
Global Shape Modeling - I

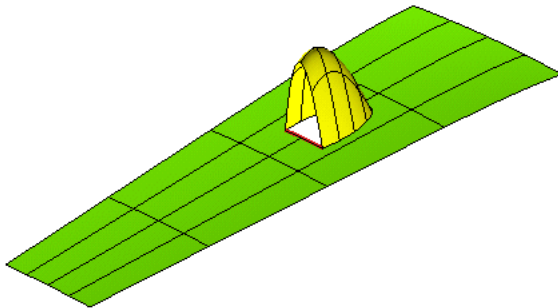
In this task, you'll be introduced to Global Shape Modeling (GSM). You'll learn GSM techniques to modify surfaces while maintaining continuity constraints. This task is targeted at users who have a good understanding of conventional surfacing and would like to learn how GSM could help them. In the start model you'll find customize Layers and Visual Bookmarks, with duplicated surfaces, to make your job a bit easier.

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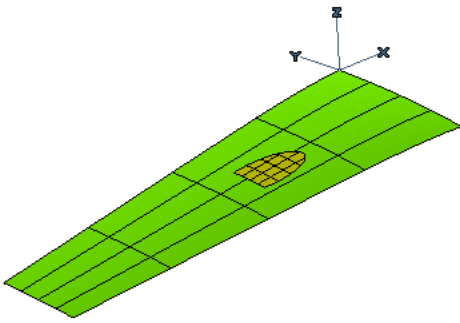
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1. Step 1: Global Shape Modeling - Interactive

In this step, we are going to do Global Shape Modeling (GSM) using the **Advanced Modeling** command. We will bulge the surfaces out, while keeping some curves same and modifying the rest. The model we are using is part of a car. GSM can be used on points, curves, surfaces or solids.



- Activate layer 0 as current and make Layer 20 also visible.
- You could use also "GSM Interactive" Visual Bookmark, just defined in the start-up file. Remember to hide all entities at the end of each Step for a better visibility.
- Start the **Advanced Modeling** command.



What entity types does GSM understand?

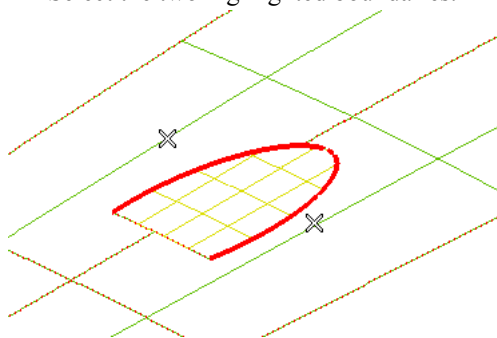
Whatever you have in the Graphics Area is "Space". GSM understands "Space", which means that it understands all the info that is in it and how it was created or modified. For curves it understands, the shape, length, if they're continuous, etc. For points it understands the distance, placement, etc. For surfaces it understands, if it's trimmed, continuous, tangent, etc. Shall we continue? I don't think so you are still convinced. Basically GSM adds more of a capability to what you have in the Graphics Area and let's you apply new rules to them.

As you know, there are many different ways of doing things in ThinkID. So instead of just showing you one method, let's go through one method and then you will have the option of going through two more, and then continue to see one more option other than the bulge option.

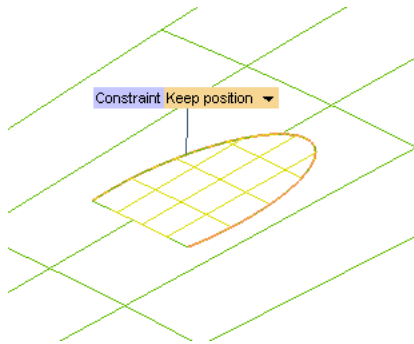
Let's see how to create a bulge (changing) through an interactive point.

Now, we are going to make the selections that have constraints on them in the GSM command.

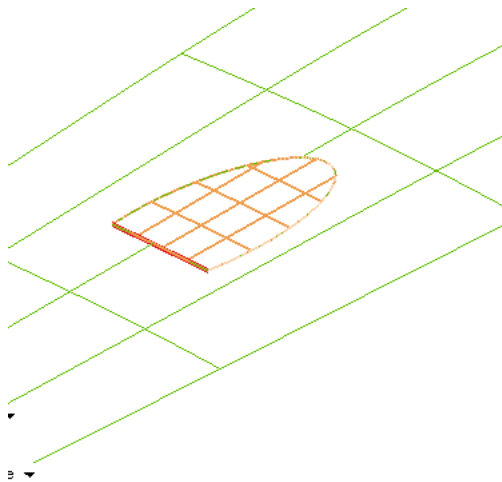
- Pick Preserving - Preserving Curves and Curves (Group 1) in the Selection list.
- Select the two highlighted boundaries.



Preserving Curves are curves (generic or surface edges/boundaries) that you want to stay the same while you modify other entities around them. Set ConstraintKeep position as rule you want keep.

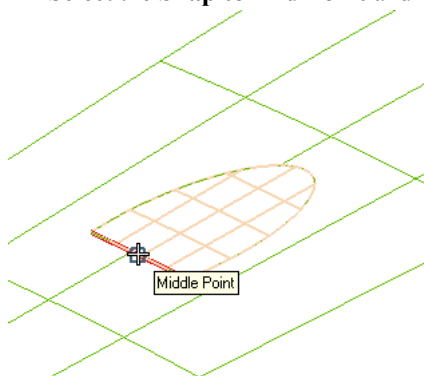


- Select Entities Surfaces under the Entities to be modified in the Selection list. Select only internal surface.



So where do we want to put that bulge in the model?

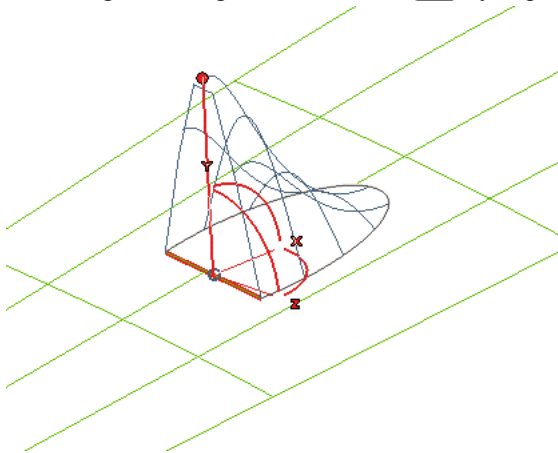
- Pick Matching, change the type to Matching Interactive.
- Active Points z.
- Select the **Snap to Mid Point** and indicates it on the red line.



Direction in Interactive mode

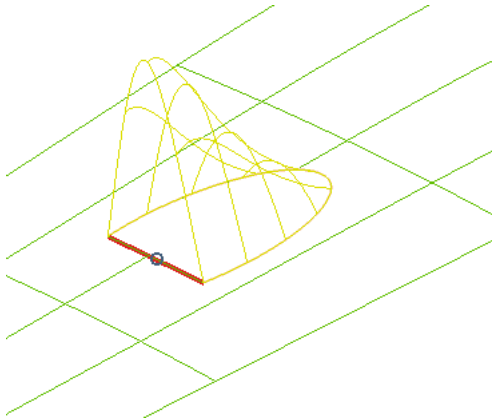
When using the Interactive mode in Global Shape Modeling (GSM), the entities always get pulled in the direction of the Normal. The Work Plane doesn't have to be on the model while it just has to be in the orientation that you need.

- Change the Length120 and hit the **Tab** key to process the calculation.



- Impose Z as Interactive under Points.

- Hit Preview.

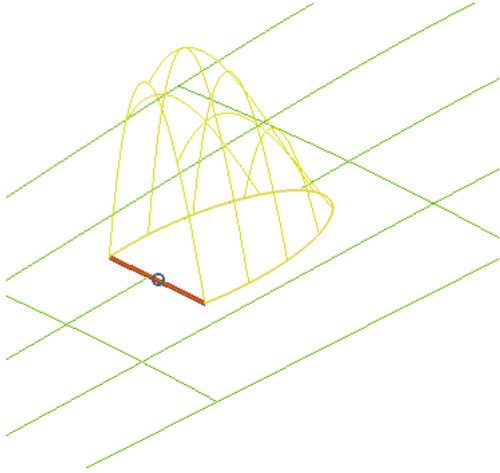


Now with the selections out of the way, it's time to set the type of modification we want.

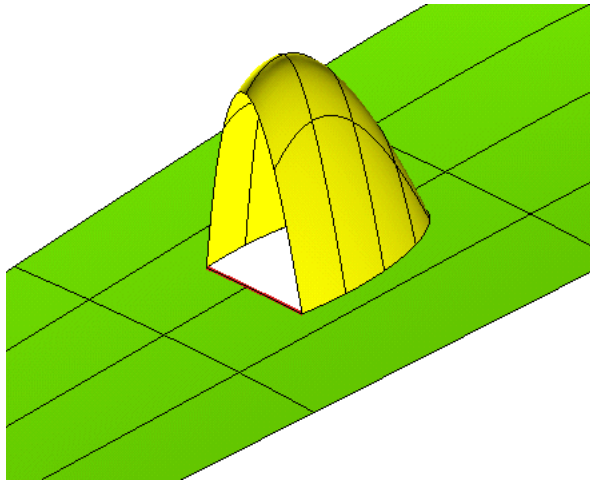
What exactly does that bulge factor do?

There are several ways to pass through a point. Think about having some planar space and a point you want to pass through. A Small bulge will give you a mountain, a Medium bulge will give you a hill and a Big bulge will give you a hill with a football field on it (a bit flatter on the top than the medium bulge) but they will all pass through the point.

- Select the More Options in the Selection list.
- Select the Shape Control option in the Selection list.
- The current is Medium. Change it to Big.
- Hit Preview.

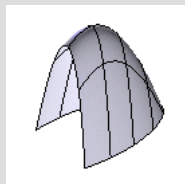


That was a pretty simple change but we have the modified shape using the original "Space" conditions and parameters that the original entities had. See the isoparameter curves in it first.

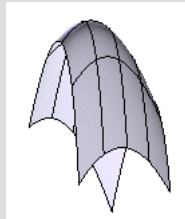


Global Modeling surface.

All entities changed by GSM command will be classified as "Global Modeling" type. It means all the data will be stored in these entities not being a generic shape as Rotational, Offset, Nurbs and so on. Use **Single Entity Info**.



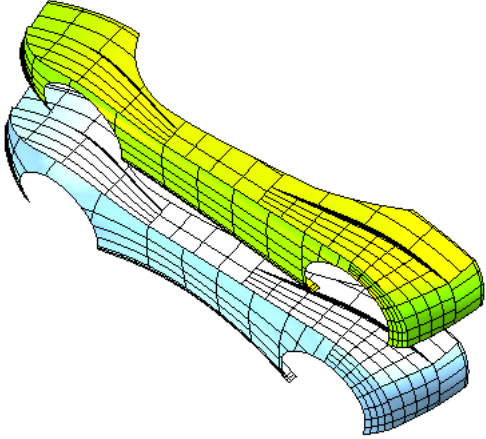
All entities changed by GSM command will be trimmed. Using **Untrim Surface** to reach the original domain.



The "Global Modeling" description could be "heavy" inside the model. If you want clean it up you need to use **Convert into NURBS**.

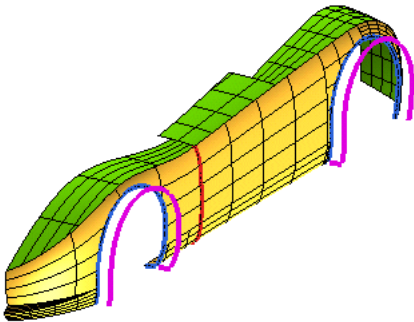
2. Step 2: GSM - Matching Curve

In this step, instead of pulling a point, you need to change an entire section of your shape because your car need to change the tread width. You will be changing the shape of the model from it's initial curves/shape to the target curves/shape while still using the **Advanced Modeling** command.

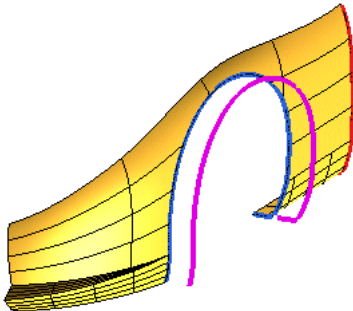


Let's get started.

- Hide the entities changed in previous STEP.
- Activate and set layer 0 as current and make Layer 25 also visible.
- You could use also "GSM Curve Match" Visual Bookmark, just defined.
- Start the **Advanced Modeling** command.



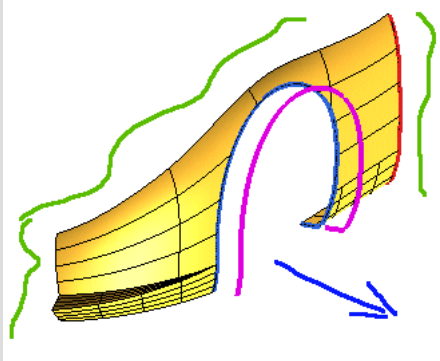
Hide temporarily all curves without the entities as shown in the image below. It needs only to simplify the selection and understand the basic of GSM command.



The curves on these layers are already setup for the GSM modification. To learn more about curve creation, go to MyTraining and search on curves.

What we want to do?

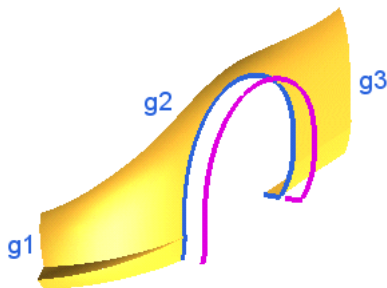
In this part of our car we need to change the tread width (blue arrow) but want to keep the large part of current fender shape (green sketcher curves).



We'll classify all constraints we need to change as Matching curves and Preserving curves as the ones we want to keep.

Now, we are going to make the selection on curves or edges. We'll split all entities that we want keep into three groups.

- Select Curves (Group 1) under the Preserving Curves that is also under Preserving in the Selection list.
- Select the three g1 boundaries (fascia).

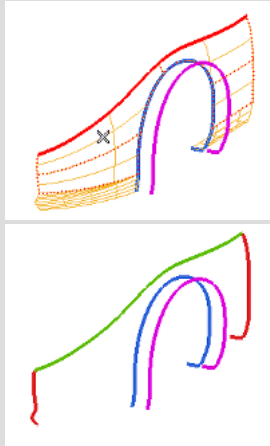


- Select Curves (Group 2) and the g2 boundary (fender-hood).
- Select Curves (Group 3) and the two g3 boundaries (fender-front door).

Set ConstraintKeep position for each group.

Generic Curve and Surface Boundary.

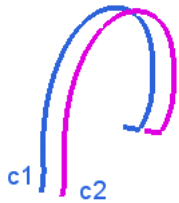
Some times, it could be necessary to hide surfaces or other entities and keep only the curves, if you have to impose position constraint for a better visibility.



If you select the boundary surface you have the possibility to impose also its tangent and curvature parameters to be kept or matched.

Now we want to modify this shape through Matching curves.

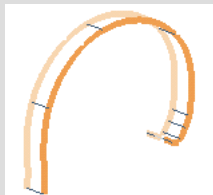
- Select Initial curves under Group 1 that is also under Matching curves in the Selection list.
- Select the current c1 curve.

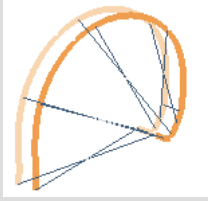


- Select Target curves under Group 1.
- Select the wanted c2 curve.
- Set ConstraintTarget position.

Curled direction.

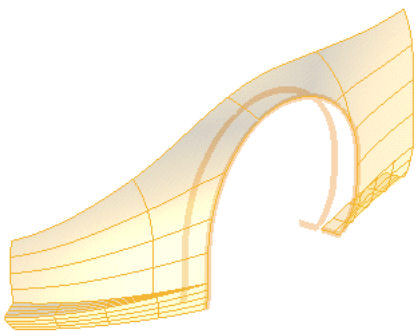
When the curve constraints are right, thinkID shows a temporary vector that indicates how the shape will change.





Selecting the More Options, by Invert correct the orientation.

- Select Entities Surfaces under the Entities to be modified in the Selection list. Select the surfaces you want change.
- Pick the Show Preview icon.

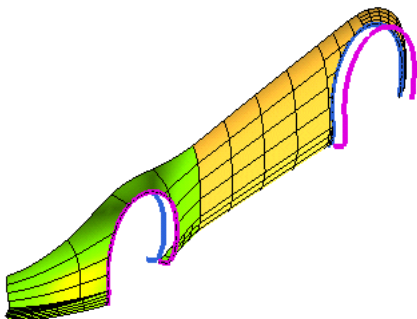


- Check Associative.
- Click OK to accept the modifications. If necessary confirm all message windows.

Let's get a good look at the modifications.

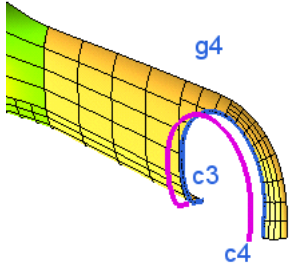
By now, you should see exactly how using the Associative option it is beneficial to someone that has to make continual engineering changes.

The Associative mode permit you to change again all the parameters to obtain different types of shapes. In our case we want to integrate in one command, also the rear part (door, quarter panel and rear fascia). **Unhide Entities** them as shown below.

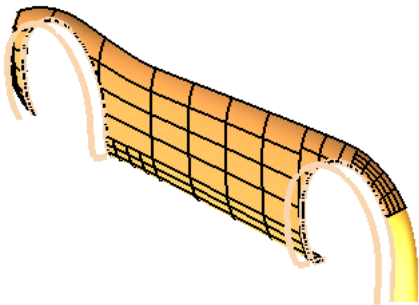


In the History Tree, under last solid, right click on the **Advanced Modeling** feature and select **Redefine Feature**. The selection list presents again the same parameters that were used before.

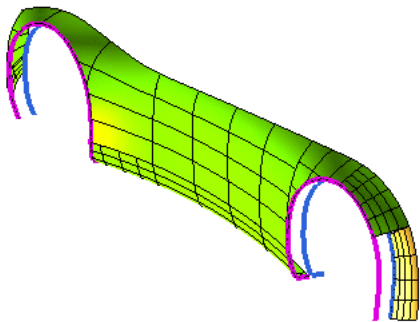
- Select Curves (Group 4) under the Preserving Curves.
- Select the four g4 boundaries (fascia).
- Set ConstraintKeep position.



- Select Initial curves under Group 2 that is also under Matching curves. Select the current c3 curve.
- Select Target curves under same subfolder. Select the wanted c4 curve.
- Set ConstraintTarget position.



- Moving the cursor on Entities Surfaces under the selection list appears a dialog with the number of entities just selected (four in this case).
- Select again Entities Surfaces and add also the other surfaces. As shown in the above image don't select the rear fascia surface. Use CTRL keyboard button to unselect if necessary.
- Pick the Show Preview icon to check if it's all right.
- Click on Rebuild to confirm and update the model. Press "Continue" if a warning Window appears.

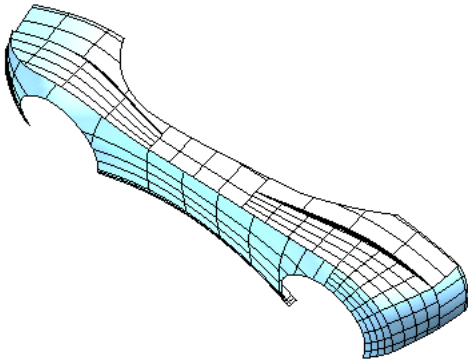


Intentionally we have to leave out a surface. We have imposed all constraints to change the shape. If you select with **Single Entity Info** on the changed surface, you'll notice that they are represented as "Global Modeling" entities.

It means that for each surface, ThinkID stores the rules and constraints used to change it.

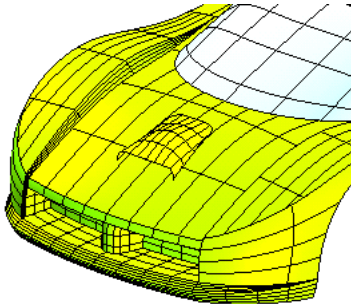
Let's verify the note's information.

- Start the **Global Replicate** command.
- As Deformed reference entity Surface select one GSM surface.
- As Entities Surfaces select the rear unselected surface.
- Hit OK

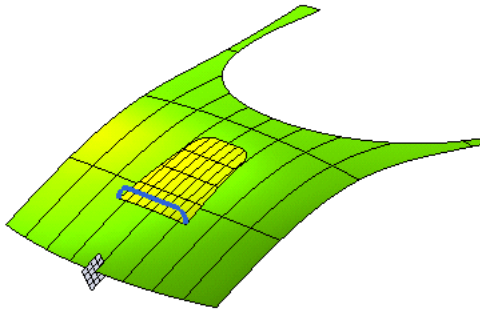


3. Step 3: GSM - Symmetry

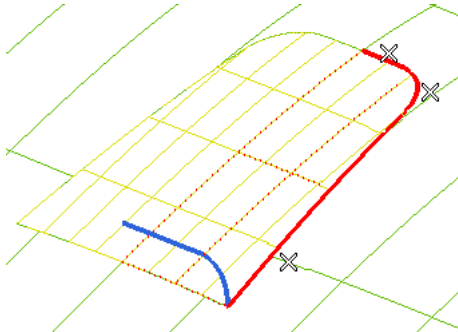
In this step we are going to do modification using the **Advanced Modeling** command. In this example we will make the shape of an airscope on the hood applying the symmetry condition.



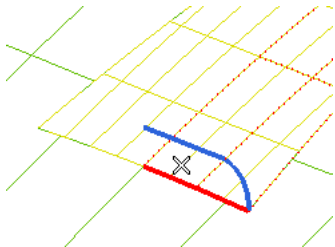
- Hide the entities changed in previous STEP.
- Activate and set layer 0 as current and make also Layer 30 visible.
- You could use also "GSM Symmetry" Visual Bookmark, just defined.
- Before to start GSM command, it needs to make a Skin by Make Solid command on the mirror plane..



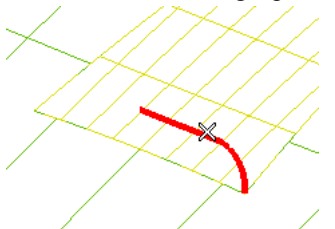
- Select Curves (Group 1) under the Preserving Curves that is also under Preserving.
- Select the three boundaries as below.
- Set ConstraintKeep position.



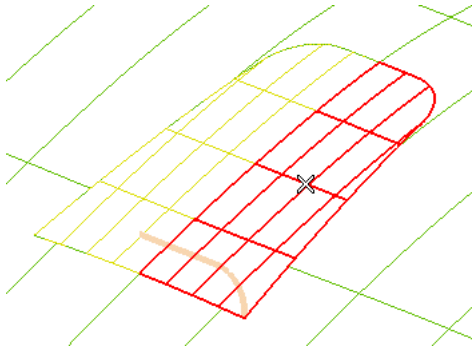
- Select Initial curves under Group 1 that is also under Matching curves. Select one curve as shown below.



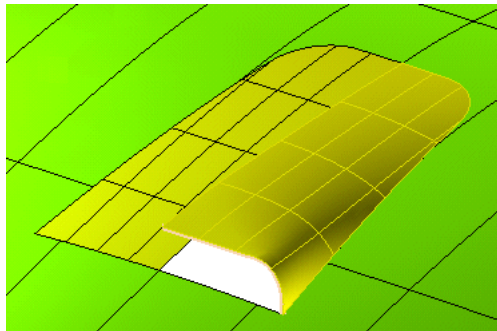
- Select Target curves under same subfolder and select the relative wanted curve.
- Set ConstraintTarget position.



- Select Entities Surfaces under the Entities to be modified and select one half surface that you want change.



- Pick the Show Preview icon to check the right selection.
- Check Associative.



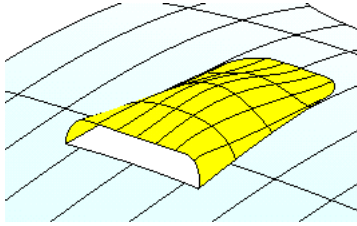
- Hit OK

Mirroring constraints

You can use the Symmetry option (under More Options) to mirror the constraints about the three Reference Planes. This is a very useful opportunity, as the model you are using is symmetric, you are enabled to apply constraints only to one half of the model and then, taking advantage of the existing symmetry, automatically apply them to the mirrored half.

In the History Tree, under last solid, right click on the **Advanced Modeling** feature and select **Redefine Feature**. The selection list would present again the same parameters used before.

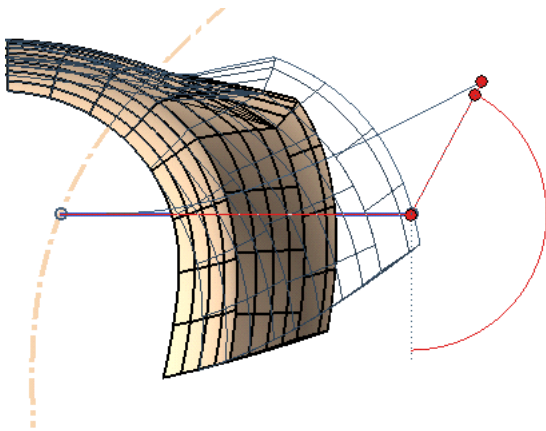
- Check Symmetry and select the Datum Plane as Reference Plane - Datum Plane.
- Moving the cursor on Entities Surfaces under the Entities to be modified, a dialog appears with the number of entities just selected (one in this case).
- Select again Entities Surfaces and add also the mirror surface.
- Pick the Show Preview icon to check if it's all right.
- Pick on Rebuild to confirm and update the model. Press Continue on the warning window that appears.



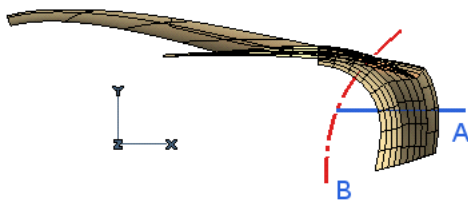
Redefine Feature and try to change the "Shape Control", under More options, Stiffness and Bulge values. Press **Tab** key to confirm data and Show Preview to see the new shape.

4. Step 4: Global Bend

In this step we are going to show how we can modify specific dimensions using the **Global Bend** command. Here we will stretch a series of surfaces along a linear vector to increase its length without changing the entire model.



- Hide the entities changed in previous STEP.
- Activate and set layer 0 as current and make the Layer 45 also visible.
- You could use also "Bend" Visual Bookmark, just defined.



Workplane

While using the **Global Bend** command you have to check for the orientation of current Workplane. As shown in the above image the A and B curves have to lie on Workplane (XY) or on a parallel plane.

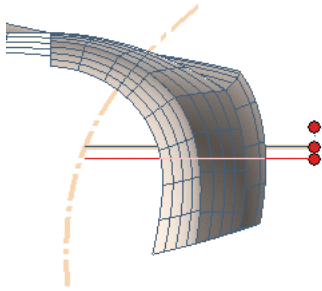
Set the **Set Work Plane to World**, press F8, rotate the model using the arrow buttons on keyboard and use **Work Plane View**.

Since there are many ways to perform this change, we will use Global Bend.

Let's see how this command works.

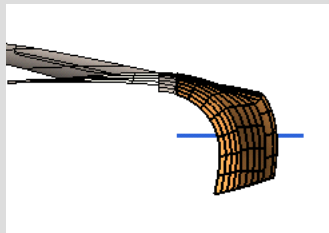
- Start the **Global Bend** command.
- Click on Bend Line and then select the horizontal line (A).
- Select Entities Surfaces under the Entities to be modified.
- Select all surfaces.

Now, thinkdesign will display 3 minialog boxes for parameters Length, Second Length and Angle.

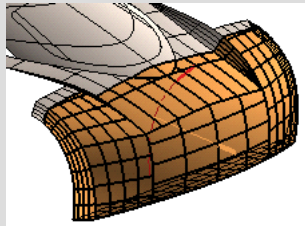


Limiting Curve

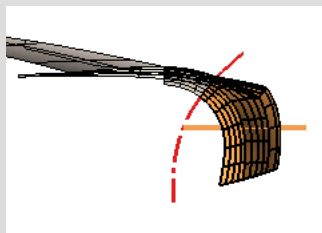
When the Use limiting curve is unchecked, ThinkID make a plane, perpendicular to bend line and passer-by second limit point. This plane will be used to split all selected surfaces in two parts.



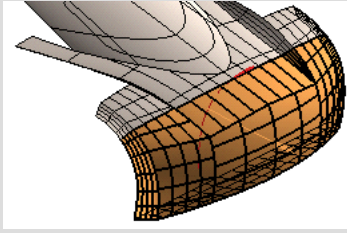
In other orientation you'll see that even the fixed window is split. We don't need it.



Using Use limiting curve and selecting a Limiting curve (B), we impose it as reference, to be used to split the entities. The direction will be perpendicular to current workplane.

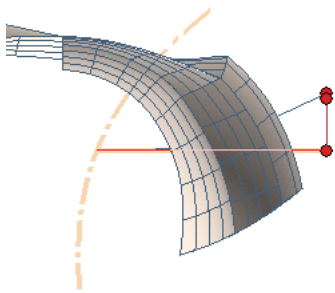


So we have the possibility to choose the real shape that we want to change.

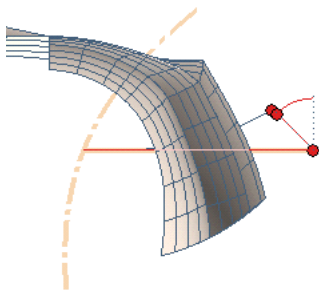


The use of Limiting Curve isn't possible if the normal in end points intersect the Bend Line.

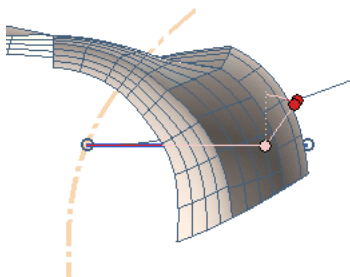
- Select More options, check Use limiting curve and select as Limiting Curve the curve (B).
- Change the values to Length200 mm. Double click on handle to invert it, if need.



- Change the values to Angle35 deg.

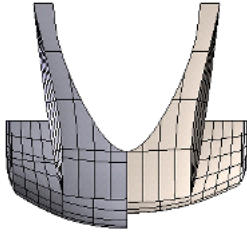


- Change the values to 2nd Length750 mm.

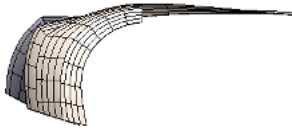


You can also grab the red handle and drag it to dynamically modify the model.

- Hit OK to compute.



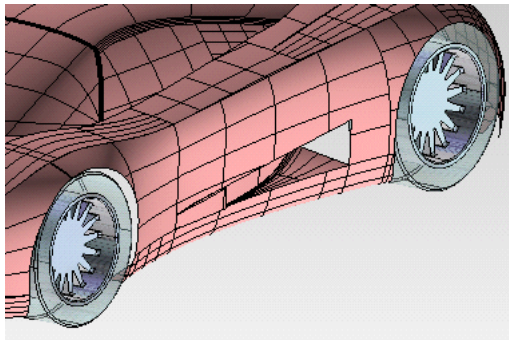
This looks perfect.



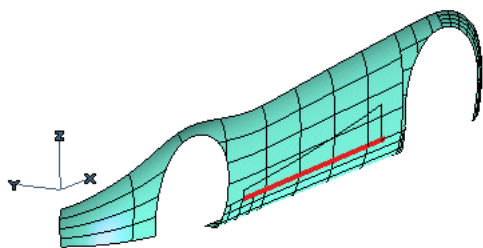
Repeat the same steps but with the Associative option checked. In the History Tree, you will see an Associative Global Bend feature and we can change the parameters at any moment by right clicking on it and click on **Redefine Feature**.

5. Step 5: Global Bend and Global Twist

In this step we are going to do modifications using the **Global Bend** and the **Global Twist** command. In this example we will modify the shape of an air inlet to cool engine and brakes in our sports car.

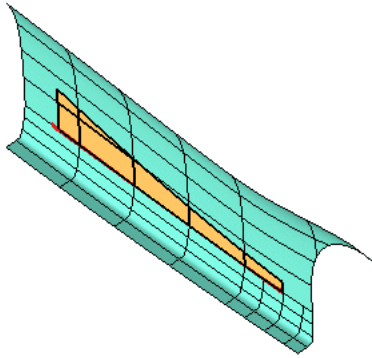


- Hide the entities changed in previous STEP.
- Activate and set layer 0 as current and make the Layer 55 also visible.
- You could use also "Bend and Twist" Visual Bookmark, just defined.
- Set the **Set Work Plane to World**.

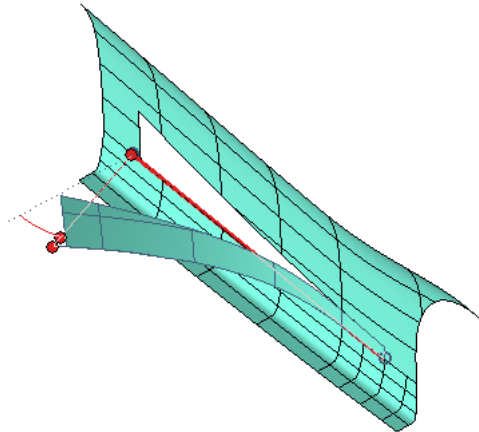


- Start the **Global Bend** command.

- Select Entities Surfaces under the Entities to be modified.
- Select the two inner surfaces on the front door.



- Click on Bend line and then select the red line, already present in the model.
- Change the value to Length150 mm.

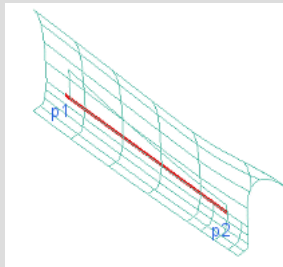


- Hit OK to compute.

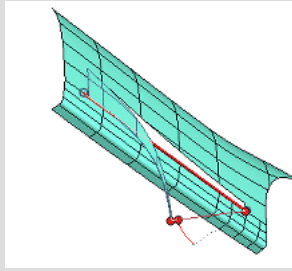
Note: Bend line as line or points

The selection of the axis and its orientation defines which side you want to Bend.

Instead of the line, let's use two points to define the bend line.

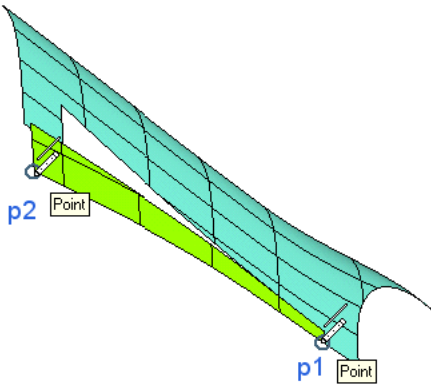


Follow the order as shown in the above image, the bend will be mirrored.

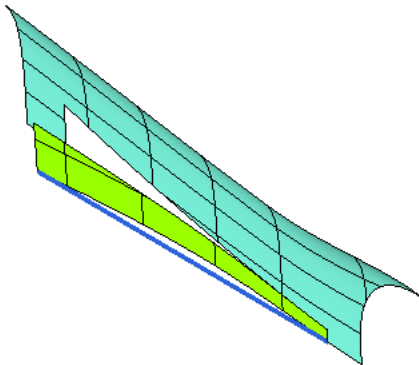


If you don't remember what it is, we suggest you use two points to select the end points of the line.

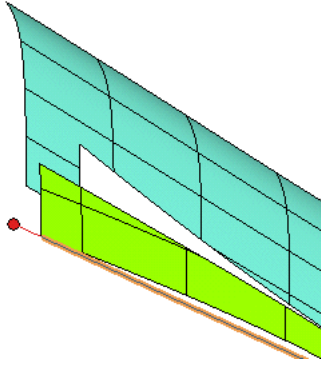
Now we want to change the Bend surfaces applying a twist in the rear side. We need a reference axis to apply it.



- Insert a new **Two point Line** following the above order.

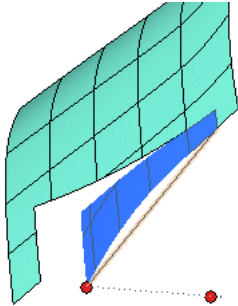


- Using **Extend Tangent**, extend the line of about 100 mm..

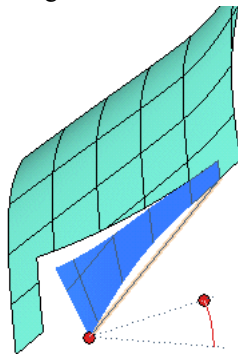


In this step we are going to perform Global Shape Modeling (or GSM) using the **Global Twist** command.

- Start the **Global Twist** command.
- Select Entities Surfaces under the Entities to be modified and select the Bend surfaces.
- Click on Axis of Twist and select the extended line.

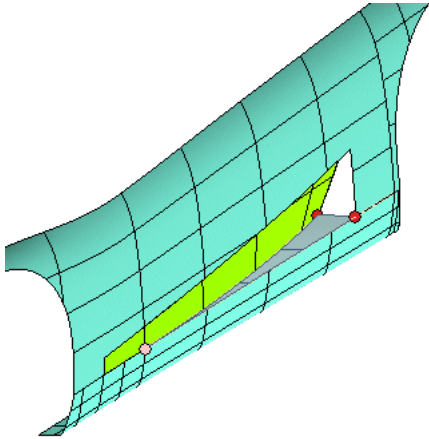


- Change the value to Angle25 deg.



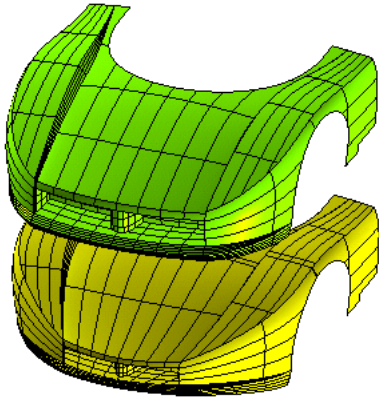
- Hit OK

Let's use **Blending Shapes** to close the shape.

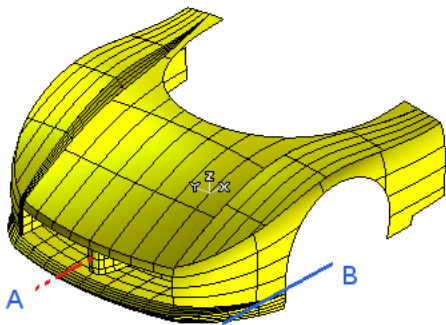


6. Step 6: Global Radial Bend

In this step we are going to do modification using the **Global Radial Bend** command. In this example we will make the shape of a car nose little more tapered. Applying radial compression or dilations to shapes can be quite useful especially in concept designs when "exploring" new shapes.



- Hide the entities changed in previous STEP.
- Activate and set layer 0 as current and make Layer 50 visible.
- You could also use Radial Bend visual bookmark, just defined.
- Start the **Global Radial Bend** command.



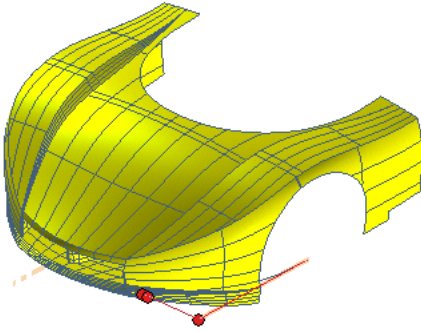
- Click on Axis of revolution and then select the axis line (A).

- Click on Bend line and then select the external line (B).
- Select More options and in Perpendicular drop-down list set to axis of revolution.

Axis of revolution - bend line.

In order to apply the controlled modification to the selected entities you will have to specify an Axis of revolution and a Bend line. The bending controlled modification will be propagated around the chosen axis of revolution, while the domain of the controlled modification — i.e.: the portion of the selected entities which will actually be affected by the controlled modification — will be defined by the bend line.

- Select Entities Surfaces under the Entities to Be Modified.
- Select all surfaces.



The surface corresponding to 2nd Length enables you to modify the length of the bending line. The ones corresponding to Angle and Length enable you to perform the bending in a polar reference system with its origin at the endpoint of the bending line

- We can try to change the value to Length400 in order to begin.

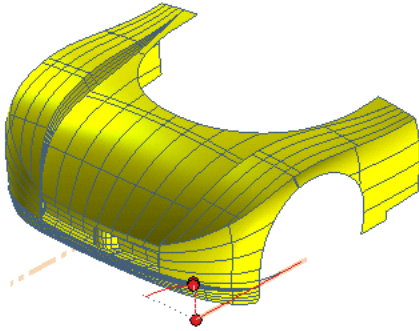
Original or Radial Bend Surfaces.

There will be a plane, perpendicular to the axis line but through the start bend line point, that splits all selected surfaces into two sides.



Front surface will be classified as "Radial Bend" while the rear will keep the original type and parameters.

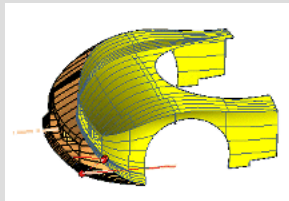
- We can try to change the value of Angle45 to apply a radial compression.



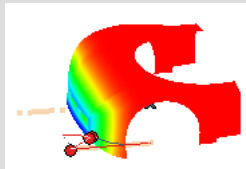
Quality Check

To use shape modeller, inside the command, we need to know the quality of our new shape with respect to the original one.

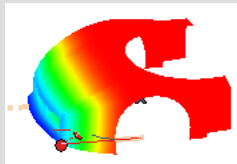
Select More options and check - uncheck the Hide box. That is a first mode to to view and compare the preview with the main shapes.



Always in More options and Quality Checks, select GSM window and check Enable. You'll see a gradual coloration on your geometries, relative to scale values, that shows the parametric distances, on resultant shapes, from the selected surfaces.



Check also Base Entity to show same concepts in the main shapes.



Using graphical modes you have a series of quick tools to check and analyse your job.

Try to change Length, Angle and 2nd Length values and observe the customized result. You can see that we can obtain many variants of the same model.

7. Step 7: User's Shapes

Now you know all the basic information about Global Shape commands, Open any model, activate only the surfaces that represent the car shape ("car shape" Visual Bookmark) and by **Advanced Modeling, Global Bend, Global Twist, Global Replicate** and **Global Radial Bend** commands, change the entities according to your pleasure and taste the results.

