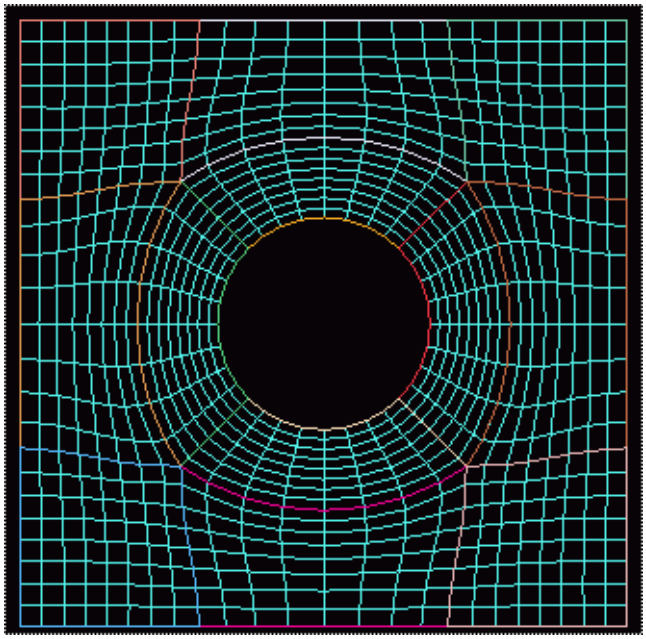
Tutorial 1.1: Getting Started

GridPro is an innovative, automatic grid generator which is easy to use when the user understands the basics of topology design. The technology is unlike any other grid generator on the market so we will begin our tutorial by starting out with a 2-D case that will emphasize the basic concepts and speed up the learning process. All of the concepts learned in 2-D will be used in 3-D grid generation that will be introduced in Part 2.

What You Will Create

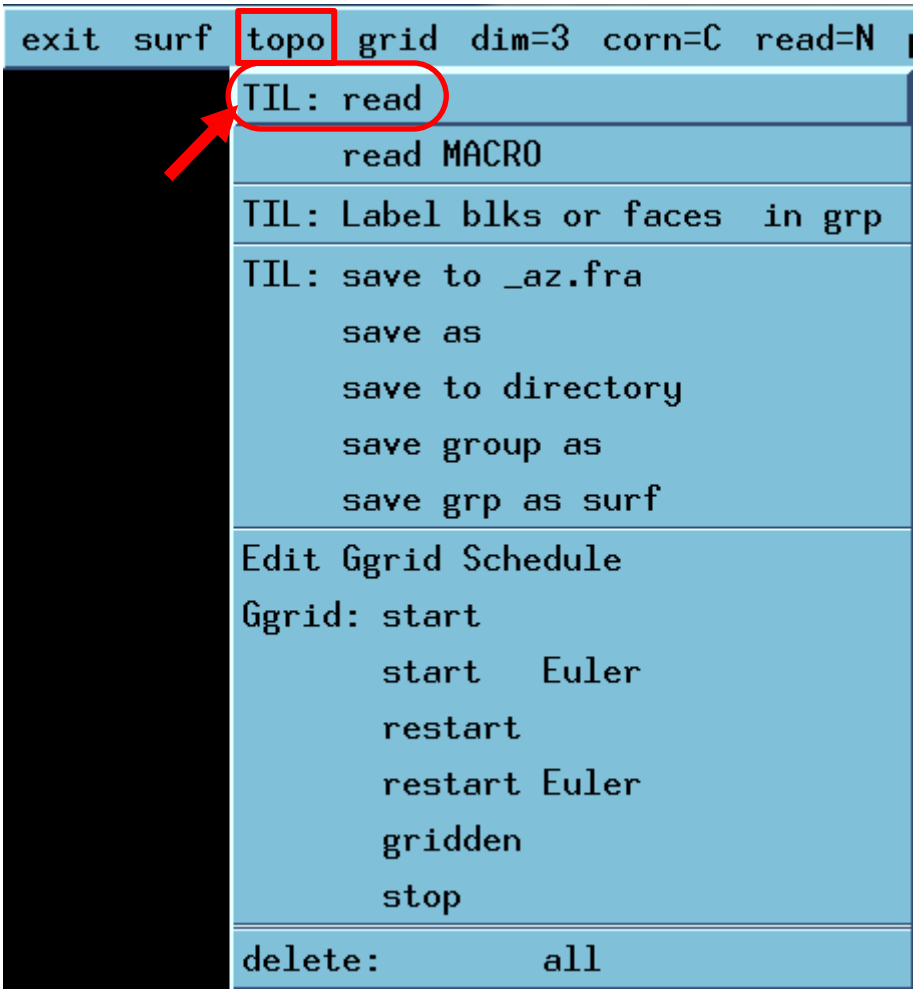


What You Will Learn

- Starting a GridPro session
- Zooming-in on geometry in the work space
- Turning on and turning off the global axis system
- Sizing the Cut-Plane
- Creating basic topology
- Inserting topology edges
- Using groups to wrap the topology
- Assigning the topology to the surface of the geometry
- Creating and viewing mesh

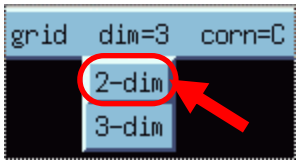
Step 1 Loading the Geometry

Load up the Tutorial 1 geometry by directly double clicking on the **Tutorial_1.fra** file, or by clicking on the topo button in the Topology menu on the top menu bar and load in the **TIL** (Topology Input Language) file by clicking on **Tutorial_1.fra**



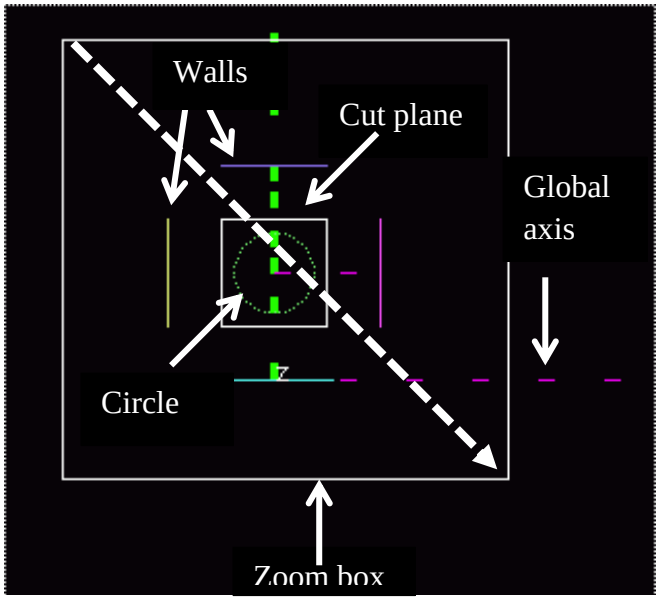
Step 2 Working in 2D

Put GridPro in 2-D mode by clicking on dim=2 in the menu bar at the top.



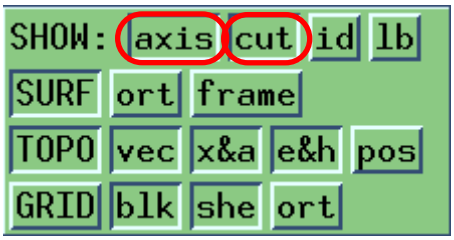
Step 3 Zooming-in

Zoom-in by right clicking on the mouse and dragging a box around the geometry which consists of a center circle and four walls as in the picture below.



Step 4 Turning off the Global Axis and Cut-Plane

The dotted straight lines represent the X and Y of the **Global Axis** and the rectangular white square the Cut-Plane. Since we are working in 2D and our geometry is relatively simple let's reduce the screen clutter by shutting off the  and the **Cut-Plane** in the **SHOW** menu on the **Command Panel** to the right (we will learn more about the Cut-Plane in a later tutorial).



Step 5 Meshing Objectives

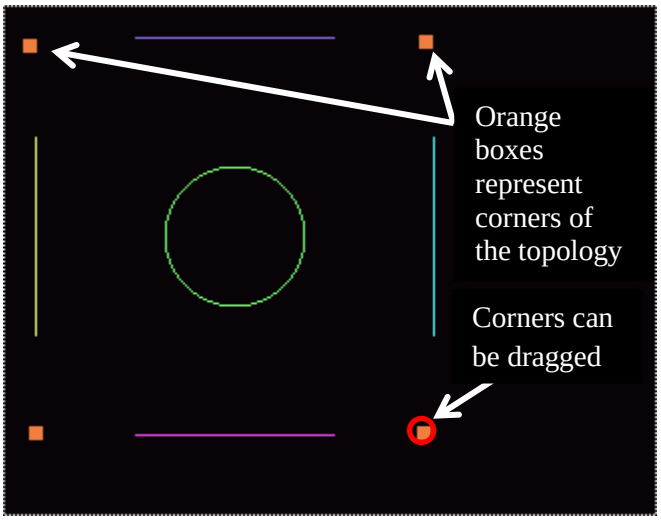
Understanding basic topology design is important in learning how to create a computational mesh. Much of the mesh in **GridPro** is automatic, however, the user must input basic topology information. This information exists in the form of points and edges that are "wrapped" around the geometry of interest. **GridPro** always makes a mesh that focuses on the most important part of the geometry, such as the boundary layer, that will remain refined and nearly orthogonal ensuring accurate and quick CFD results.

In this case two objectives must be accomplished:

1. Creating a mesh around the cylinder
2. Bounding the mesh at the four walls

Designing Topology

Start building the topology by creating four corners of a box around the geometry by pressing down the C key on your keyboard while clicking in the screen at the location where you would like to place the point, as in the picture below.

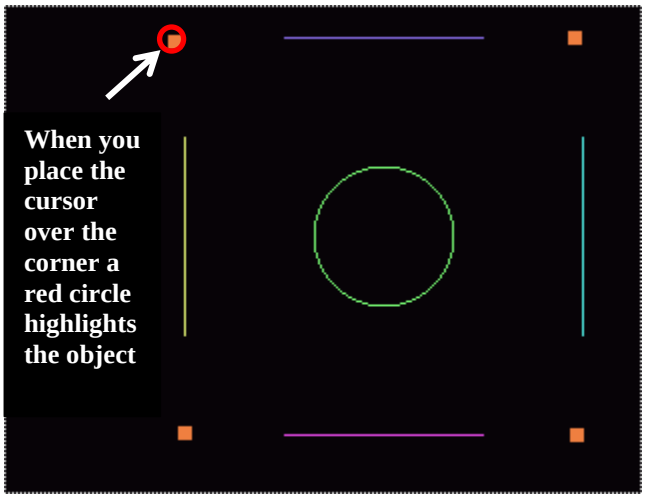


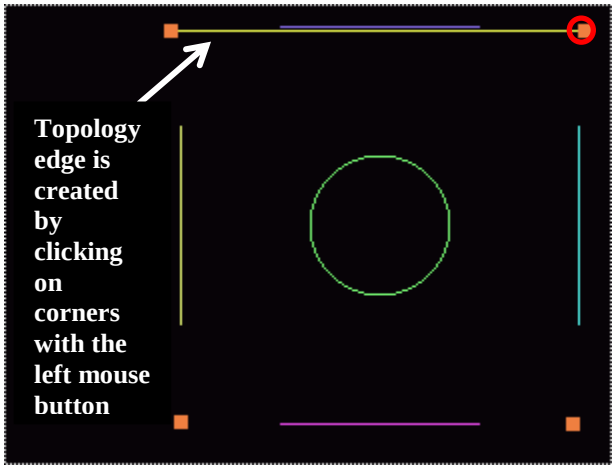
Dragging Corners

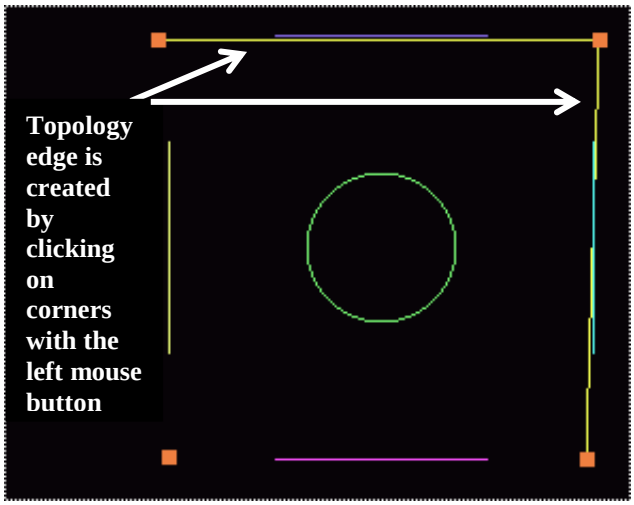
In **GridPro** all of the topology corners can be moved at any time. Place the cursor on the corner, and when a red or white circle lights up, the corner can be dragged with the left mouse button.

Step 6 Creating Outer Edges of the Topology

The topology needs to be "wrapped" around the geometry. The wrap is created by connecting the corners with edges. Press down the E on the keyboard and make the edges by clicking on the upper left corner, and while continuing to press E, click the upper right corner.

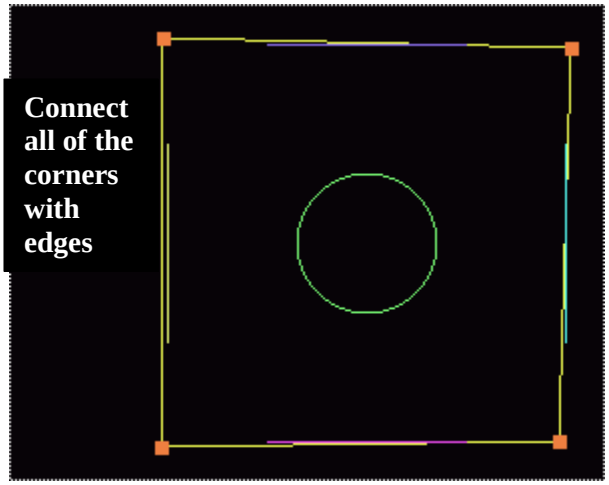






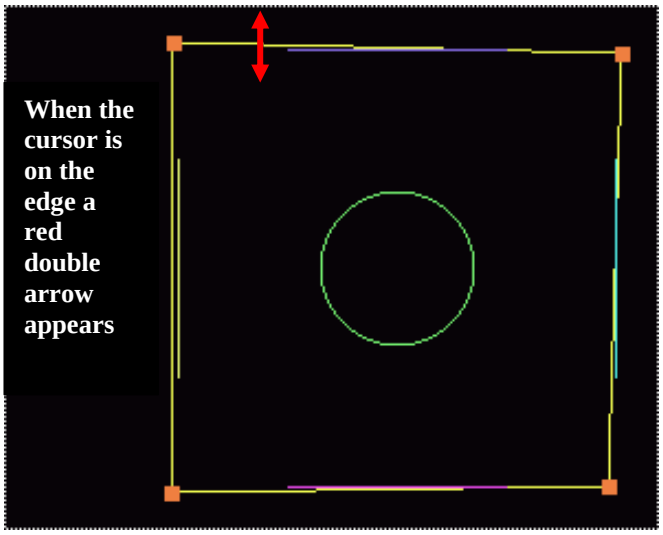
Flexibility in Topology Design

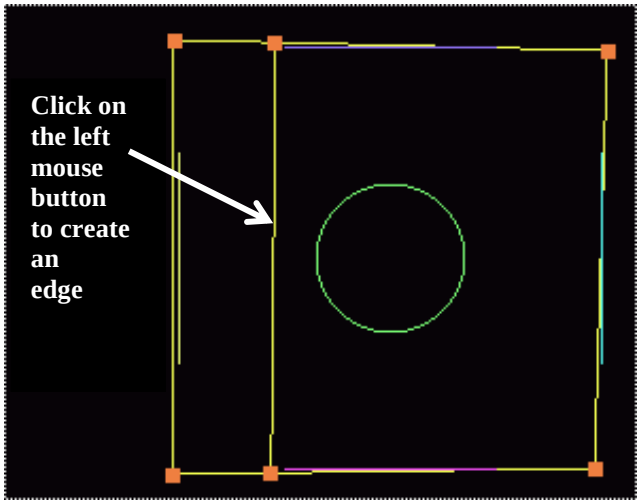
You do not need to make the edges straight or the corners perfectly symmetrical. **GridPro** allows flexibility in topology design. The corners and edges will be smoothed later during the gridding process.

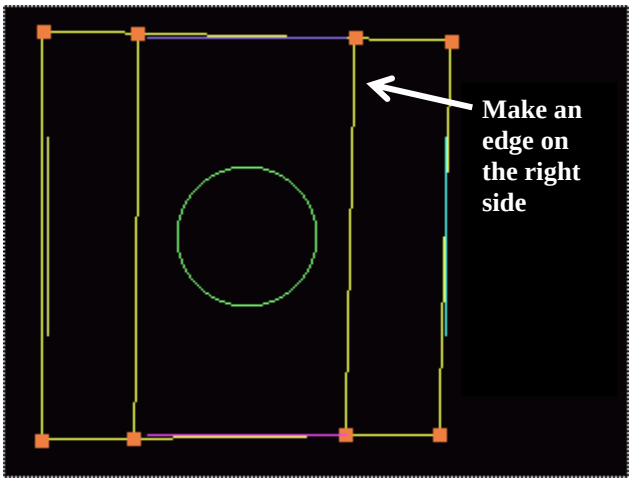


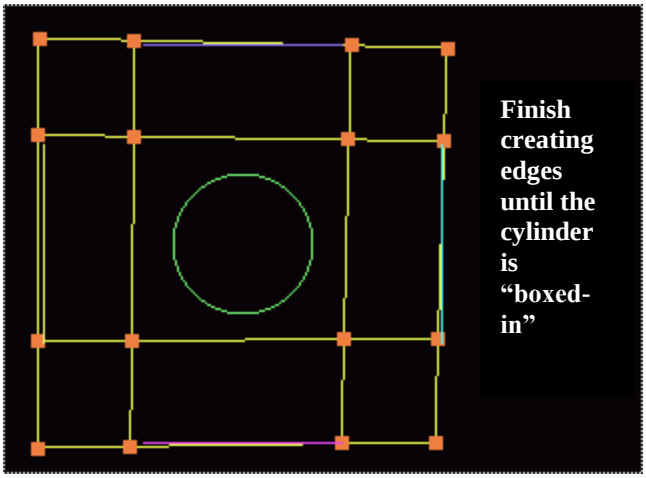
Step 7 Creating the Inner Edges of the Topology

Once the outer edges are defined, a wrap must be created around the cylinder. The objective is to "box-in" the cylinder by placing **Edge Sheets** through the outer topology. Once a box is created around the cylinder it will be used to "wrap" the geometry. While holding down  on the keyboard, place the cursor about 1/3 of the way from the upper left corner of the top edge and click the left mouse button.





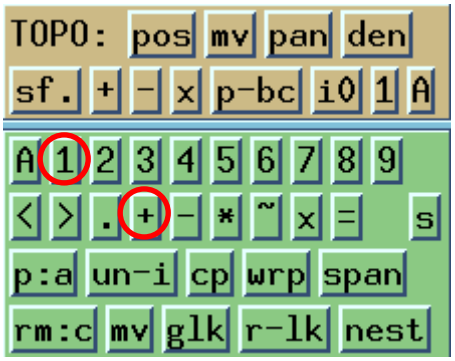




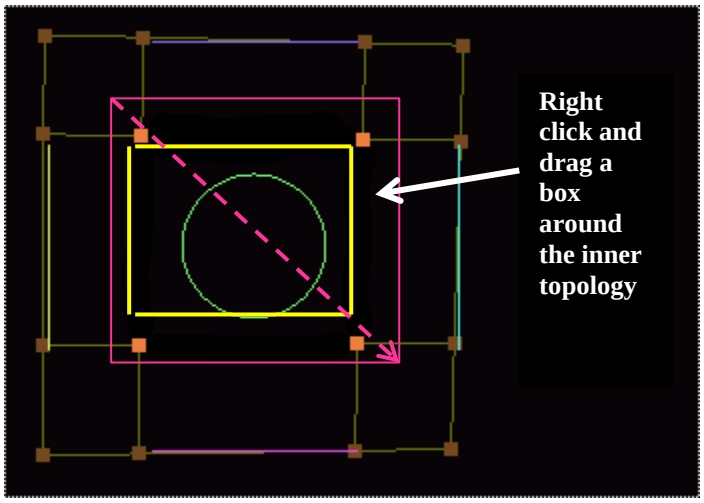
Step 8 Creating the Wrap

The wrap is created by grouping the four inner corners of the topology and extruding it a desired distance inward. A group consists of a certain number of edges and corners

chosen by the user. In this case an inner wrap around the cylinder is necessary. To group these corners and edges click on the  button in the TOPO menu and then on the  as in the picture below.

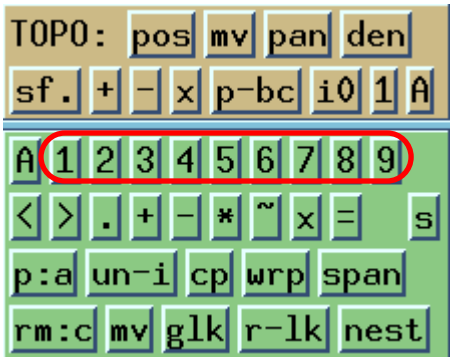


Now create a topology group by right clicking and dragging a box around the corners and edges. Since we would like to wrap the inner circle we choose the inner topology as in the picture below.



Grouping

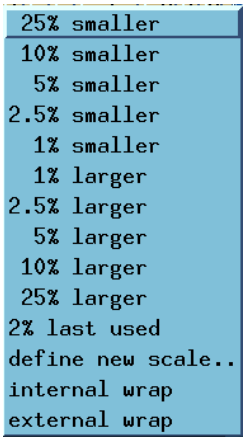
Notice that when the topology is selected it turns on and is highlighted while the remaining topology is off. Now if you turn on the group 2 button the entire topology turns off again because a group has not yet been defined. ONLY those corners and edges that have been added to a group will be highlighted when you pick on the group number. Groups in **GridPro** are very important particularly when creating a mesh for geometries of increasing complexity. Nine groups can exist at one time but an infinite number can be created, deleted and then recreated. Advanced grouping functions will be covered in a later tutorial.



Step 9 Wrapping

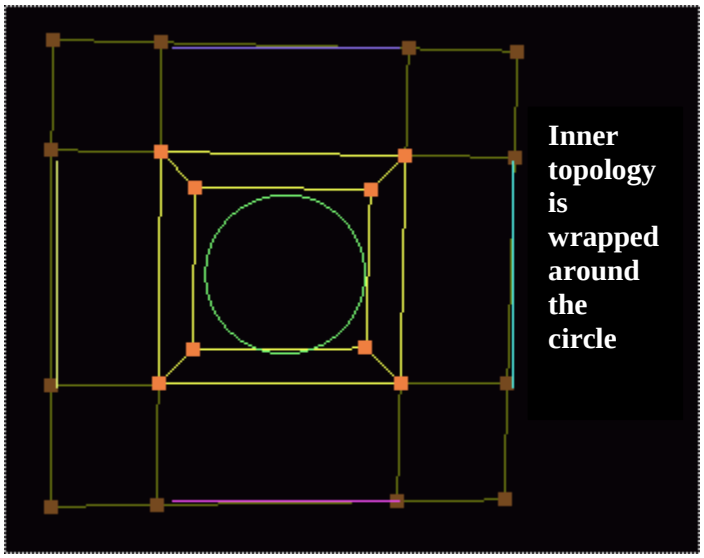
To wrap the topology make sure that the group 1 button is on and click on the wrp button in the **TOPO** sub-command panel to pull down the wrap options as in the picture below.

Wrap Options



Many "wrap options" are available. When you make a wrap smaller the edges and points are shrunk and are moved inwards at the chosen percent. If a wrap is larger, the size will increase and extend a distance proportional to the chosen percentage.

Choose a wrap that is 25% smaller. Notice that the points and edges automatically shrink at a 45 degree angle as in the picture shown below.

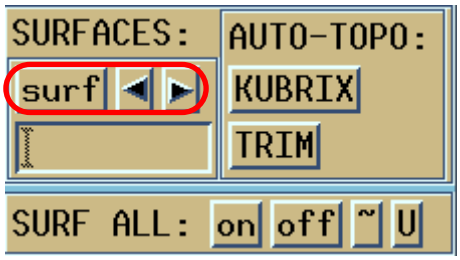


Step 10 Surface Assignments

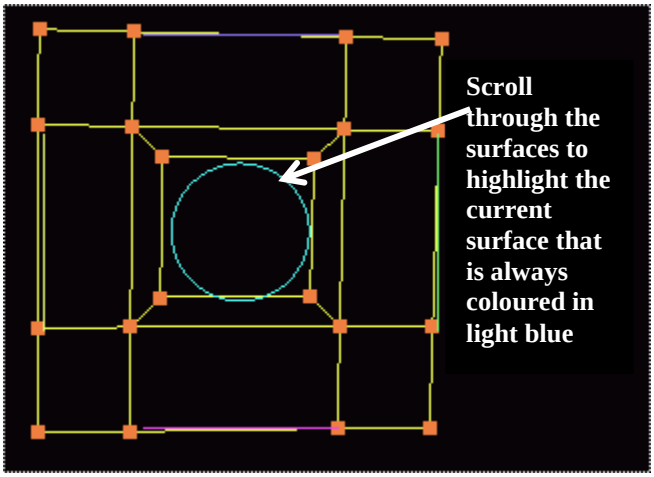
Once the wrap is created we are ready to assign the corners to the surface. In doing so, we need to keep two things in mind. First, a well-defined mesh needs to surround the circle to capture the boundary layer flow. Second, a well-defined box-like structure defined by the walls surrounding the circle needs to encompass the mesh region.

To satisfy our first condition, assign the inner wrap of corners to the circle by highlighting the current surface by scrolling through the surface selection 

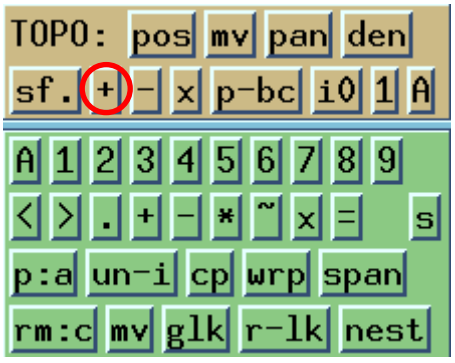
in the **CURRENT** menu.



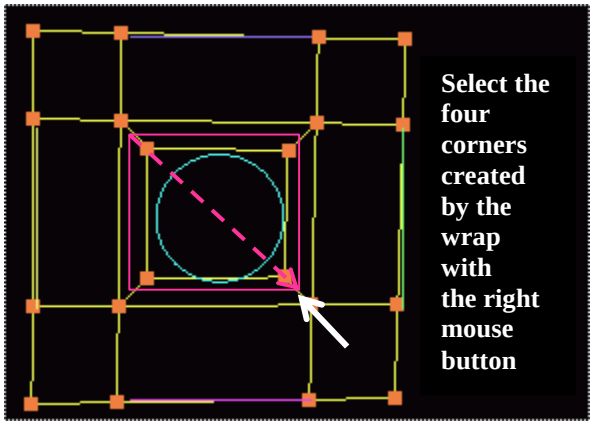
All current surfaces appear in light blue as in the picture below.



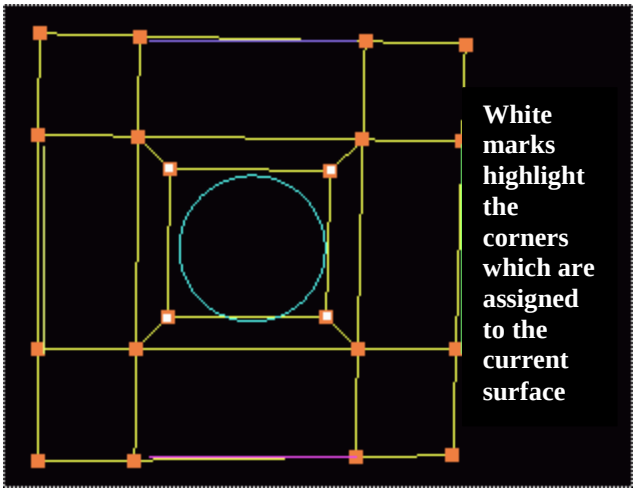
Once the current surface is chosen, you can assign the corners of the topology to it. Follow this procedure by selecting the + button to the right of the sf. in the TOPO menu.



Now click on the right mouse button and drag a box around the four corners created by the wrap (the corners closest to the circle). Zoom-in if you need a better view to pick the corners.

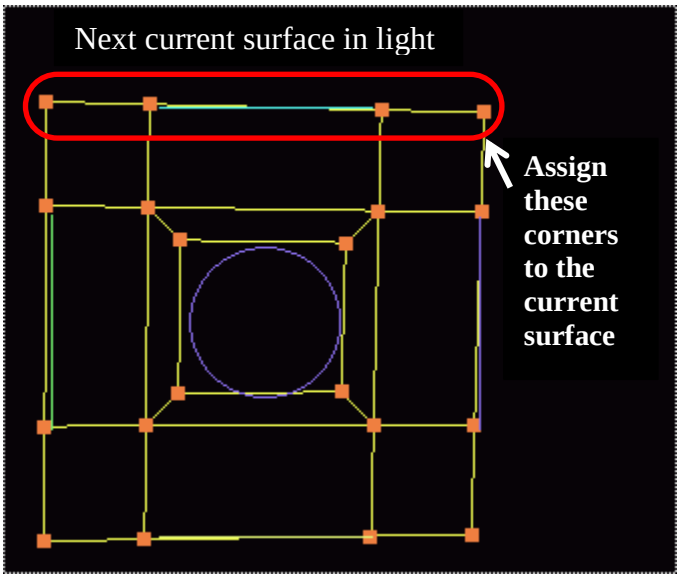


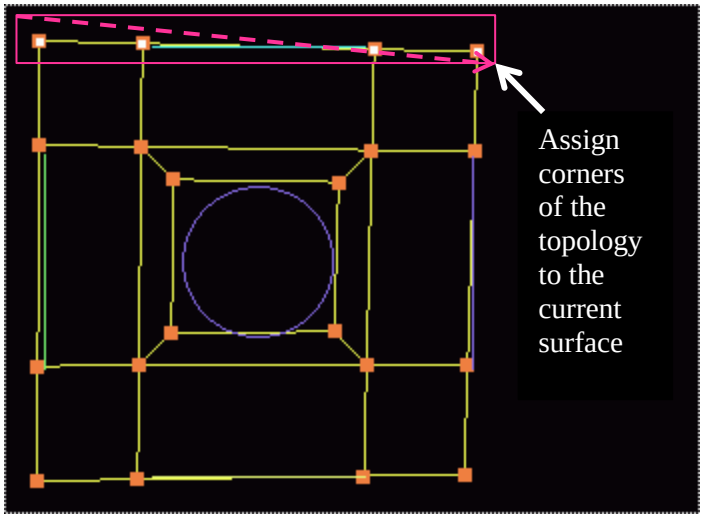
When the corners are selected they will be highlighted with a white mark. These marks are very useful in showing which corners are assigned to the current surface.



Scroll to the next current surface, to one of the walls, using the 

function. Notice that the white marks assigned to the circle turn off when you scroll to the next current surface. Assign the corners to the current surface.

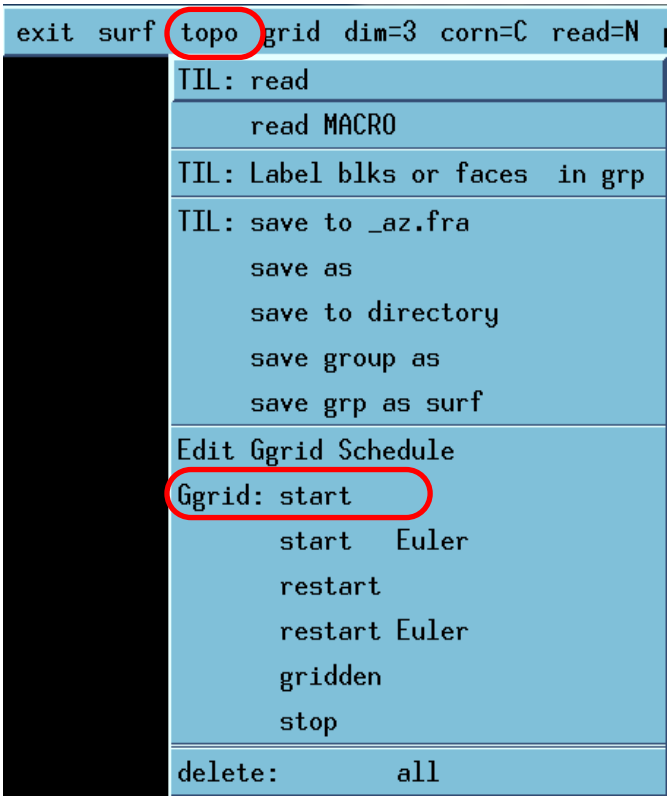




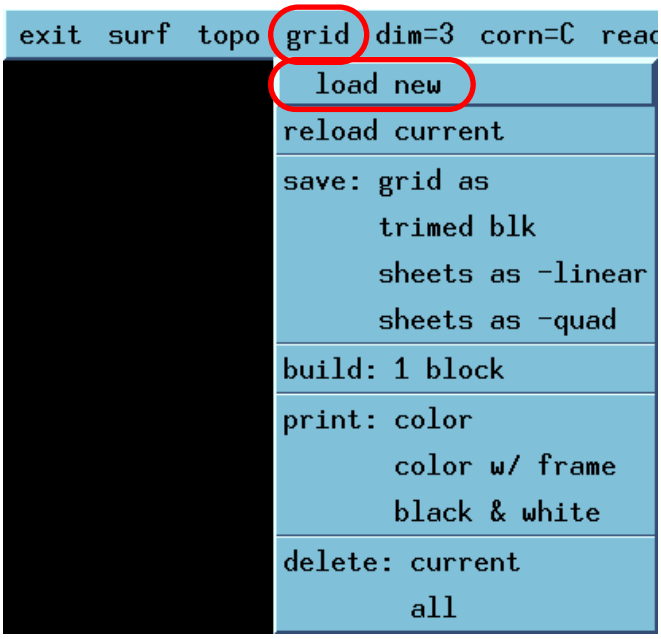
Assign the remaining topology to the four walls of the box surrounding the circle. NOTICE that you will NOT assign the corners in between the outer and inner most topology to a surface. Those corners and edges will remain within the mesh volume. The reasons for using this method will be explained later. Once the circle and all four walls are assigned with the topology corners, scroll through the current surfaces and notice that the white corner marks remain assigned to the selected surface.

Step 11 Creating the Mesh

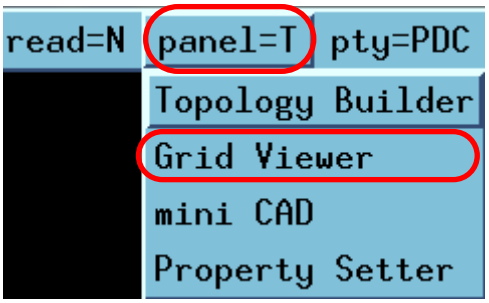
Now that you have created the topology and assigned the surfaces, let's create the mesh. Go to the **Top Menu Bar** and left click on the topo button to pull down the **topo** menu and click on **Ggrid Start** to begin the meshing process.



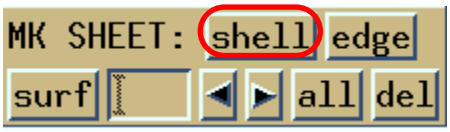
GridPro will tell you that the topology is complete and if it is **ok** to continue. Press **ok** to start the gridding process. Once the process begins, monitoring information will be exported to the UNIX or DOS window. Wait a few minutes and import the grid by going to the grid button to pull down the **grid** menu and click on **load new** and load the mesh by double clicking on the **blk.tmp** file.



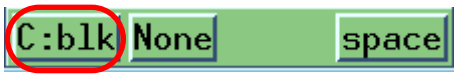
To view the grid, change the panel from **Topology Builder** to **Grid Viewer** in the panel=T pull down menu.

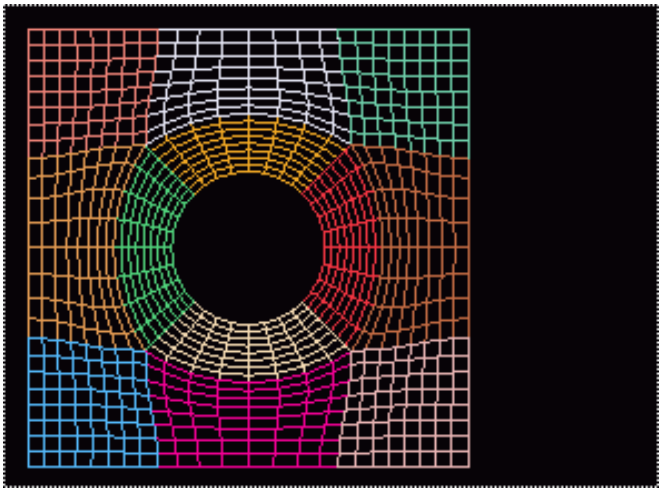


View the mesh by clicking on shell in the **MAKE SHEET** menu and,



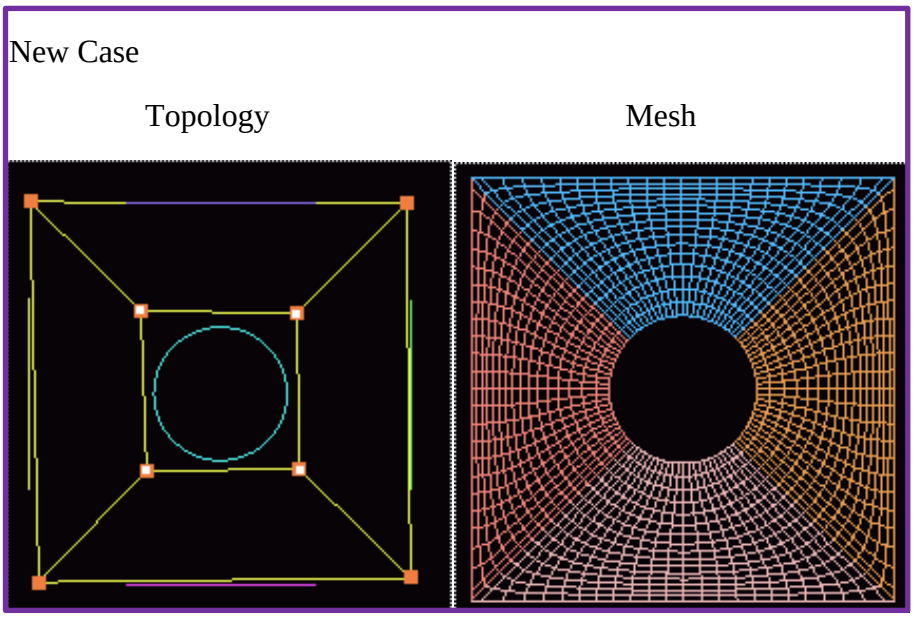
colour the blocks of the mesh by choosing **Colour by Block** in the sub-panel at the very bottom of the command panel.

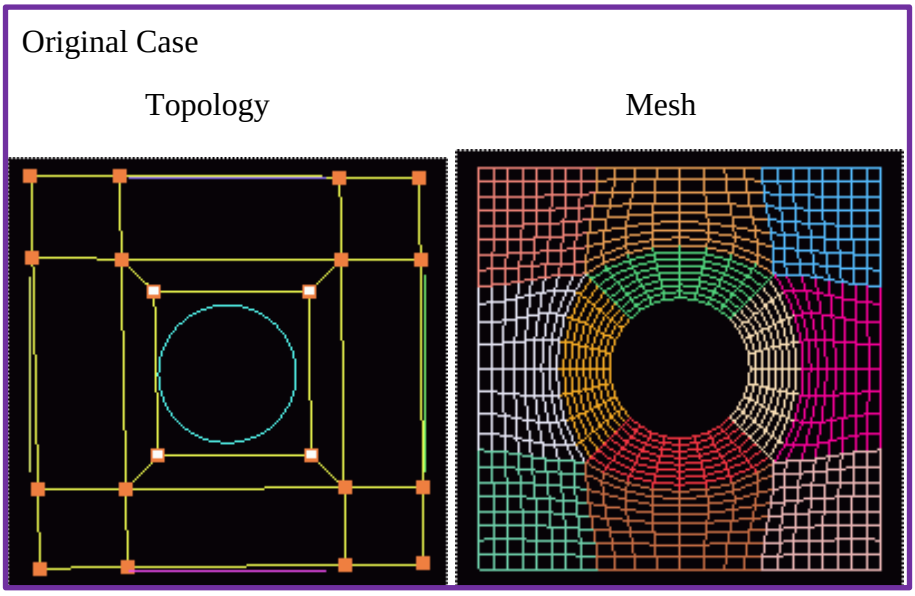




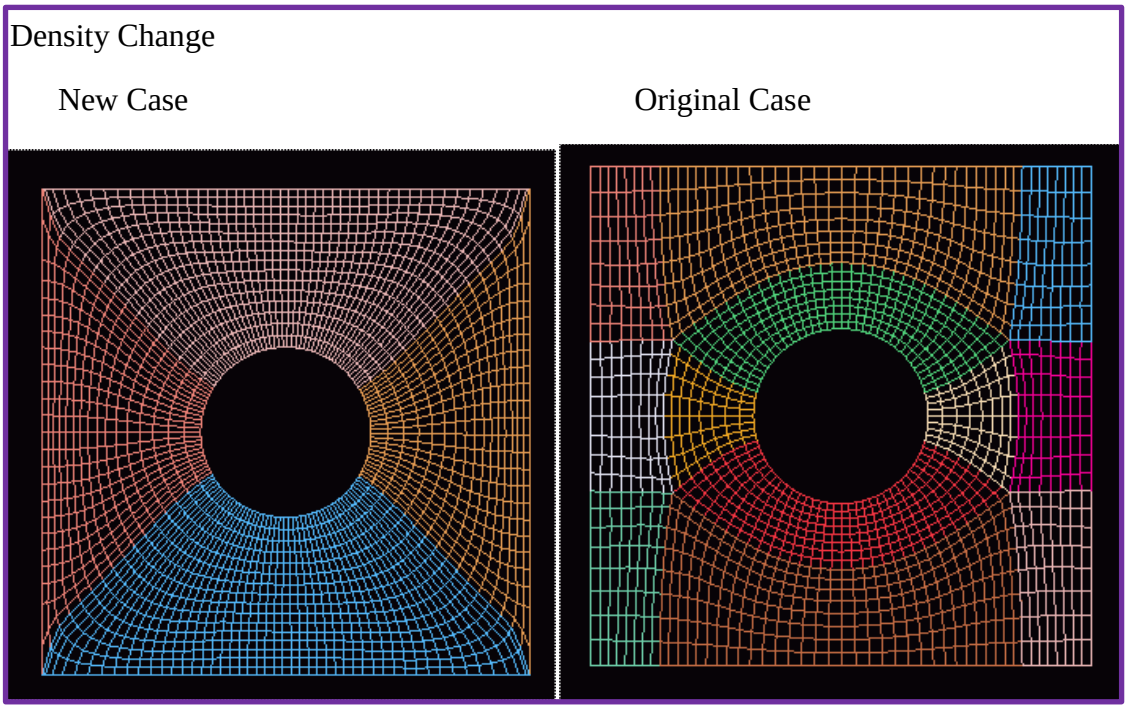
Topology Design Intent

As you use **GridPro** to mesh more complex geometry, you will discover that a mesh can be created in many ways. However, the reason for using **GridPro** is to optimize the mesh on the area of most importance, such as, the surface of the geometry. In this case the mesh on the circle and four walls are of interest. Let's mesh this case with the same mesh density in another way by creating the topology at the walls and assigning its wrap to the circle and compare it to our original case.





As can be seen, the original topology creates a mesh with a more orthogonal grid at the boundaries of the circle and the wall. The inner topology of corners and edges are allowed to come to equilibrium within the mesh volume creating a blocking pattern. The result is a fine mesh at the boundaries of the geometry. The corners of the new mesh are forced to come to equilibrium at the boundaries without the intermediate topology. This method creates a four block structure with a distorted mesh at the walls. Now let's look at density change along one of the blocks and review the mesh (you will learn how to change the density in a later tutorial).



As can be seen from the above picture, the New Case's grid is highly distorted while the Original Case's grid remains non-distorted and nearly orthogonal.