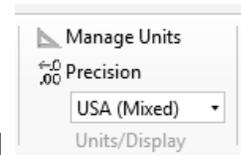
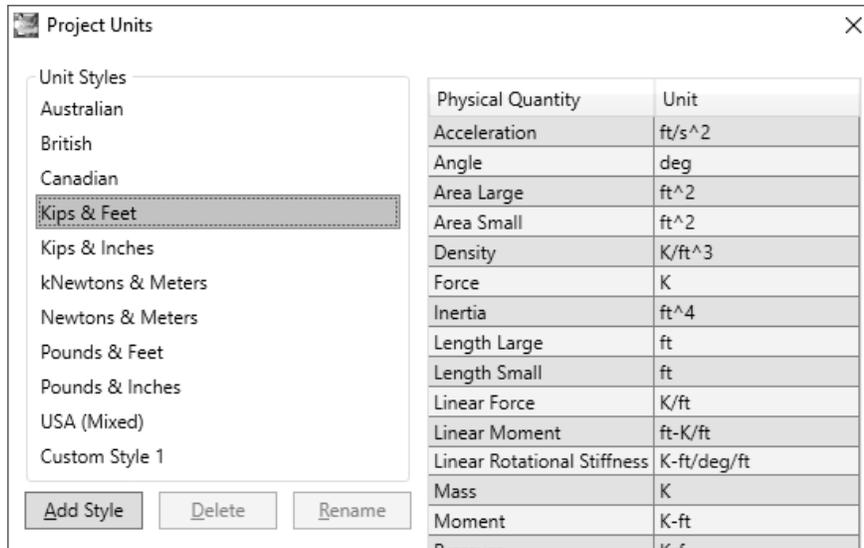


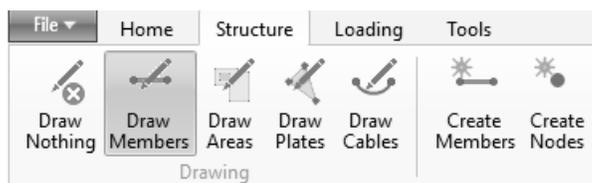
Frame Analysis Using Visual Analysis

- The software is available at the Open Access Labs (OAL) and the Virtual OAL at <http://voal.tamu.edu> in Programs under the Windows Start menu. The software can also be downloaded for use on student computers. To download, go to <https://www.iesweb.com/edu/index.htm> and follow the instructions that requires your TAMU email address to obtain the download link. The license is valid for one academic year, and may require registration renewal.
- There is detailed documentation and tutorials available in the Help menu of the software by choosing Table of Contents. The first task is to define the unit system:
 - Choose Manage Units from the Home tab or use the style listed in the drop down menu. Unit Styles are available for the most common units, although a Custom Style can be defined.

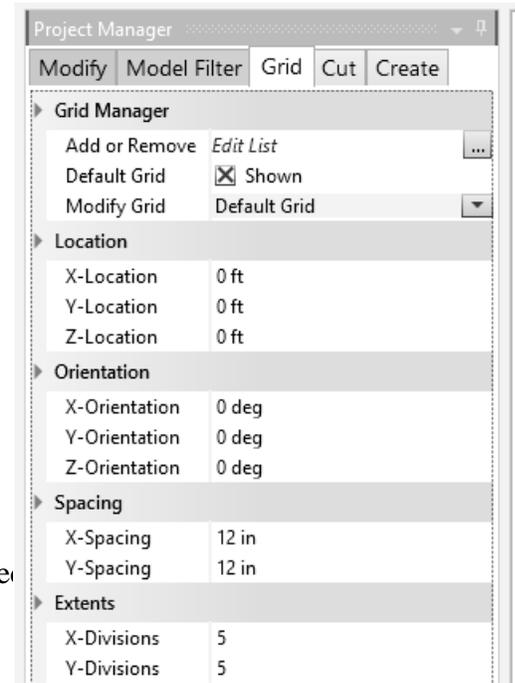


To set the scale of the geometry grid, a Grid tab is available in the Project Manager window:

- Choose Grid, and specify the grid spacing for both axes and how many divisions to be displayed for each axes.
- To create the geometry, you must be in the Structure tab and Model View. Draw Members allows you to draw line members with the mouse that snap to the grid. You can also define end coordinates with Create Members:

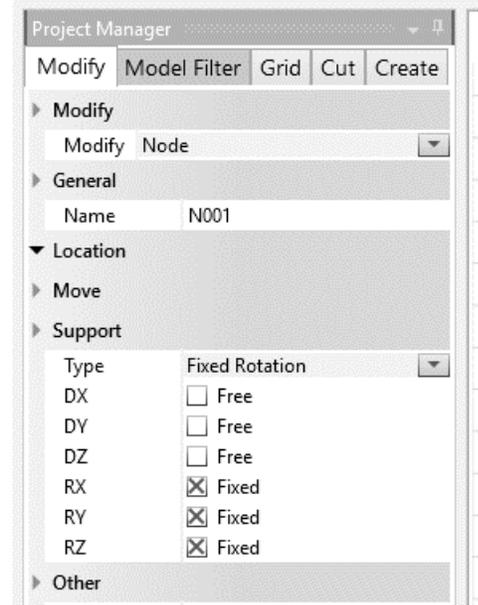


- The Create Tab of the Project Manager shows other objects created. (Hovering over the menu gives instructions.)

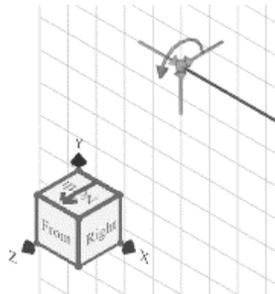


To support a node, chose the node, and in the Modify tab of the Project Manager choose from the Support sub-item. There are four support types (no roller). A pinned support will fix all the displacements (DX, DY, DZ). A rigid support will fix the displacements and all rotations (RX, RY, RZ). The individual restraints can be chose as well.

- If a hinge connection needs to be included between members, you will need to change the member Connections Type to Simple-Rigid, or Rigid-Simple depending on where the node with the hinge is. Be careful to make just *one* member end at the hinge Simple.
- Because a pin support will allow rotation out of plane, there must be rotation restriction out of plane. **At least one support needs to have RX fixed.**

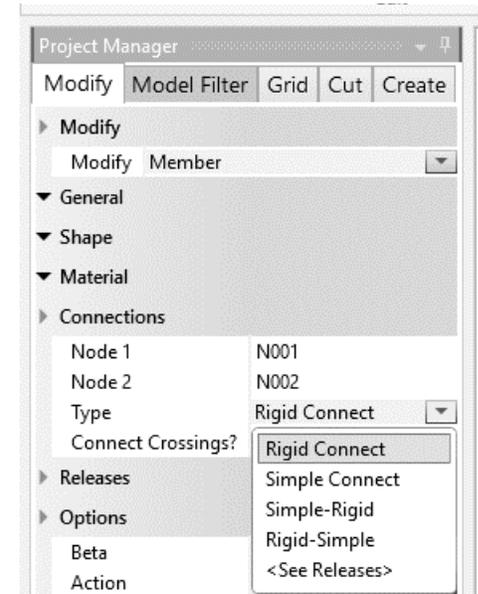


NOTE: The support forces will be determined in the analysis. Do not add loads at these nodes.



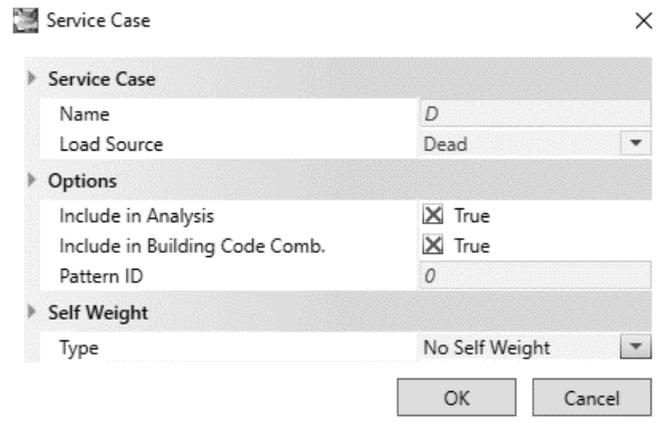
4. The frame geometry is complete, and we need to put on loads. We also might need to tell Visual Analysis that there will be “weightless” members by choosing the Loading tab that shows the service case is “D”.

- Choose Edit Load Case and under the Self Weight Type and choose No Self Weight.



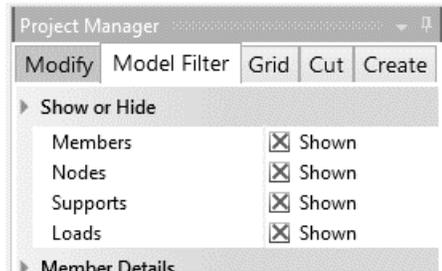
5. The loads that can be applied in the Loading menu are grayed out until the node or member or other element are chosen. If the loads need to be assigned to types, there are defined Service Case types including wind and which direction of the load (ex. W+X). The Load Case manager tool has Load Combinations by building codes.

- Choose the member or node to be loaded and select the load type (here shown for member loading)



- Chose the Load Type. Choose the direction. Enter any other load information required

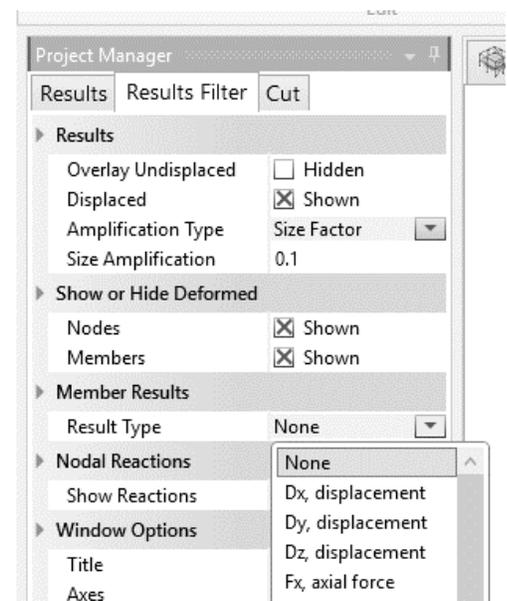
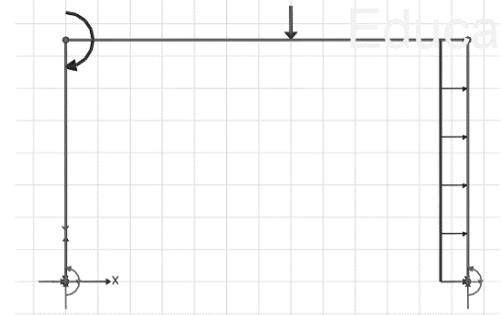
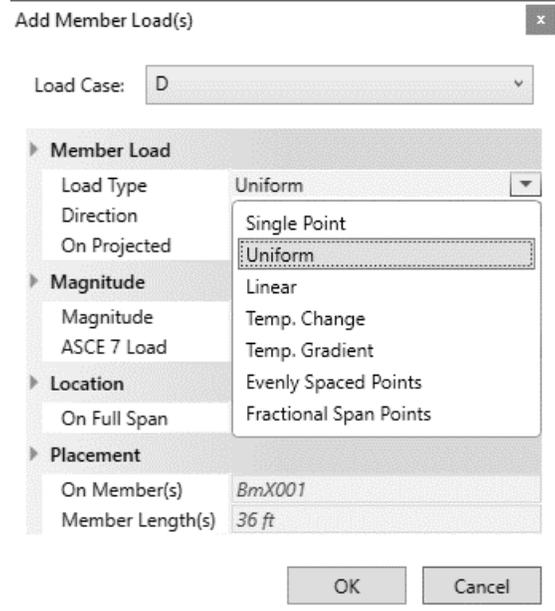
- Enter the magnitude of the force. A negative value is opposite of the positive global direction.
- To display the load value, the load graphic must be selected first. Under the Model Filter tab of the Project Manager, select the options under the Show or Hide sub-item.

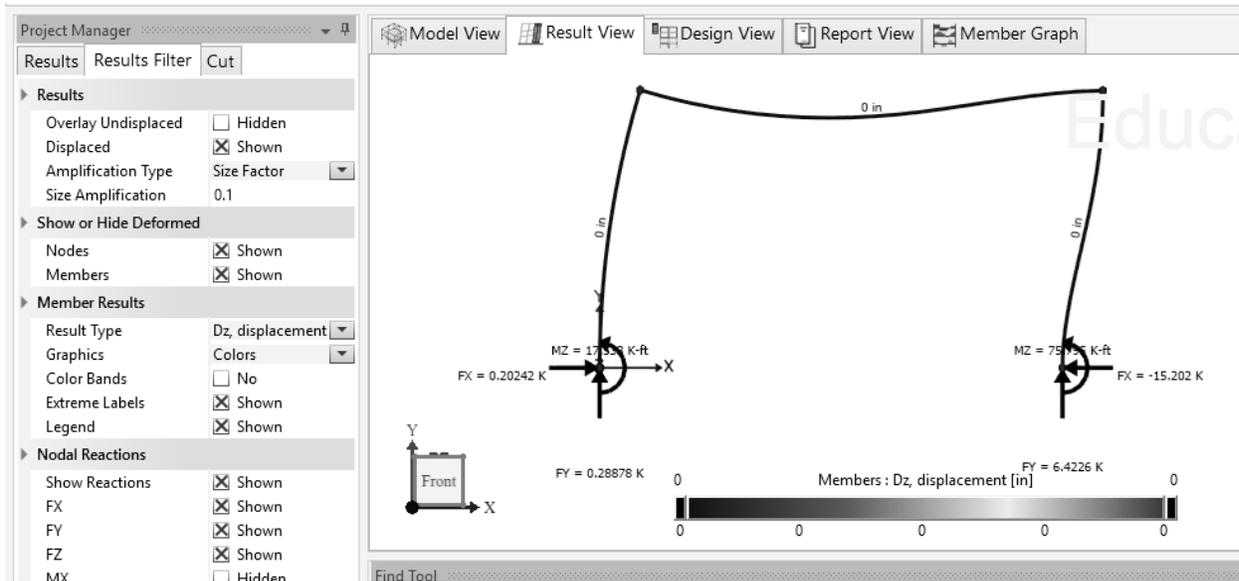


- If the force units are not what you want, you must exit the loading dialog and manage the units first.

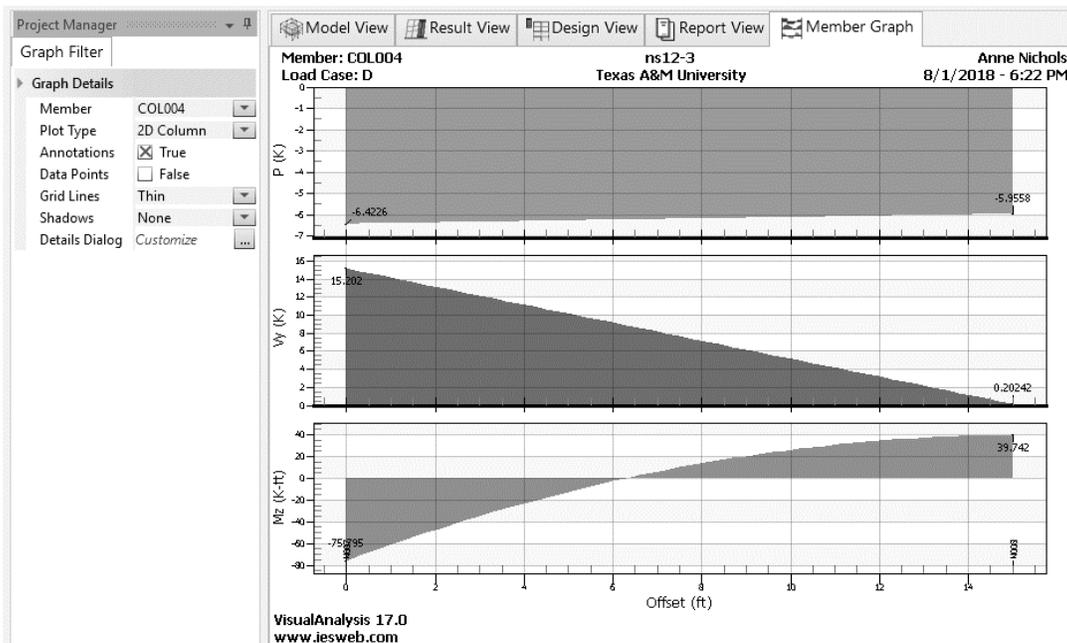
NOTE: *Do not put support reactions as applied loads. The analysis will determine the reaction values.*

- To run the linear analysis after the geometry, member properties, and loading have been defined, make certain that the Modify tab of the Project Manager shows under the Analysis sub-item that the Static Method is First Order.
 - Choose the Results View tab.
- If the analysis is successful, there will not be any error message displayed. To see the specific results, choose the Results Filter tab in the Project Manager.
 - To show the axial force results, choose the Result Type of Fx, axial force. To show the shear results, choose the Result Type of Vy, shear force. To show the bending moment results choose the Result Type of Mz, bending moment.
 - With the Graphics option of Colors, tensile members will have positive values, while compression members will have negative values.





- With the Graphics option of Diagram, the relative sizes for the Result Type chosen will appear as colored bars over the length of the members.
- To show the undeflected diagram, choose the Overlay Undisplaced box under the Results sub-item.
- To show the forces at the supported nodes, choose Show Reactions under the Nodal Reactions sub-item.
- To animate the deflection diagram, in the Results View tab, choose Choose Animate Results from the right-click menu.
- To see exact values of member forces, connection forces, and displacements of a member, chose the member and choose the Member Graph tab. Hover over the point on the plot and the value will be displayed next to the hand pointer icon.



8. The Report View tab allows for a variety of tables to be included by dragging the item onto the place needed in the report view. To include the images from the Model or Results View, use $\text{Ctrl}+\text{C}$ for copying and $\text{Ctrl}+\text{V}$ to paste into the report.

Member Forces, Detailed

Member	Result Case	Offset ft	Fx K	Vy K	Mz K-ft
COL004	D	0.0000	-6.4226	15.2024	-75.7946
COL004	D	1.6667	-6.3707	13.5358	-51.8572
COL004	D	3.3333	-6.3188	11.8691	-30.6799
COL004	D	5.0000	-6.2670	10.2024	-12.2925
COL004	D	6.6667	-6.2151	8.5358	3.3249
COL004	D	8.3333	-6.1633	6.8691	16.1623
COL004	D	10.0000	-6.1114	5.2024	26.2196
COL004	D	11.6667	-6.0595	3.5358	33.5070
COL004	D	13.3333	-6.0077	1.8691	38.0044
COL004	D	15.0000	-5.9558	0.2024	39.7417

Member Stresses

Member	fa Min Ksi	fa Max Ksi	fbx Min Ksi	fbx Max Ksi	fbz Min Ksi	fbz Max Ksi
COL004	-0.7035 (1)	-0.6523 (1)	0.0000 (1)	0.0000 (1)	-19.2821 (1)	19.2821 (1)

(extreme rows only)

9. To save the file choose Save or Save Project from the File menu.
10. To load an existing file choose Open Project from the File menu.
11. To print a plot choose Print or Print Preview Window from the File menu. There is a Page Setup command under the File menu.
12. To print a plot Choose Print Window... from the File menu. As an alternative, you may copy the plot ($\text{Ctrl}+\text{c}$) and paste it in a word processing document ($\text{Ctrl}+\text{v}$).

Example of Combined Stresses:

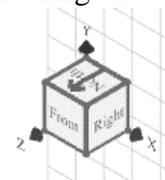
for member COL004: $M_{\max} = -75.7946 \text{ k-ft}$, $P = 6.4226 \text{ k}$

knowing $A = 9.13 \text{ in}^2$, $I = 375 \text{ in}^4$, $c = 7.95 \text{ in}$

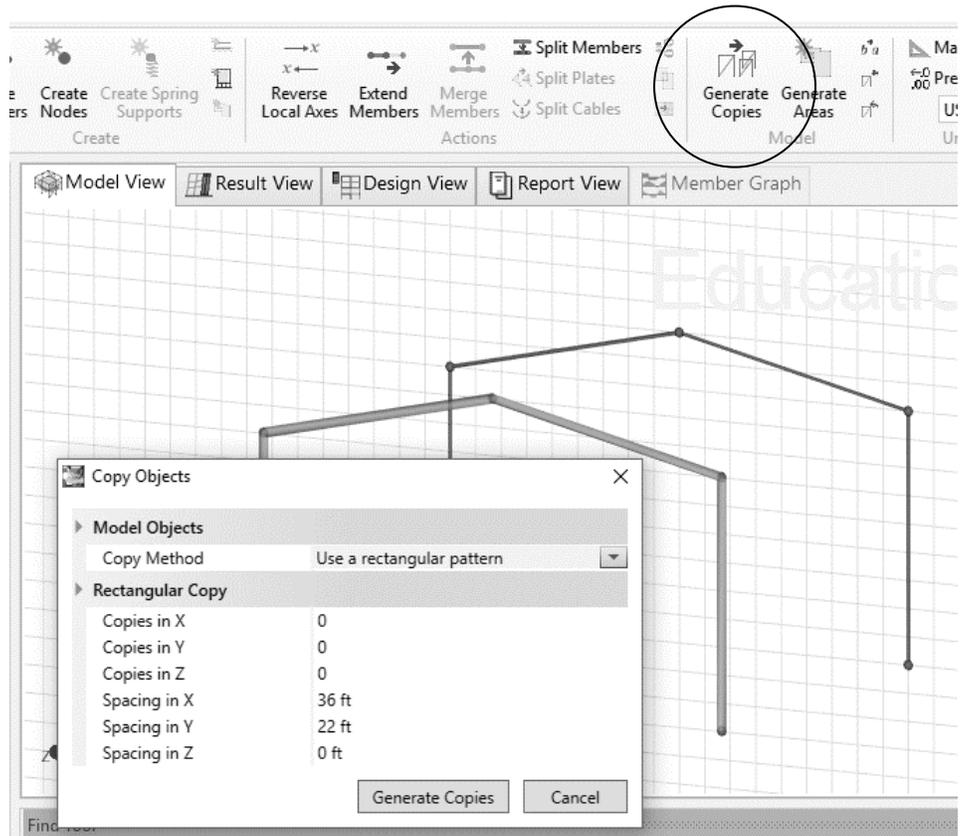
$$f_{\max} = \frac{6.4226 \text{ k}}{9.13 \text{ in}^2} + \frac{75.7946 \text{ k-ft} \cdot 7.95 \text{ in}}{375 \text{ in}^4} \cdot \frac{12 \text{ in}}{\text{ft}} = 0.703 \text{ ksi} + 19.282 \text{ ksi} = 19.985 \text{ ksi}$$

For 3D Frames:

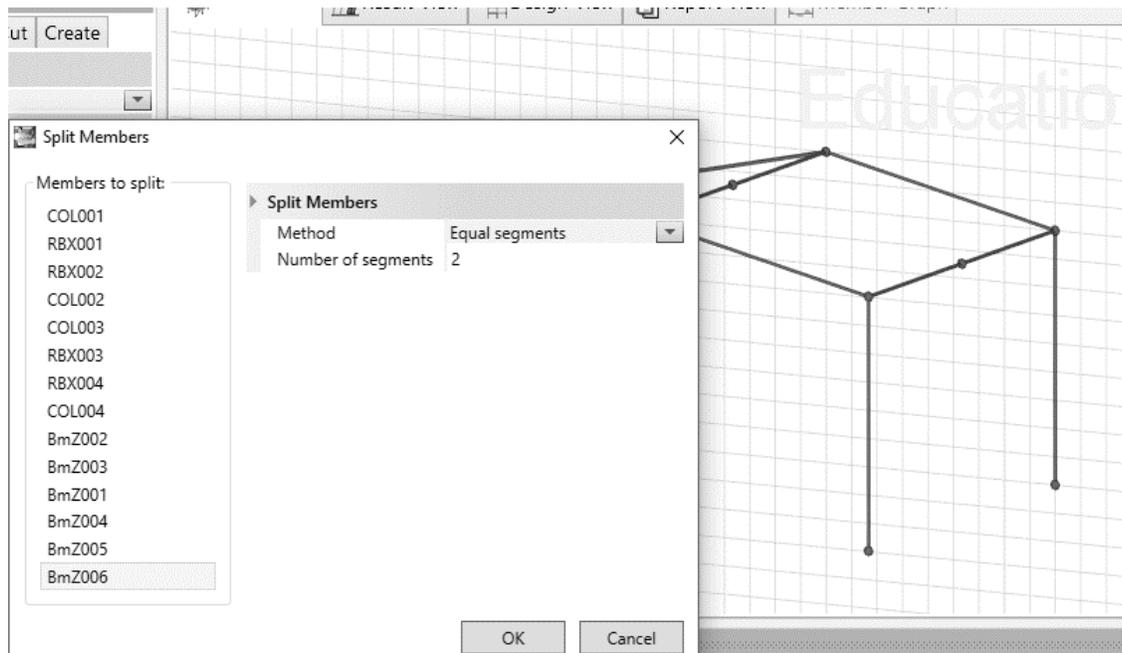
- There is detailed documentation and tutorials available in the Help menu of the software by choosing Table of Contents. Sketching in 2D is recommended, along with the ordering of beam ends
- It is helpful to move the grid. The cube can be used, or if you have a mouse with a wheel, you can use Ctrl with the wheel to rotate the grid.



- The Create Tab of the Project Manager shows other objects and systems that can be created. (Hovering over the menu gives instructions.)
- The other frame members can be drawn or a set can be selected, and the Generate Copies menu can be used to create a copy offset in one of the major axis directions.



- If you wish to have additional beams supported by the beams of your frame, choose the beam and use the Split Members menu from a left-click. This will make additional nodes, but keep the segments together. Or, alternatively, draw members where you would like them to be, and nodes will be generated if your grid is oriented to allow for it.



- To support a node, choose the node, and in the Modify tab of the Project Manager choose from the Support sub-item. There are four support types (no roller). A pinned support will fix all the displacements (DX, DY, DZ). A rigid support will fix the displacements and all rotations (RX, RY, RZ). The individual restraints can be chosen as well.
 - If a hinge connection needs to be included between members, you will need to change the member Connections Type to Simple-Rigid, or Rigid-Simple depending on where the nodes with the hinge is. Be careful to make just *one* member end at the hinge Simple.
 - Because a pin support will allow rotation out of plane, there must be rotation restriction out of plane. **At least one support needs to have RX fixed.**
13. If there is an area that has a uniformly distributed load (and load tracing is NOT required), plates and area loads can be defined in the Structure tab, with Model View using Draw Plates, **however they can only be analyzed in the full version of Visual Analysis**. Create a 3 sided or 4 sided plate by drawing the ends of one side of the plate and then choosing each corner. End the plate segment by double clicking.
- The plate must be split into a mesh to distribute the loading. Choose the plate, and select Split Plates from the Structure tab or the right-click menu. Using a finer mesh produces better results.
 - To specify the support conditions of the selected plate, use the Releases submenu under the Modify tab. To make a simple support, check the M boxes to
 - To load the plate, create an area and use the Apply Area Load menu, or use the Apply Plate load menu.

