Advanced Unstructured Block Creation

Many of the face creation buttons may seem obscure at first, but they can save you a lot of time when making complex block faces. In this Pointer we will cover how to use the various face creation commands to make unstructured block creation just a little easier.

Definitions

An **unstructured block** is the volume enclosed by an unstructured face. An **unstructured face** is a manifold (closed) surface composed of domains. The domains can be unstructured, structured, or a combination of both. A **baffle face** is a non-manifold surface included in the block definition. By non-manifold, we mean it can have free edges and can join another face along an edge. Baffle faces are useful for representing thin surfaces and for gaining additional control over grid spacing on the interior of unstructured blocks.

Face Creation Commands

Since this is "advanced" face creation we are only going to discuss the more exotic buttons on this menu. If you need a refresher on the others, please refer to Gridgen's on-line help.

The buttons we will use are:

☑ NonMnfld Cnnct 1 This controls whether to allow non-manifold connections when trying to build a face. In general, you only want this toggled on if you are building the face manually. This will allow you to build abutting blocks, which would be prevented if you could only pick domains with manifold connections. If there are not any non-manifold connections between domains in your grid this setting has no effect.

AutoSave ◆ Off ○Face ○Faces The AutoSave options govern in what manner Gridgen will try to attach domains when building a face.

Off is used when you want to assemble the face manually. Use the **Save the Face** button to indicate the face is complete when building a face manually.

Use AutoSave **Face** when the domains you are selecting all fit into a valid closed face or baffle faces of an unstructured block.

After your selection, Gridgen will try fit as many domains as it can into a face and then save that face. It begins with one of the selected domains and grows the face from there. Any of the selected domains that cannot be added to the face, either because they do not adjoin the face or due to one of the selection filters (**Struc, Unstr, NonMnfld Cnnct**) will be left out.

AutoSave **Faces** assembles the selected domains into as many faces as are necessary to use them all. It may make more than one face from the selected domains. Domains that are not connected to other domains end up as baffle faces and separate faces will be set up where there are non-manifold connections.

Example Face Creation

Next, let's look at an example block and see how the face creation commands can help us create it. For simplicity, we will use Gridgen's **Mixer** Tutorial case, which is shown in Figure 1. You might want to read it into Gridgen, and try some of these things yourself as you read this.
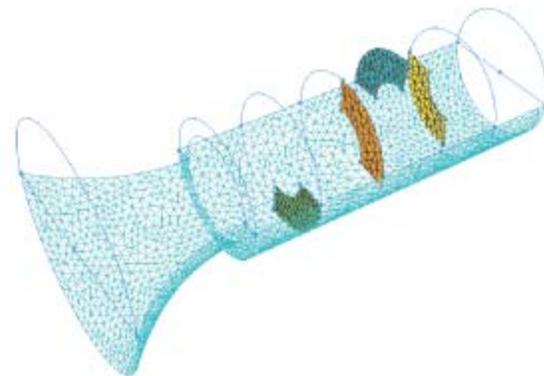

Figure 1 - A mixer with baffles

The geometry has a converging inlet section on the left, followed by a cylindrical passage with four baffle surfaces in it. In the unstructured block, we will have one face (the walls of the inlet and passage plus inlet and outlet domains) and four baffle faces to represent the mixing plates in the channel (the domains shown in solid/wireframe in Figure 1). You could build these by carefully picking each domain that makes up the face, saving the face, and then doing the same for the baffle faces, but there is an easier way.

If you are following along in Gridgen, read in the **Mixer** tutorial, and delete its block while keeping the domains. Next, go to **Blocks, Create** (make sure **unstructured** is picked), then **Assemble Faces**, and **Assemble 1st Face**.

Now for the automatic part, toggle off **NonMnfld Cnnct** and
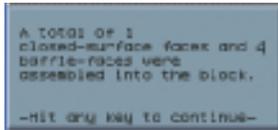
select AutoSave **Faces**, then Pick **All Domains**. If you followed all that correctly, the message window will say:
This is exactly what we want, so hit any key, save the block, and you are done.

But what happened? There were two things. First, turning off **NonMnfld Cnnct** told Gridgen not to add domains along any edge of the developing face that has non-manifold connections (adjoins more than one other domain). Second, AutoSave **Faces** told Gridgen you want to make as many faces as possible with the selected domains. This allowed Gridgen to sort through all the domains and correctly figure out which ones belonged in baffle faces and which ones were part of the enclosing face.

There is a caveat to this. Gridgen identifies baffle faces by looking for domains with free edges, i.e. edges that do not connect to other domains. In this case, our baffles all have free edges, so it works fine. If we had a baffle that completely spanned the passage, AutoSave **Faces** would not correctly identify it, and we would have to build the face manually.

Example 2: Bounded baffle
Let's look at a more complicated situation now, one which violates the above caveat. Replace the second baffle domain from the left with one that touches the walls of the passageway all
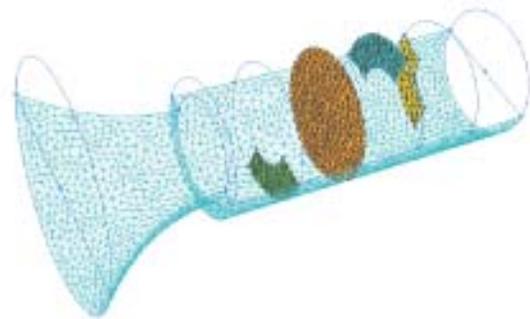

Figure 2 - Mixer with a fully bounded baffle face

the way around as shown below. This baffle is fully bounded with no free edges.
Create the block using AutoSave **Faces**, **NonMnfld Cnnct** toggled off, and Pick **All Domains**. The message window will give the same report as the previous example.

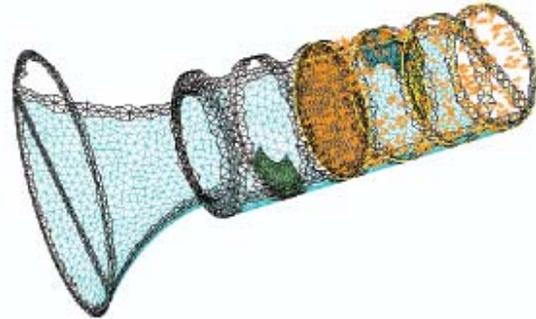That sounds promising since we expect to get one closed face

Figure 3 - Automatic procedure gives partial face
and 4 baffle faces from this. However, let's look a little closer. The image in the Display window is shown in Figure 3.

Note all the orange arrows pointing into the volume to the right of the bounded baffle and the lack of arrows on the left side. That is because Gridgen has incorrectly determined that the surface domains to the left of the bounded baffle fit together into a single baffle surface. Gridgen did not recognize the bounded baffle as a baffle face and included it in a closed face along with the surface domains to the right of it in the figure.

To get around this problem, you can create the block manually.

Face construction tips
Based on the behaviors demonstrated above, here are a few tips for building unstructured faces.
- Toggle on **NonMnfld Cnnct** for manual face construction when you need to pick a domain that joins more than one other domain along the same edge. Otherwise, toggle it off.
- Use AutoSave **Faces** to build a closed face and multiple baffle faces all at once.
- Do not use AutoSave **Faces** if you have any baffle faces without free edges.

In summary, there are some automated tools to help you construct unstructured block faces. They can make it easy to build quite complex face topologies. However, you should examine the faces they create carefully to make sure they are exactly what you want.