Global Twist Modeling and Replicate behavior

This tutorial is an introductory document about the behavior of the Global Twist and Global Replicate commands. This Global Replicate command is used to implement the modification of parameters from one entity onto other entities which are associated with each other through the GSM command. The following image shows the final shape of the model that we want to achieve.

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1. Step 1: Let's use Capping

In this step we will use Capping feature to close the topend of the Fan. Let's start with the input model.

> **Note:**
>
> With a double click on the exe file you can run the webtraining session. ThinkDesign will be open with the right model to start.
>
> If request to open a file, you can find it in the C:\MyTraining path.

- **Open** the model file Fan.e3. The model file resides in the files folder inside the task folder whereever it is downloaded.

We need to cap the topend of this part. As previously discussed, we'll use the Capping command to create the surface but first we need to set up some construction curves.

We want to develop Silhouette curves from the surface which we just created.

- Activate the Insert - Curve - Light Contours command and set type Silhouette.

- Select the conic surface.

- Select the parallel direction as Z.

- Click Apply or the ⏎ Enter key to apply the command. This will create the silhouette curves and keep the command active.
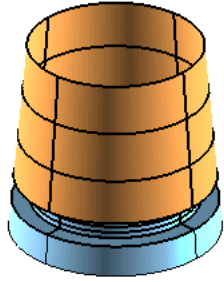
- Click on the Parallel Direction and change it to X instead of Z.
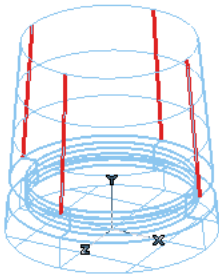
- Click ✔ OK.

Now we have four Silhouette Curves that we'll use as Construction Curves. Using these Construction Curves as reference, we'll be able to build curves upon which we'll build our final surfaces.

- Start the **Connect Curve** command.

- Select the two silhouette curves generated from the Z.

- Set Curvature as Continuity for both.

- Chang to 2 both Weight.

- Click ✔ OK.
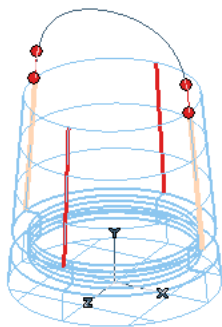
With the **Connect Curve** command, create an other curve with the set of Silhouette Curves generated by X direction projection.
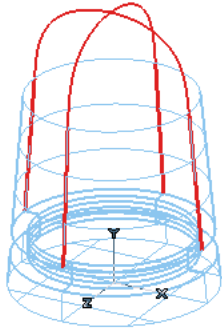
Now, we have a top boundary of the surface as curve and two arcs (Internal Curves) with which we can create a Capping surface to complete the top portion of our model.

- Start the **Capping** command.

- Select the Circular Boundary curve as the Constraint Boundary curve and keep constraint ConstraintPosition + tangent + curvature .
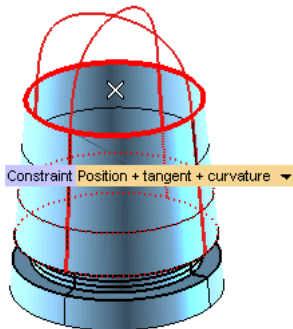

- Under Constraint Internal curves, click on ⊕ Group 1 to activate it.
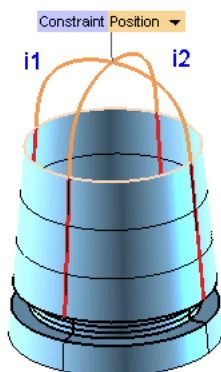
- Select both (i1 - i2) of the connect curves and leave the constraint as ConstraintPosition.

- In the selection list, check the ☑ Associative.

- Click on 🔍 Preview to see the basic shape of our surface.
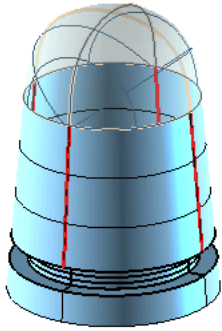
- Click ⊞⋯ More Options

  Click ⊞⋯ Precision to open the dialog box and set No. points - 30 and No. loops - 5.

  Click ⊞⋯ Approximation and check ☑ Enable.

- Click on still on 🔍 Preview to last check.

- Click ✅ OK to create the Capping Surface and end the command.
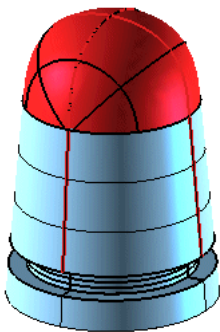
Next, let's hide the curves and then change all of our surfaces to one color.

- Click on **Select Filter** and select curves. Then with your right mouse button, press and choose **Select All**. All of the curves will be highlighted.

- Click **Hide Entities**. This will hide all the visible curves that we just selected through our Filter.

Speed Tip:

One easy way to create a curve filter is to hit the [c] key on your keyboard. This starts a selection filter that only allows Curves to be selected. thinkdesign has other similar shortcut keys that are available whenever the Text tool is NOT being used. Some of these shortcut keys are: [s] - creates a surface filter (only surfaces can be selected), [p] - Only Profiles can be selected and [x] - Only Points can be selected. To view all of your shortcut keys, see the **Keyboard Map**.


- Once again **Select All**. Then, with the surfaces highlighted, go to the attributes toolbar or inside status bar, and click on the down arrow next to the current color.

- Press the F8 key. This will reset your view so that you are looking perpendicular to the work plane.

2. Step 2 Let's apply Global Twist and Replicate

Let's make an associative solid from these set of surfaces.

- Next, let's pre-select the surfaces we want to turn into a solid. Press the S key. This will create a "Surface Only" filter then select Ctrl + A to select all of our surfaces.

- Start the **Make Solid** command. Notice how our pre-selected surfaces are accepted by the command and we get a 🔴 Surfaces or Solids indicating we can complete the command but we have one more step here.

- In the selection list, check the ☑ Associative checkbox as shown below.
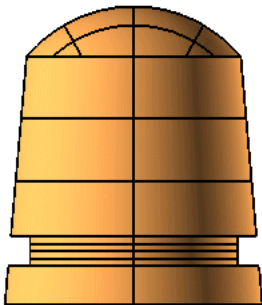
- Click ✅ OK.

- Give visibility also to Layer 6.

- The three static solids, by Tools - Modeling - Check Manifold, are open.
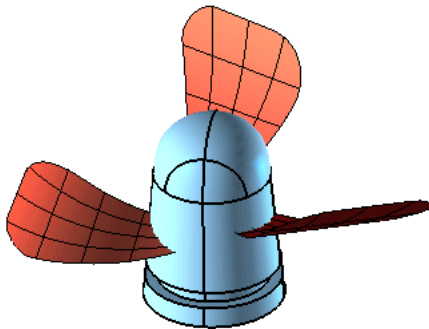
Now, let's add thickness to these static solids.

- Start the **Solid Shell** command.

- Select ⊞ Mode as "Add Thickness".

- In the History Tree, select one of the open static solids.

- Enter the thickness value as Global Thickness3 mm . We want to add thickness to the underside of these blades.
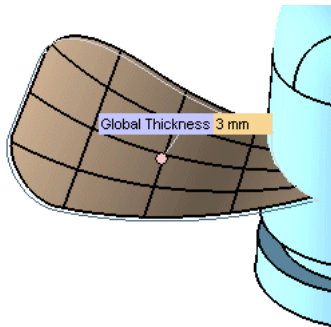
- Hit ⬛ Apply to add thickness and remain in the command.

- For each other follow the same procedure.

Next, we'll draw a **Two-point Line** from the center of the bottom face of the solid vertically up to a point on our Workplane. We'll use this line as a reference line for out **Global Twist** command.

- Hit the ⌨F8 key to arrange the view such that you are looking perpendicular to your workplane. Hit the ⌨W key to toggle the workplane on and off so you can see that you are looking at the X-Y workplane.

- Start the **Two-point Line** command. We want Type: Limited and Sequence: Single.

- Select **Snap to Arc Center** and select the center point of the bottom face of the solid; equal to **Work Plane Origin**.
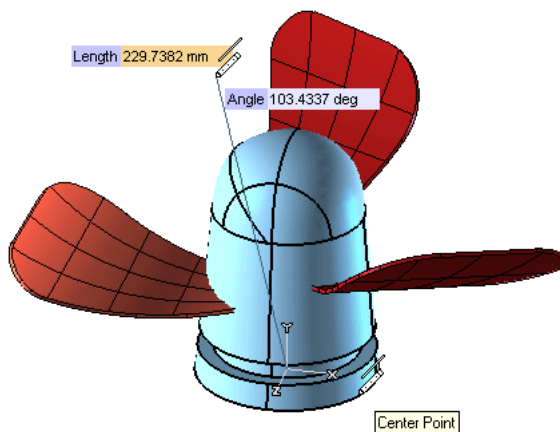

- To make selecting the Arc Center easier, rotate the model up so you are looking at the bottom face of the part. Then select just inside of the circle to Snap to the center of this circular face. Then hit your ⌨F6 key to return to your last view or your ⌨F8 key to return to looking at your workplane.

- For the second point of the line, move you cursor up and enter the values as Length250 mm and Vertical90 deg to align to Y axis.

Let's do the Twist! Now it's time for us to apply the Global Twist command. For the purpose of showing you how the Global Twist and Global Replicate commands work, we'll use some exaggeration in the Global Twist step so that it will be very obvious to you how the tools work and how they are best applied. We'll also redefine the Twist with exaggeration so this change will also be obvious to you.

- Start the **Global Twist** command.

- Choose solid as ⊞ Entities to be Modified and select the lower blade solid.

- Pick on the ◉ Axis of Twist Line to activate it. Then select the line that we just drew as our "Axis of Twist".

- Keep the check on for ☑ Associative.

- Change the angle value to Angle60 deg and Length180 mm . Although this is a severe twist, it will help us better demonstrate how these Global Modeling commands work.
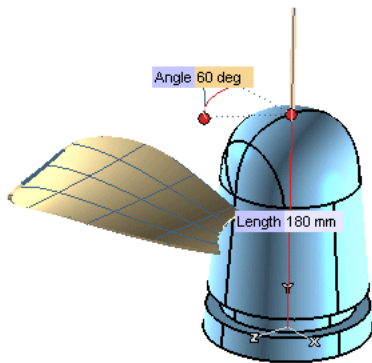

- Click ⊞ More Options and Click ⊞ Quality Checks.

- It shall open a window where you have to choose GSM folder and check ☑ Enable. A quick mode to analize how the shapes are changing.
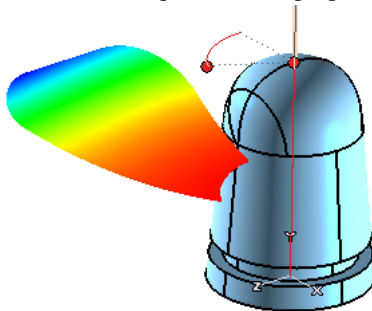
- Click ✅ OK to complete this command.

Next, we'll use the **Global Replicate**. command to implement this change of angle on the other two blade solids in our model.

- Start the **Global Replicate** command.

- Pick ◉ Deformed reference entity and select changed solid.

- Pick ▣ Entities to be modified and select other solids - two blades.

- Keep the check on for ☑ Associative.

- Click on the Preview Button to get an idea of what we will get with our Global Replication.
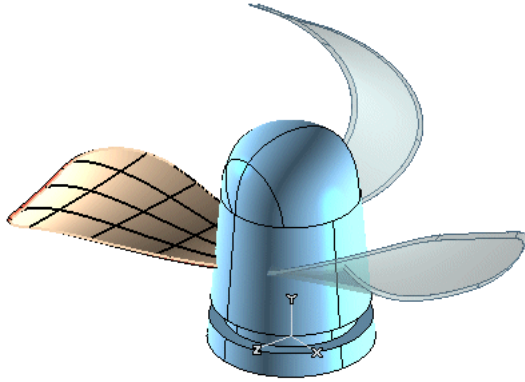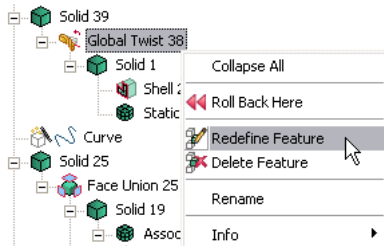
• Click ☑ OK to complete this command.

Lets have a look to History Tree. Since we have built this part with the Associative check "ON", we can redefine this operation if we need to.

Let's Redefine our Global Twist and see how it will rebuild through the part to give us another design possibility.

• Right Click on the Global Twist Feature in the History Tree.

• Change the angle value to Angle45 deg and Length200 mm .

• Click ☑ OK to complete this command.

• Click on the **Rebuild Model** Button in the toolbar to rebuild the entire model.