



MEscope Application Note 34

Drawing Structure Models

NOTE: The commands in this App Note are available if a VT-620 package is authorized by your MEscope license. Check **Help | About** to verify authorization of this package.

Requirements for Animation

The following steps are required in order to display shapes in animation on a structure model,

1. Create a Structure Model

1. Draw the model in a Structure window
2. Or import a structure model

2. Import or Acquire Measurements

1. Import time or frequency data into a **Data Block**, or shape data into a **Shape Table**
2. Or acquire data directly from an acquisition front end using an **Acquisition** window

3. Link M#s to the Model

1. Execute **M# Links | Create M# Links** in the Structure window in which shapes will be displayed
2. Or execute **Animate | Create M# Links** in the Animation Source window (Data Block, Shape Table, or Acquisition) from which shapes will be displayed

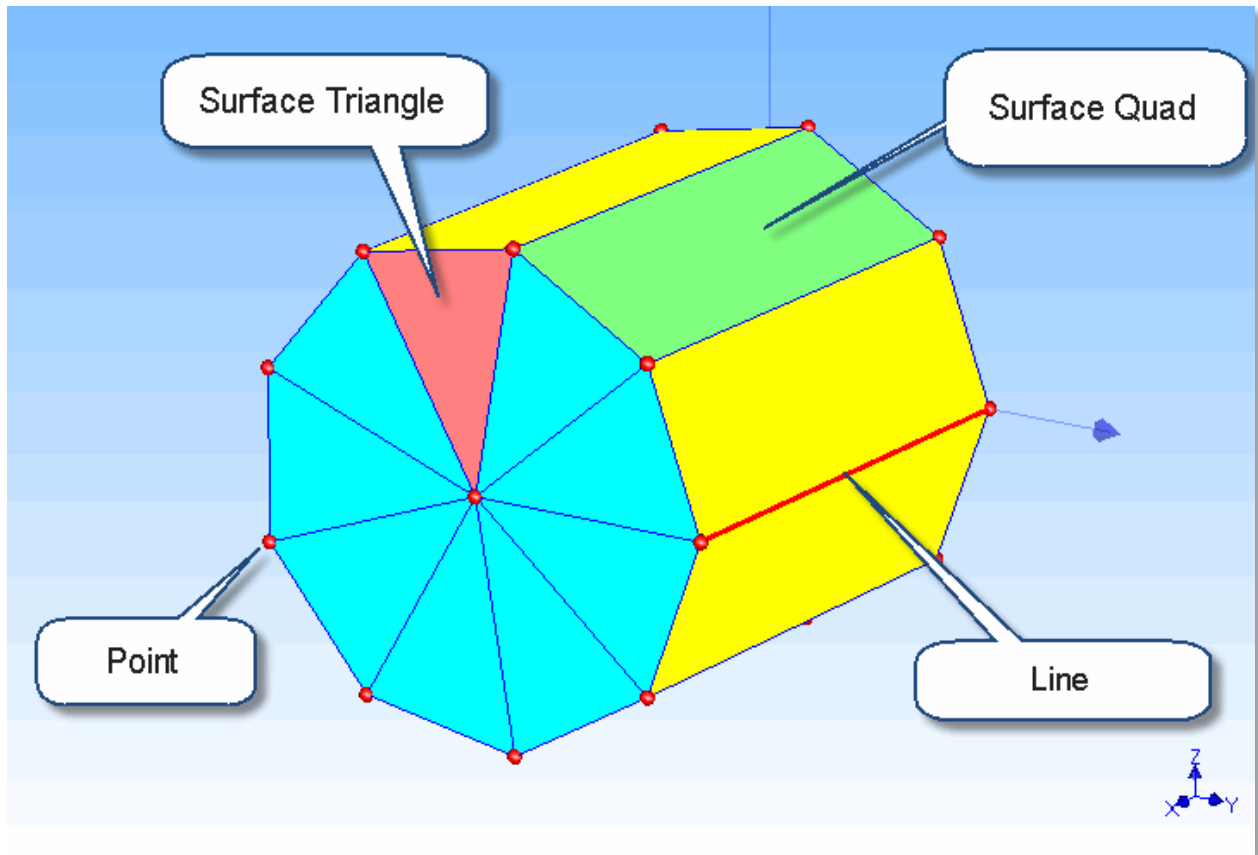
4. Start Animation

1. Execute **Draw | Animate Shapes** in the Structure window
2. Or execute **Animate | Animate Shapes** in the Animation Source window

Types of Drawing Objects

Structure models are created using the following Drawing Objects;

- **Points**
- **Lines** (Lines are defined between 2 Points)
- **Surfaces** (Triangles are defined between 3 Points, Surface Quads are defined between 4 Points.)
- **Substructures**
 - A Substructure is a group of Points, Lines & Surfaces
 - Substructures can be manipulated just like Points, Lines & Surfaces
 - Complex structure models are more easily created by creating several Substructures
 - **Multiple Substructures** can reference the **same Points, Lines & Surfaces**



Drawing Objects.

Point Coordinate Units

NOTE: Length units are *not required* in order to draw a structure model. However, units can be chosen at any time, even after the model has been created.

To select **Length** units for the Point coordinates in a Structure window;

1. Execute **File | Structure Options** in the Structure window.
2. On the **Units** tab, choose the desired **Length** units, and **click** on **OK**.

Types of Structure Models

All structure models are created with Points, Lines & Surfaces. Different types of structure models can be used for displaying shapes in animation.

Wire frame (or Stick) model

Wire frame or stick model contains **only Points & Lines**. This type of model can be created by adding Points to a Structure window and adding Lines between the Points.

Surface (or Solid) model

A surface model contains **Points & Surfaces**. Adding Lines is **optional**. Surface models are easily created by using the **Drawing Assistant** in a Structure window. With **lights shining on its surfaces**, a surface model is also called a **solid model**. A solid model is a **more realistic looking model** of the test structure.

Surface Texture model

A surface texture model contains **Points & Surfaces with Surface textures**. Adding Lines is **optional**. A surface texture model is also a **more realistic looking model** of the test structure.

NOTE: Surface texture models must be created using third party software, but can be imported into MEscape.

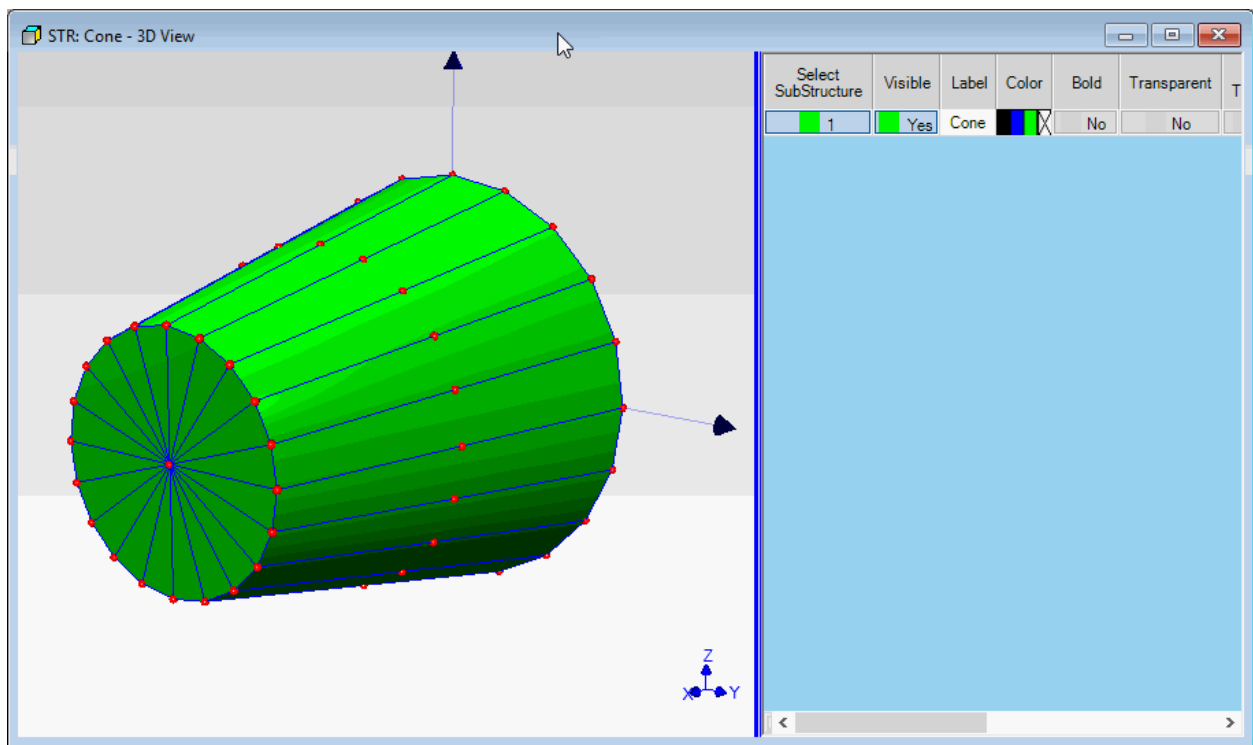
Photo-Realistic model

A photo-realistic model contains Points & Surfaces with digital photos attached to the surfaces. Adding Lines is **optional**. A photo-realistic model is the **most realistic looking model** of the test structure because it contains marking from the real structure which are captured in digital photographs of it.

NOTE: Photo-realistic models must be created using third party software, and can be imported into MEscape using the **WaveFront (.OBJ)** file format

Example 1. Creating a Cone Structure

In this example, the **cone** structure shown below will be created by starting with a **cylinder** Substructure in the **Drawing Assistant**.

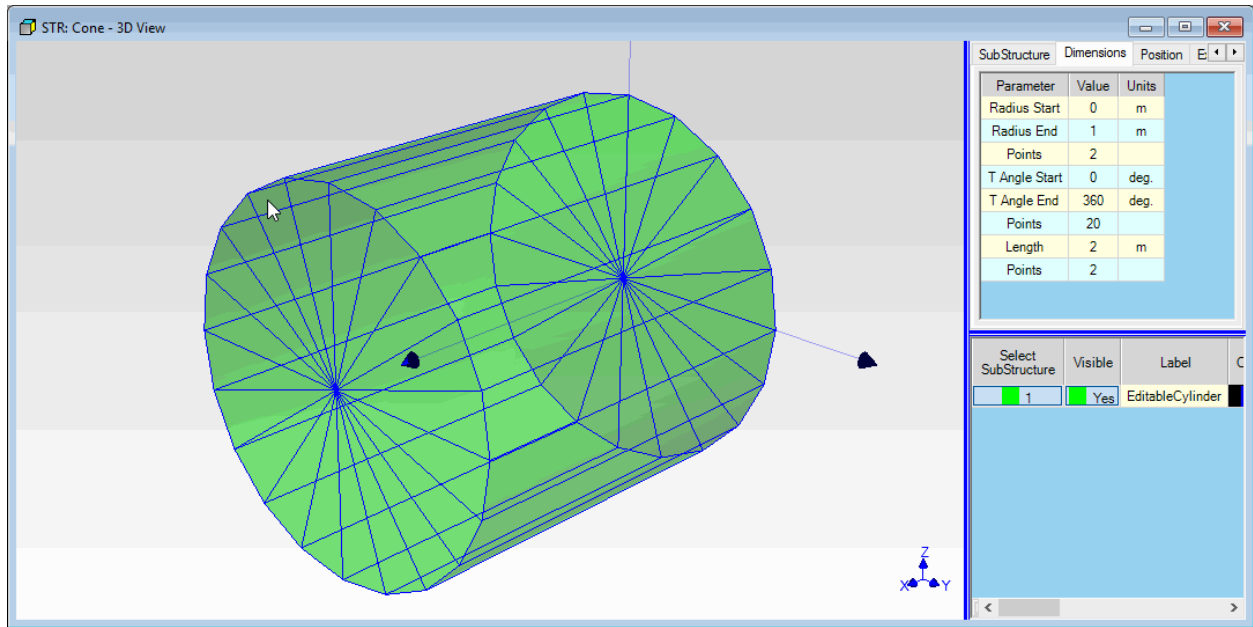


Cone Substructure.

- Execute **Project | New Project** to open a new Project file.
- Execute **File | New | Structure** in the MEscape window to open a new (empty) Structure window.
- Execute **Draw | Drawing Assistant**  in the Structure window.

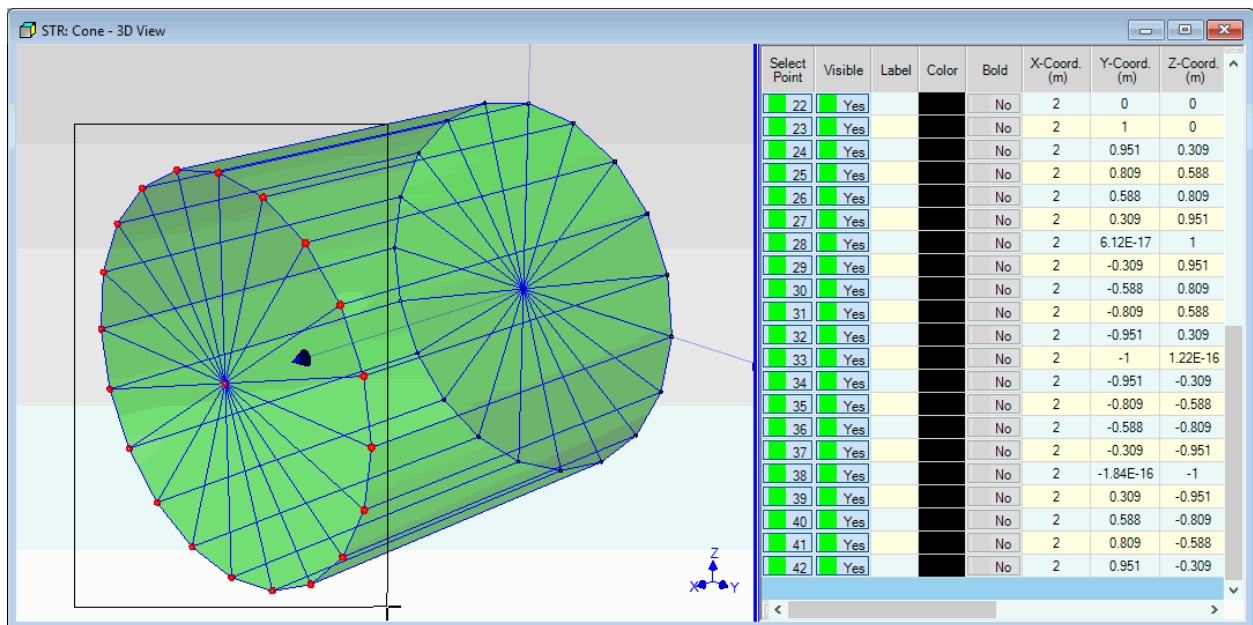
When the **Drawing Assistant** is **enabled**, its **Drawing Assistant tabs** are displayed above the **Substructures** spreadsheet on the **right side** of the window.

- On the **Substructure** tab, **double click** on the **Editable Cylinder** Substructure from the browser.
- On the **Dimensions** tab, enter **20 Points** into the spreadsheet as shown below.



Cylinder With 20 Points on Each End.

- Execute **Edit | Current Objects | Points** to close the **Drawing Assistant** and display the Points spreadsheet.
- Execute **Edit | Select Objects | Selection Box**.
- Draw a **Selection Box** to enclose the Points on one end of the cylinder, as shown below.



Points Selection Box.

- Execute **Edit | Resize Objects**.
- Move the mouse pointer into the graphics area.

Notice that the mouse cursor is changed to the **re-size** cursor.

- **Click & drag** the mouse cursor from the **upper right corner** toward the **lower left corner** of the graphics area.

Notice how the cylinder changes into a **cone**.

- If you make a mistake, execute **Edit | Undo** and repeat the above steps.

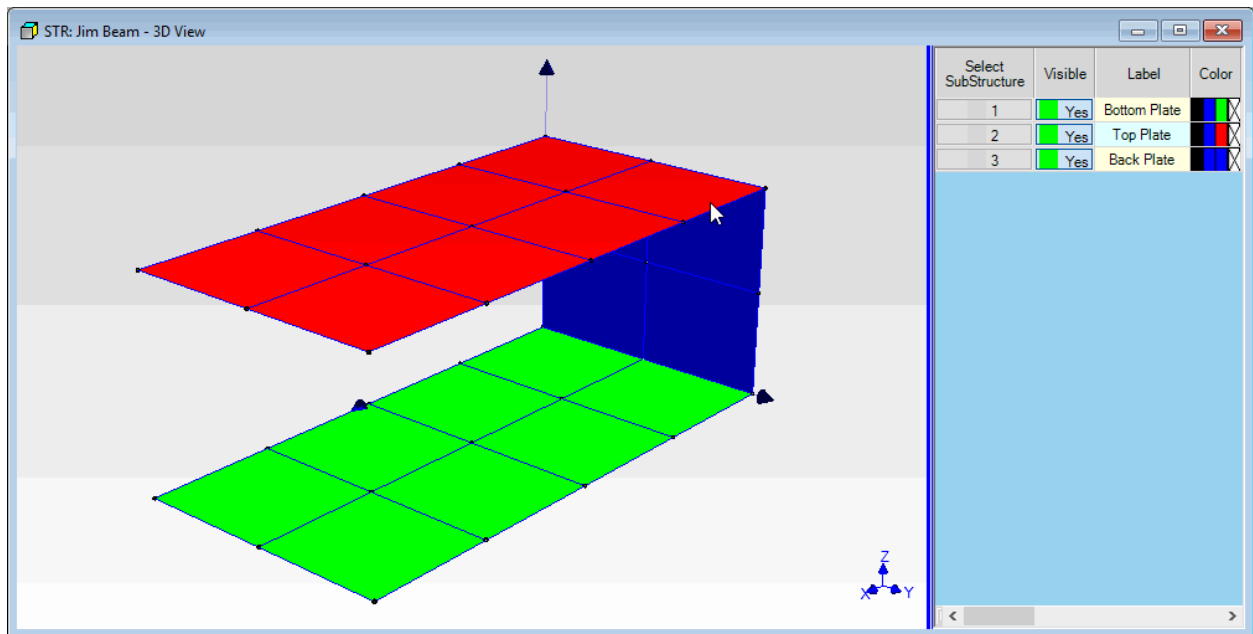
Meshing a Substructure

- Execute **Edit | Current Objects | Substructures** to display the Substructures spreadsheet.
- **Press** the **Select Substructures** button on the Substructures spreadsheet.
- Execute **Draw | Mesh Objects | Mesh Longest Edge**.

The **longest edges** of the Surfaces on the cone are now **divided** in **half**, as shown in the first cone picture above.

Example 2. Building the Jim Beam with Three Substructures

In this example, the Jim Beam structure shown below will be built with the **Drawing Assistant** using three Substructures. .



3-Plate Beam Structure.

- Execute **Project | New Project** to open a new Project file
- Execute **File | New | Structure** in the MEscape window to open a new (empty) Structure window
- Enter **"Jim Beam"** into the next dialog box to name the STR file.

Creating the Bottom Plate

- Execute **Draw | Drawing Assistant**  in the Structure window

When the Drawing Assistant is **enabled**, the **Drawing Assistant tabs** are displayed above the **Substructures** spreadsheet on the **right side** of the Structure window.

A Bottom Plate Substructure will be created as a grid of Points spaced **1 unit** apart, with **3 Points** in the **width** direction and **5 Points** in the **height** direction.

On the Substructure tab

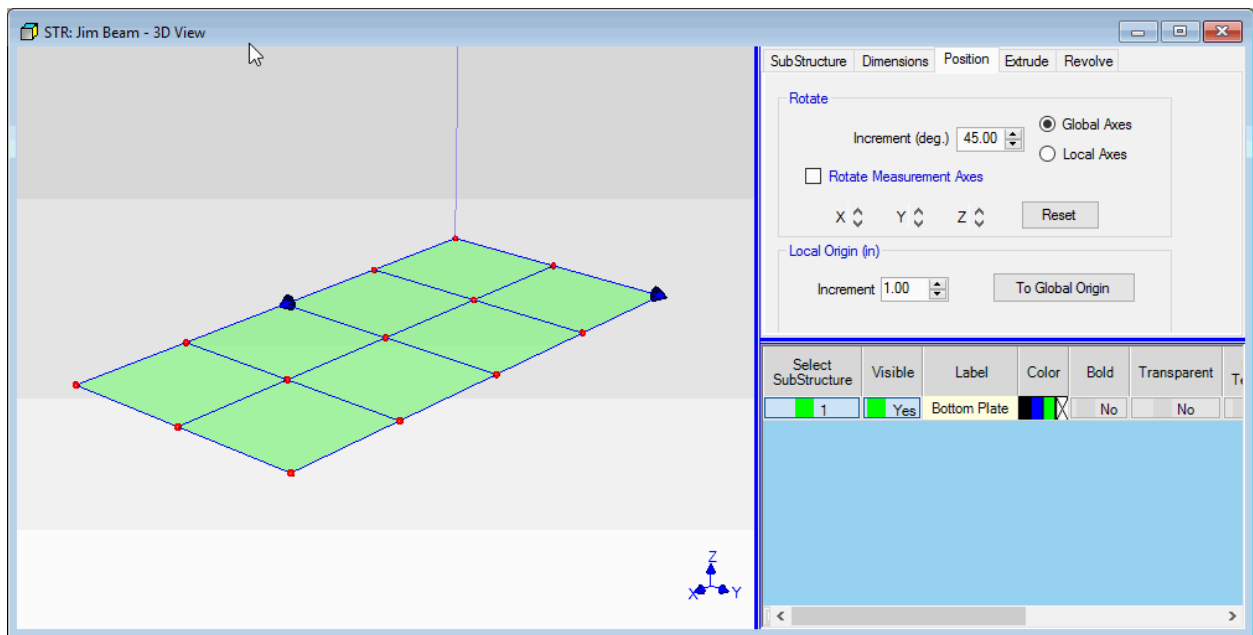
- **Double click** on the **Editable Plate** Substructure from the browser to add a vertical plate Substructure to the window.

On the Dimensions tab

- Enter **Width = 6** and **Points = 3** below it.
- Enter **Height = 12** and **Points = 5** below it.

On the Position tab

- In the **Rotate** area, enter **45** into the **Degrees** box.
- **Click** on the **Y Up Arrow** **twice** to rotate the plate into a horizontal position, as shown below.
- **Double click** on the **Label** column header in the Substructure spreadsheet (**lower right**), and enter "**Bottom Plate**" into the dialog box.



Drawing Assistant Showing the Bottom Plate.

Creating the Top Plate

The Top Plate will be created by making a **copy of the Bottom Plate**.

- Execute **Edit | Copy Objects to File**.

Since the **Bottom Plate** is still **selected** in the Substructures spreadsheet, it will be copied.

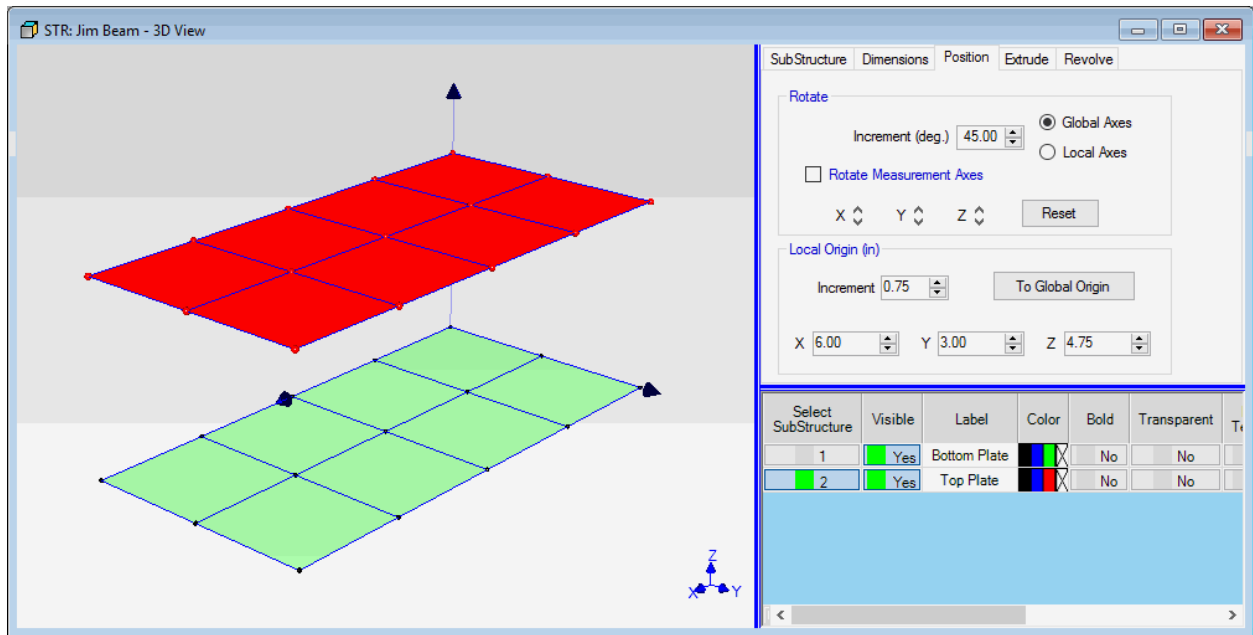
- Select **STR: Jim Beam** in the dialog box that opens, and **press** the **Add To** button.

Notice that there are now **two Substructures** named "**Bottom Plate**" in the Substructures spreadsheet.

- **Select** only the **second** Substructure in the Substructures spreadsheet
- Make sure the Increment is set to "**1**", and **click** on the **Z Up Arrow** **4 times** in the **Local Origin** area on the **Position** tab.
- Enter **0.75** into the **Increment** box, and **click** on the **Z Up Arrow** **one more** time.

The top Plate should now be **4.75 units above the Bottom Plate**.

- **Double click** on the **Label** column header in the **Substructure** spreadsheet, and enter "**Top Plate**" into the dialog box.
- **Double click** on the **Color** column header, and select **Red** as the **Surface** color.



Drawing Assistant Showing Top and Bottom Plates.

Creating the Back Plate

The Back Plate Substructure will be created as a grid of Points spaced **1 unit** apart, with **3 Points** in the **width** direction and **3 Points** in the **height** direction.

On the Substructure tab

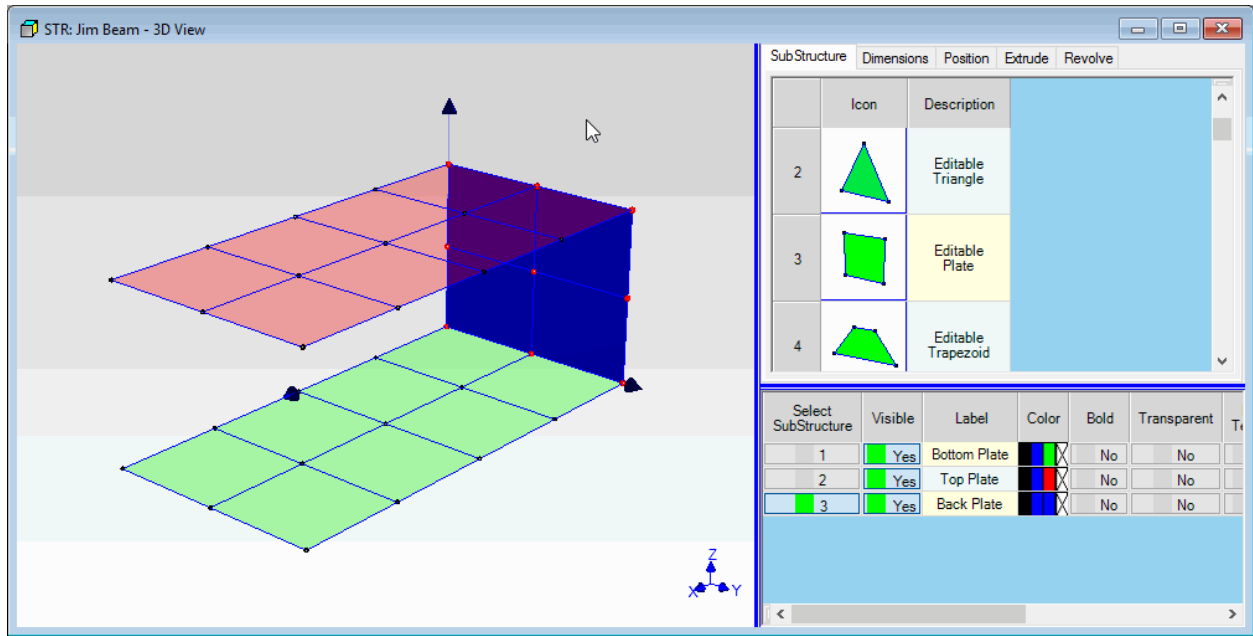
- **Double click** on the **Editable Plate** Substructure again to add another plate to the drawing.

On the Dimensions tab

- Enter **Width = 6** and **Points = 3** below it.
- Enter **Height = 4.75** and **Points = 3** below it.

In the Substructure spreadsheet

- **Double click** on the **Label** column header, and enter "**Back Plate**" into the dialog box.
- **Double click** on the **Color** column header, and select **Blue** as the **Surface** color.



Drawing Assistant Showing Three Plates

Four Views of the Model

It is often easier to create a 3D model by working in one of its **2D Views**, and then switching to another one of its 2D Views. This is done by **double clicking** in a View.

- The structure has four different Views of a structure model; **X-View**, **Y-View**, **Z-View**, and **3D View**,

The structure model can be displayed in **one** of the 2D Views, or **all four** Views together in what is called the Quad View.

- Double click** anywhere on a Single View to display the Quad View.
- Double click** anywhere on one of the Views in the Quad View to display only that View.

Active View

NOTE: One of the four Views is always **active** in the Structure window.

- The **active** View is indicated by the **yellow box** in the **Display | View** list .

If the **upper right** quadrant is **yellow**, the **3D View** is **active**.

- Click** anywhere on a View to make it **active**.

Zoom & Pan

To **Zoom** the structure model in a View,

- Click** in the View to make it **active**, and **spin** the **mouse wheel**

To **Pan** the structure model in a View,

- Hold down** the **Shift** key, and **click & drag** the mouse in the View

To **Re-center** the structure model in a View,

- Click** in the View to make it **active**, and execute **Display | mooZ**

NOTE: The **Display | View Control** command can also be used to Zoom & Pan the **active** View.

Example 3. Creating a Plate with Points, Lines & Surfaces

In this example, the plate model shown below will be created using **four** Points, **four** Lines, and **two** Surface Triangles.

- Execute **Project | New Project** to open a new Project file.
- Execute **File | New | Structure** in the MEscape window to open a new (empty) Structure window.

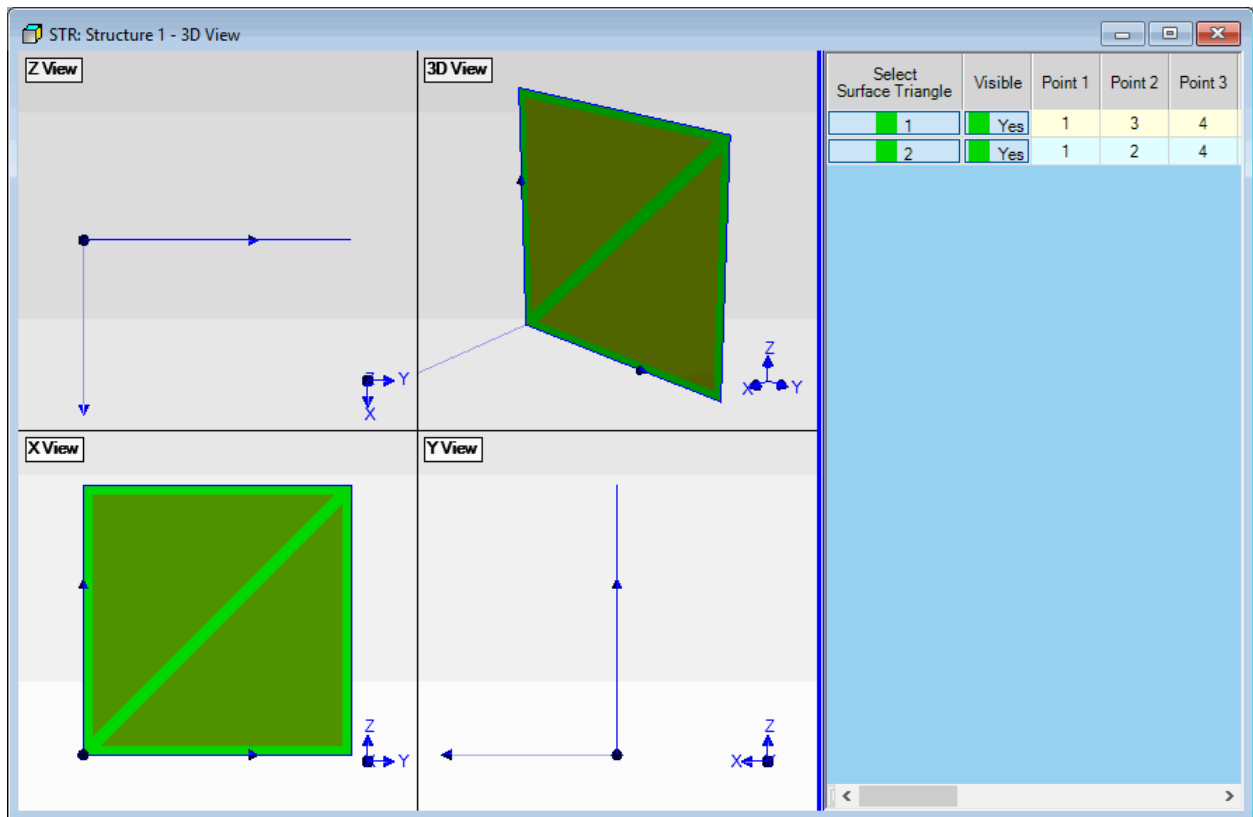


Plate Model with 4 Points, 4 Lines, and 2 Surface Triangles.

Global Axis Lines

- Execute **File | Structure Options** to open the Options box
- On the **Labels** tab, **check** the **Axis Lines**, **XYZ Axes** and **View** boxes, and **click** on **OK**

Larger Point Size

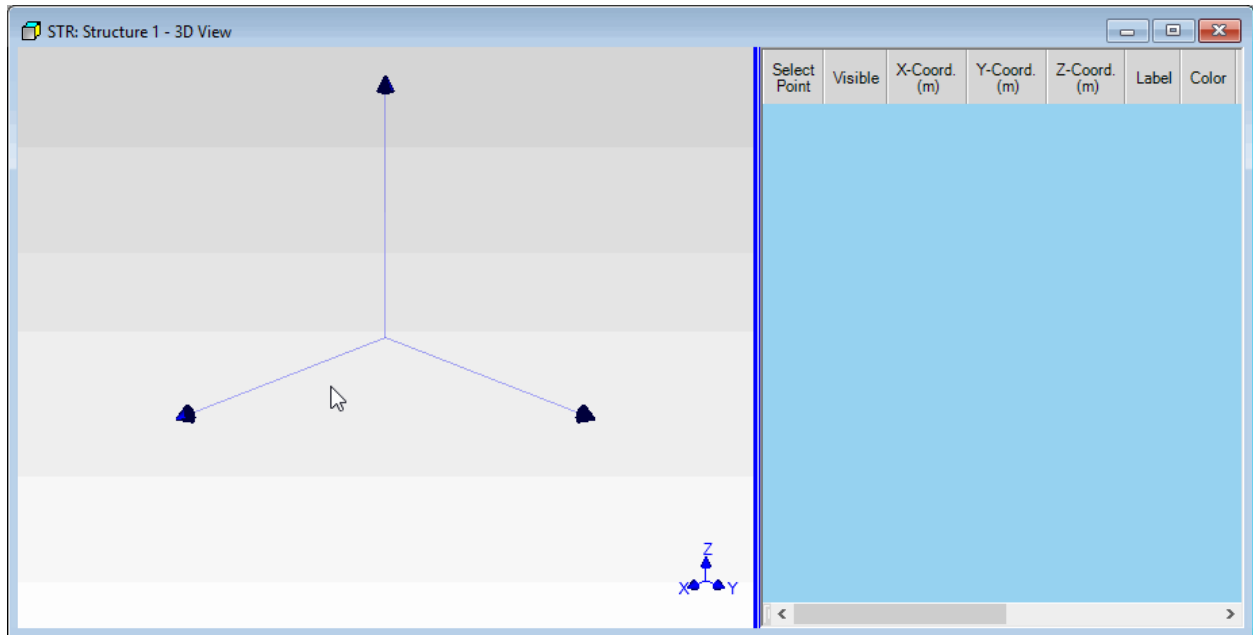
- Execute **Edit | Current Objects | Points** to display the Points spreadsheet
- **Double click** on the **Point Size** column heading, enter **5** into the dialog box, and **click** on **OK**

Re-Arranging Spreadsheet Columns

The Points spreadsheet columns can be **re-arranged** so that it is easier to work with the Point Coordinates.

- Execute **Edit | Current Objects | Points** to display the (empty) Points spreadsheet
- **Click & drag** the **X-Coord** column heading in the Points spreadsheet to position it next to the **Visible** column, as shown below

- **Click & drag** the **Y-Coord** column heading, then the **Z-Coord** column heading into position, as shown below



Structure Window Ready for Adding Points.

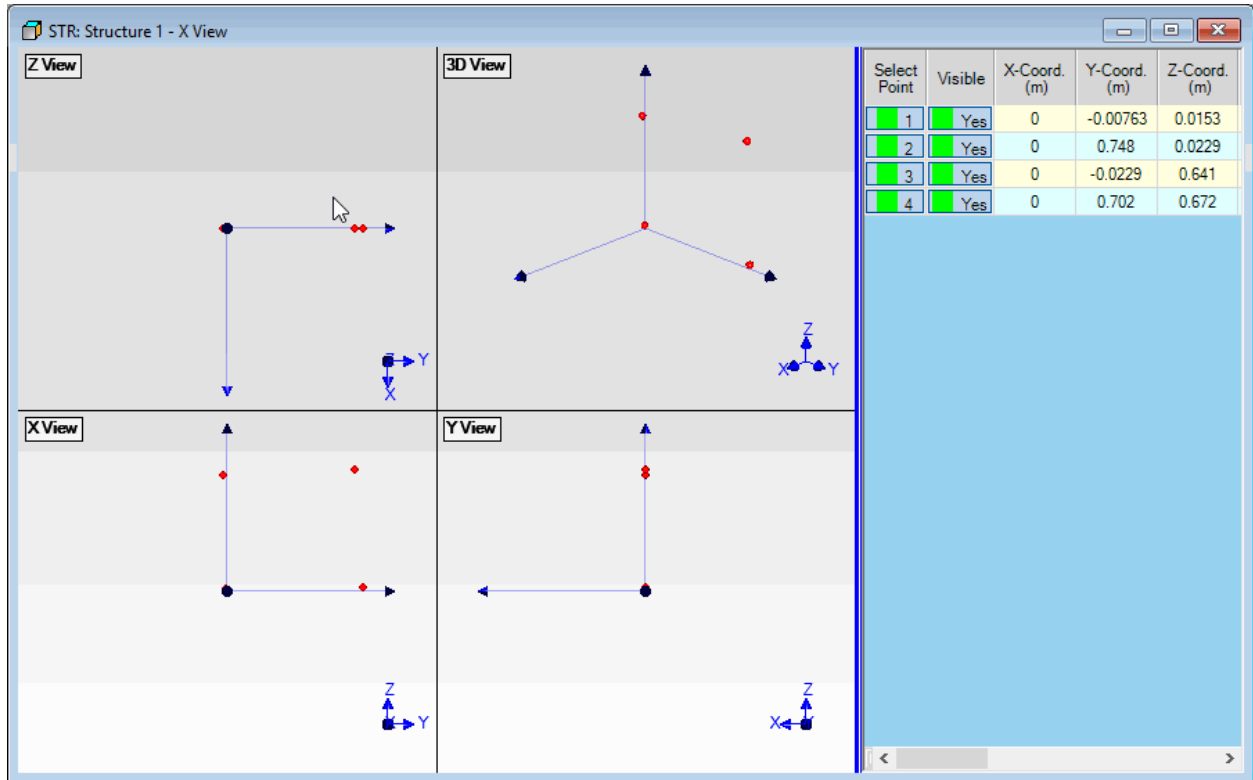
Adding Points

- **Double click** in the 3D View to display the **Quad View**
- Choose **Points**  in the **Edit | Current Objects** list
- Execute **Edit | Add Objects**  to **enable** the **Add Points** operation
- **Move** the mouse pointer into the **X View**, and **click** to add the first corner Point near the origin, as shown below

When a new Point is added to the drawing, it is displayed as a **selected** Point in all Views, and a **new row** is added to the Points spreadsheet on the right of the **vertical blue splitter bar**.

WARNING: When the **Add Points operation** is enabled, each time you **click** on a View, a new Point will be added to the model.

- **Move** the mouse pointer to the next **approximate** corner of the square, and **click** to add the next corner Point
- Add the last two corner Points of the square to form an **approximate square**, as shown below
- Execute **Edit | Add Objects**  **again** to **terminate** the **Add Points** operation



Structure Window Showing Four Corner Points.

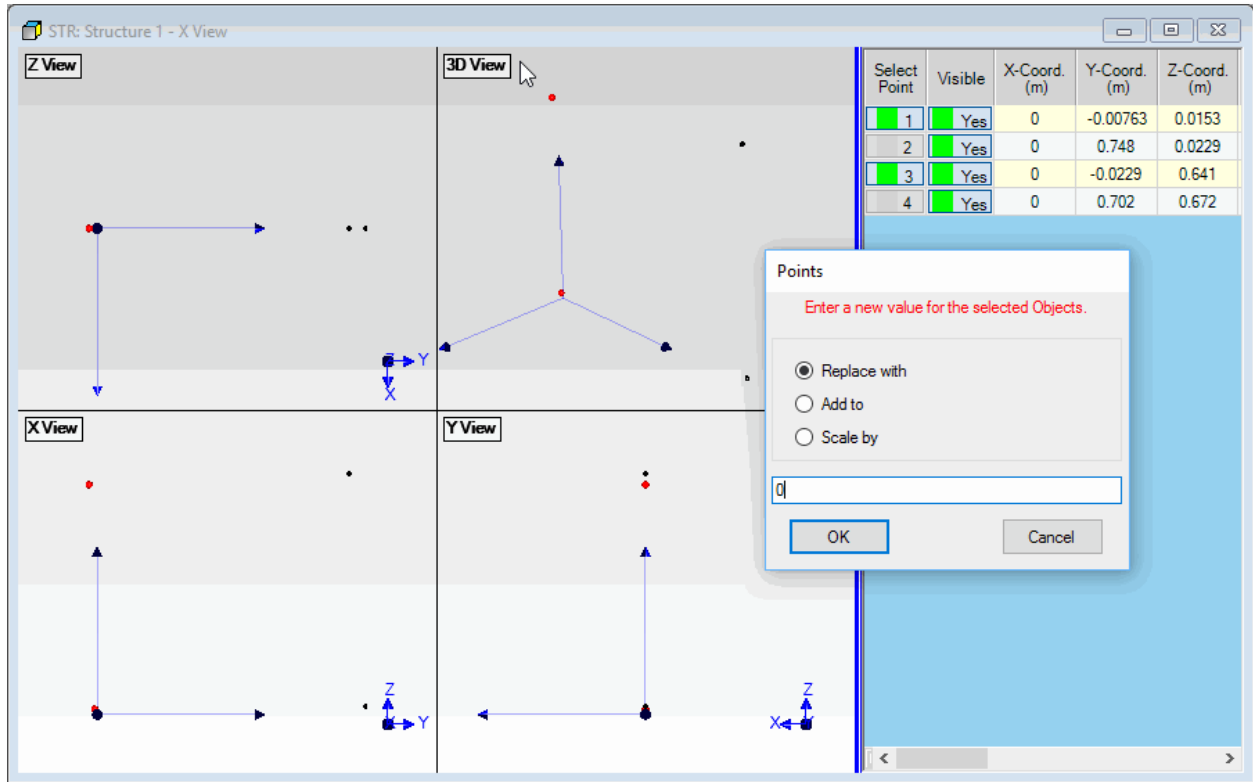
Editing Point Coordinates

The coordinates of the four previously added corner Points can be edited so that they form a **perfect square**. The coordinates of **multiple Points** can be changed by first **selecting** them and then editing their global X, Y, or Z coordinates.

- **Double click** on the **X View** to display it alone

To align the **two** Points on the **left side** of the square,

- **Double click** on the **Select Points** column heading to **Un-select** all Points
- **Hold down** the **Ctrl** key, and **click near** the **upper left** corner Point to **select** it, then **click near** the **lower left** corner Point to **select** it, as shown below
- **Double click** on the **Y-Coord** column heading in the Points spreadsheet to open the **Y-Coord** editing box
- Enter **"0"** into the dialog box, and **click** on **OK**



Y-Coordinate Editing Box.

To align the **two** Points on the **right side** of the square,

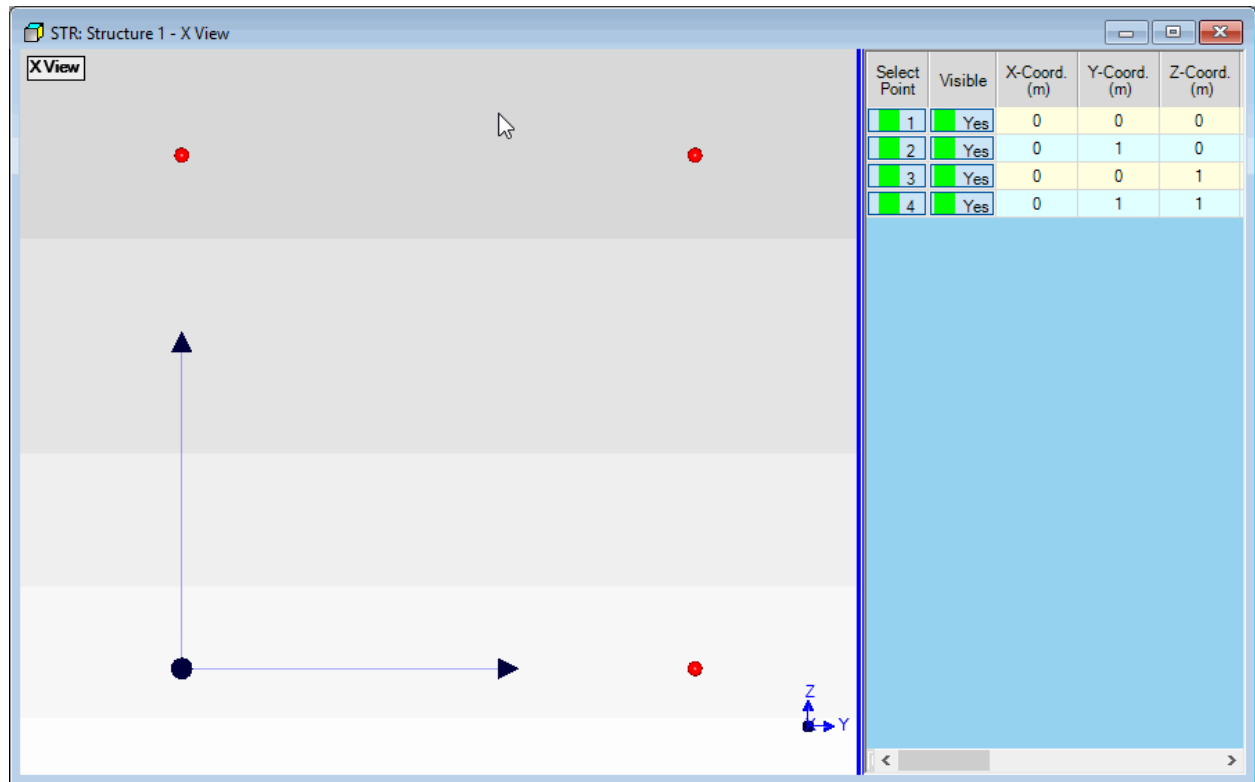
- **Un-select** all Points
- **Hold down** the **Ctrl** key, and **click near** the **upper right** corner Point to **select** it, then click near the **lower right** corner Point to **select** it
- **Double click** on the **Y-Coord** column heading to open the **Y-Coord** column editing box
- Enter a "**1**" into the dialog box, and **click** on **OK**

To align the **two** Points on the **bottom** of the square,

- **Un-select** all Points.
- **Hold down** the **Ctrl** key, and **click near** the **lower left** corner point to **select** it, then **click near** the **lower right** corner Point to **select** it.
- **Double click** on the **Z-Coord** column heading in the Points spreadsheet to open the **Z-Coord** column editing box.
- Enter a "**0**" into the dialog box, and **click** on **OK**.

Finally, to align the **two** Points on the **top** of the square,

- **Un-select** all Points.
- **Hold down** the **Ctrl** key, and **click near** the **upper left** corner Point to **select** it, then **click near** the **upper right** corner Points to **select** it.
- **Double click** on the **Z-Coord** column heading in the Points spreadsheet to open the **Z-Coord** column editing box.
- Enter a "**1**" into the dialog box, and **click** on **OK**.
- Execute **Display | Re-Center All Views** to make the model visible in all Views.



Four Points Aligned in a Square.

Adding Lines to the Model

Each Line is defined **between 2 Points**. Adding Lines between Points turns the drawing into a **stick model**

- Choose **Lines**  in the **Edit | Current Objects** list to display the Lines spreadsheet
- Execute **Edit | Add Objects**  to **enable** the **Add Lines** operation
- **Click near** a corner Point to **select** it
- **Click near** an **adjacent** corner Point to **select** it

Notice that after you **selected** the **second** Point, a **new selected** Line was added between the two Points on the drawing, and a **new row** was added to the Lines spreadsheet.

WARNING: When the **Add Lines** operation is **enabled**, a **new** Line will be added to the model each time you **click near two different** Points in succession.

- Repeat the above steps to add the other three Lines needed to define the square, as shown below.
- Execute **Edit | Add Objects** again to **terminate** the **Add Lines** operation.

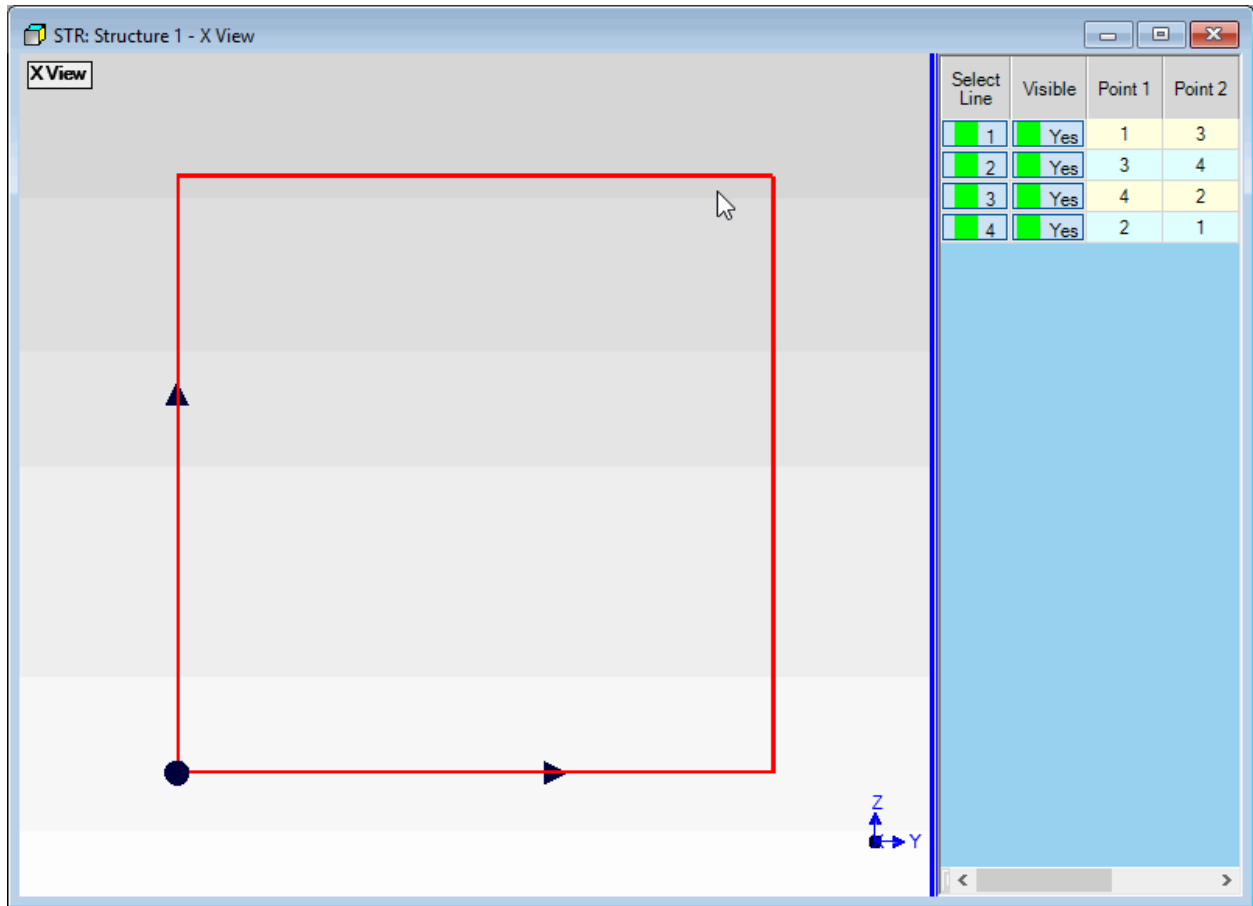


Plate After Adding Four Lines.

Adding Surfaces to the Model

A Surface Triangle is defined **between 3 Points**.

NOTE: Surfaces are required in order to display shape **Contour Colors** and **Node Lines** during animation.

- Choose **Surface Triangles**  in the **Edit | Current Objects** List to display the Surface Triangles spreadsheet
- Execute **Edit | Add Objects**  to **enable** the **Add Surfaces** operation
- **Click near** a corner Point to **select** it
- **Click near** an adjacent corner Point to **select** it
- **Click near** another corner Point to **select** it

After you have **selected** three Points, a new **selected** Surface Triangle is displayed between the Points, and a **new row** is added to the Surface Triangles spreadsheet on the right of the **vertical blue splitter bar**.

WARNING: When the **Add Surfaces** operation is **enabled**, a **new Surface Triangle** will be added to the model each time you **click near three different** Points in succession.

- Repeat the above steps to add the second Surface Triangle that defines the other half of the surface, as shown below
- Execute **Edit | Add Objects** again to **terminate** the **Add Surfaces** operation

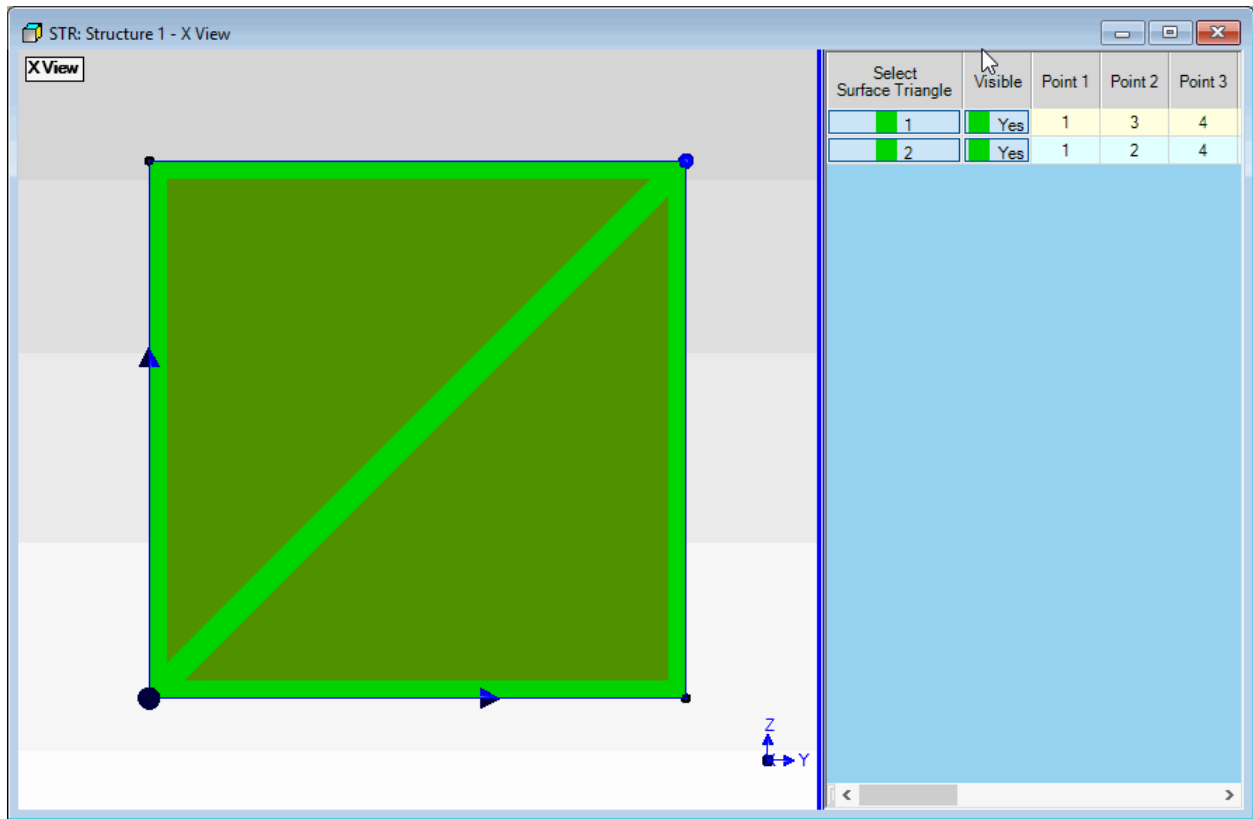


Plate With 2 Surface Triangles.

Creating a Substructure

The square plate model (consisting of **4 Points**, **4 Lines**, and **2 Surface Triangles**) can be defined as a Substructure.

NOTE: Substructures **only reference** drawing Objects. Objects referenced by Substructures still exist as **unique** Objects in the Structure file. Multiple Substructures can reference the **same** Objects.

- Choose **Points**  in the **Edit | Current Objects** List to display the Points spreadsheet
- Execute **Edit | Select Objects | Select All**  to **select** all Points
- Execute **Draw | Substructures | Add Objects to Substructure**
- **Press** the **New Substructure** button in the dialog box that opens, and **click** on **OK** to create a new Substructure

The **selected** Points, (plus the Lines & Surfaces that reference the Points), are now **referenced** by the new Substructure

Notice also that Substructures  is chosen from the **Edit | Current Objects** List, and that the Substructure spreadsheet contains the new Substructure.

Substructure Library

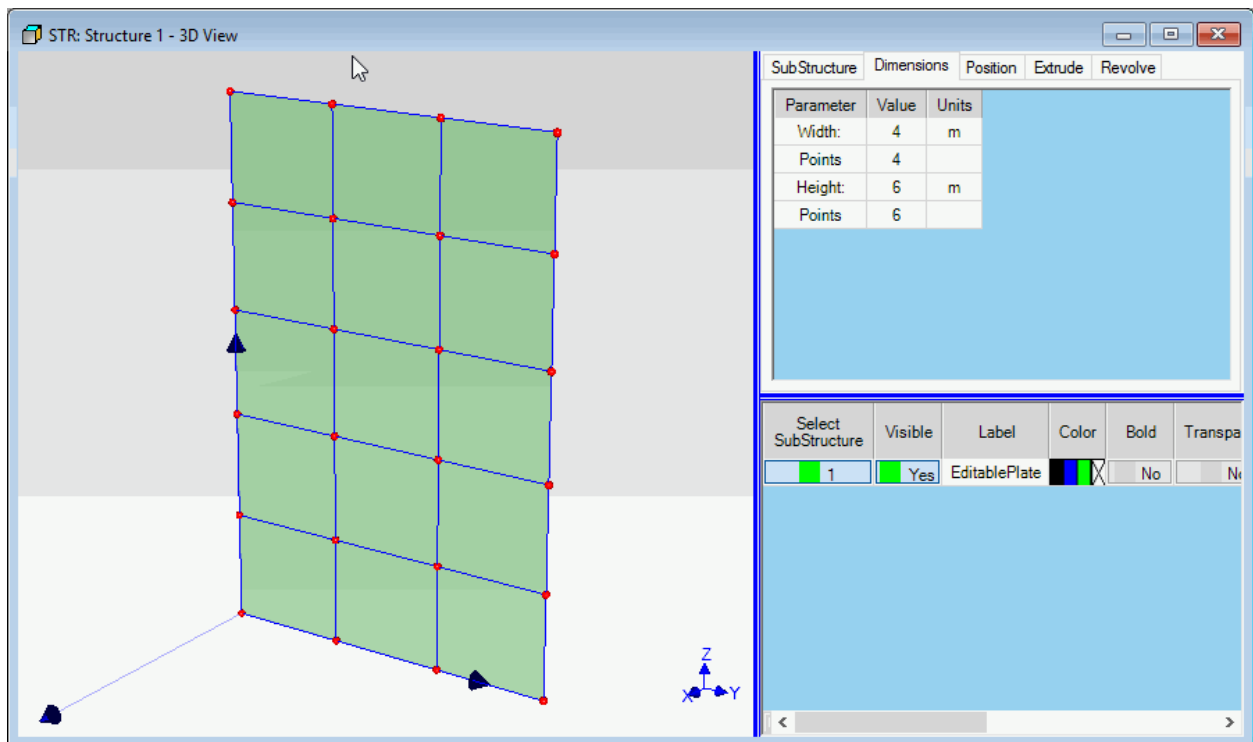
Any model in a Structure window can be added to the **Substructure Library** and used for building other models. All of the Substructures in the Substructure Library are displayed in the **Substructure** browser when the **Drawing Assistant** tabs are displayed.

- Execute **File | Save In Substructure Library** to add the square plate Structure to the Substructure Library

Example 4. Extruding a 2D Substructure

Many 3D models can be built by **extruding** or **revolving** a 2D profile or cross section of a structure. In this example, a 2D **cross section** of an **I-beam** will be extruded to create a **3D I-beam** model.

- Execute **Project | New Project** to open a new Project file
- Execute **File | New | Structure** in the MEscape window to open a new (empty) Structure window
- Execute **Draw | Drawing Assistant**  in the Structure window to display the Drawing Assistant tabs
- On the **Substructure** tab,
 - **Double click** on the **Editable Plate** Substructure from the browser
 - A vertical plate Substructure will be displayed, as shown below
- On the **Dimensions** tab,
 - Enter **Width = 4** and **Points = 4** below it
 - Enter **Height = 6** and **Points = 6** below it



Editable Plate Substructure.

- Choose **Points**  in the **Edit | Current Objects** list

- Execute **Edit | Select Objects | Select None**  to **un-select** all Points
- **Hold down** the **Ctrl** key, and **click near** the two mid-Points on **each side** to **select** them, as shown below
- Execute **Edit | Delete Objects** to delete the **selected** Points

A dialog will open asking if you want to also delete the other Objects referencing the Points.

- **Click** on **Yes** to also **delete** the Lines & Surfaces connected to the **selected** Points

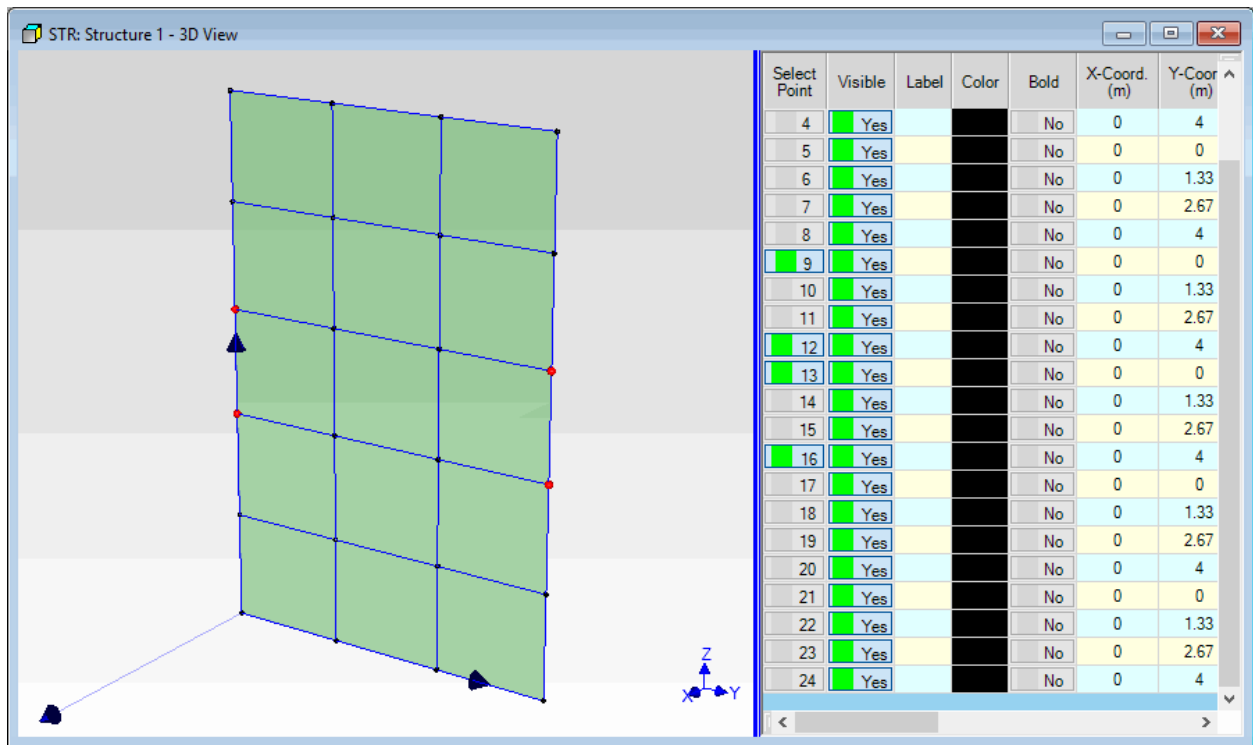


Plate Substructure Showing Selected Points to be Deleted.

The (vertical) web of the beam will be **narrowed** so that it is **0.5 length units** wide.

- Execute **Draw | Drawing Assistant**  in the Structure window to re-open the Drawing Assistant tabs
- On the **Position** tab, **click** on the **To Global Origin** button to center the Substructure about the Global origin
- Choose **Points**  in the **Edit | Current Objects** list
- Execute **Edit | Select Objects | Selection Box**  and draw a selection box around the Points on the **left side** on the web, as shown below.
- **Double click** on the **Y-Yoord** column heading in the Points spreadsheet.
 - Enter **"-0.25"** into the dialog box that opens, and **click** on **OK**
- Repeat the steps above, but this time **select** the Points on the **right side** of the web, and change their **Y-Yoord** to **"0.25"**.

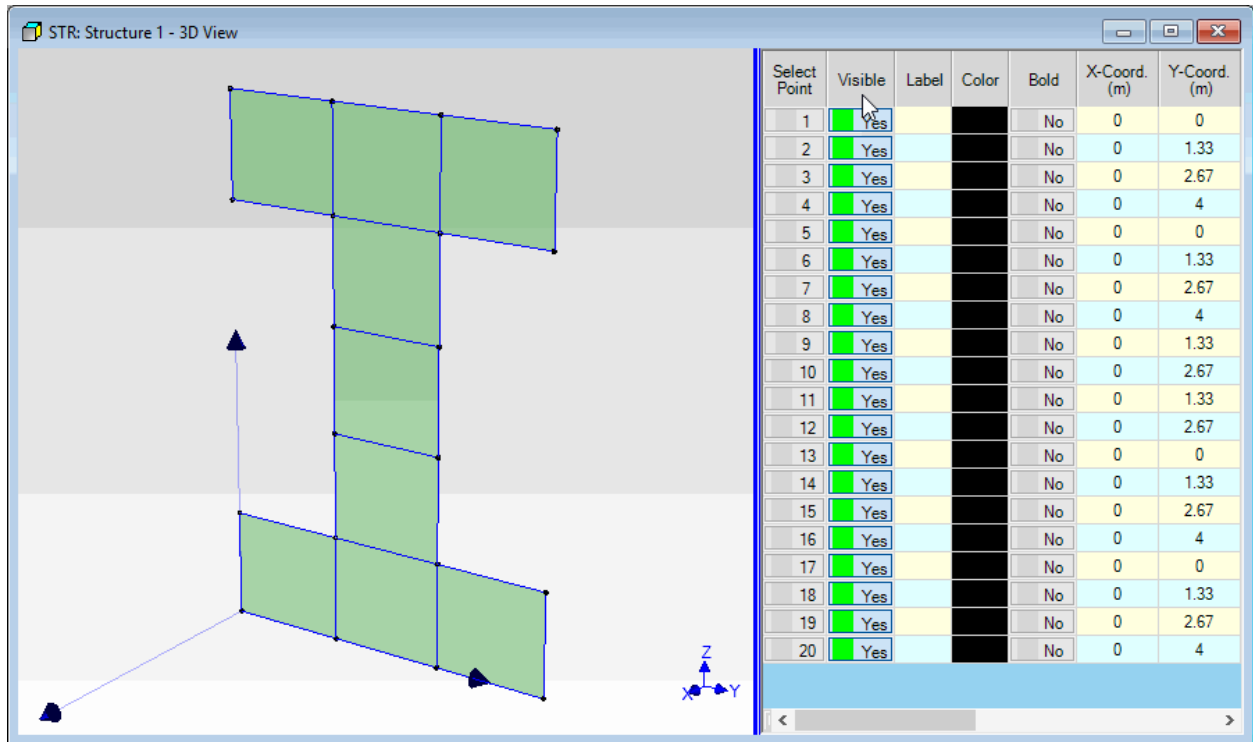


Plate Substructure With Deleted Points, Lines, and Surfaces.

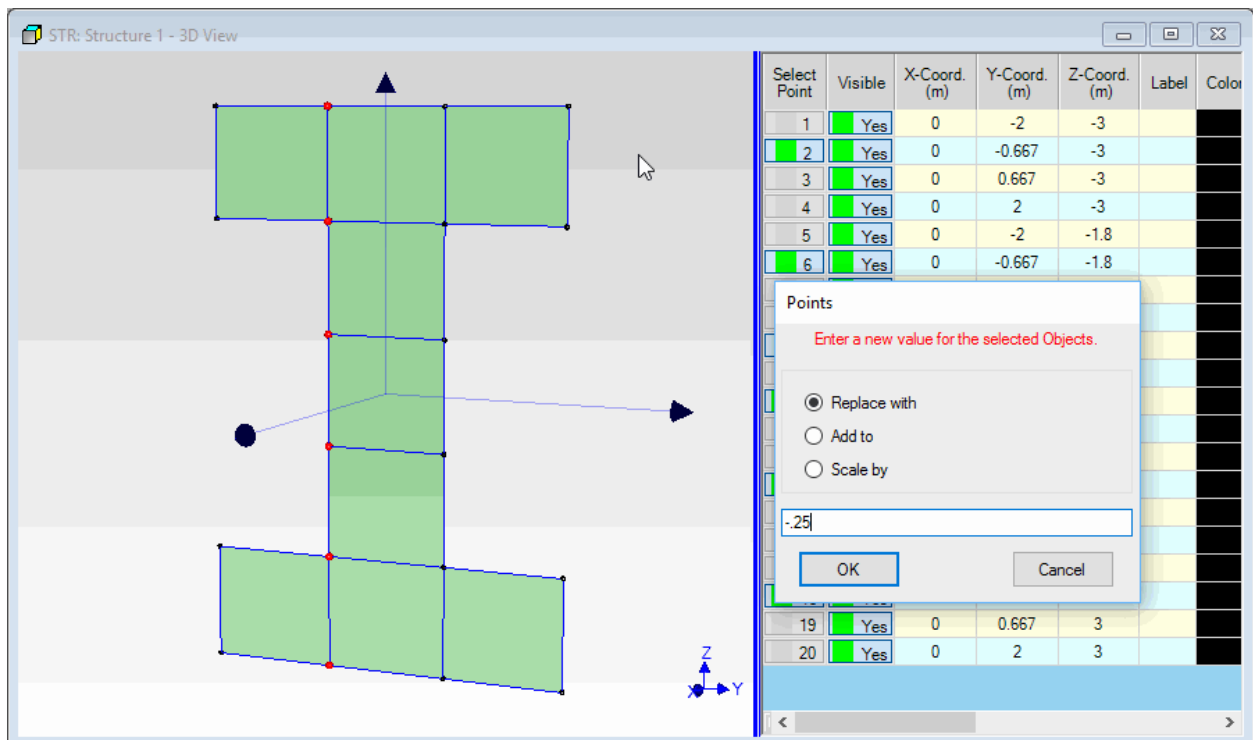


Plate Substructure Showing Selected Points on the Web.

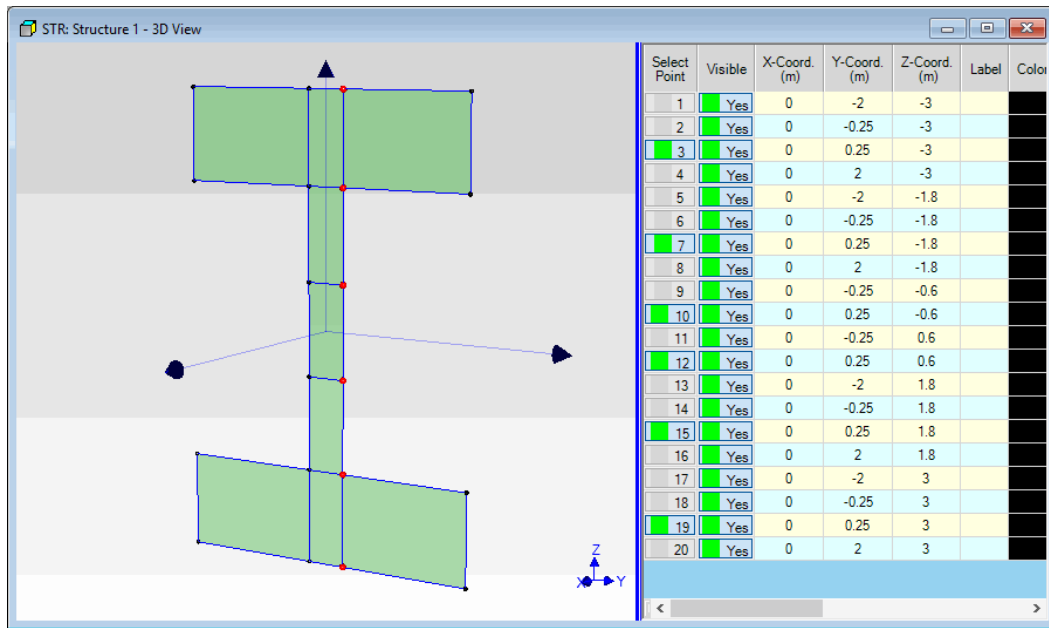
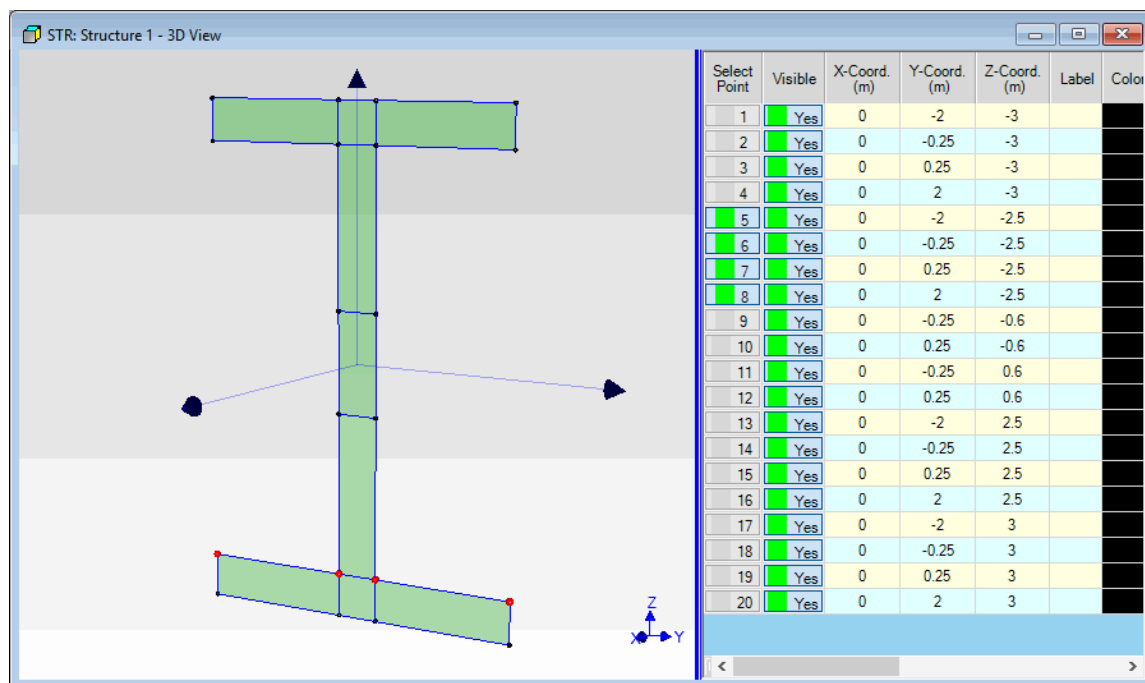


Plate Substructure Showing 0.5 Units Wide Web.

The Structure should look like the one shown in the figure above. Next, the top & bottom (horizontal) flanges will also be narrowed to **0.5 length units**.

- Select the **bottom row** of Points on the **top flange**, and change their **Z-Coord** to "**2.5**".
- Select the **top row** of Points on the **bottom flange**, and change their **Z-Coord** to "**-2.5**".

The cross section should now look like the one shown below.

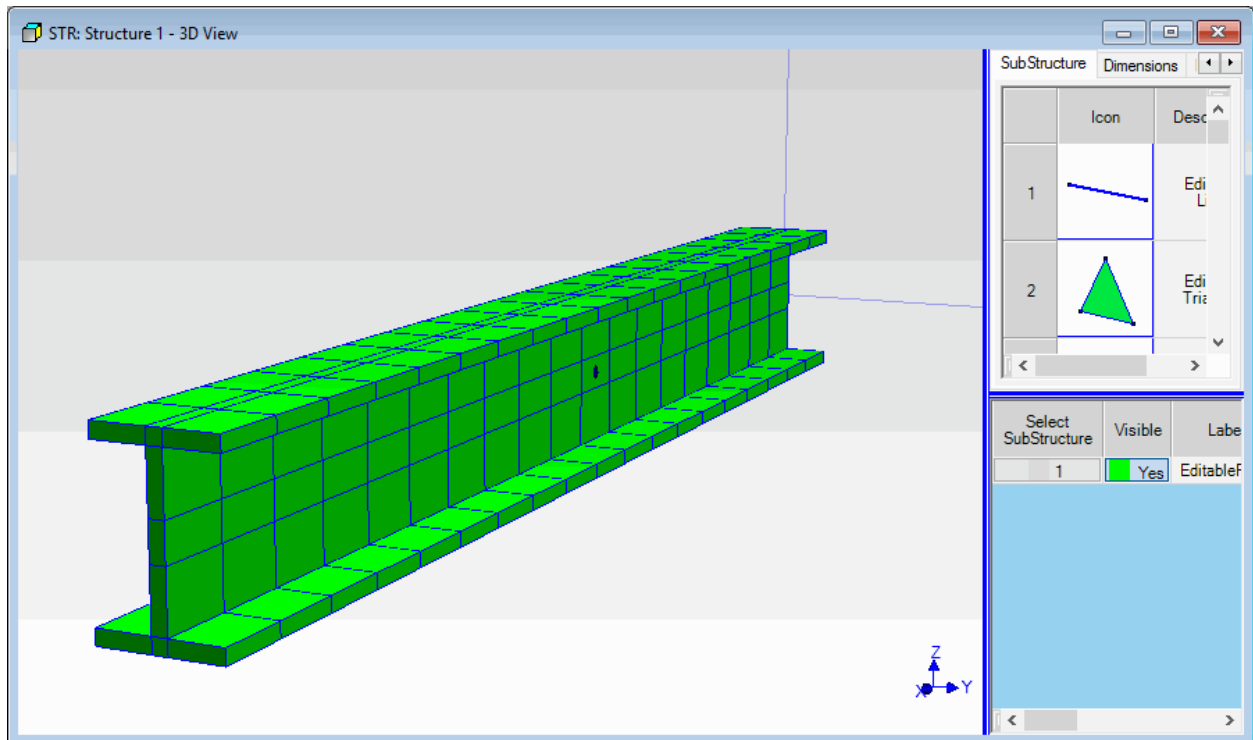


Substructure Showing Narrow Web and Flanges.

Plate

Extruding the Cross Section

- Execute **Draw | Drawing Assistant**  to display the Drawing Assistant tabs again
- **Select** the **Editable Plate** Substructure
- On the **Extrude** tab,
 - Select **X** in the **Extrude Axis** section
 - Enter **Length = 50**, and **Points = 20**
 - **Click** on the **Extrude** button to create the **I-beam**, as shown below



I-Beam Substructure.

Example 5. Tracing a Profile from a Photograph

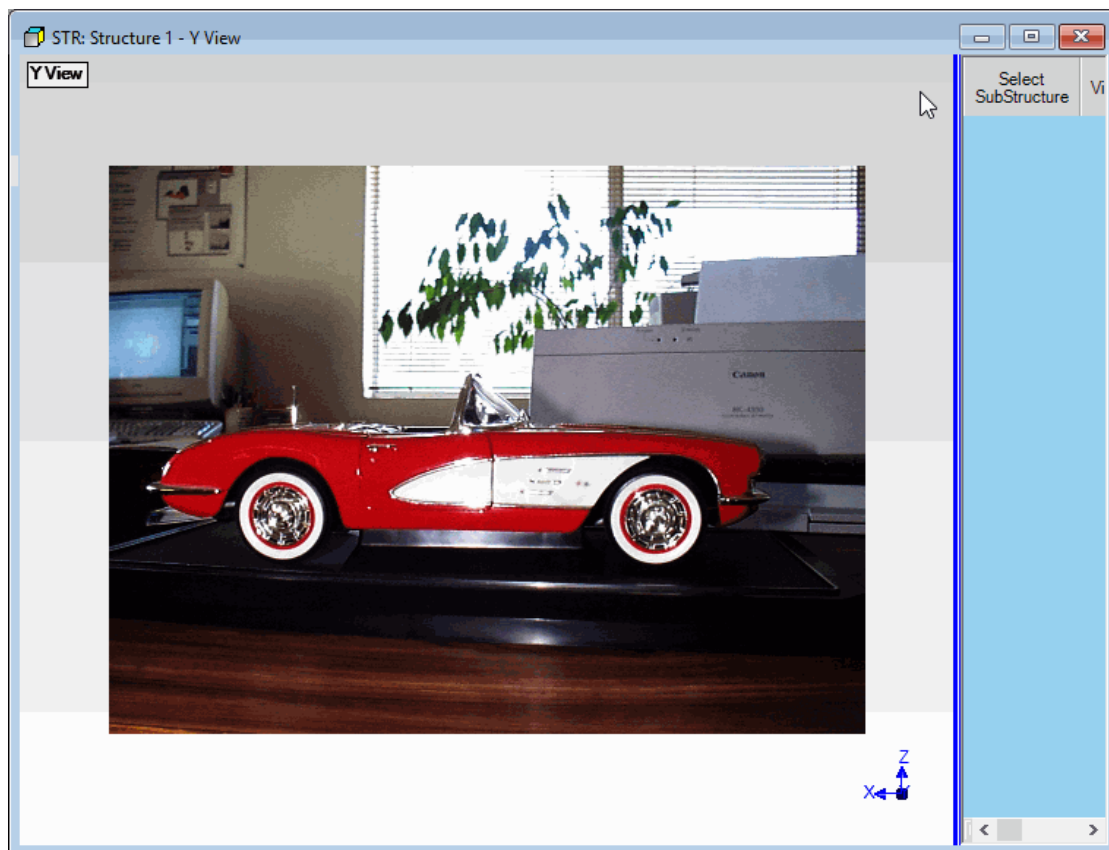
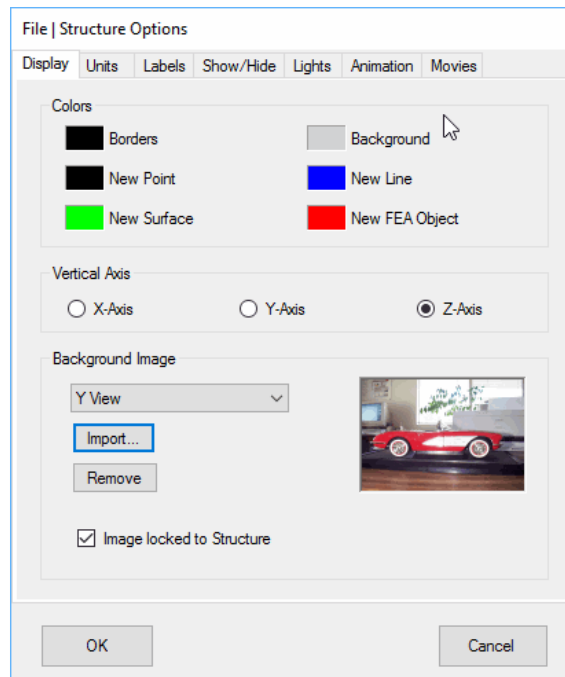
A 2D profile can be **traced** from a digital photograph by placing the photograph in the background of one of the 2D Views in the Structure window. In this example, the profile of a car will be created by tracing it from a side view photograph of the car. Following that, wheels will be added to the profile using the Drawing Assistant.

- Execute **Project | New Project** and create a new Project file
- Execute **File | New | Structure** in the MEScope window to open a new (empty) Structure window
- Execute **File | Structure Options** in the Structure window to open the Structure Options box

On the **Display** tab,

- **Choose Y View**, as shown below
- **Click** on the **Import** button, select **JPG** in the file extension list, and open **VETTE55.JPG** from the **MEScope \ Tutorials** folder
- **Click** on **OK** to close the Options box
- Display the **Y View** in the Structure window

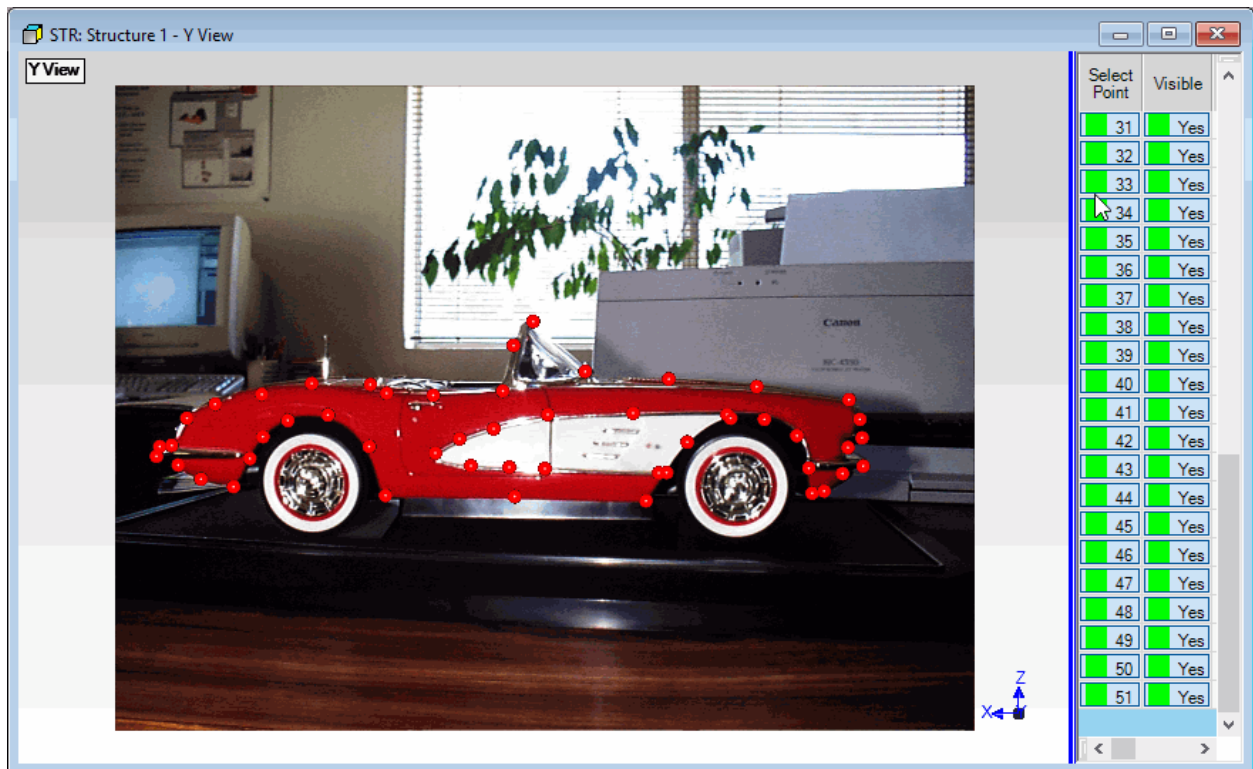
- A car profile should be in the background of the Y-View, as shown below.



Structure Window Showing Corvette Photo as Background.

Tracing a Car Profile

- **Maximize** the Structure window, and **drag** the spreadsheet **splitter bar** to the **right**
- Choose **Points**  in the **Edit | Current Objects** list
- Execute **Edit | Add Object**  to enable the **Add Points** operation
- **Move** the mouse pointer into the **Y View**, and **click** on the edge of the **red body** to add a Point
- Continue **clicking** along the edge of the **red body** to add as many profile Points as desired.
- When you have completed the profile, execute **Edit | Add Object**  again to terminate the **Add Points** operation



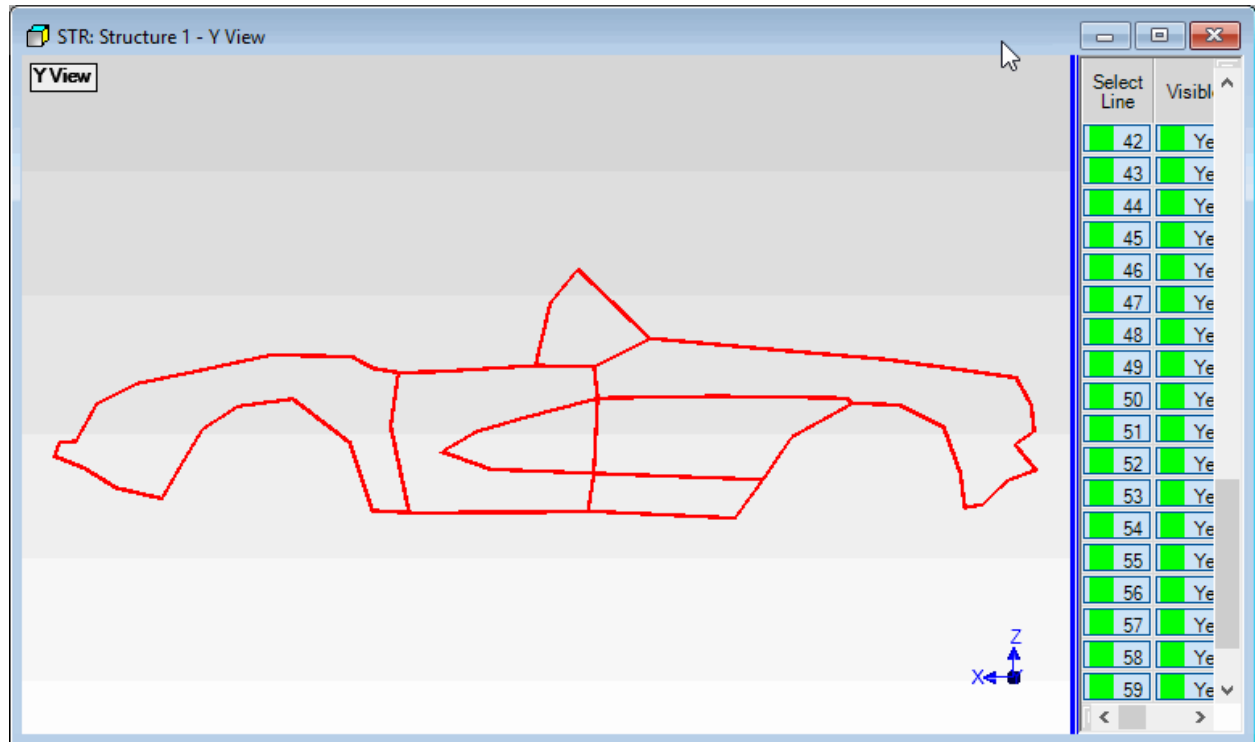
Y View Showing Points Added to Define the Car Profile.

After all of the Points are added from the profile, the background picture can be removed from the Y View.

- Execute **File | Structure Options** to open the Structure Options box
- On the **Display** tab, select the **Y View**, and **press** the **Remove** button.

Now you can proceed to add Lines and/or Surface to the profile before extruding or revolving it into a 3D model

- Choose **Lines**  from the **Edit | Current Objects** list
- Execute **Edit | Add Objects**  to enable the **Add Lines** operation
- **Click near** a Profile Point to **select** it
- **Click near** an **adjacent** Point to add a new Line between the two Points
- Repeat the two steps above until all desired Lines are added to the car Profile



Completed Car Body Profile.

Adding Wheels

- Execute **File | New | Structure** in the MEscape window to open a new Structure window
- Execute **Draw | Drawing Assistant** to display the Drawing Assistant tabs

On the **Substructure** tab,

- **Double click** on the **Editable Circle**

On the **Position** tab,

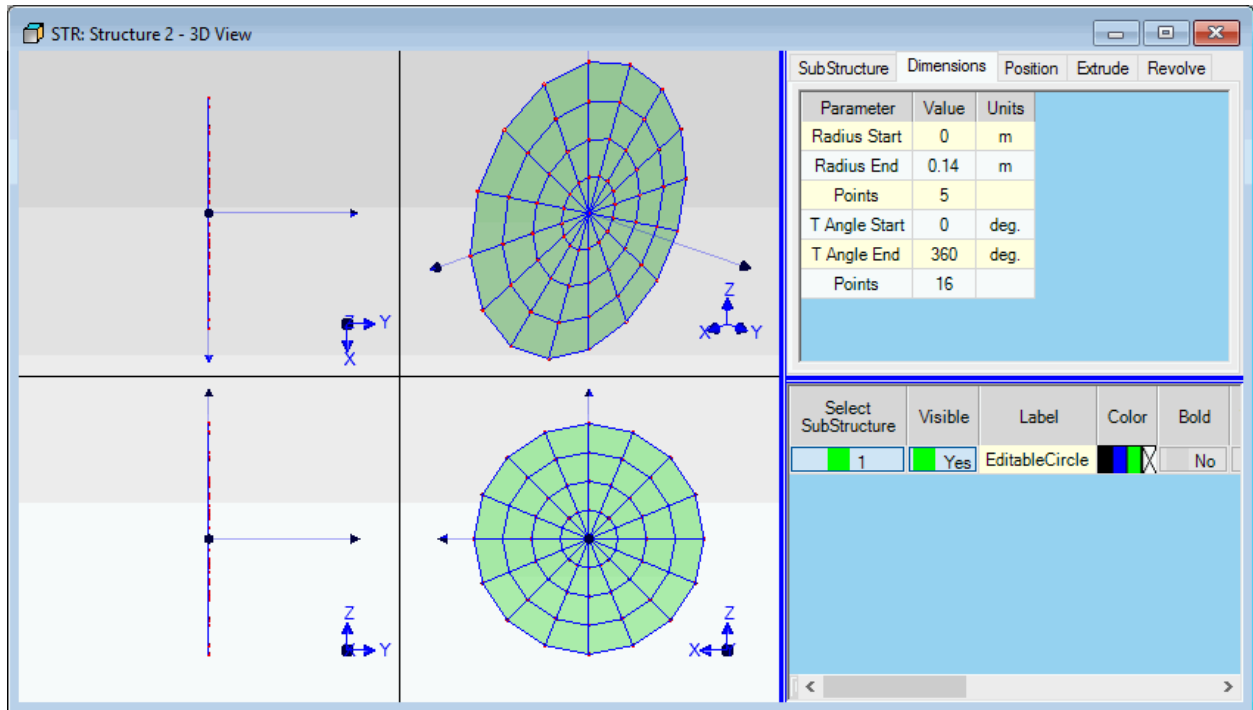
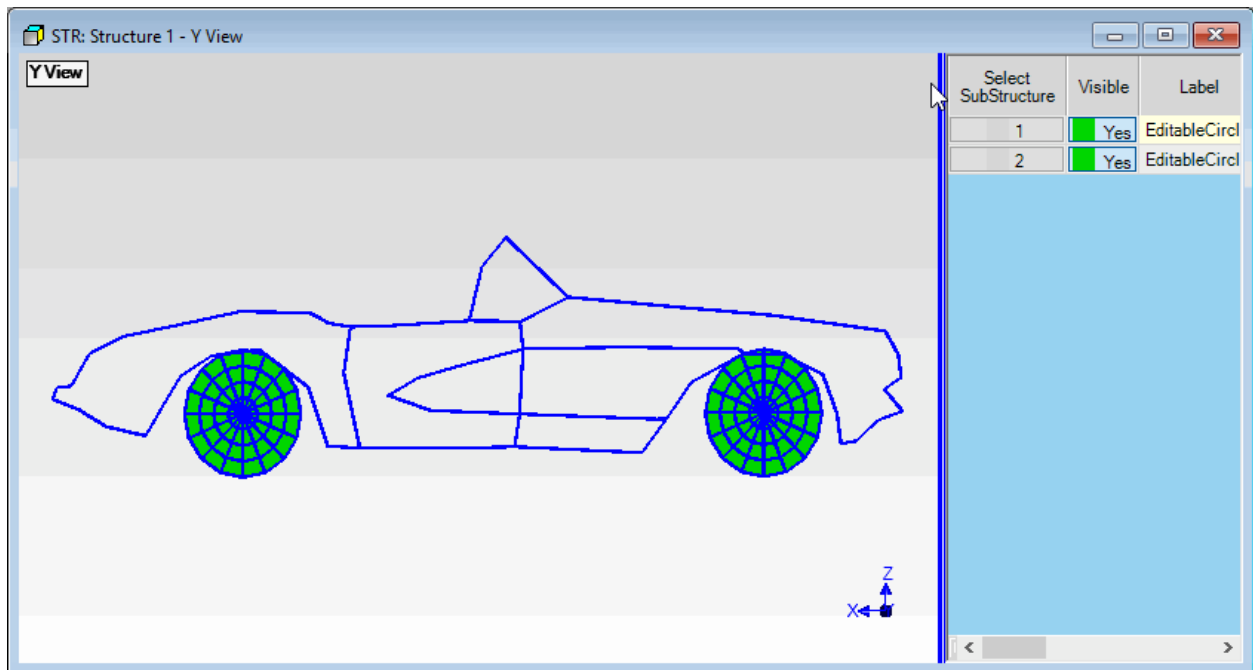
- **Rotate** the Substructure about the **Z-axis** so that it is "**facing**" the **Y-axis**

On the **Dimensions** tab,

- Enter the parameters shown in the figure below
- In the Structure window containing the car profile, execute **Edit | Paste Objects from File**
- In the dialog box that opens, choose the Structure window with the wheel in it, and **click** on **Paste**
- Execute **Edit | Drag Selected Objects**, and **drag** the wheel into the **front** wheel opening in the profile
- **Edit | Paste Objects from File** again, but this time choose the Structure window with the profile in it, and **click** on **Paste**

The selected Substructure (**Editable Circle**) is pasted into the profile as a **second copy** of the wheel Substructure

- Execute **Edit | Drag Selected Objects** again, and **drag** the second copy Substructure into the rear wheel opening, as shown below.

*Wheel Substructure.**Car Profile With Wheels.*