Exercise 6b - 3D Solid Meshing with Hexas and Pentas

This exercise will demonstrate a method for splitting a solid and then use the solid map function to create Hexa/Penta Solid elements. It is important to note that this is simply one way of splitting this solid. As with any solid geometry there are often many ways of obtaining a fully mappable solid and while some are better than others, there is rarely a "right" way of doing it. Experience is the key with this function; so experiment with different techniques for solid splitting and observe the results you get.

Step 1: Import the model

1. Locate and import the Geometry file `06b-STAND-SOLID-MAP.prt`

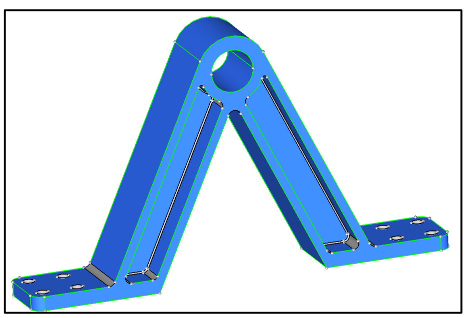
   This model is in a ProE .prt format.

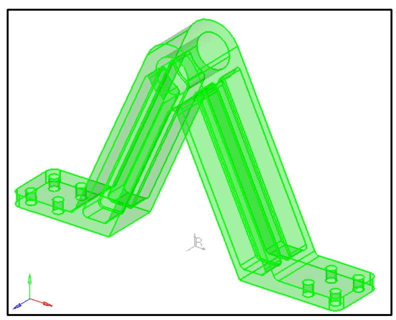
Step 2: Defeaturing

Small fillets make the geometry substantially more difficult to split into mappable regions and result in a far more complex solid mesh. In many cases, these fillets are for manufacturing purposes and can be eliminated from the geometry.

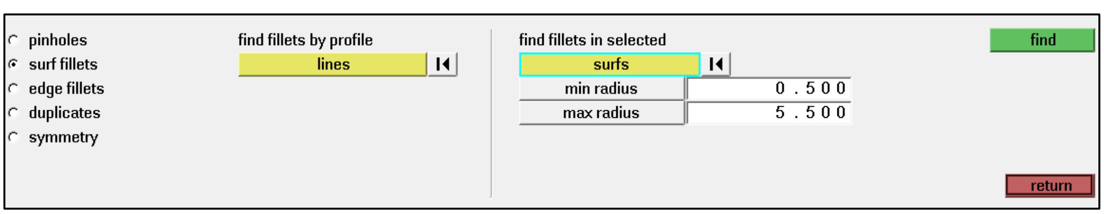
1. **Defeature** all of the small internal surface fillets.

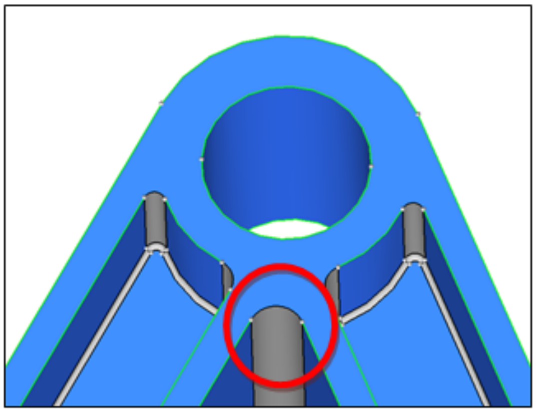
   From menu bar, click **Geometry > Defeature > *Surface Fillets***

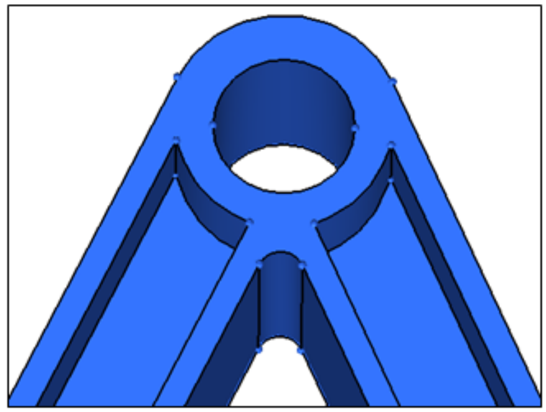




<u>HINT:</u> Setting the search values to be **0.5 > 5.5** will select all of the fillets needed. This range will also result in the fillet shown in the picture below to be selected (fillet in the red circle area). This fillet must be removed (**mouse >*Right Click***) from the selected fillets, before to proceed with "***remove***", as defeaturing it would cause a sharp point that would act as a severe stress concentration area.



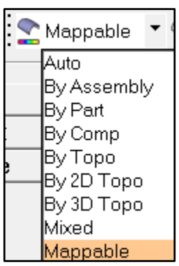




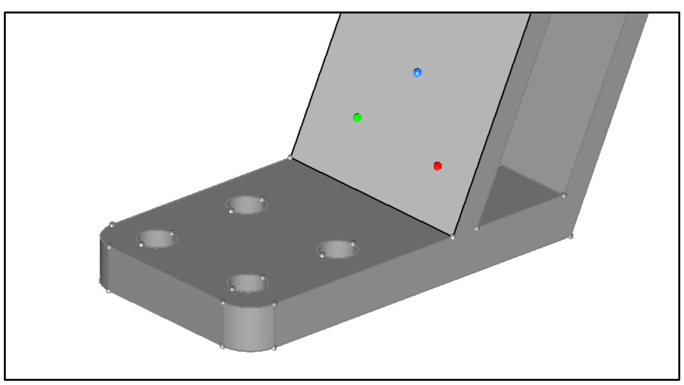
Step 3: The first split

There is no set method for splitting a solid and often the first cut is the hardest, as picking the location to begin can be confusing. Often it is easiest to find areas that look to be close to being mappable. Many regions are only one cut away from becoming mappable and these frequently are the best place to start. In the case of this model, these areas are the flat “feet”. One cut will separate them from the rest of the solid and they will immediately become mappable.

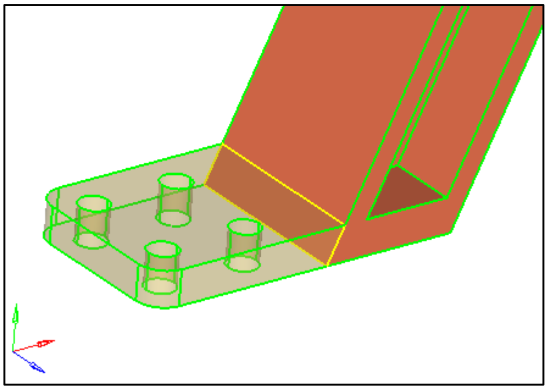
1. Turn on **Mappable** visualization:



2. From menu bar, click **Geometry > Edit > Solids >** ***Trim with Plane/Surfaces.***
3. Select the solid and using the **N1 N2 N3** option, define a plane on the flat area as shown in the picture below.



4. Trim the solid and the result will be a mappable region on the “foot”.

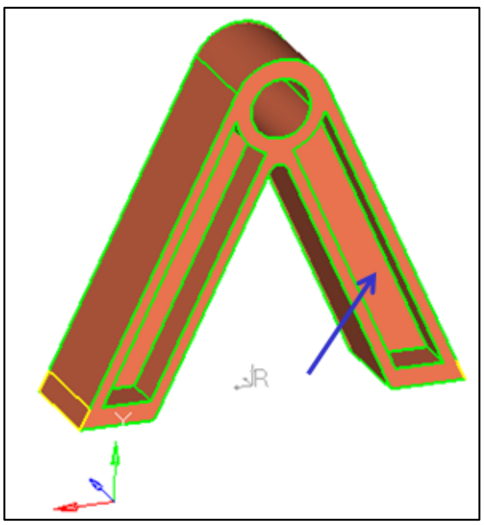


5. Repeat this trim on the other side of the part.

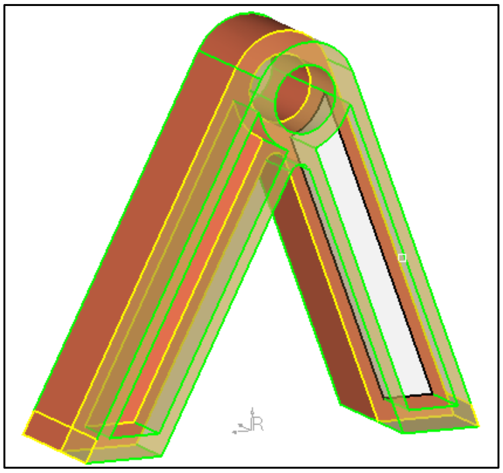
Step 4: Splitting out further mappable regions.

With the first splits done, now we can look to what is remaining and determine how these regions can be made mappable. It is often easiest to visualize this by masking the areas already split into mappable regions, thus showing only the areas of the part that remain to be split.

1. **Mask** the two mappable solids that were created in Step 3.

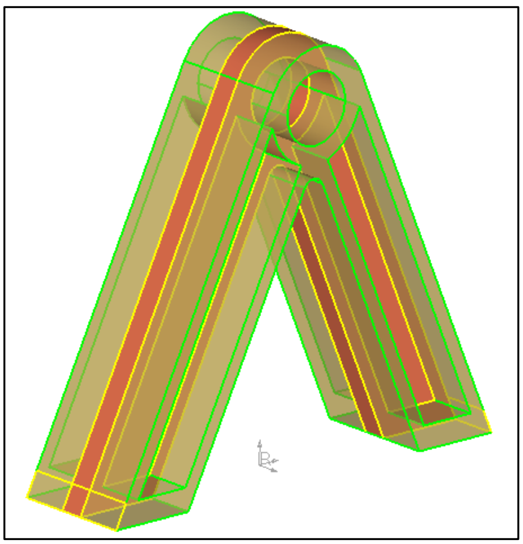


2. From the **trim with plane/surf** subpanel, select the solid and define a plane on the flat recessed area.
3. **Trim** the solid.



4. Repeat on the other side.

   The solid is now in three distinct regions; the two outer regions being mappable and the central region which is still un-mappable.



5. **Mask** the two newly created mappable solids.

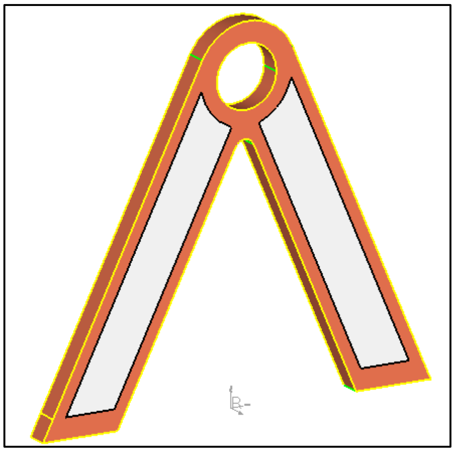
Step 5: The last trims.

With the thin slice of the part remaining, it is now important to determine which feature(s) is (are) causing this solid to remain non-mappable.

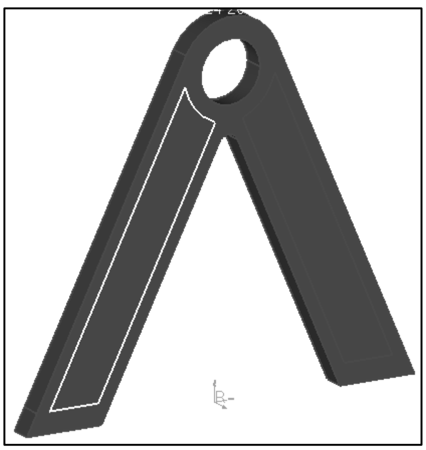
Remember that the rules state that a mappable solid can have multiple source faces but only ONE destination face.

The surfaces that make up the face of the pocket that was on the complete solid (highlighted in white in the picture below) occur on both sides of the remaining solid. This means there are multiple surfaces on both sides of the solid and thus violate the mappable rules.

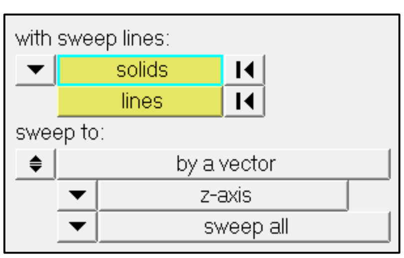
In instances where specific regions prevent a solid from mapping, trimming those regions out can result in a mappable solid.

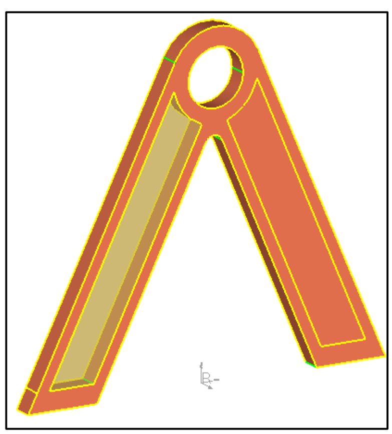


1. Select the **trim with lines** subpanel or
   from menu bar, **Geometry > Edit > Solids > *Trim with Lines.***
2. From the **with sweep lines** column, pick the remaining solid.
3. For the **sweep lines,** select the outline of one of the surface shown in white above.



4. As this model is aligned with the Global Axis, select the **sweep to:** option to be ***by a vector >> z-axis***, select the **sweep all** option, and then **trim** the solid.

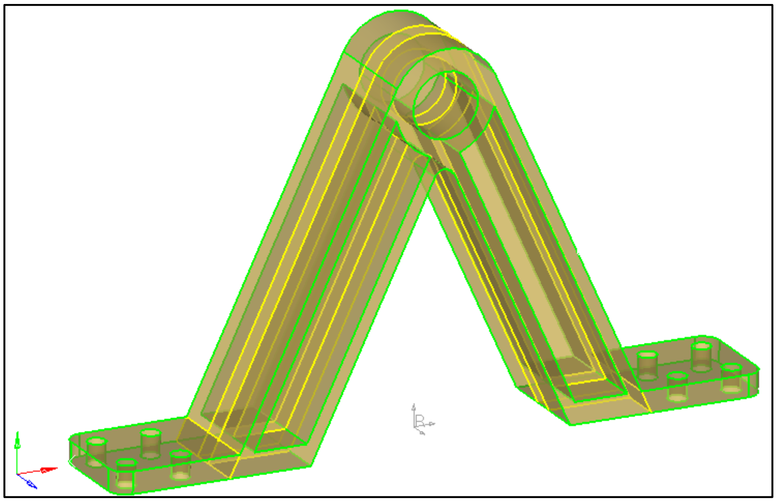




5. Repeat this process for the other side.

   This will result in a fully mappable solid.

6. **Save** the model.

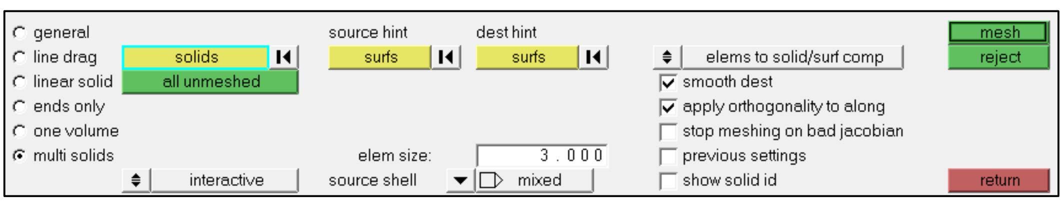


Step 6: Solid Meshing

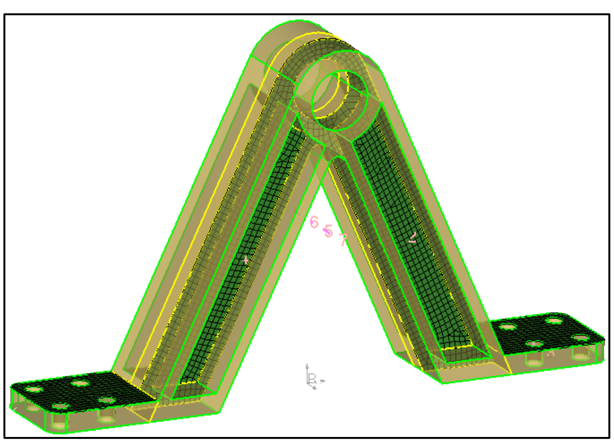
With a fully mappable solid, the solid meshing tools can now be used to create the 3D elements.

1. From menu bar, click **Mesh > Create > *Solid Map Mesh***.

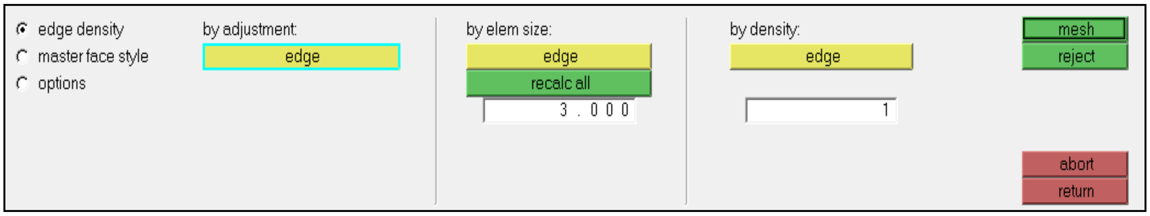
2. Set the options shown below, click **all unmeshed** (or ***solid>>displayed***) and then click **mesh**.



The interactive multi solid meshing will allow for 2D mesh customization prior to the creation of the 3D mesh. HyperMesh will show the order in which each solid is to be meshed and will indicate the direction in which the mesh will be extruded.



Additionally the panel now allows the user to alter the 2D mesh that will be used as the pattern to extrude the 3D elements. A panel similar to that used in interactive shell meshing is opened and the pattern mesh is displayed on the solids.



Using procedures identical to 2D meshing, edge densities can be adjusted, element sizes can be recalculated, mesh styles can be changed and other meshing options can be altered. Clicking the **mesh** button will show the solid mesh but the mesh will not be finalized until the **return** button is clicked so further changes can be made.

3. Use the **edge density**, **master face style** and **options** sub panels to make changes to the mesh and see their outcome on the 3D mesh, proceed to mesh the solids. When happy with the 3D mesh, **return** from the function and **save** the part.