Corrugated pipes

There are at least two ways by which objects such as freely flowing corrugated pipes can be generated. The first is based on placing profile shapes on a line corresponding to the shape of the pipe, and then c-meshing them. The second creates long and straight objects of revolution which are then deformed to the desired shape. They can both be quite tedious, given that the final object is typically required to be of a significant length. However, certain tricks can be used to make these processes substantially easier.

Method 1: Placing profiles and c-meshing them

The first method requires that you strategically place profiles of different sizes on a path line, then select them in the proper order to generate a c-mesh with or without smoothing. This is the general method which would generate any variation of a pipe-like object. However, placing many profiles and then selecting them individually in the proper order are very tedious tasks. The following procedure reduces this tediousness.

1. Generate your path shape. We drew it by snapping to the segments of a cuboid.

2. Use the Place tool in multi-copy mode to place a simple profile shape (we used a square) on the path line. These shapes will be used as “place-holders.” That is, the profiles we shall actually use for the c-mesh will be placed by attaching them to these squares.

3. Generate four (or as many as required) shapes (we drew decagons) in the order they will be connected (the order is very significant).

We first drew the lower small decagon (a), then the lower large decagon (b), then copied the large decagon (c), and then copied the small decagon (d), moving up with the Perpendicular switch on. Make certain that their first points and their directions line up. Then join the four decagons into a single object, using the Join tool.

4. Attach copies of this object to each of the squares you placed earlier, in proper order (very important). Use the Attach tool with topological level at Face (face attachments) to do this. Selecting Clicking Inside Boundaries in the Pick Options dialog will make your job easier. When you select a face of the joined object to be attached and the square to which it will be attached, always click close to the same segments to properly line up the first points and to avoid twists.

5. You can now delete (or hide) all the other objects, except for the octagons. Frame pick the octagons and separate them, using the Separate tool.

6. Frame pick the separated octagons and generate a c-mesh (with or without smoothing). In our example, we did it both ways.

Here are the tricks you used:

- You carefully generated your profiles in the order the c-mesh needed to connect them. This allowed you to frame pick them, rather than picking them individually. Frame picking picks the objects in the order they are generated.
- You placed repetitive patterns of profiles by joining them and then attaching them to place-holding shapes. Being able to place any object, rather than 2D shapes only, will make this task even easier. Such a feature will soon be included in form-Z.

As in previous issues, the technical notes published in these pages were initially in response to “how would you do this” questions addressed to our Technical Support department. We have selected those for which we had the most requests. As in the past, they also point out desirable extensions that would make our users’ job easier. For example, bending an object relative to a (control) line, a tool already promised for v. 3.0, would make the modeling of corrugated pipes much easier.

We are also happy to offer more examples of model prototyping in the last section of these Technical Notes, thanks to contributions by Max Probasco. Not only did he send us examples of rapid prototyping and tool path machining, two methods that have been available for quite some time, he also rushed into testing our new unfolding operations and sent us an example as this newsletter was going to press. This made the notes on prototyping all-inclusive.
Method 2: Using objects of revolution

This method starts with a straight corrugated object of revolution, copies of which are then deformed. The final pipe is constructed from a number of pieces attached together. This method involves the potentially tedious task of generating the long 2D profile by drawing a repetitive pattern over and over. The following process eliminates this tediousness.

1. With Grid Snap on, draw the pattern.

2. Make as many copies as desired (we made 11 copies). With Multi-Copy and the Move tool active, click on the first and the last points of the shape you drew.

3. Join them all in one. In the Line Edit Options dialog select Join All and with the Edit Line tool click in the window. Now it is a continuous line.

4. Next, you may want to smooth your profile using the C-Curve tool. In our example we generated a Quadratic curve.

5. You may also add two segments extending to the axis at the two ends of your profile. This will generate a solid object of revolution that will make the attachments easier. At the ends of the profile, draw two horizontal lines with proper directions.

6. Join them with the profile shape.

7. Revolve your profile. With the Object of Revolution tool active, click on the profile and on the axis. You may also set the # Of Steps parameter in the Revolution Options dialog to a value other than the default. We used 20.

8. To make the execution of the attachments easier, transform the 20 faces at each end of your object to one. Set the topological level to Point and with the Delete tool click on the point in the middle of the 20 faces at the top and bottom of your object.

9. Make one or more copies of your object. We used 2 copies.

10. Deform each of these copies as appropriate (A and B).

11. The pipe we show consists of three pieces (A,B,A), which were assembled by executing face attachments. After they are attached, you may also union them.