

Fermilab

I-DEAS Tech Tip Modifiable 3-D Swept Tube Procedure

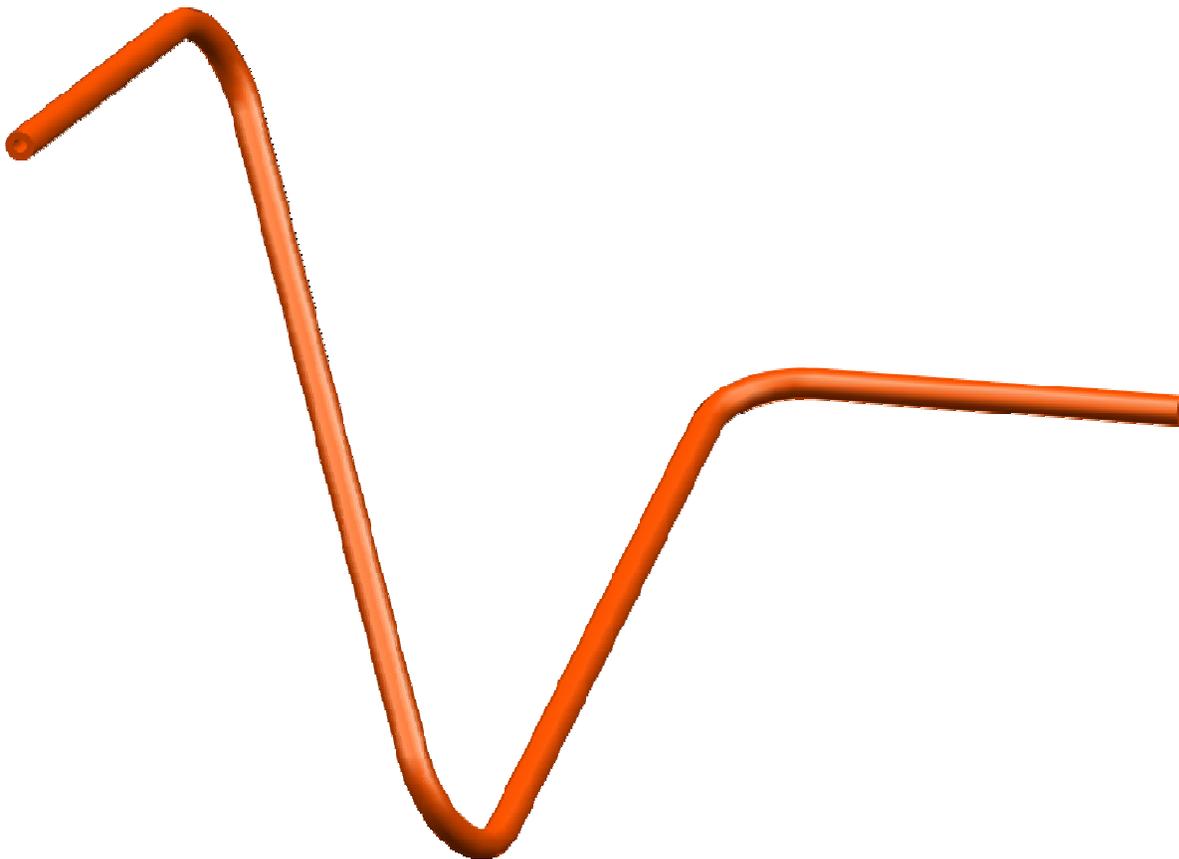
10/27/2003

D. Mitchell, TD Engineer

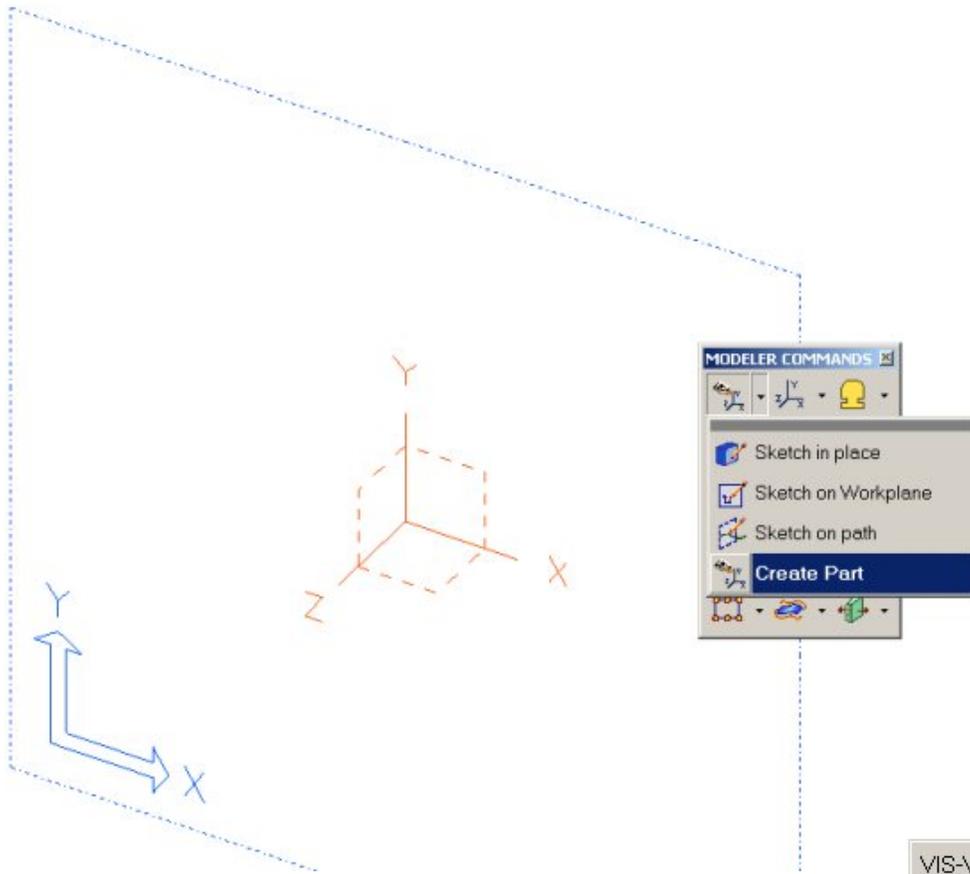
To: Fermilab I-DEAS 3-D Users

Scope: This procedure can be used to model a complicated 3-D tube routing in a manner that can be easily modified. These steps illustrate how to create a tube with 3 bends but can be extended to model any 3-D tube with many more bends. Once this part is modeled, there should be no need to model it again. At any time that a new tube is needed, a copy of this part can be made and easily modified for the new application. It would be wise to create tubes with 3-bends, 4-bends, 5-bends, and 6-bends and then store them in the library for future use.

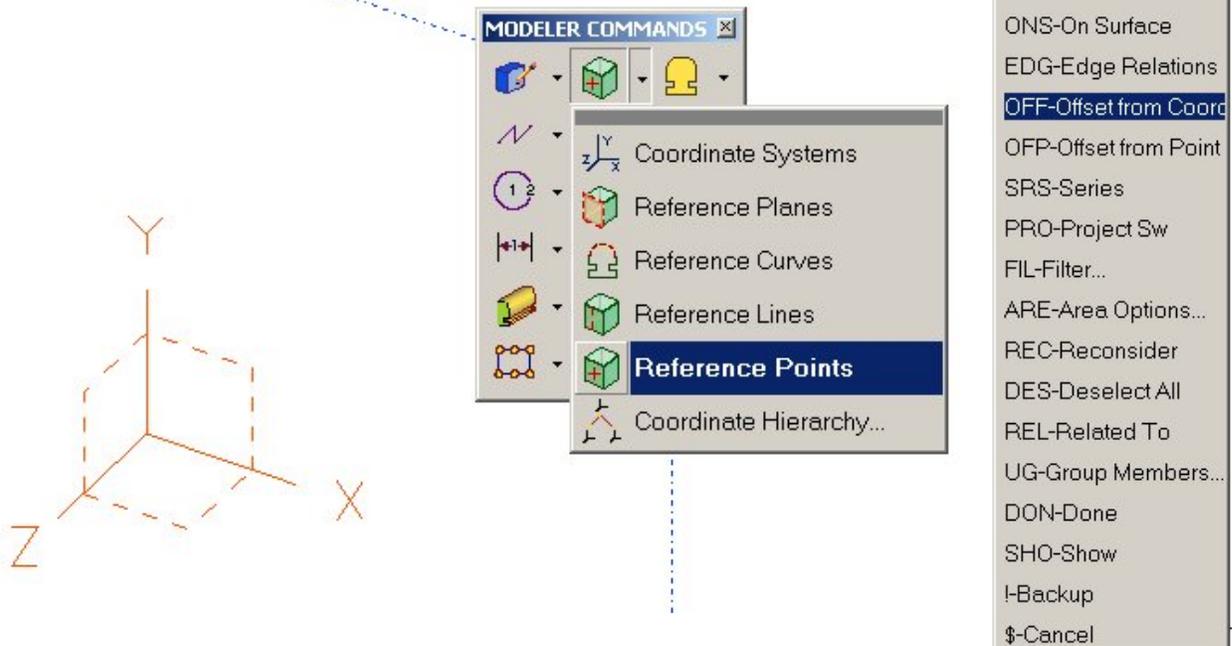
Additionally, these steps can be followed as a training exercise to learn the use of reference points, coordinate systems, and the sweep command.



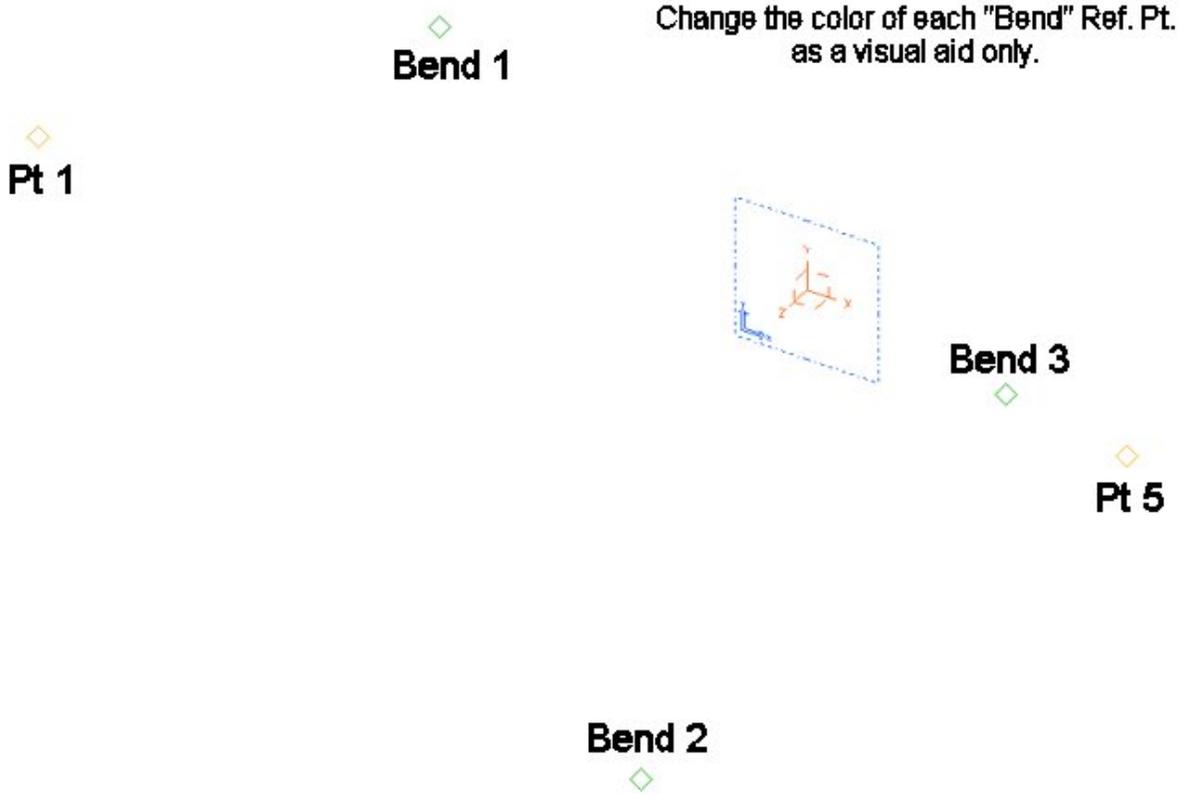
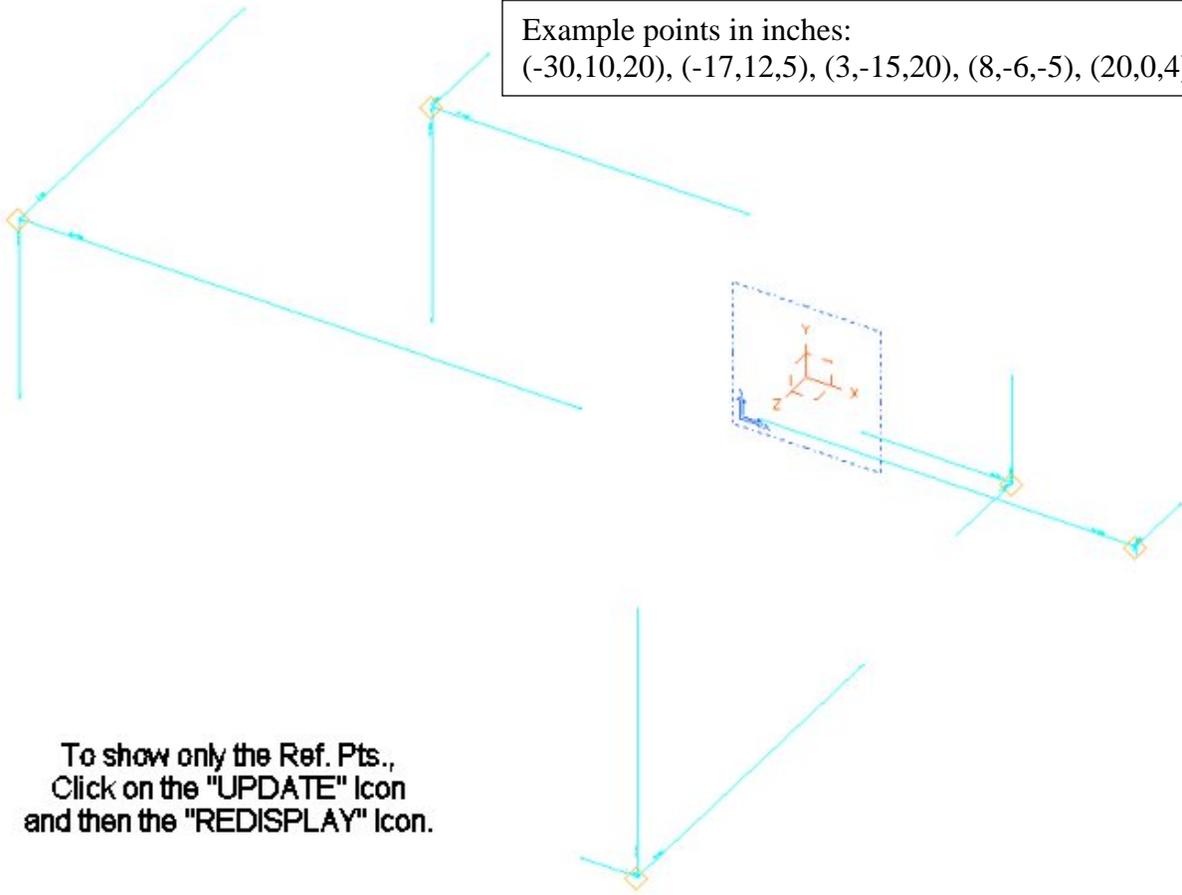
STEP 1: Create a part using the **BORN** method.



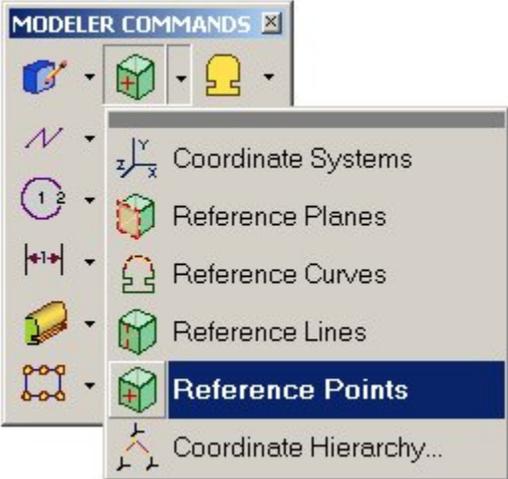
STEP 2: Create Reference Points using the RMB (Right Mouse Button) *Offset From Coordinate System* option. Create points at the start and end of the tube and at each bend point as shown below. Change the color of the Ref. Pts. at **each bend** for a visual aid. To clear off the displayed dimensions, use *Update* and *Redisplay*.



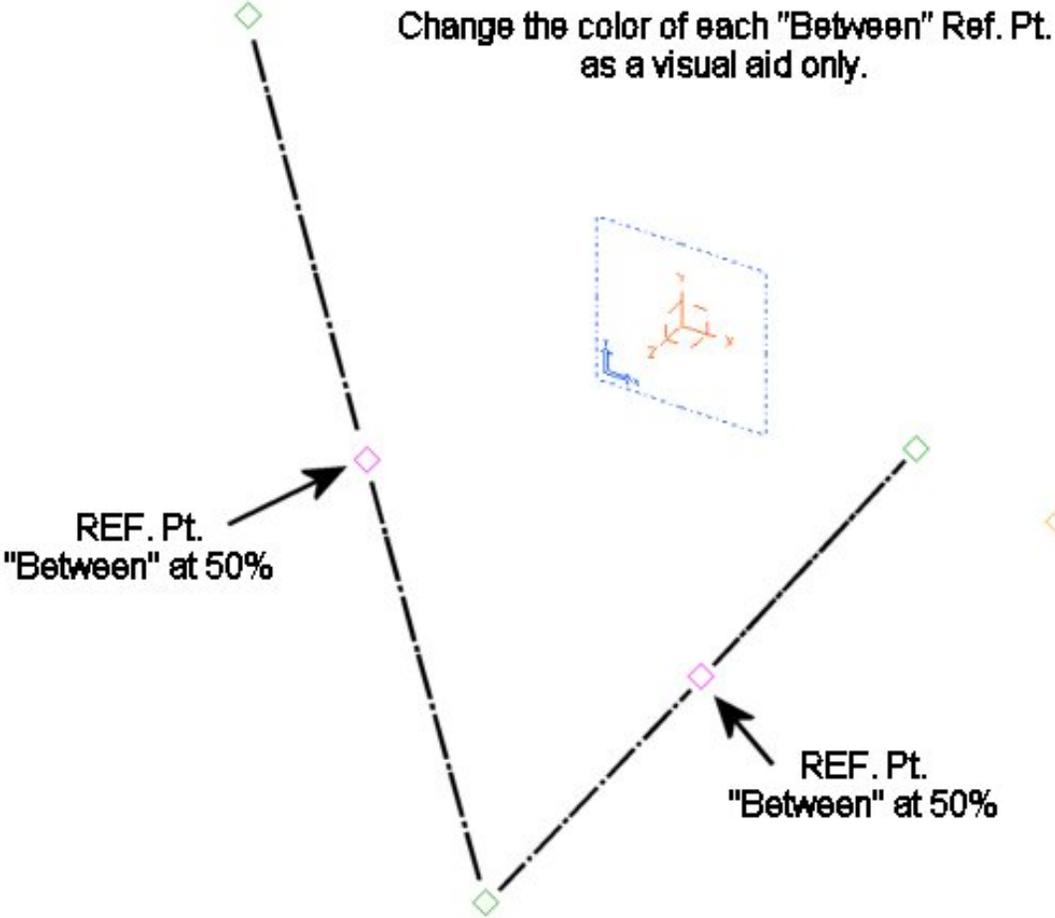
Example points in inches:
(-30,10,20), (-17,12,5), (3,-15,20), (8,-6,-5), (20,0,4)



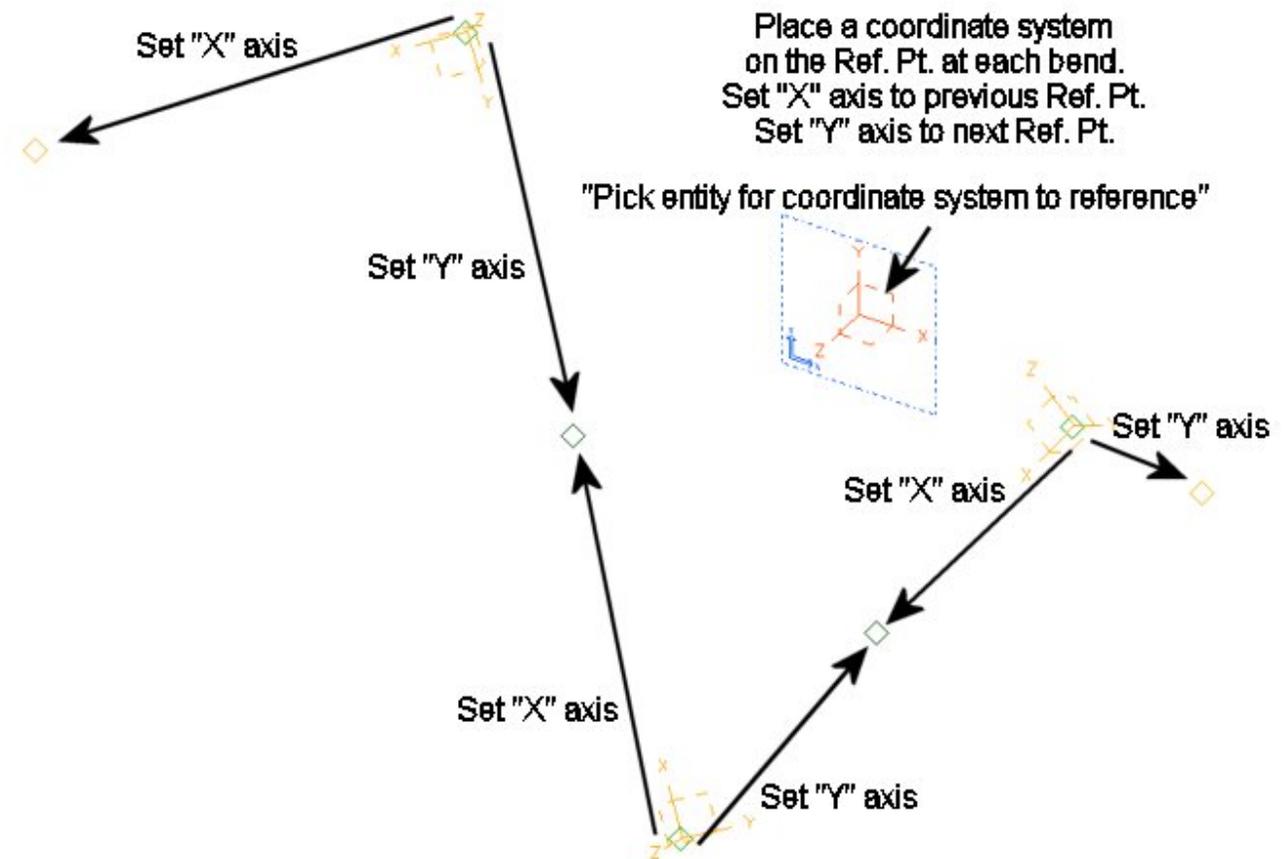
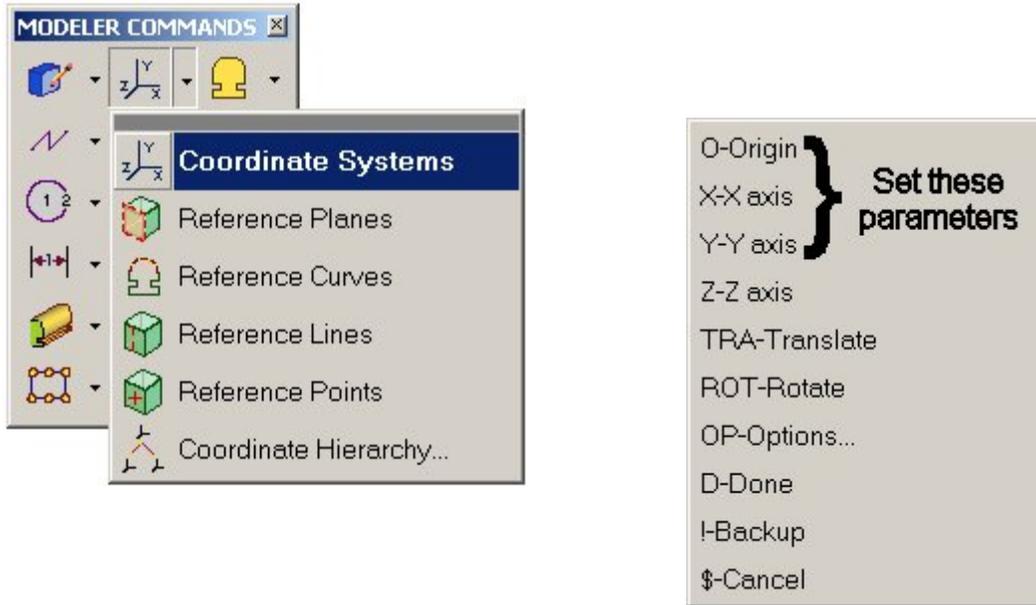
STEP 3: Create Reference Points between **consecutive bends**. Use RMB *Between* with a **50%** value to place these points. Again, change the color of these reference points only as a visual aid.



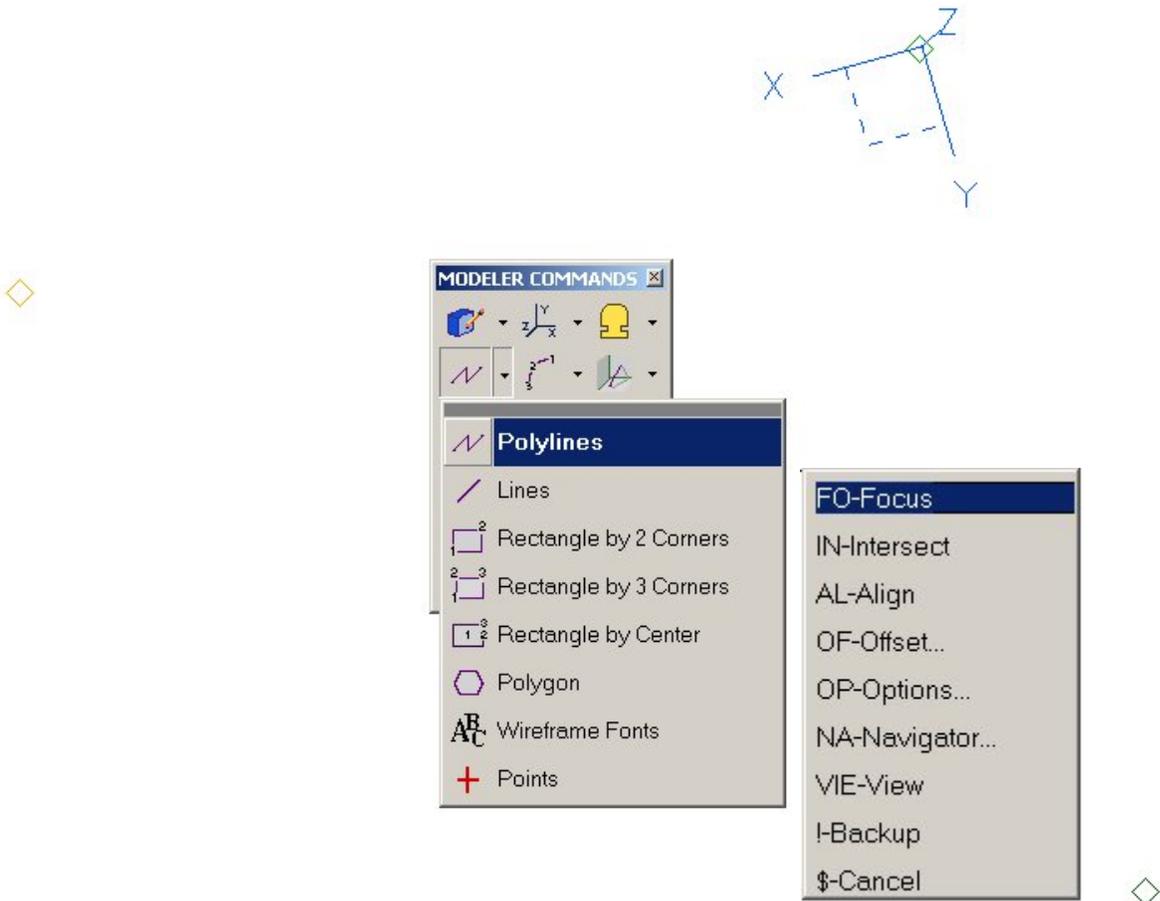
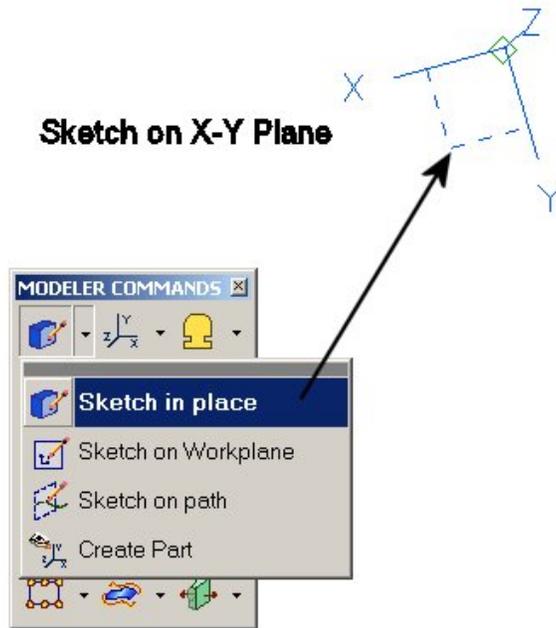
- VIS-Visible
- LAB-Label
- SCR-Screen Location
- KEY-Key In
- INT-Intersection
- BET-Between**
- TRA-Translated
- ONC-On Curve
- ONS-On Surface
- EDG-Edge Relations
- OFF-Offset from Coor
- OPF-Offset from Point
- SRS-Series
- PRO-Project Sw
- FIL-Filter...
- ARE-Area Options...
- REC-Reconsider
- DES-Deselect All
- REL-Related To
- UG-Group Members...
- DON-Done
- SHO-Show
- I-Backup
- \$-Cancel

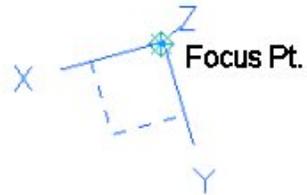


STEP 4: Create coordinate systems at each bend reference point. Locate the C.S. origin on the reference point. Direct the X-axis toward the previous Ref. Pt. Direct the Y-axis toward the following Ref. Pt. The axes will be displayed at a 90 degree angle but a plane containing the 3 reference points will be defined.



STEP 5: Create the wireframe tube path by sketching on each coordinate system's X-Y plane. You must first *focus* the three reference points before creating the 2 straight lines and 1 fillet. Repeat this process for each coordinate system.





Focus Pt.

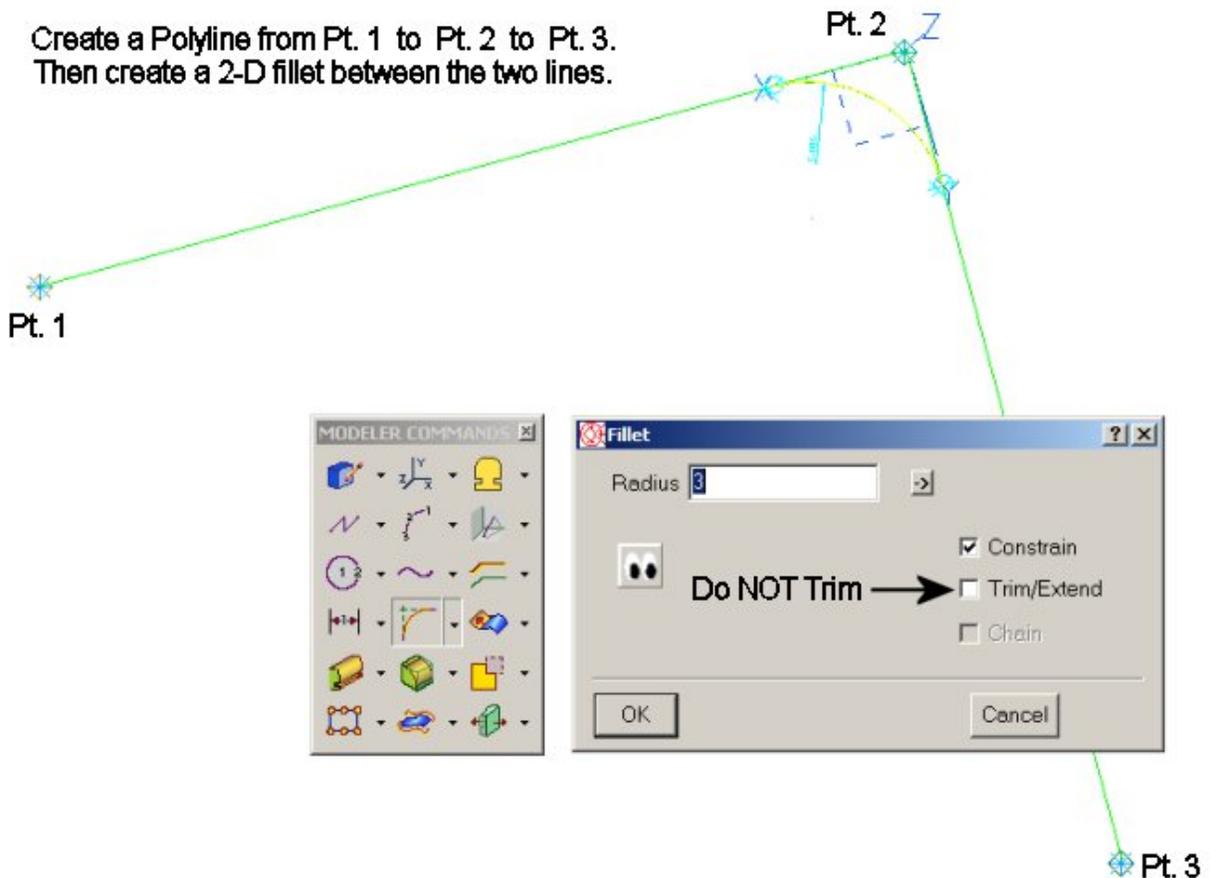


Focus Ref. Pts. NOT the C.S. Origin!

Look at the "List" region to see which item you have selected and, if needed, use F8 (Reconsider) to toggle through the possible item choices.

Focus Pt. 

Create a Polyline from Pt. 1 to Pt. 2 to Pt. 3.
Then create a 2-D fillet between the two lines.



MODELERS COMMANDS

Fillet

Radius: 3

Constrain

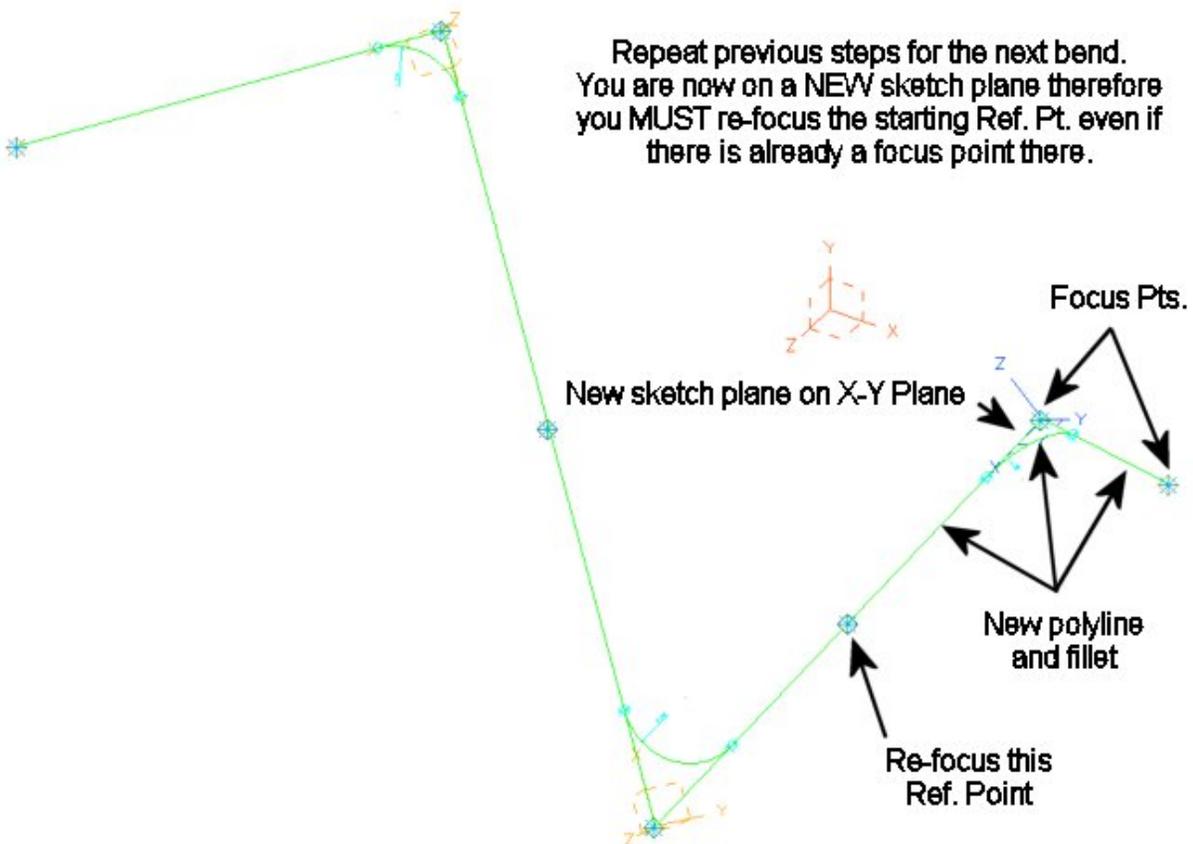
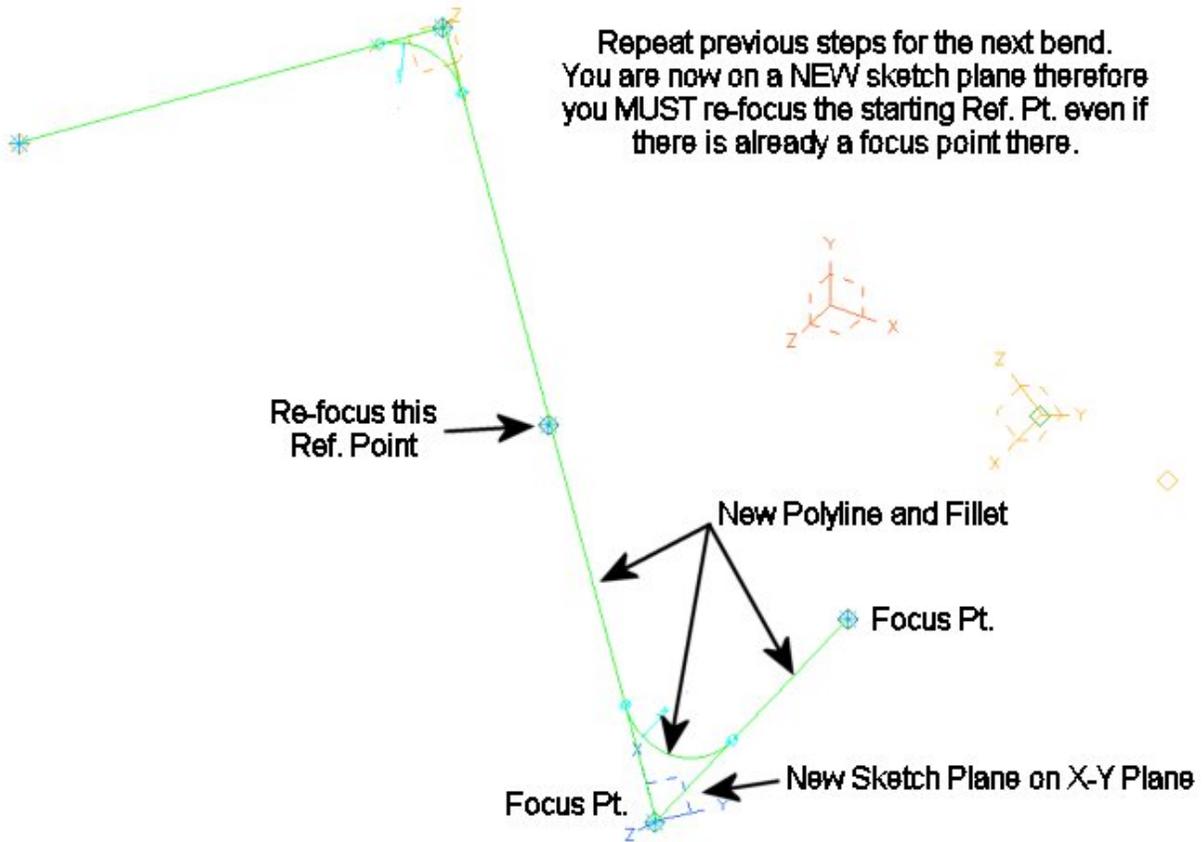
Trim/Extend

Chain

Do NOT Trim →

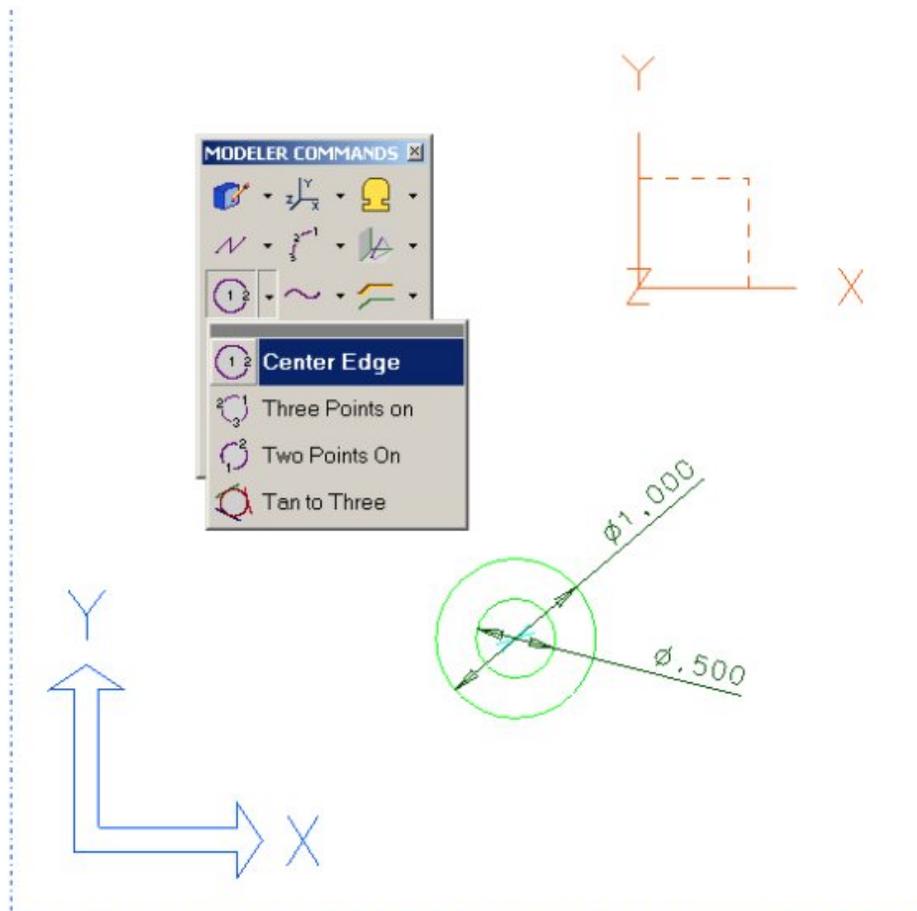
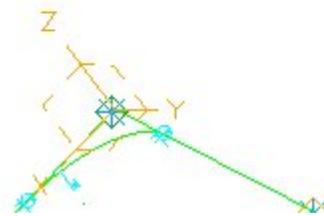
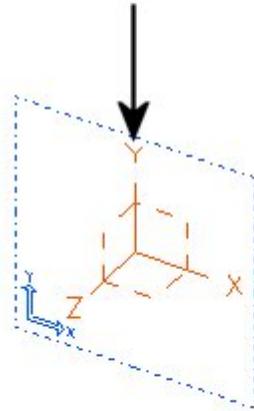
OK Cancel

Pt. 3

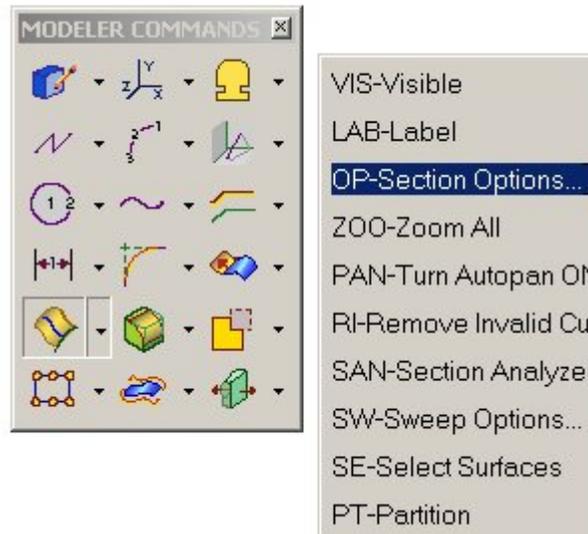
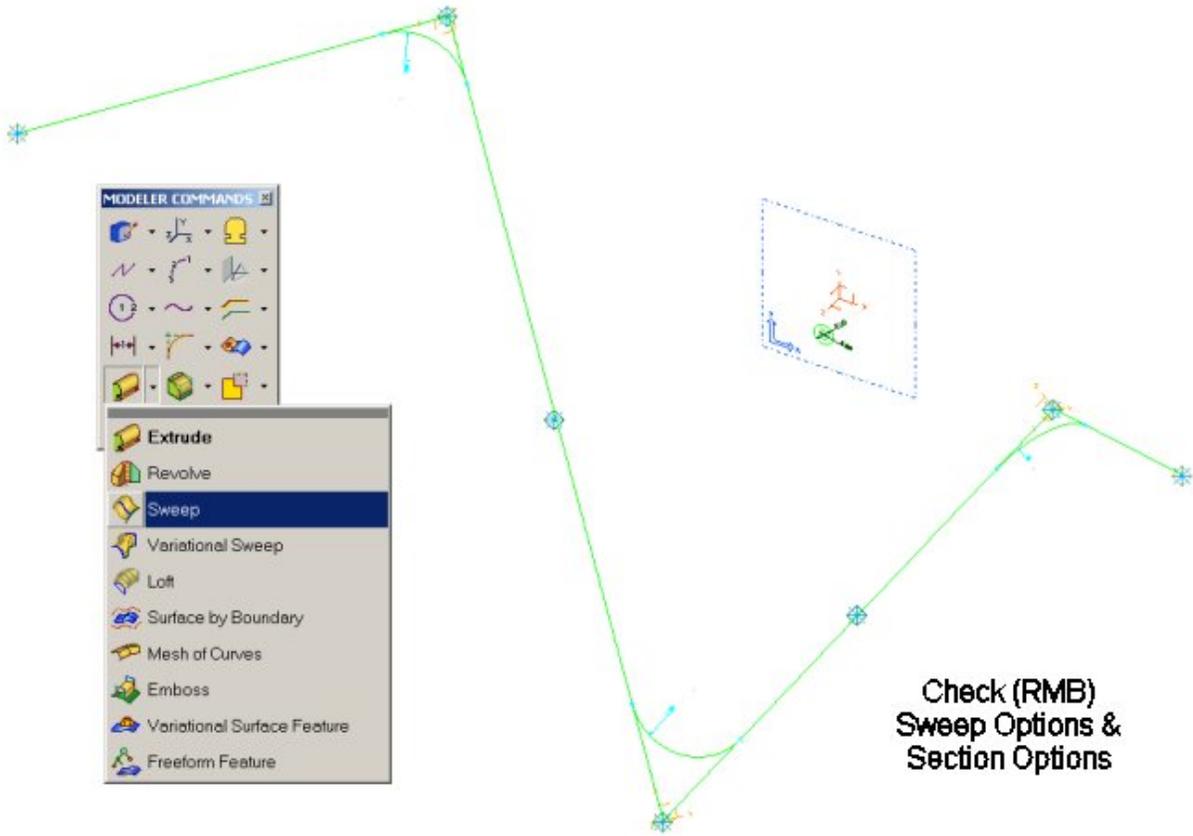


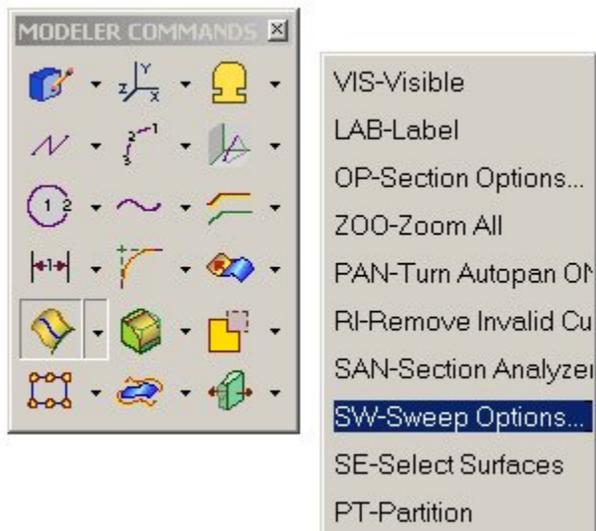
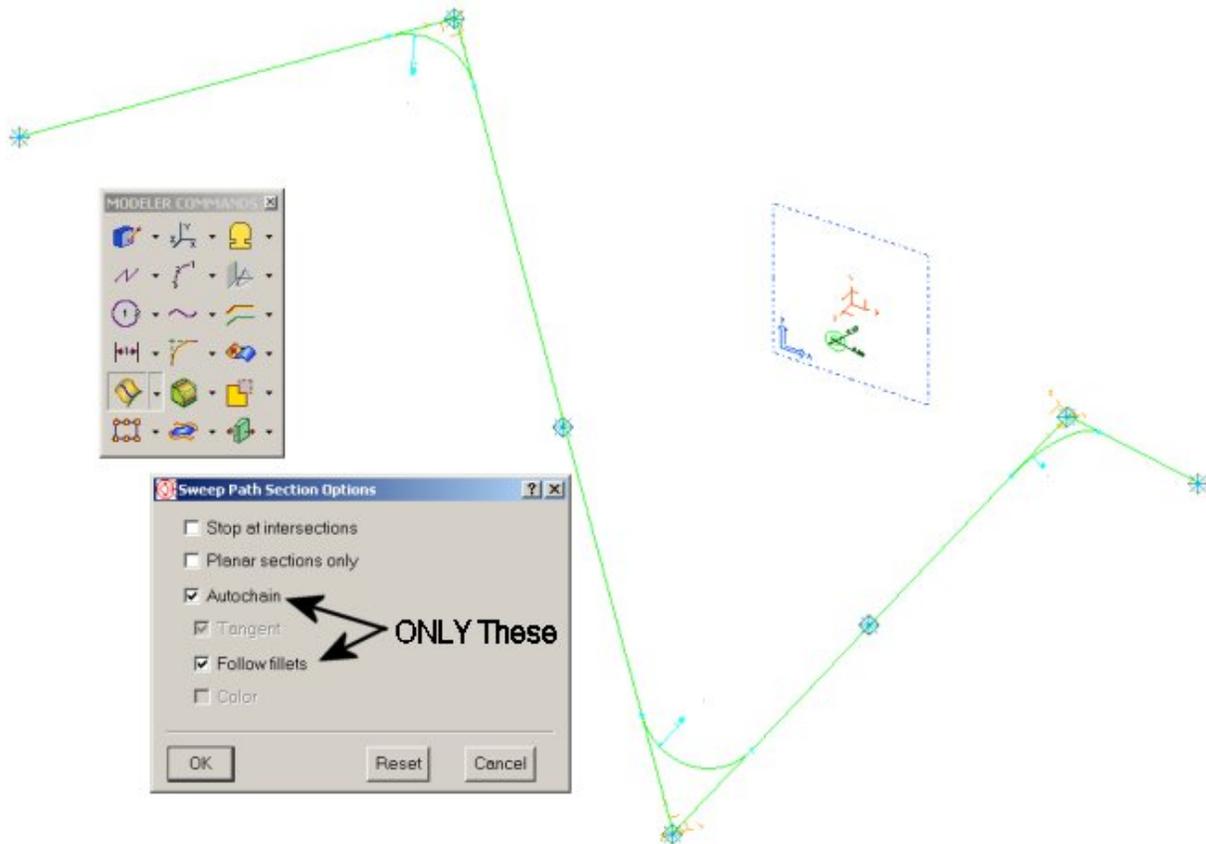
STEP 6: Create the tube wireframe by first, sketching two concentric circles, with dimensions, on the *Workplane*.

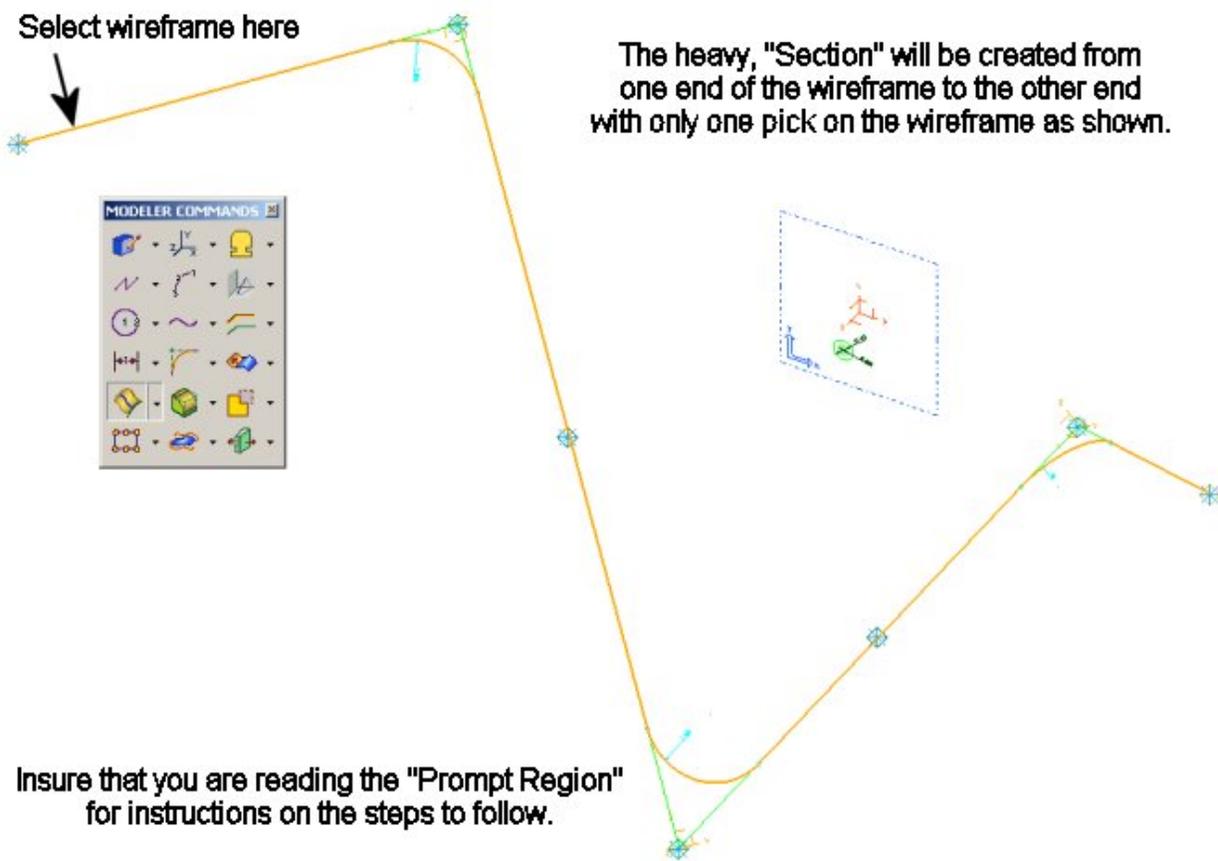
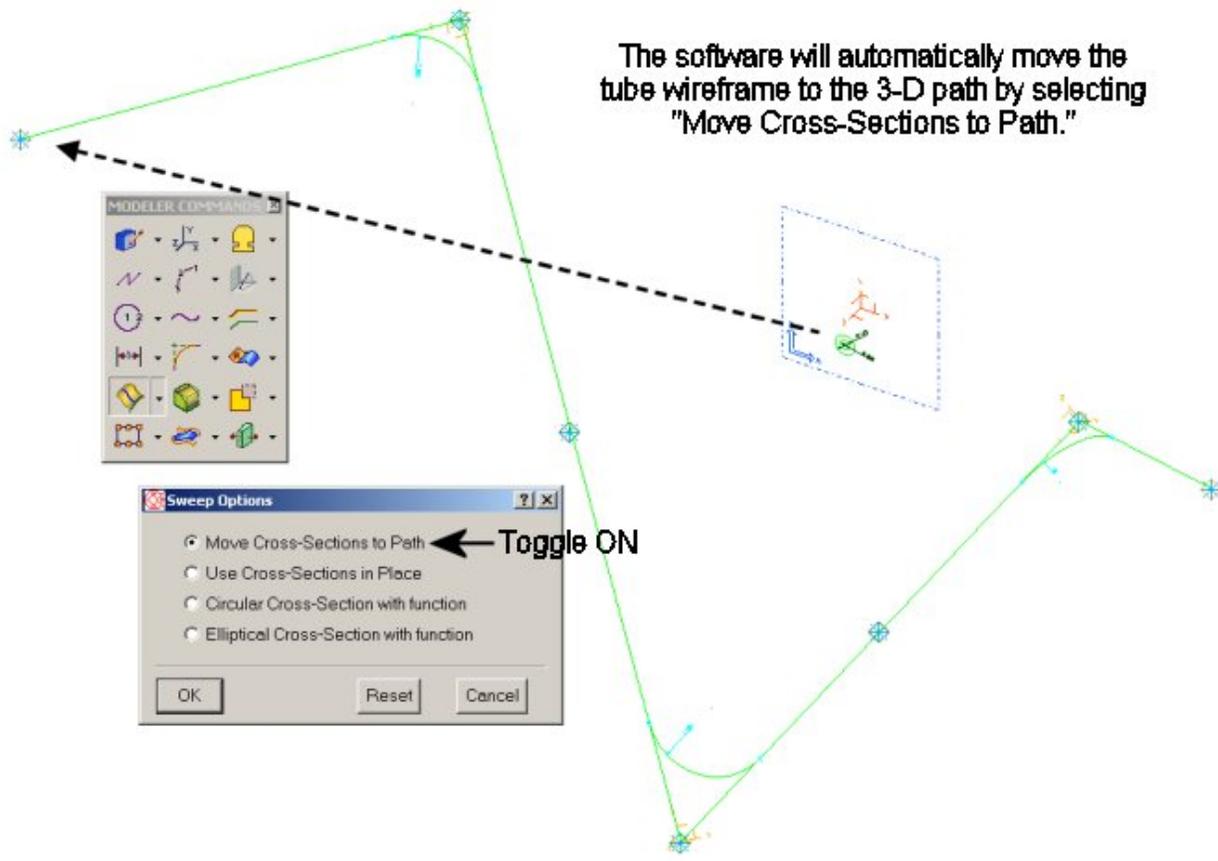
Create Tube "Wireframe"
on the Workplane,
NOT on a Coord. Sys.



STEP 7: Create the tube using the *Sweep* command. Set the RMB *Section Options* to have ONLY the *Auto Chain* and *Follow Fillets* toggled on. Set the RMB *Sweep Options* to have the *Move Cross-Section to Path* toggled on. Follow the steps below and make sure that you are reading the *Prompt window* for instructions.







Insure that you are reading the "Prompt Region" for instructions on the steps to follow.

Pick I.D. and O.D. circles for the cross-section curves and insure that the directional arrows point in the same direction.

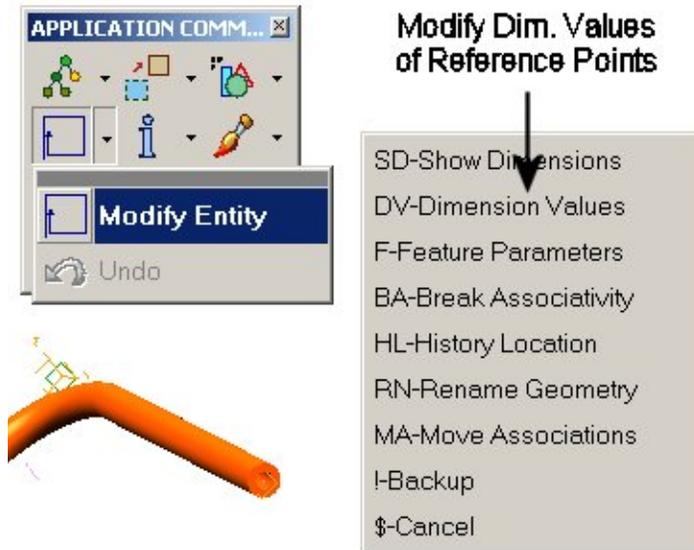
Click here when complete.

Completed 3-Bend tube.
The same process can be used to create tubes with more bends.

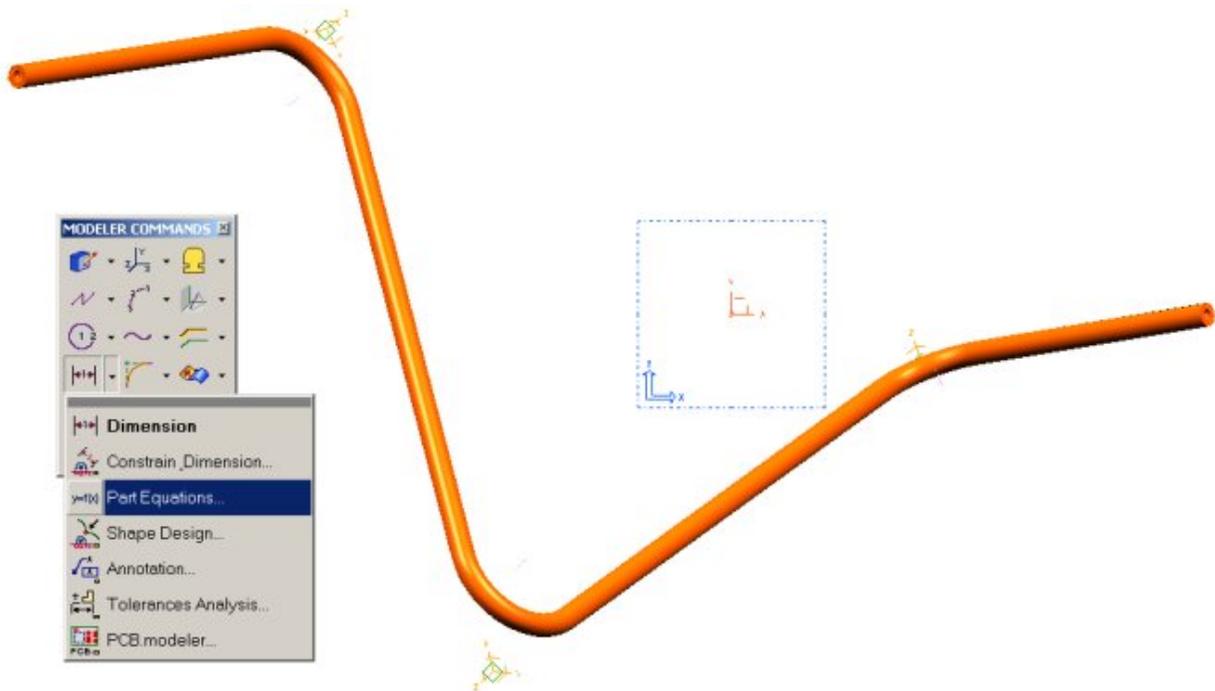
To modify the path, ONLY "Modify" the initial Reference Points. These are the points at each end and at each bend.

DO NOT use the "Move" command and DO NOT try to modify ANY Coordinate Sys.

STEP 8: Change the tube's shape by using *Modify* on the desired reference points. With RMB *Dimension Values*, the X, Y, and Z value of the key reference points can be altered. ONLY modify the original reference points that were used to define the start, end, and bend locations. The part could be considered complete at this point but the color, mass properties, and any part annotation could still be added. Congratulations, you are done! Now try this same technique on a tube with 4-bends, 5-bends, or greater. Then, store these modifiable tubes in a library for future use by you and other group members.



Optional: Enhance the part's ease of use by taking advantage of *Part Equations*. With *Part Equations*, the variables such as the tube I.D. and O.D. as well as the bend radii can be modified rather quickly to accommodate just about any tube routing with the same number of bends.



Equations

```
tube_OD=1.1[in]
tube_ID=.625[in]
bend_1_rad=3.25[in]
bend_2_rad=2.75[in]
bend_3_rad=3.0[in]
```

Set the Tube size and bend radii here.

Name	Expression	Value
RF1_X	-30	
RF1_Y	10	
RF1_Z	20	
RF2_X	-17	
RF2_Y	12	
RF2_Z	5	
RF3_X	3	
RF3_Y	-5	
RF3_Z	20	
RF4_X	8	
RF4_Y	-6	
RF4_Z	-5	

Modify X, Y, and Z values here.

>

Dimension Variables