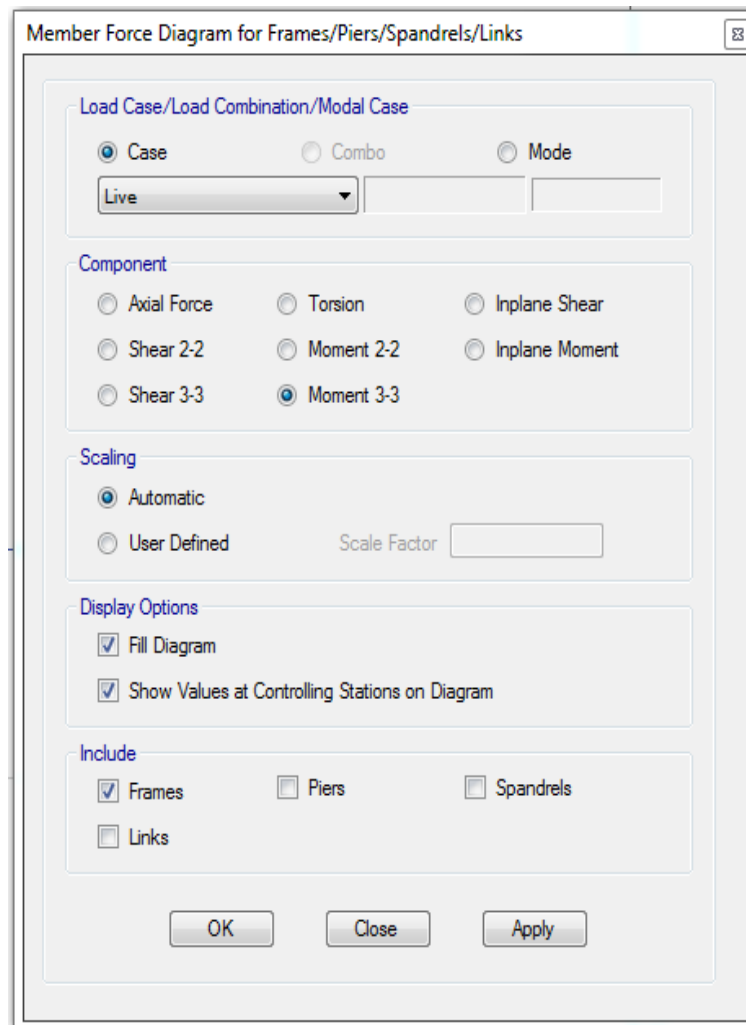


Fig: Joint Assignment-Restraints form

14. Perform **Model Check** by clicking on **Analyze** menu and select **Model Check** option from the dropdown list and select all the checks and click on **OK**.
15. To perform analysis click on **Run Analysis** from the drop down list of **Analyze** menu. As the analysis completes it shows the deflection diagram initially.
16. To check the results like BMD or SFD click on **Display Frames/Piers/Spandrels/Links** or **F8**, select live load under load case, select Moment 3-3 or Shear 2-2 respectively and click on **OK**



The dialog box is titled "Member Force Diagram for Frames/Piers/Spandrels/Links". It contains several sections for configuring the analysis:

- Load Case/Load Combination/Modal Case:** Includes radio buttons for "Case" (selected), "Combo", and "Mode". Below "Case" is a dropdown menu showing "Live".
- Component:** Includes radio buttons for "Axial Force", "Torsion", "Inplane Shear", "Shear 2-2", "Moment 2-2", "Inplane Moment", "Shear 3-3", and "Moment 3-3" (selected).
- Scaling:** Includes radio buttons for "Automatic" (selected) and "User Defined". Next to "User Defined" is a "Scale Factor" input field.
- Display Options:** Includes checkboxes for "Fill Diagram" and "Show Values at Controlling Stations on Diagram", both of which are checked.
- Include:** Includes checkboxes for "Frames" (checked), "Piers", "Spandrels", and "Links".

At the bottom of the dialog box are three buttons: "OK", "Close", and "Apply".

Fig: Member Force Diagram for Frames/Piers/Spandrels /links form

Elevation View - 1 Moment 3-3 Diagram (Live) [kN-m]

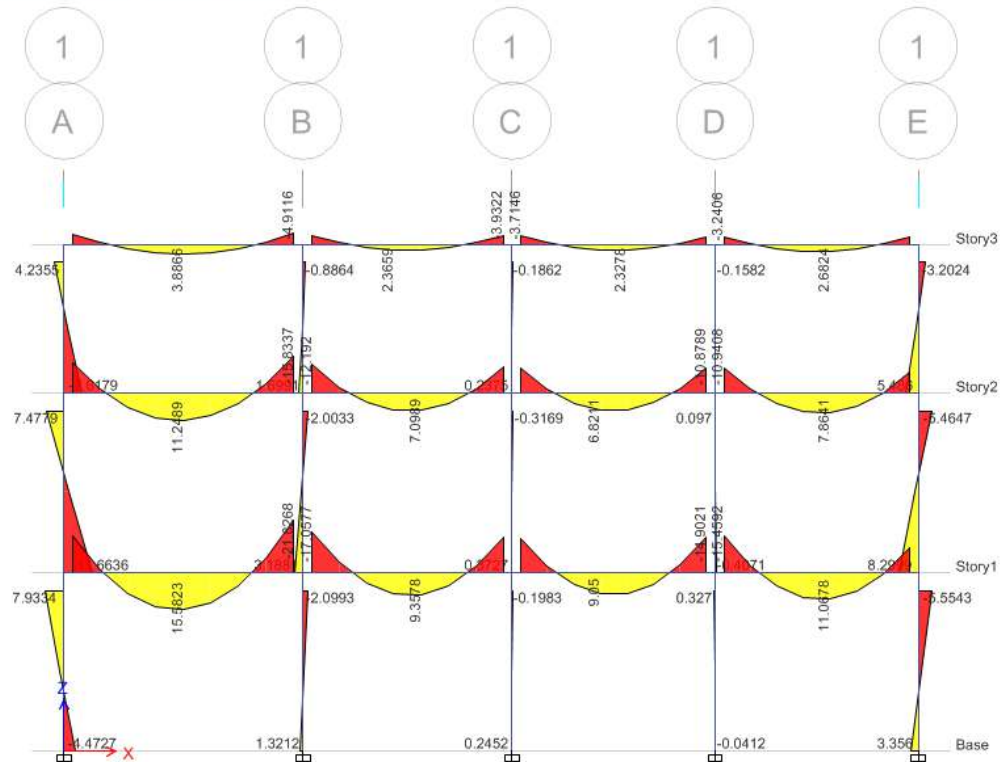


Fig: BMD

Member Force Diagram for Frames/Piers/Spandrels/Links

Load Case/Load Combination/Modal Case

☒ Case ☐ Combo ☐ Mode

Live

Component

☐ Axial Force ☐ Torsion ☐ Inplane Shear

☒ Shear 2-2 ☐ Moment 2-2 ☐ Inplane Moment

☐ Shear 3-3 ☐ Moment 3-3

Scaling

☒ Automatic ☐ User Defined

Scale Factor

Display Options

☒ Fill Diagram ☒ Show Values at Controlling Stations on Diagram

Include

☒ Frames ☐ Piers ☐ Spandrels

☐ Links

OK Close Apply

Fig: Member Force Diagram for Frames/Piers/Spandrels /links form

Elevation View - 1 Shear Force 2-2 Diagram (Live) [kN]

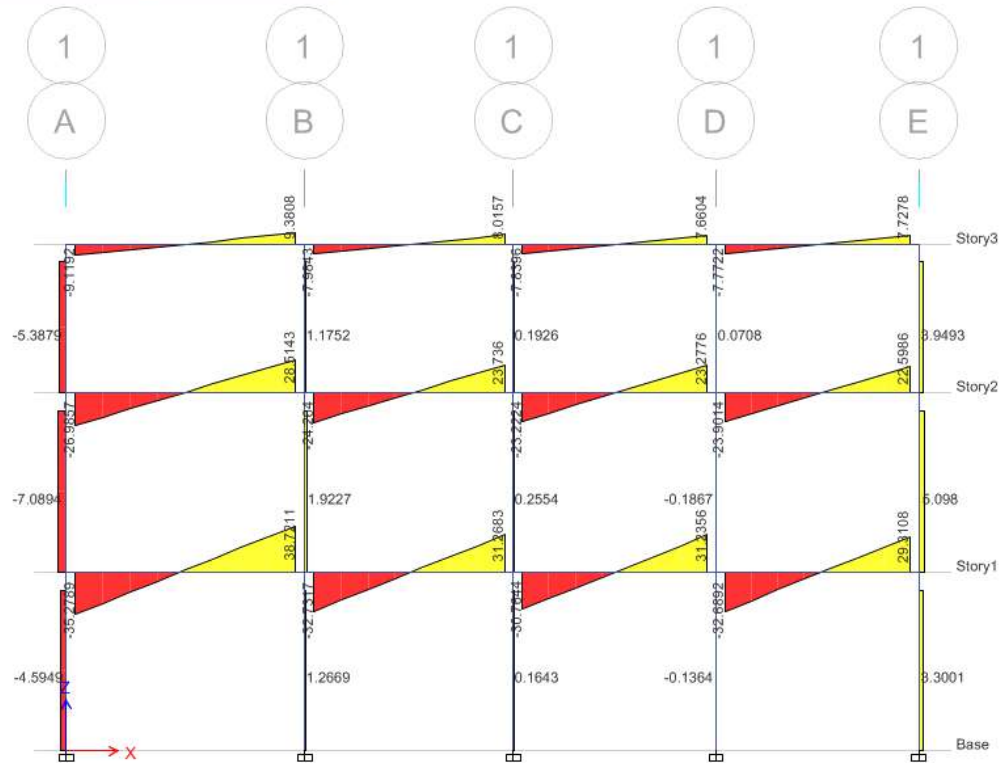


Fig: SFD

- To see the results like BMD, SFD & Deflection for any individual beam or column, select the frame and specify right click immediately it will display the form as shown below. Select the load case from the dropdown list for which you would like to view the results. And then click on the **Close** button to close the form.

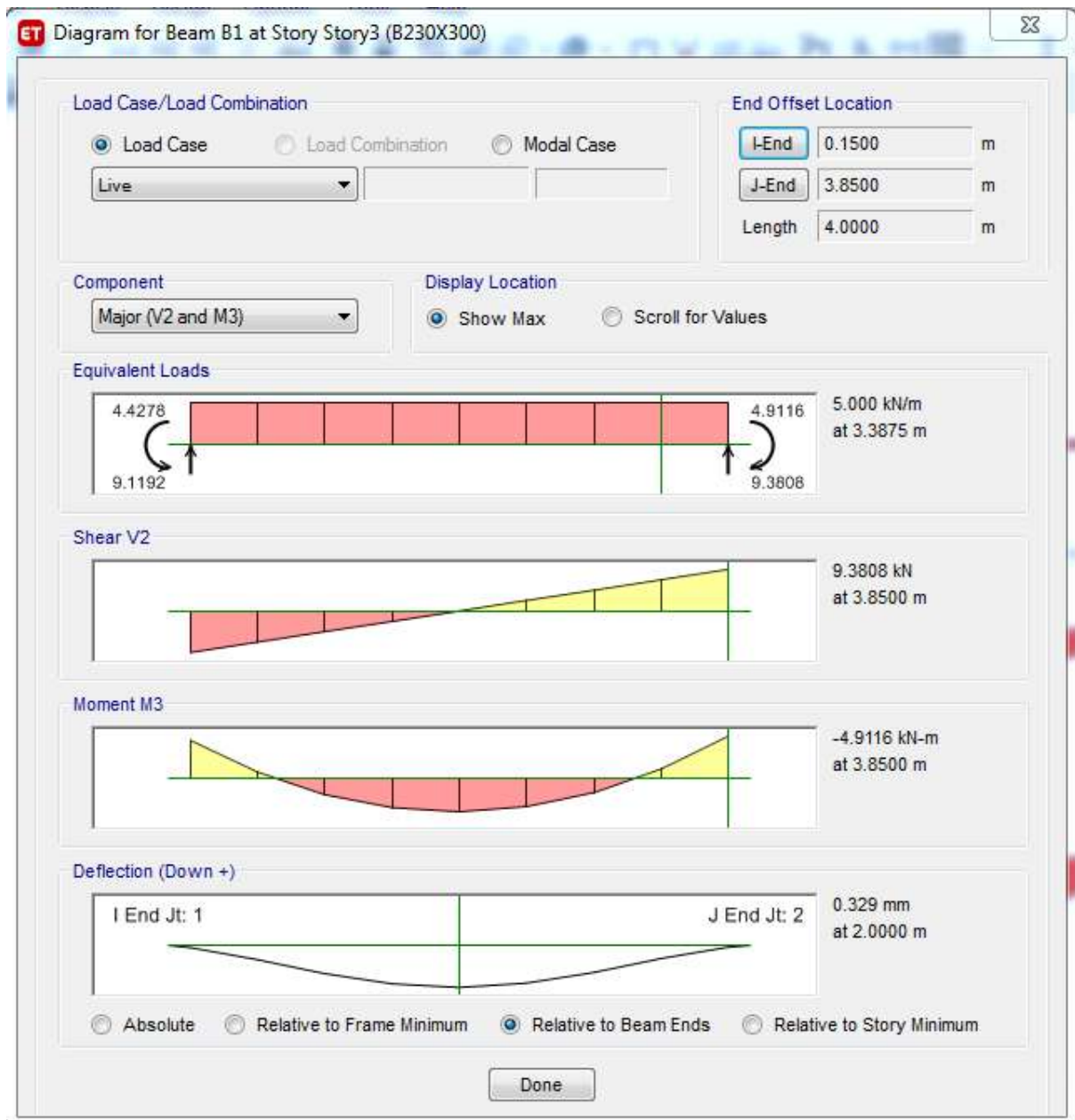


Fig: Diagram for Beam form

Here ends the process of 2D Frame Analysis in ETABS