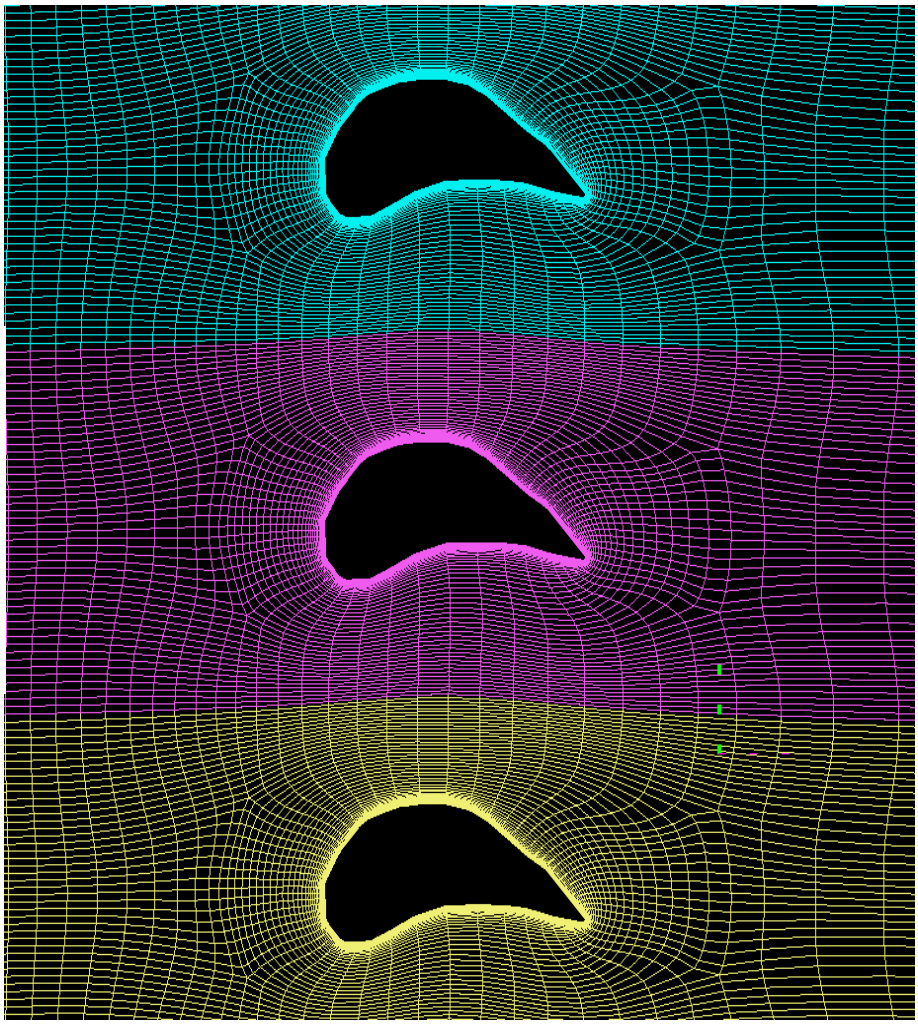
Tutorial 6.1: GRIDS WITH PERIODIC SURFACES

Some geometries involving grid generation are translationally or rotationally recurrent to their furthest extent. A common and important example is the axial turbine. When the geometry is recurrent, rather than computing the whole grid about the object at once, **GridPro** can grid a ***periodic section*** of the object and then duplicate that section to easily construct the grid about the whole object. This process saves you time and effort, and allows you to construct the topology for only a fraction of the region you want gridded.

This tutorial deals with meshing such symmetric geometries. In Tutorial_6**.1**, we will grid a 2-D cascade of turbine blades. In Tutorial_6**.2**, we will generate a 3-D grid for a rotationally symmetric turbine**.**

A Translation Periodic Cascade of Turbine

What You Will Create



What You Will Learn

- Using the *xyz* pseudo surface to represent the Translational periodic boundaries
- Assigning corners in pairs to the periodic surface
- Duplicating the grid section to generate the complete grid using the *trf* utility

Step 1 Loading the Geometry

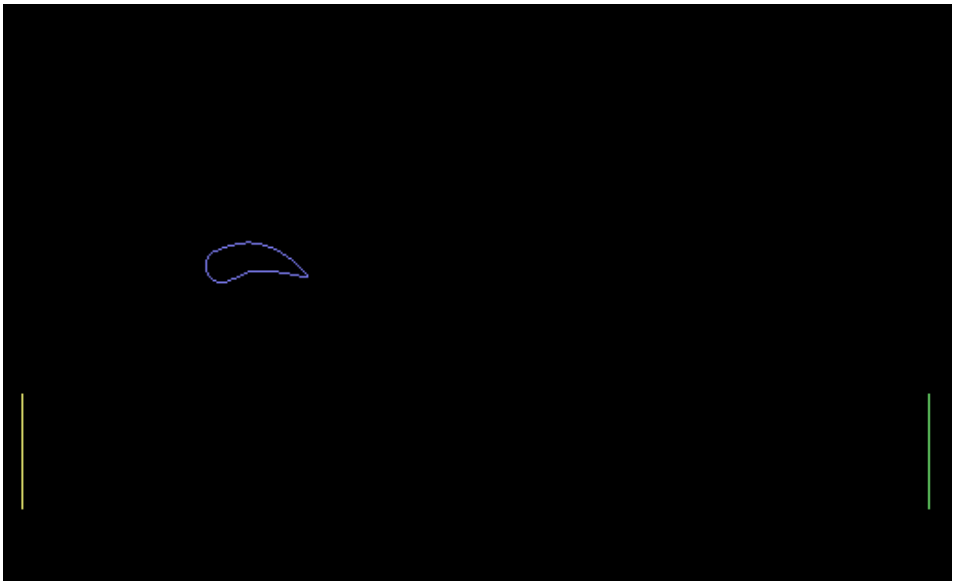
Load the **Tutorial_6.1.fra** file. This is a TIL (Topology input language) file. The file automatically loads the blade surface from the **blade.tmp** file. So, make sure that the **blade.tmp** file is also accessible (i.e., the path) by the **az** graphic manager.

You should be able to see the surfaces as shown in the next page. Make sure that you have set the dim=2 in the dim menu.

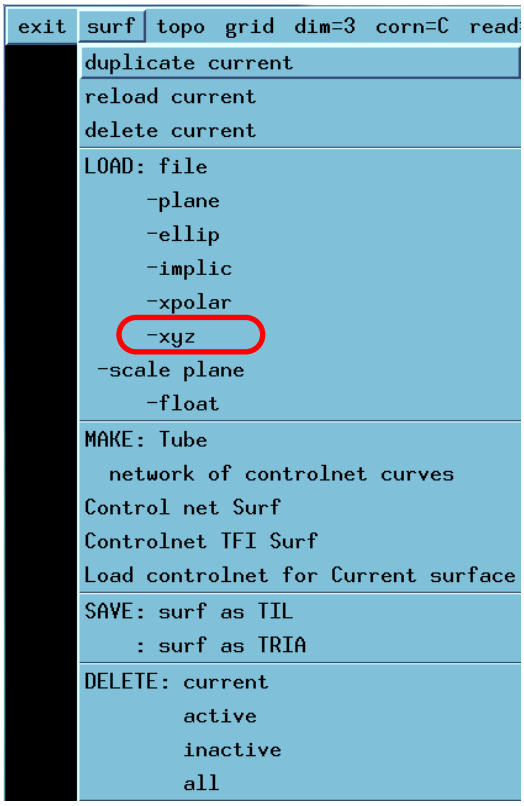
Creating Surfaces in GridPro

The blade which appears in the screen when you load the TIL file has been created in **GridPro** itself. While not accurate, creating geometries using **GridPro** is easy. You can create and manipulate much geometry in **GridPro**. **GridPro** also has many nice features for you to fine-tune the surface you have created. You can create the appropriate topology and use the **Save topology as surface** in the **topo** menu as you had done in **Tutorial 4** to create the internal surface.

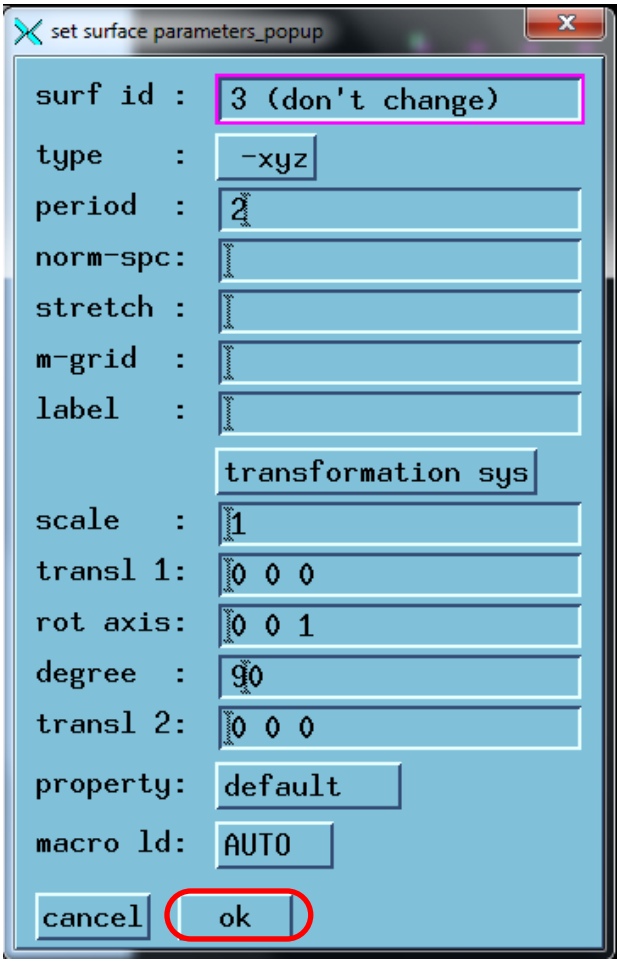
As you can see, there are three surfaces: The left plane, the right plane, and the blade. Since we are creating a cascade of turbine blades, there are top and bottom planes. The top and bottom part will be the periodic surfaces - **xyz** surfaces which we have to create.



Now, we are going to create the pseudo xyz surface for the top and bottom portions of the surface. Go to the **surf** menu and select **load -xyz** from the pull down menu.



A **set surface parameter** window wills popup. Enter the period 2. By default, the periodic axis of the xyz surface is the x-axis. To change this, you have to rotate the surface by 90 degrees. Go to the **Degree:** part in the bottom part of the window and enter **90**. Leave the other values to the default values.



Press **apply** to create the surface. You will not see any new surfaces displayed. Don't panic. The surface has been created, and you can confirm this by scrolling through the surfaces. You will see that there are four surfaces now. This is because the xyz surface is a pseudo surface and does not show up on the screen. Nevertheless, it is there.

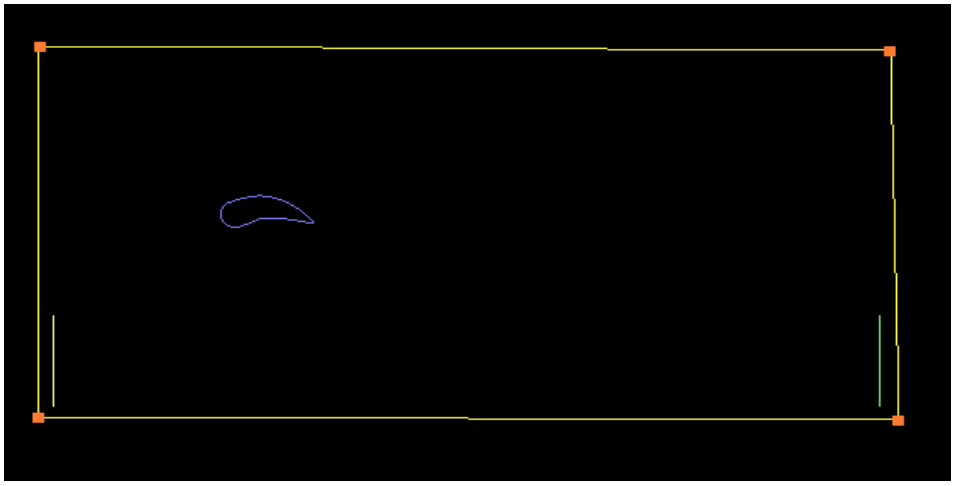
You are now ready to create the topology.

Step 2 Creating the Topology

The topology for this geometry is the same as the topology you created for the circle inside a box in **Tutorial 1**.

First create four corners around the geometry as shown below. This is done by pressing **C** in the keyboard and left-clicking at the appropriate places. This constitutes the outer region of the topology.

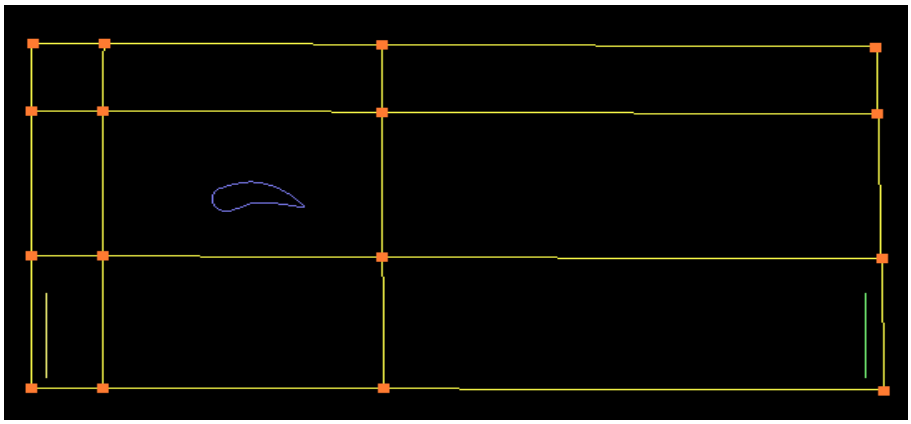
Now, connect them by pressing **E** in the keyboard and clicking on consecutive points until you get a box around the geometry as shown below.



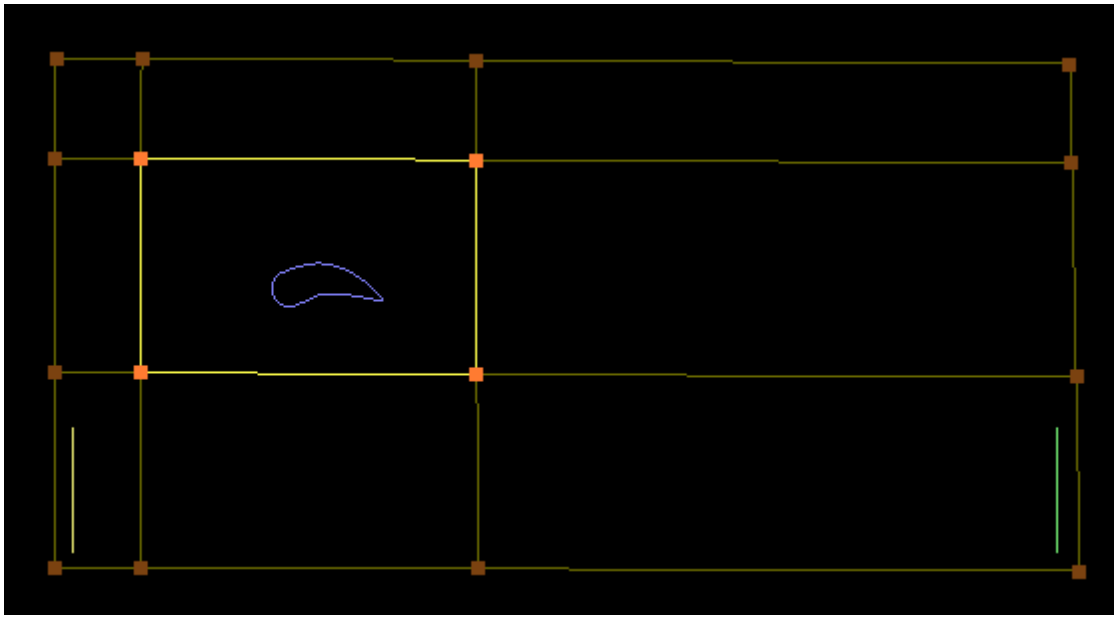
After Creating the Box

Now, insert new corners as shown below. This is done in the same way as you did in **Tutorial 1**, by pressing the **I** key and clicking on the appropriate location. Insert the corners such that they form another smaller box around the blade.

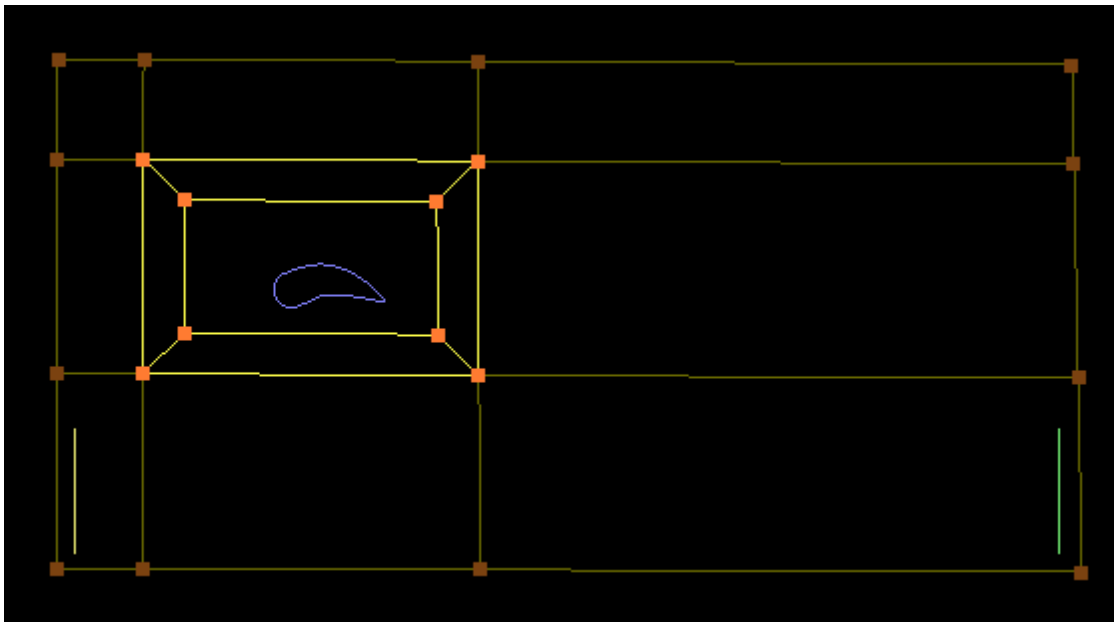
After this, add the inner box to a group (like group 2) as shown. Wrap the group by 25% lesser. If the wrap is too small, then drag the corners around to make the inner wrap fit the blade surface.



After inserting the corners



Add the Inner Box to a Group

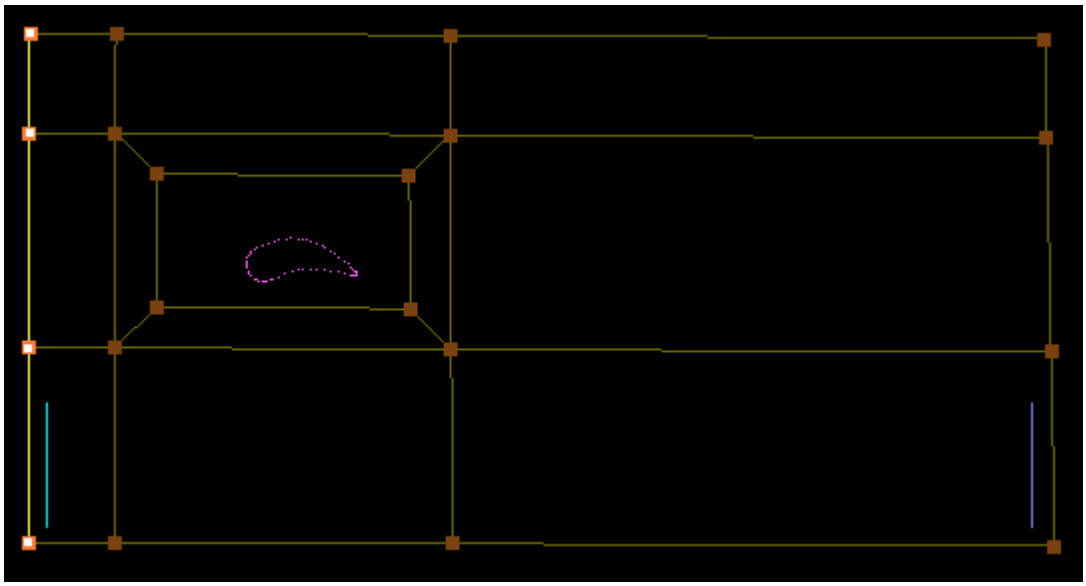


After Wrapping the Group

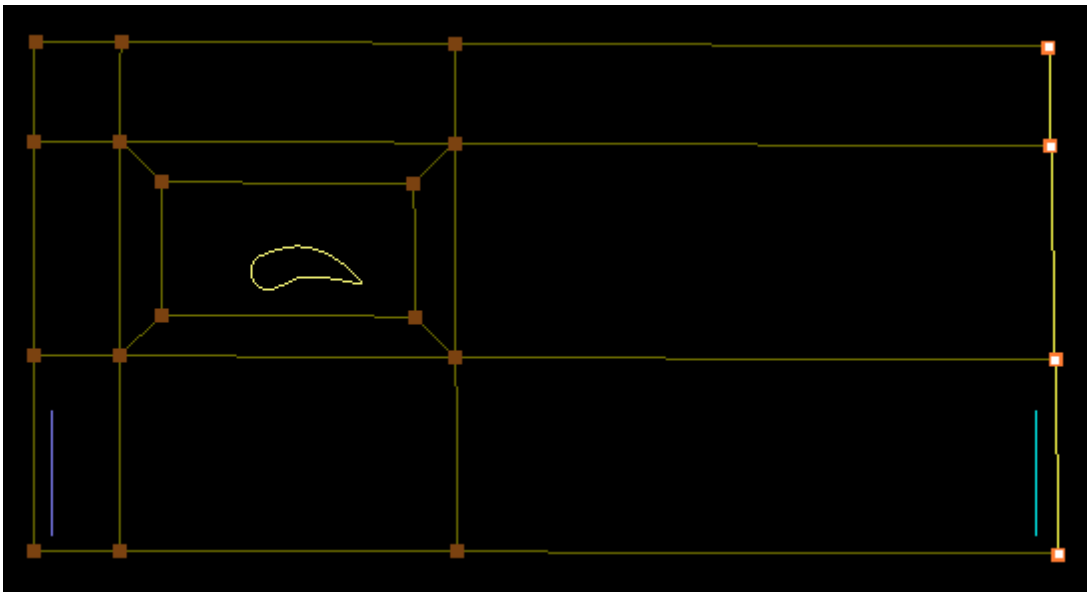
Step 3 Surface Assignments

The surface assignments for the right plane, the left plane and the blade are done in the usual manner. The four corners in the left edge are assigned to the left surface. The

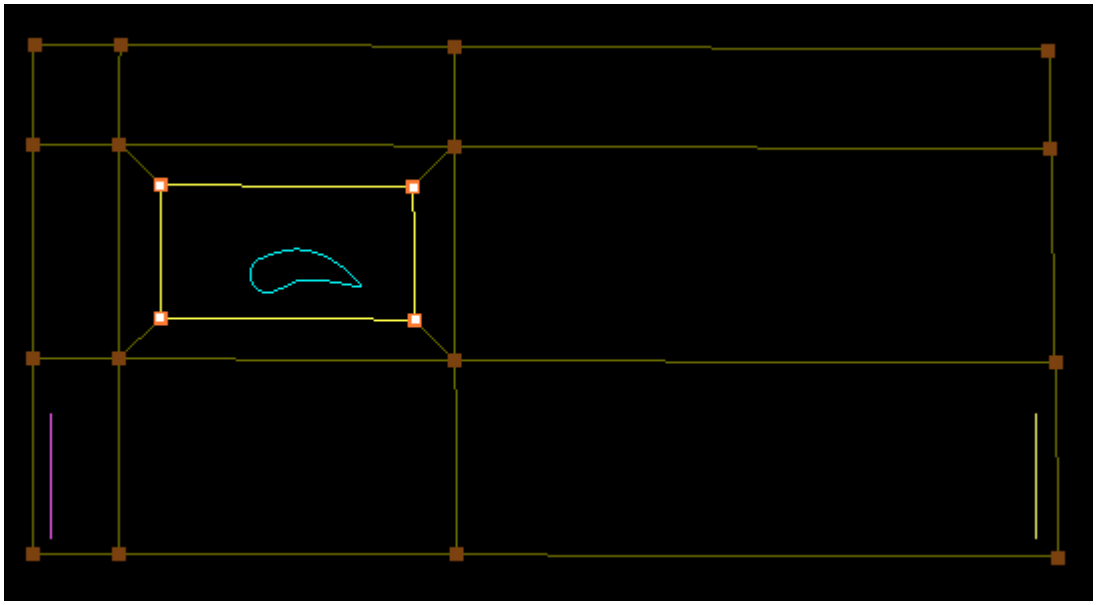
four corners in the right edge are assigned to the right surface. The inner wrap is assigned to the blade surface. These are shown in the figures below.



Surface Assignments for the Left Plane



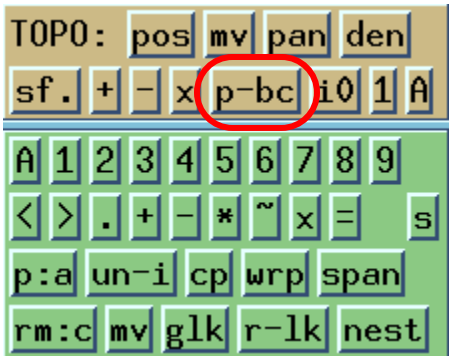
Surface Assignments for the Right Plane



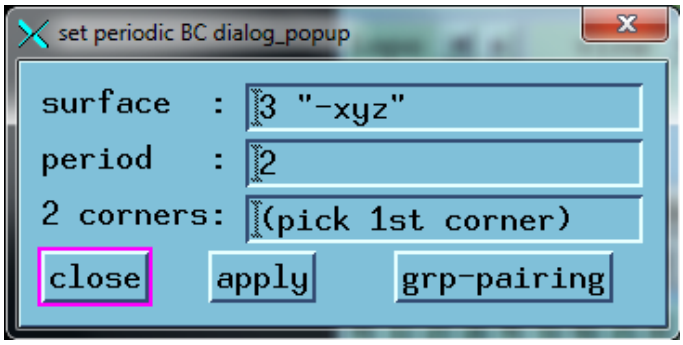
Surface Assignments for the Blade

There is still one more surface for which we have assigned the corners. This is the xyz surface. The way we assign corners to a periodic surface is different from the way we assign corners to a normal surface. For a periodic surface, the corners are assigned in pairs. To do this, you assign corners to a periodic surface as illustrated below.

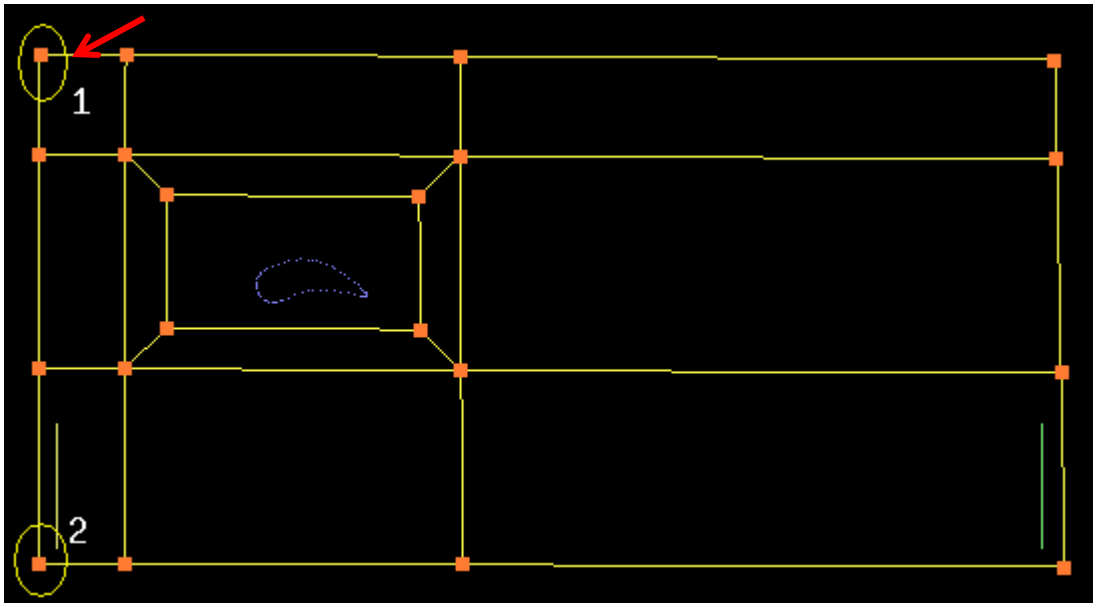
First, make the xyz surface the current surface. Then, click on the **p-bc** button on the **TOPO** panel.



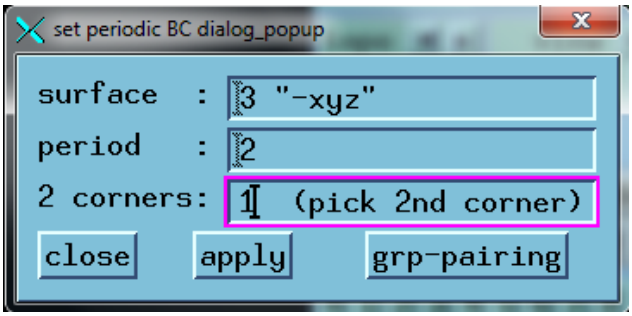
A pop-up window will appear. It looks like this.



At this stage you have to select the corners for the surface. As mentioned before, you have to select them in pairs. First click on the corner marked **1** in the picture shown below.

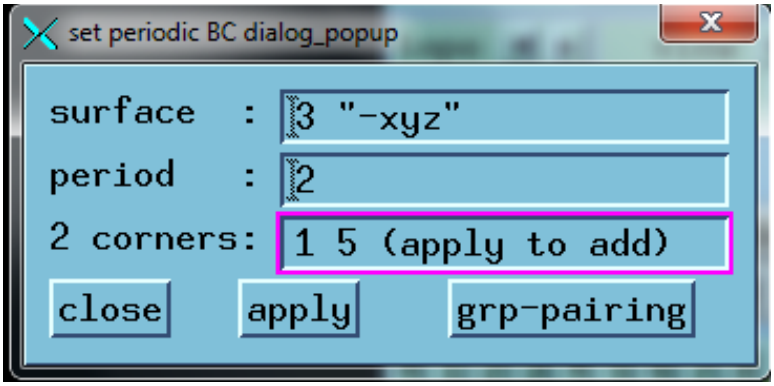


After you click on that corner, the pop-up window should change to something like this. It should be asking you to enter the second corners, which are number **2** in the picture shown above.



If the window does not ask you to pick a second corner, it means you have not clicked on the first corner properly. So, carefully click again on the first corner to make the window will ask you for the second corner.

Click on the second corner (marked 2). The window should then change to this.

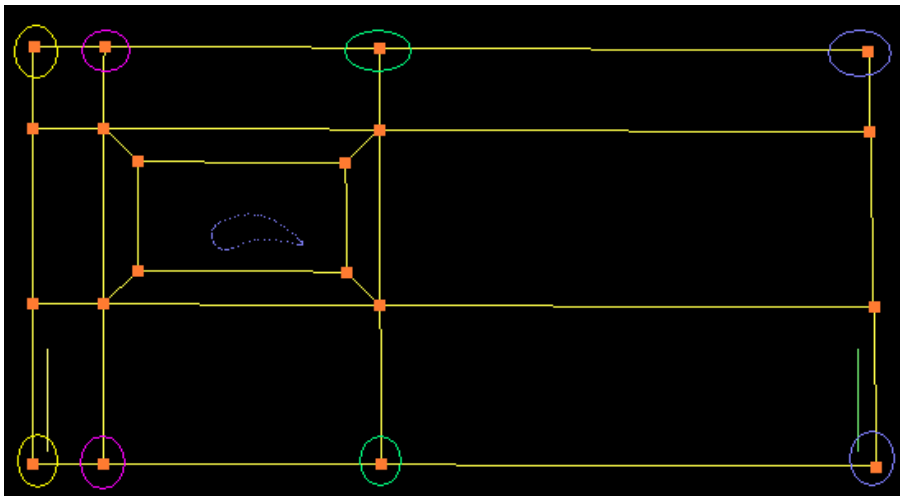


Click on **apply** to assign this pair of corners to the xyz surface.

Assignments in Pairs

You need to assign corners to periodic surfaces in pairs to identify the periodicity of the surface. For example in this case, you are saying that corner 1 is the same as corner 2, but with a type of phase shift by period 1.

Assign the other 6 corners in the same way. In the picture given below, the corners circled by the same color make up the pairs.



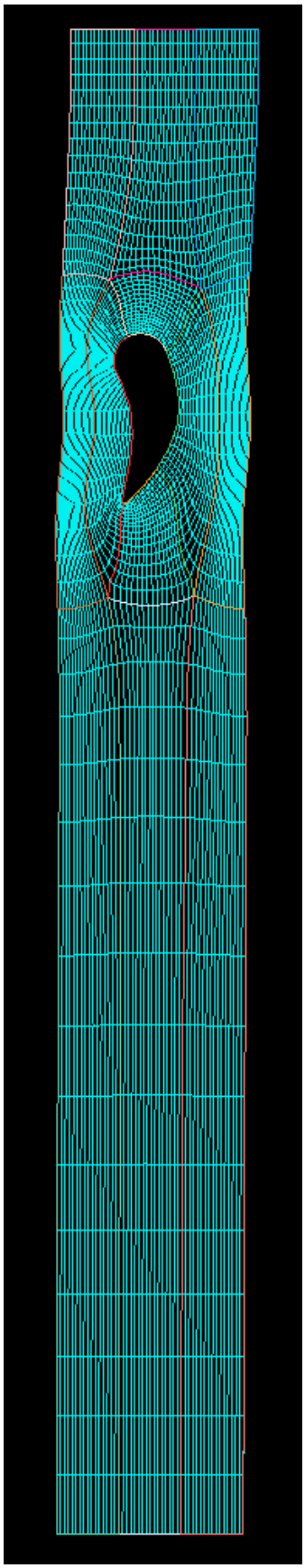
Colored Circles around the Corners Represent the Pairing

After you have made the assignment as shown below, you will see the corners assigned to be highlighted if the xyz surface is the present surface.

Step 4 Generating the Grid

You are now ready to generate the grid. You might want to change the densities of some edges before this, but this can be done interactively too.

Go to the **topo** sub-menu and select **Ggrid -start** to start the girding process. Load the grid into the **grid viewer**. After pressing **shell** in the GRID panel, you will see the grid like the one shown below. The two sides represented by the periodic surface seem straight at first, and the grid looks like the solution of a general blade in a box. But upon closer examination, you will see that the sides represented by the periodic surfaces are curved. This will be much more visible in Tutorial_**6.2**.



Step 5 using the *trf* utility

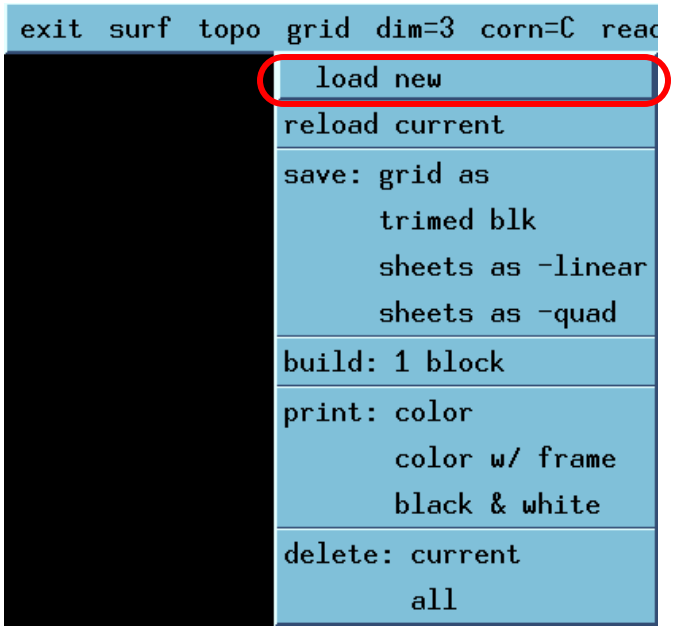
Now, to cascade the grids to together, you will need to use a **GridPro**® command line utility called the **trf** (short for transform). For a full description of the **trf** utility, type **helpaz trf** at the command line

The **trf** utility is a non-graphic utility, called so because it cannot (yet) be invoked from the graphic manager. You will have to go the command line, which will be the dos prompt in the case of windows machines. In windows machines, you can load the dos prompt by running **command** in the **start>run** option.

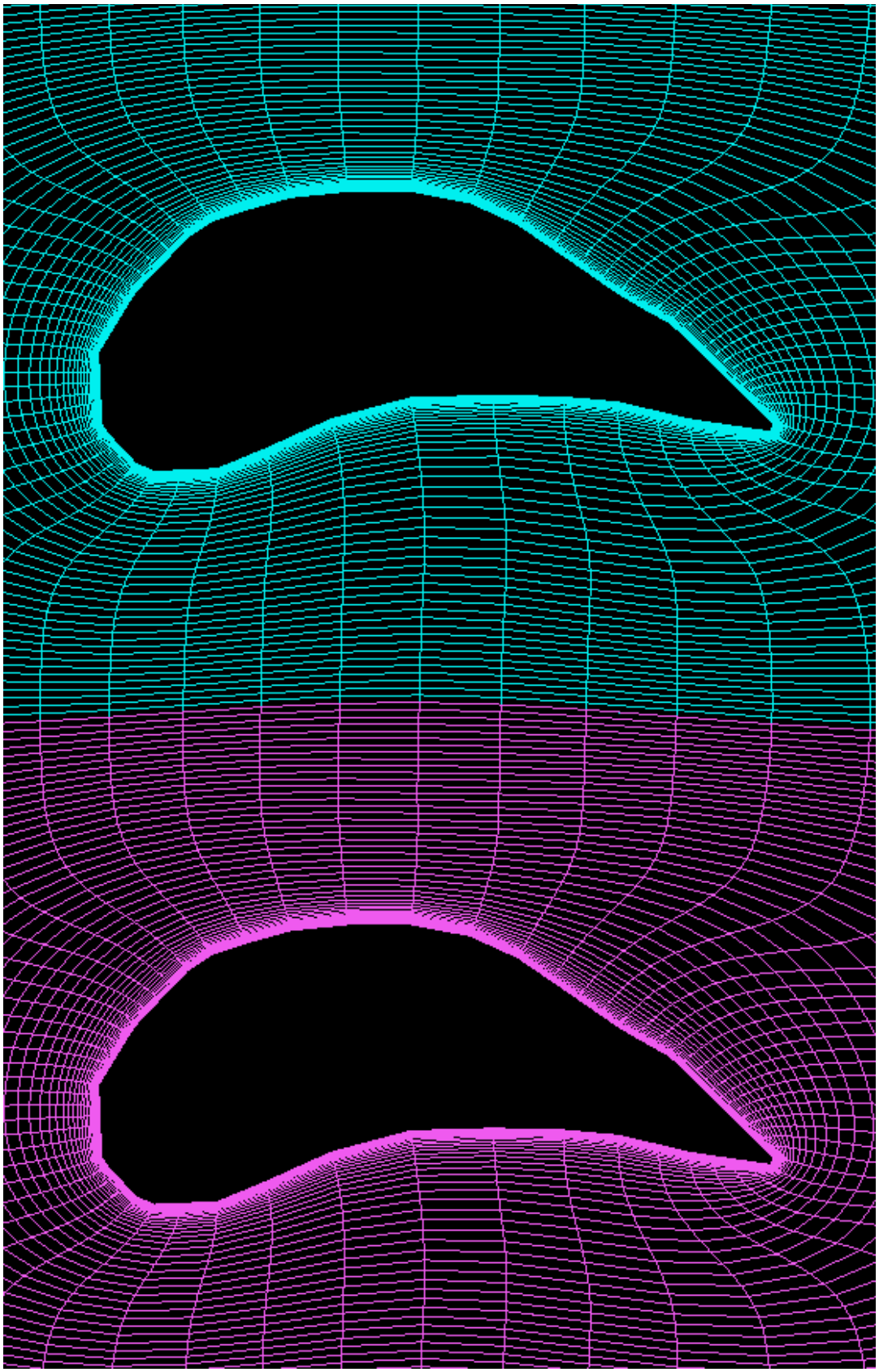
In the dos prompt, or in the UNIX shell prompt, go to the directory in which the **blk.tmp** file, the grid file which you had loaded, exists. At the command line type,

trf blk.tmp -t 0 -2 0

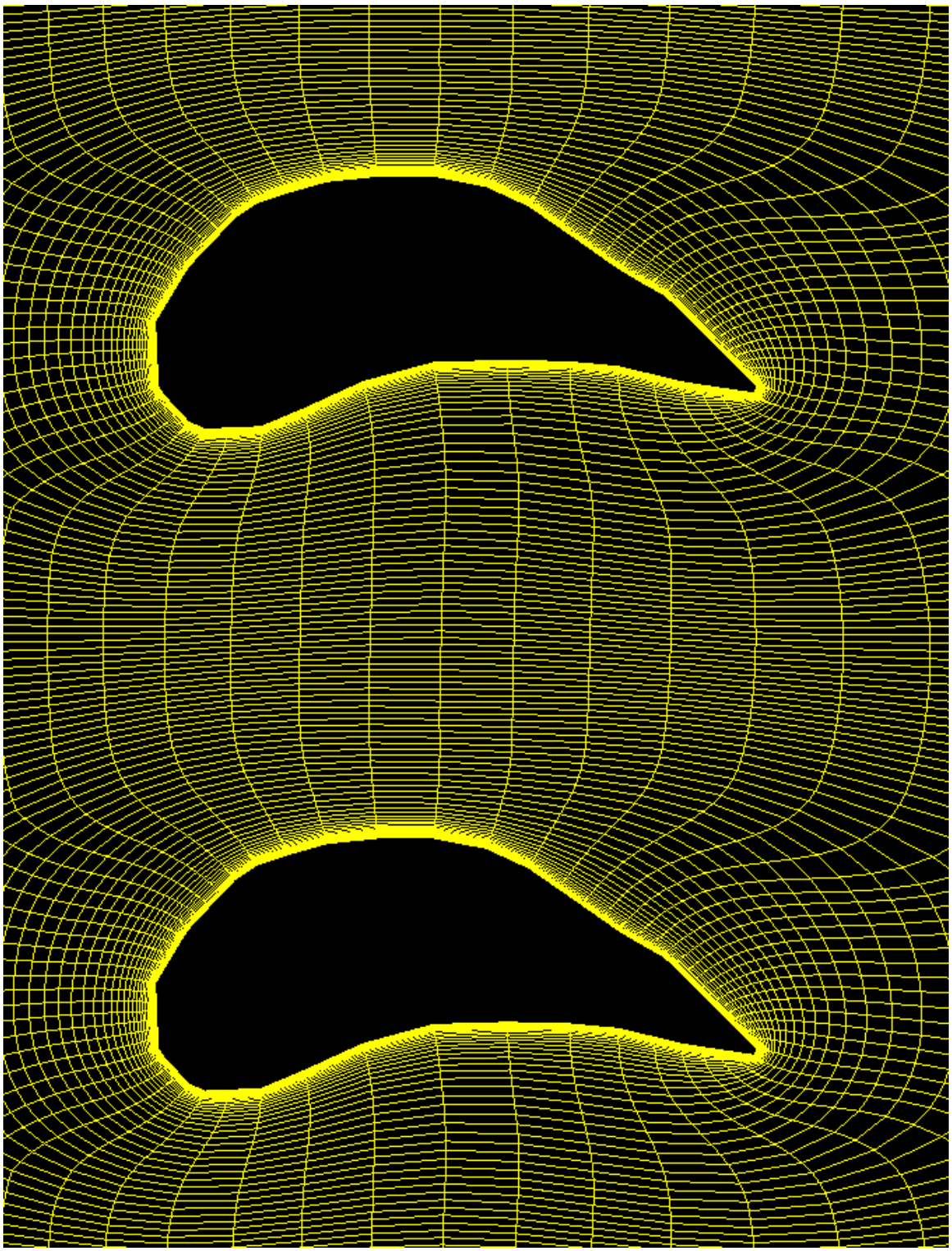
This will generate a new grid which is translated in the y direction by -2. This grid will be saved to the file **blk.tmp.tmp**. Load this file using the **load new** option in the **grid** submenu.



You will then be able to see both the grids cascaded as shown below.



Colored by Sheets



Colored by IJK

You can scroll through the grids by clicking on the arrows near the **grid** button in the CUR panel.

You can make more cascades similarly, and stack them on top of each other.