# PowerSHAPE 2016 R1 Tutorials Manual

**Surface Modelling** 



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#### **Patent Information**

Emboss functionality is subject to patent number GB 2389764 and patent applications US 10/174524 and GB 2410351.

Morphing functionality is subject to patent application GB 2401213.

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# **Surface Modelling Tutorial**

# Saving a project file

### 1. Import the model

1 If you are not already running **PowerMILL**, double click on the PowerMILL icon shown below to run the program.



- 2 Click File.
- 3 Click Import Model.



Open Project	Ctrl+0
Open Project Read-Only	
Close Project	
Save Project	Ctrl+S
Save Project As	
Save Template Objects	
Import Model	
Export Model	
Extract Electrode	
Examples	
Print Preview	
Print	Ctrl+P
Recent Projects	•
Recent Models	•
Delete All	
Exit	
	Open Project Read-Only Close Project Save Project Save Project As Save Template Objects Import Model Export Model Extract Electrode Examples Print Preview Print Preview Print Recent Projects Recent Models Delete All

The Import Model dialog is displayed.

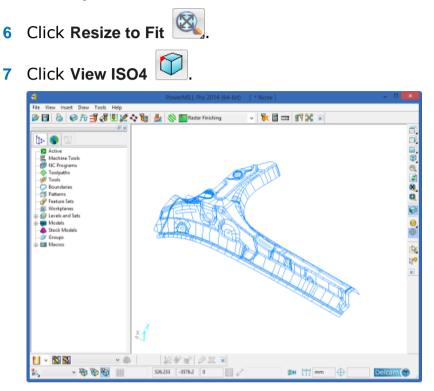
4 Browse to the following file:

#### \*\PS-TutorialsXXXXX\common\_files\

#### pmill\s\_mod\dgk\surface\_modelling.dgk

where XXXXX is the version number of the PS Tutorials and \* is the drive on which PS Tutorials is installed.

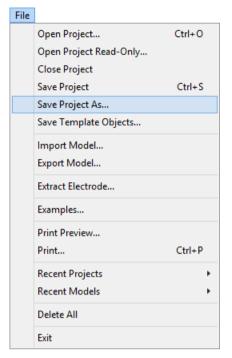
5 Click Open.



### 2. Save a project

1 Click File.

2 Click Save Project As..

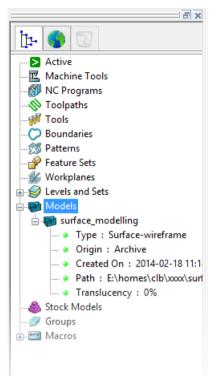


- **3** Enter **pmillexample** for the name of the project.
- 4 Click Save.

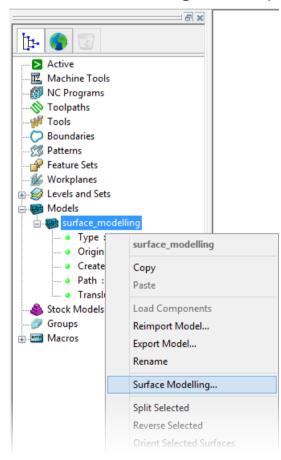
# Using surface modelling

### 3. Start surface modelling

2 The tree should look like the image shown below:



- 3 Right mouse button click on surface\_modelling
- 4 Click **Surface Modelling...** on the popup menu.



### 5 Click Yes.

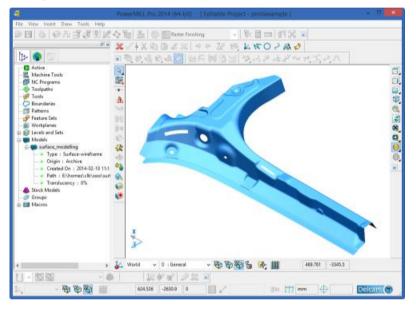
8

The model will now be transferred into the surface modeller.

- 6 Click View ISO4
- 7 Click Shaded View



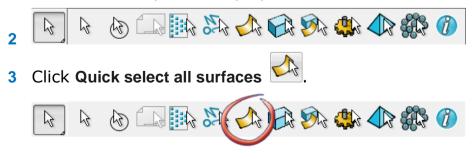
9 Click anywhere in the graphics window to deselect the model. The model is displayed in the graphics window, shown in the image below:

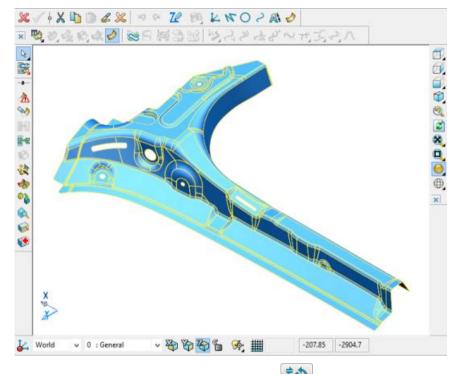


# **Fixing undercut areas**

### 4. Check for badly trimmed surfaces

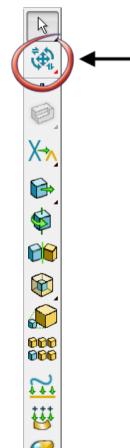
1 Click **Select** using the right mouse button. The **Selection** flyout is displayed.





The surfaces on the model are selected.

4 Click **Show General Edits Options** using the right mouse button.



The General Edits options flyout is displayed.





5 Click Show the model fixing options The Model Fixing toolbar is displayed.



	Click Identify Badly Trimmed Surfaces	
6	Click Identify Badly Trimmed Surfaces	

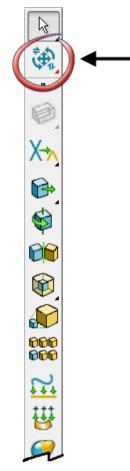


7 Click OK.

There are no badly trimmed surfaces in the model.

## 5. Check the model for undercuts

1 Click **Show General Edits Options** using the right mouse button.



The General Edits options flyout is displayed.



2 Click Show the model analysis options

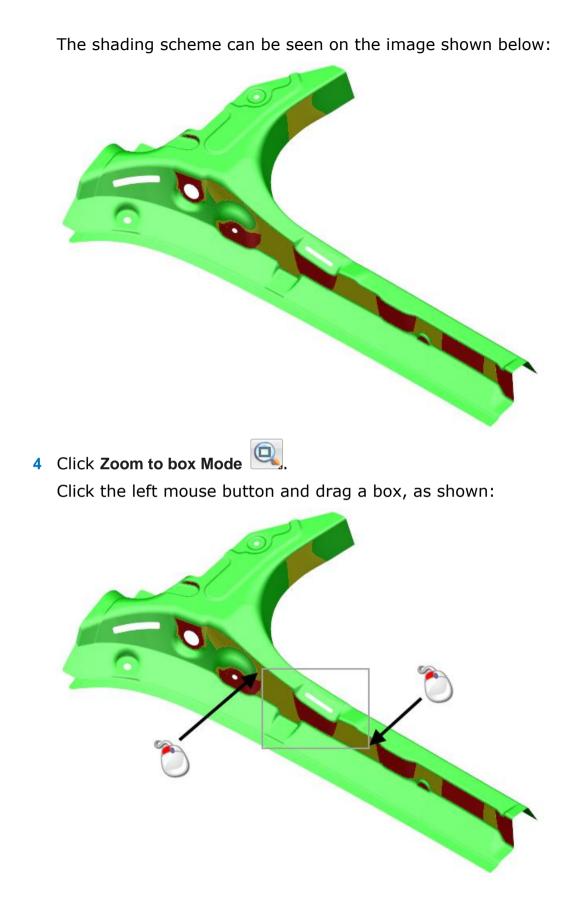
The model analysis toolbar is displayed.



The shading of the model changes.

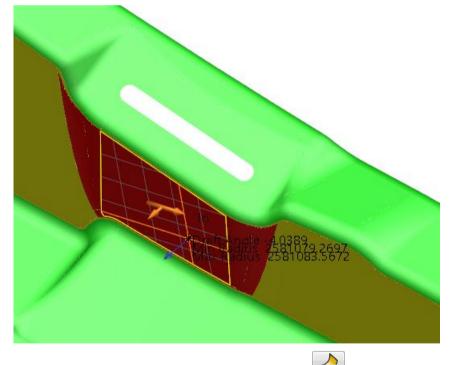
The shading now displays all areas of the model where there are undercuts that cannot be machined correctly.





- <image>
- 5 Click the surface in the undercut area to select it.

- 6 Click Toggle Surface Inspection mode
- 7 Click on the surface again to see the **Draft Angle** of the surface.

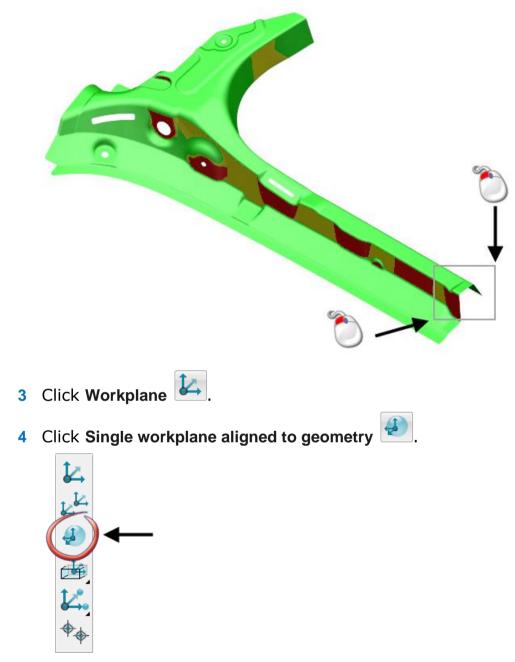


- 8 Click Toggle Surface Inspection mode
- 9 Click anywhere in the graphics window to deselect the model.

10 Click Resize to Fit

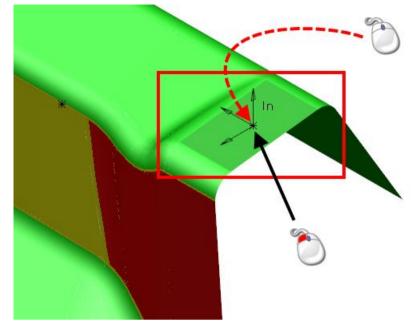
## 6. Fix the undercut areas

- 1 Click Zoom to box Mode
- 2 Click the left mouse button and drag a box, as shown:

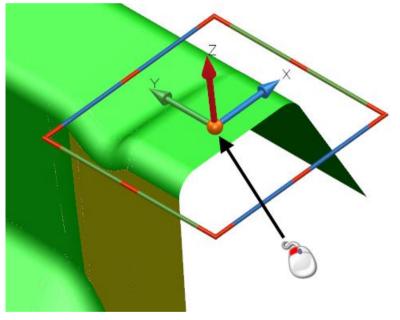


5 Move the cursor over the surface shown below.

**6** when *In* displays, click to position the workplane on the surface.

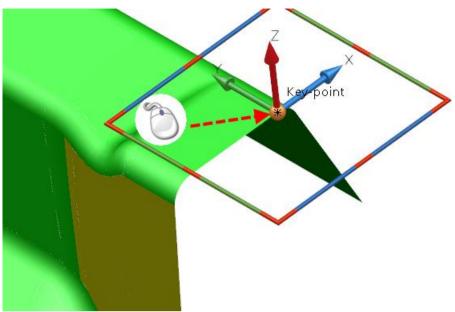


**7** Click again on the centre of the workplane and hold down the left mouse button.

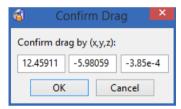


8 Drag the workplane to the right corner, shown in the image below, until *Keypoint* displays.

**9** Release the mouse button to fix the workplane in the new location.

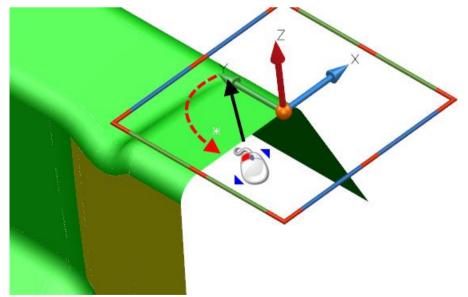


10 Click OK on the Confirm Drag dialog.

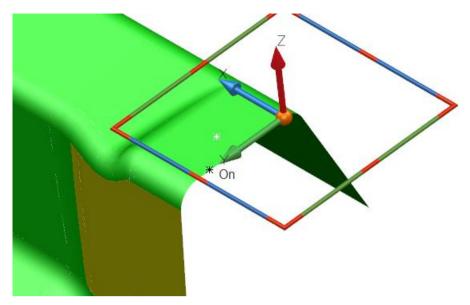


**11** Click on the **Y** arrow head of the workplane.

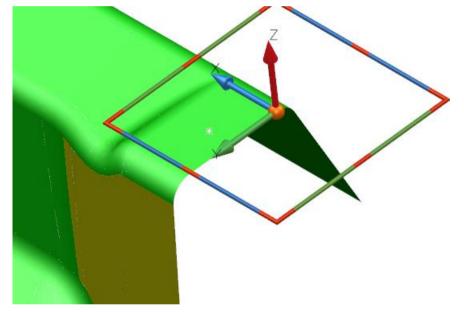
**12** Drag the arrow until it aligns with the edge of the surface.



When *ON* displays, release the mouse button.



Your model should look like the one shown below:



**13** Click on the workplane using the right mouse button.

### 14 Click Modify.

	Workplane '1' (Level 0 : General)
	Cut
	Сору
	Paste
	Paste Special
	Delete
	Next Selection
	Clear Selection
	Select All
	Blank
	Blank Except
	Undo
	Redo
	Selection Information
	Modify
~	Active
	Master
	Group
	Locked
	Shaded Plane

- 15 The Workplane dialog is displayed.
- **16** Click **Twist around X**, shown in the image below:

🚳 Workplane 💌
Name 1
Active Group
Master
Workspace World 🗸
0.000332 -3045.699 -77.62553
Axis
📣 🗸 Alignment
OK Cancel Help

The Calculator is displayed.

#### 17 Enter -3.

6	Calculator
Scientific	Parameters Functions Measure
-3	▲ ▼
-3	
MC 7	8 9 * 1/x 🔐 🕁 ᡝ 🖉 📐
MR 4	5 6 / sqrt 🔚 🕆 🐼 Ŭ
MS 1	2 3 + C Projected
M+ 0	+/- 💽 - 🚾 🔀 🔀 🖬 🖌 🏹
	Backspace
	OK Cancel Help

18 Click OK.

- **19** Click **OK** on the **Workplane** dialog.
- 20 Click Resize to Fit



- **21** Click anywhere in the graphics window to deselect the model.
- 22 Your model should look like the one shown below:

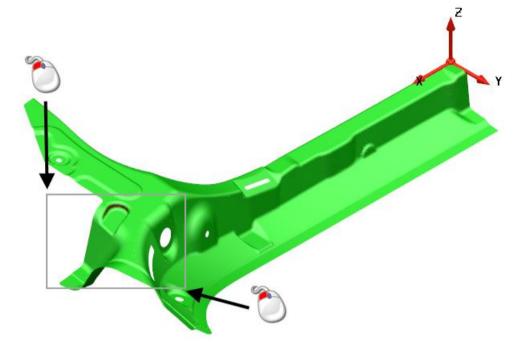


The undercut has now been removed.

# **Changing the draft angle of a surface**

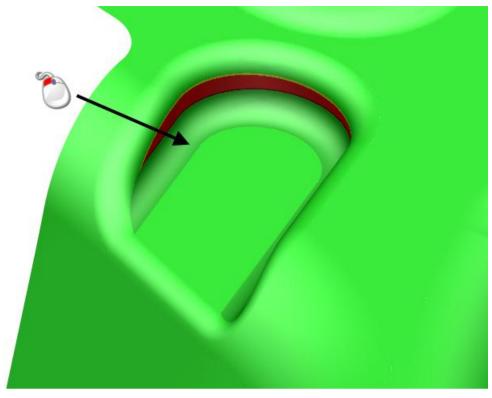
## 7. Create a draft curve on a surface

- 1 Click ISO 3 💟.
- 2 Click Zoom to box Mode
- 3 Click the left mouse button and drag a box, as shown:

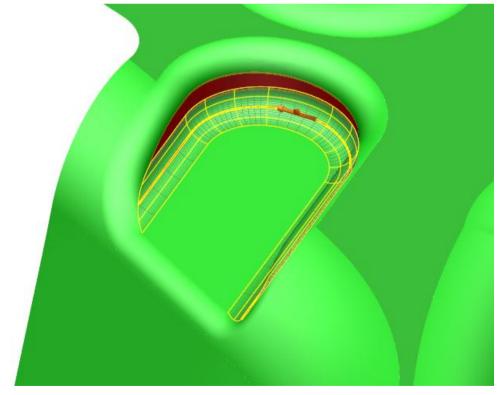


4 Move the mouse over the surface shown below, to highlight it.

5 Click on the highlighted surface to select it.



The surface is now selected, shown in the image below.



6 Click on the surface using the right mouse button.

7 Click Blank Except.

NURB Surface '1_22' (Level 0 : General)
Cut
Сору
Paste
Paste Special
Delete
Next Selection
Clear Selection
Select All
Blank
Blank Except
Undo
Redo

8 From the **Status Bar** at the bottom of the screen, click the **Z** principal plane.

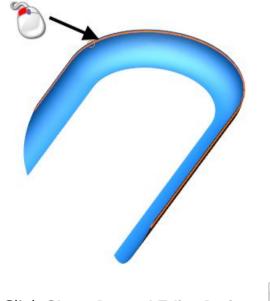
	🛵 World 👻	0 : General	+ ¥9 ¥	5		4 ▦
			4		•ı₄ ±	<b>" \</b>
9	Click Curve	2				
10	Click Create	a Draft Cu	rve 🄌			
11	Enter a <b>Dra</b>	ft Angle of	2.			
	6	Draft	×			
	Draft Angle	2				
	Create as compo	site curves				
	ОК	Cancel H	elp			
12	Click <b>OK</b> .					
13	Click Shade	d View 🦲				

Your model should look like the one shown below:



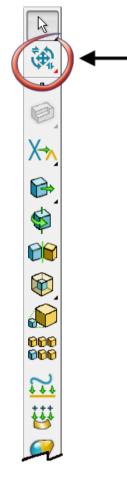
## 8. Use a draft curve to limit the surface

- 1 Move the mouse over the composite curve shown below, to highlight it.
- 2 Click on the composite curve shown below to select it.



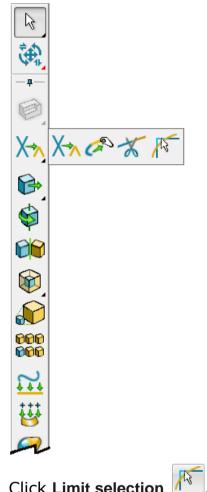
3 Click Show General Edits Options

*Keep clicking the button until the toolbar shown below is displayed.* 



4 Click Interactively Limit Wireframes kind using the right mouse button.

The Limit flyout is displayed.

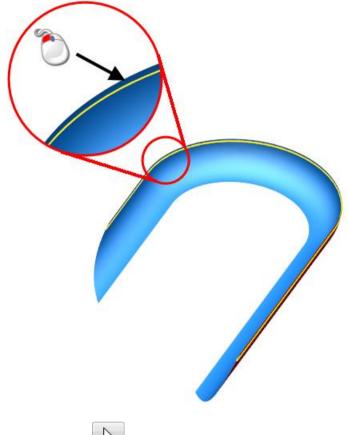


5 Click Limit selection

The Limit selection toolbar is displayed.



6 Click on the edge of the surface in the position shown below.



- 7 Click Select
- 8 Click in the graphics area, using the right mouse button.

### 9 On the popup menu, select **Unblank**.

	View
	Wireframe
	Shaded
	Shaded Wireframe
	Dynamic Hidden Line
$\checkmark$	Inside Material
	Use Wireframe Colour
	Dynamic Sectioning
	Lock Rotation Centre
	Paste
	Paste Special
	Clear Selection
	Restore Previous Selection
	Select All
	Blank Toggle
	Unblank
	Undo
	Redo
✓ ✓	Intelligent Cursor
$\checkmark$	Drag Move
	Options
	RA

10 Click Resize to Fit 🥙.

**11** Click anywhere in the graphics window to deselect the model.



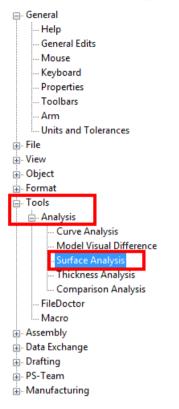
### 9. Check the radius of the fillet surfaces

- 1 Click in the graphics area away from the model, using the right mouse button.
- 2 From the popup menu, click **Options**.

	View
	Wireframe
	Shaded
	Shaded Wireframe
	Dynamic Hidden Line
~	Inside Material
	Use Wireframe Colour
	Dynamic Sectioning
	Lock Rotation Centre
	Paste
	Paste Special
	Clear Selection
	Select All
	Blank Toggle
	Unblank
	Undo
	Redo
•	Intelligent Cursor
~	Drag Move
	Options

The **Options** dialog is displayed.

3 Expand the tree be clicking **Tools** - **Analysis** - **Surface Analysis**, shown in the image below:



The Surface Analysis options page is displayed.

4 Enter a Cutter Tip Radius of 3.

- 5 Click OK.
- 6 Click in the graphics area away from the model.

7 Click **Show General Edits Options** using the right mouse button.



The General Edits options flyout is displayed.

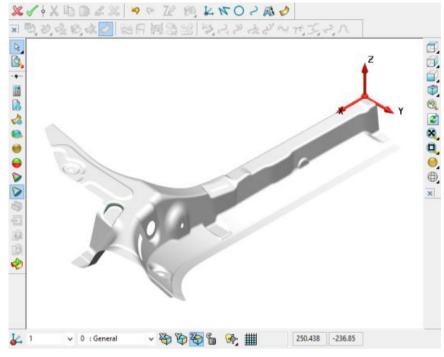


8 Click Show the model analysis options

The model analysis toolbar is displayed.







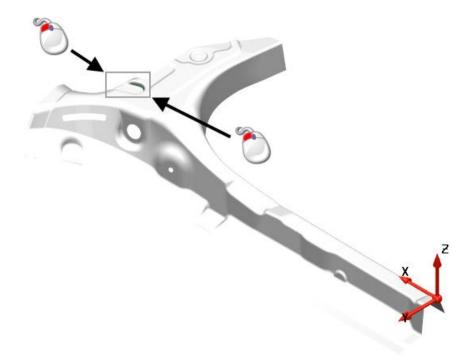
**10** Click anywhere in the graphics window to deselect the model.

You will see that the surfaces are all grey and have a radius of *3*, as specified in the options.

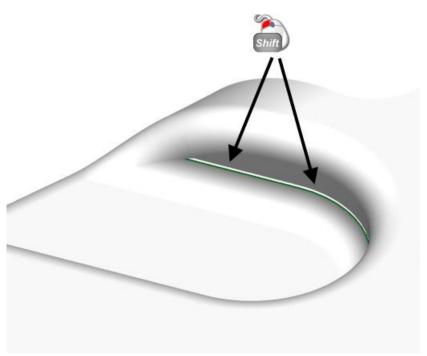
### **10. Delete surfaces**

- 1 Click View ISO4
- 2 Click Zoom to box Mode

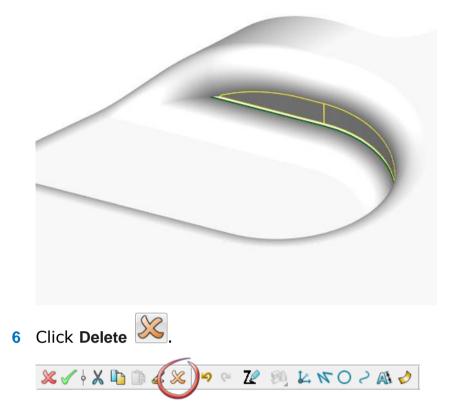
3 Click the left mouse button and drag a box, as shown:



4 Hold down the **Shift** key and click on the two surfaces shown below to select them.



5 Your model should look like the one shown below:



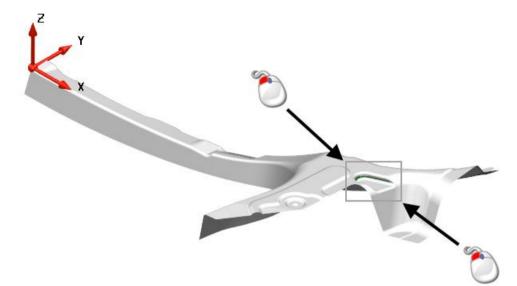
7 Click View ISO1 using the right mouse button



X

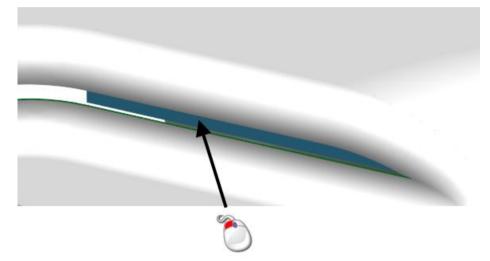
9 Click Zoom to box Mode



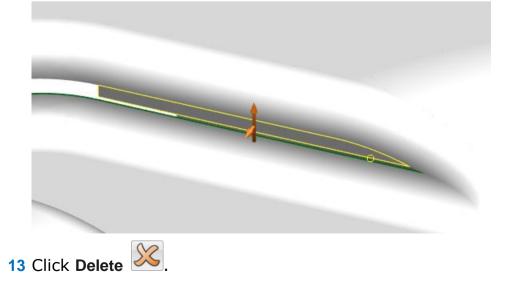


**10** Click the left mouse button and drag a box, as shown:

**11** Click on the surface shown below to select it.

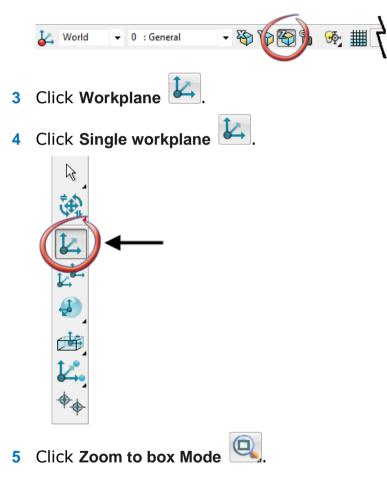


**12** Your model should look like the one shown below:



### 11. Create a workplane

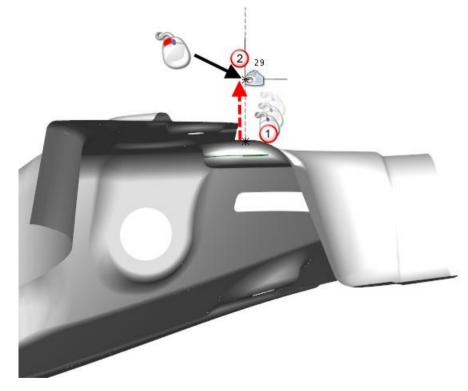
- 1 Click View from Front .
- 2 From the **Status Bar** at the bottom of the screen, click the **Z** principal plane.



# Z Y X

Click the left mouse button and drag a box, as shown:

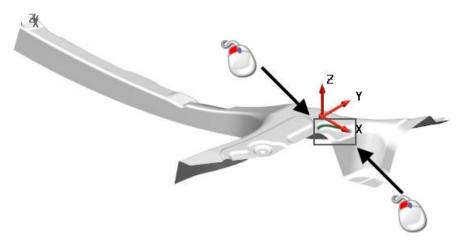
- 6 Move the cursor around the model.Construction lines and dimensions activate and display.
- 7 Move the cursor up the construction line until *ON* displays.
- 8 Click when the cursor is in the position shown below.



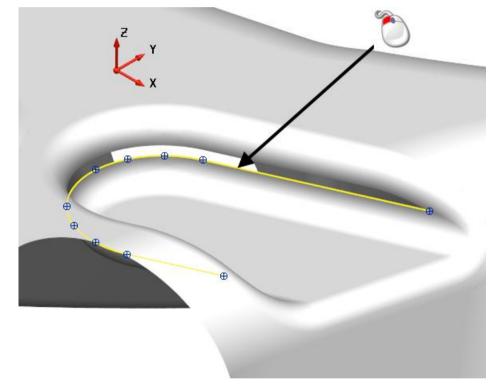
## 12. Create a draft surface

1 Click **ISO 2** 

- 2 Click Zoom to box Mode
- 3 Click the left mouse button and drag a box, as shown:

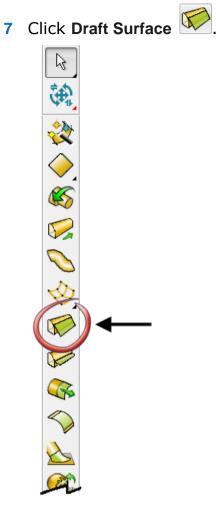


4 Click on the composite curve shown below to select it.



5 From the **Status Bar** at the bottom of the screen, click the **Z** principal plane.





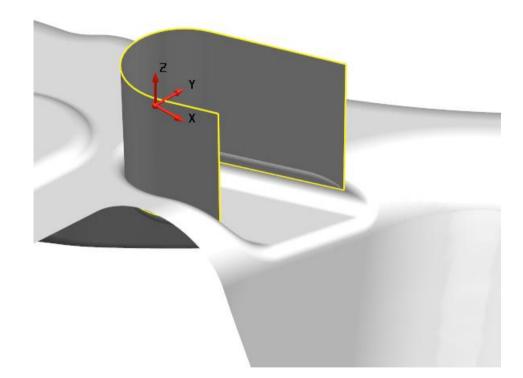
The **Draft Surface** dialog is displayed.

- 8 Make the following changes:
  - ① Enter 0 for the **Draft angle**.
  - ② Click Tangent to underlying surface.

3 Click Project onto principal plane.

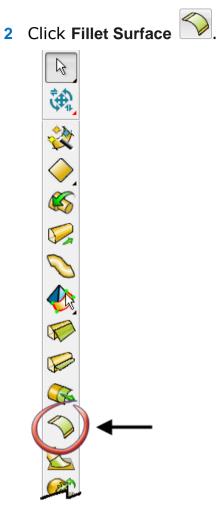
🚳 Draft Surface	×
✓ Valid Selection	
Draft Angle 0 1 riable	
Measure angle from	
<ul> <li>Normal to principal plane</li> </ul>	
Tangent to underlying surface	
Type of Projection	
Project onto principal plane	
O Project onto selected surface	
Options	
Draft both sides of surface	
Smoothing	
Preview Apply Dismiss Help	

- 9 Click Apply.
- 10 Click Dismiss.
- **11** Your model should look like the one shown below:



# **13. Create a fillet surface**

1 Click Surface 🤣.

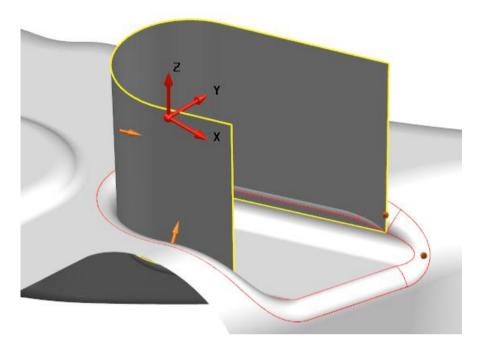


The draft surface should still be selected and becomes the primary selection.

The Fillet Surface dialog is displayed.

**3** Hold down the **Shift** key and select the fillet surfaces shown below:

You may need to box select the surfaces instead of using a single click.



4 Make the following changes:

- 1 Enter a Fillet Radius of 3.
- 2 Click Convex.

6	Fill	et Surface	×
	Fillet Radius 1	3	]
	O Concave	<ul> <li>✓ Trim</li> <li>☐ Fillet along creases</li> <li>☐ Fillet all routes</li> </ul>	
	Corner Type	Roll 🗸	
	Fullness	1	
Se	lection		
	Primary	<ul> <li>Secondary</li> </ul>	
	Surfaces 🖌 🖌	Surfaces 🖌 🖌	
		Wireframe 🗶	
F	Preview Apply	OK Cancel He	lp

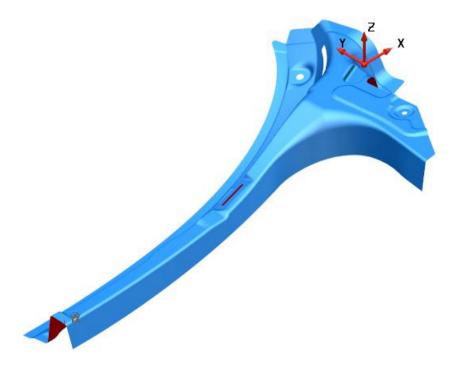
5 Click OK.

6	Select Fillet Route
Select Route Select start lin Select one of	e the highlighted branches <b>Complete</b>
Select or inse Current Arc	1 V ABS V 0 Delete
Arc Radius Corner Radius	
Preview	Reset nominal radius 3

#### The Select Fillet Route dialog is displayed.

- 6 Click OK.
- 7 Click ISO 1 🔍.
- 8 Click Shaded View
- 9 Click anywhere in the graphics window to deselect the model.

The undercut areas have now been corrected, shown in the model displayed in the graphics window.



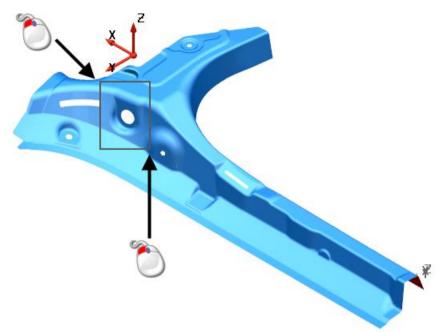
# **Removing the holes from the model**

## 14. Blank the large circular holes

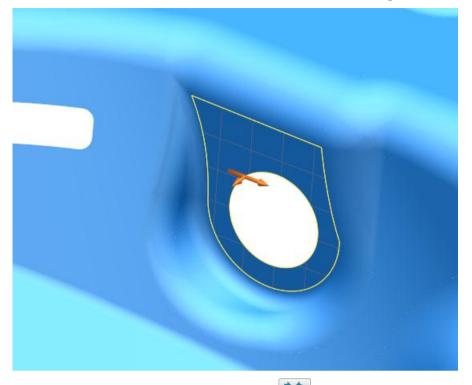
- 1 Click View ISO4 2
- 2 Click Zoom to box Mode



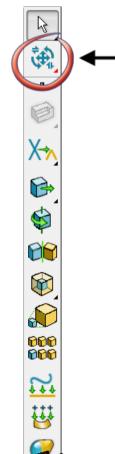
3 Click the left mouse button and drag a box, as shown:



4 Click the surface to select it, shown in the image below.



5 Click Show General Edits Options wing the right mouse button.



The General Edits options flyout is displayed.





6 Click Show the model fixing options The Model Fixing toolbar is displayed.



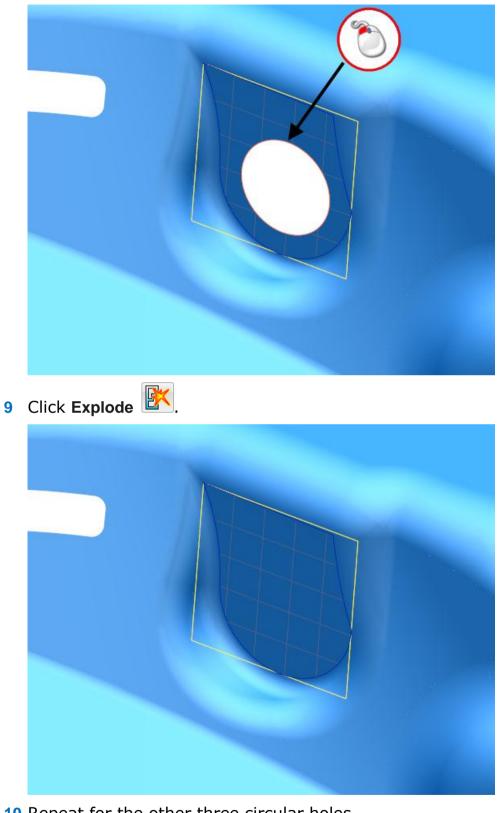
7 Click Surface trim region editing

Image: Click Surface trim region editing

The Trim region editing toolbar is displayed .



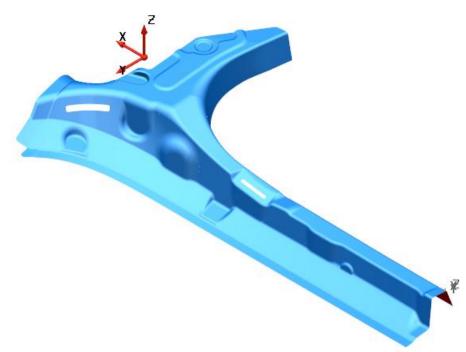
0



8 Click the Boundary curve on the surface as shown below..

- **10** Repeat for the other three circular holes.
- 11 Click Surface trim region editing 2.

12 Your model should look like the one shown below:



#### 15. Use Make watertight to close gaps

- 1 Click in the graphics area away from the model, using the right mouse button.
- 2 From the popup menu, click **Options**.



The **Options** dialog is displayed.

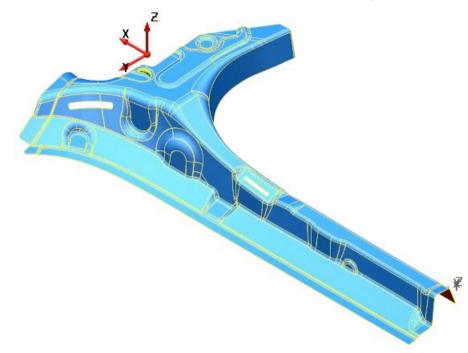
- **3** Expand the tree in the Options dialog, **Object > Solid**.
- 4 Click Version 8 solids.

There should be a tick in the box now.

- 5 Click OK.
- 6 Click Select
- 7 Click Quick select all surfaces



The surfaces are selected, shown in the image below:



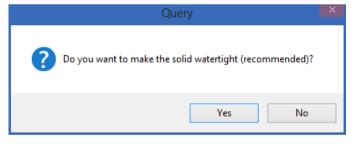
8 Click Solid from selected surfaces





 $\mathbf{k}$ 

9 Click Yes. in the Query dialog.



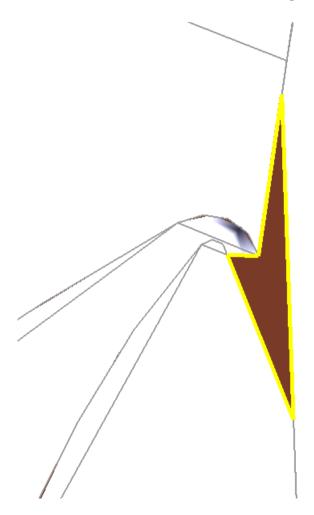
The model is checked. The holes in the model are found automatically and the results displayed in the dialog shown below:

6	Make Watertight Wizard	×	
Set the maximu	Im linking tolerance	_	
Present solid linking tolerance	0.01 0.066 Maximum solid linking tolerance 0.1		
The solid's linking tolerance is the size of the largest linked gap or overlap between edges of the solid. Make Watertight will link all holes to matching edges up to the maximum linking tolerance that you specify above. Repair options			
(3) Large Holes	Holes are intentional and should not affect watertight status	<b>~</b>	
(1) Medium Holes	Mark with curves (manually fix before re-running this wizard)	~	
(59) Small Gaps	Make tolerant edges across gaps	~	
Edges within tolerance			
Options Advanced	Next > Cancel Help		

- 10 Click Advanced.
- **11** The next page of the wizard is displayed.
- 12 Click Healing to deselect the option.

6	Make Watertight Wiza	ard 🛛 🗡
Repair holes in	the solid	<b>8-8-</b> 6-6
Hole state		
Selected hole width	0.102 🗸	
(4 hole(	s) remain)	
Repair hole by Healing Filling while jumping g	aps under 0.05	] Tangentially
Preview Apply	Skip	Finish Help

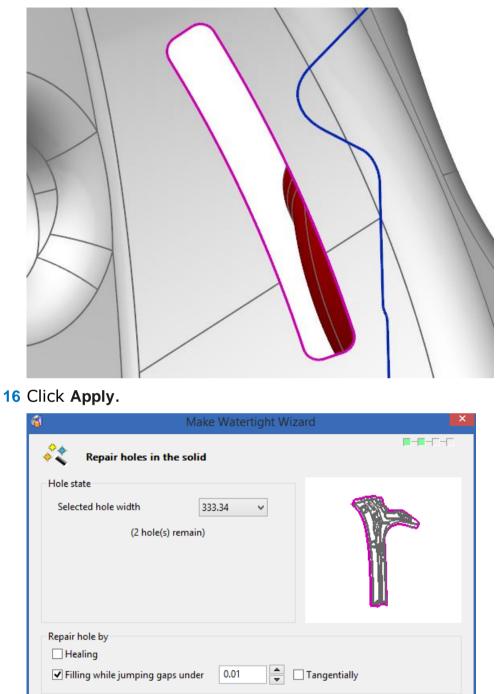
**13** Select the hole, shown in the image below:



#### 14 Click Apply on the dialog.

🚳 Make W	atertight Wizard 🛛 📉 🗙
Repair holes in the solid	■-■-[[]
Hole state	
Selected hole width 0.102	✓
(4 hole(s) remain)	
Repair hole by	
Healing	
✓ Filling while jumping gaps under 0	05 Tangentially
Preview Apply	Skip Finish Help

#### 15 Click Apply.



**17** Click **Finish** as the last large hole is the outside of the model.

Finish

Skip

Preview

Apply

Help

#### 18 Click Next.

6	Make Watertight Wizard	×
Set the maximu	■-□-□- um linking tolerance	-
Present solid linking tolerance	0.01 0.066 Maximum solid 0.066 Inking tolerance	
	is the size of the largest linked gap or overlap between edges of the nk all holes to matching edges up to the maximum linking tolerance	2
(1) Large Holes	Holes are intentional and should not affect watertight status	¥
(1) Medium Holes	Mark with curves (manually fix before re-running this wizard)	~
(61) Small Gaps	Make tolerant edges across gaps	~
Edges within tolerance		
Options Advanced	Next > Cancel Help	

#### 19 Click Finish.

6	Make Watertight Wizard	×
**	Review solid state	<b>₽-₽-₽</b> -(**
This soli	id is linked to a tolerance of 0.072 and is not yet watertight.	
Manua	al repair operations	
1 larg	ge hole(s) - deliberate	
0 med	dium hole(s)	
1 sma	all gap(s)	
0 slive	er(s)	
Cr	reate wireframe for all remaining problem areas	
< Ba	ick Next > Finish Dismiss	Help

**20** The results as shown in the model shown below:

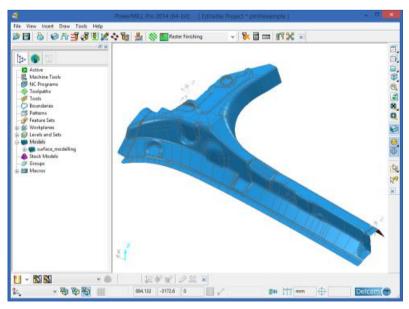


#### 16. Exit Surface modelling

1 Click *Solution* on the main toolbar to return to **PowerMILL**.



- 2 Click Plain shade 🧕.
- 3 Click Save



# Summary

You have modified surfaces using PowerMILL Modelling You have done the following:

- Saved a project file in PowerMILL
- Started surface modelling
- Fixed undercut areas of your model
- Recreated surfaces to change the draft angle
- Removed holes using trimming tools and Make Watertight Wizard
- Returned the fixed model to PowerMILL