R6 F1 Car Tutorial

Using the 223MM X 65MM X 50MM Balsa Blank

JAGUAR F1 TEAM IN SCHOOLS

CAD/CAM DESIGN CHALLENGE

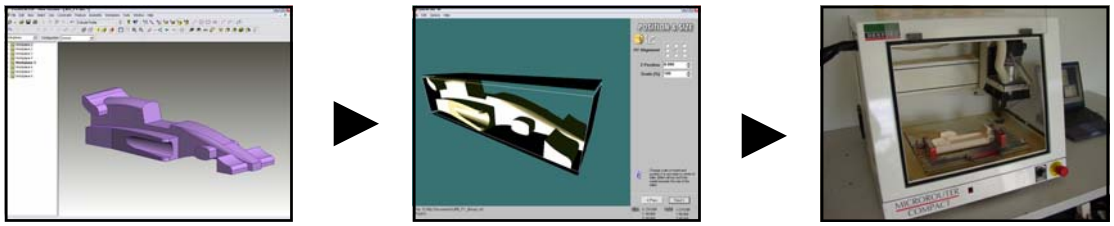
How does this Tutorial Work?

This tutorial is divided into three sections and concentrates on the **DESIGN** and **MAKE** portions of the *F1 in Schools CAD/CAM Design Challenge*.

1) **Designing the F1 Car in Pro/DESKTOP 8.0**
   - Start off with a template of an F1 car and follow along while you are guided through the creation of a 3D model. You will also get your chance at design when you have the opportunity to create your own wings for the F1 car. This section is also referred to as CAD (Computer Aided Design).

2) **Creating the F1 Car file for Manufacture using QuickCAM 3D**
   - In this section, you will convert your STL file that was created in Pro/ DESKTOP, into a file that the machine will read to produce the final part. This sections is also referred to as CAM (Computer Aided Manufacturing).

3) **Manufacturing the F1 Car**
   - Learn how to setup the F1 Car fixture, set machine offsets, and machine the F1 Car.



CAD **CAM** **CNC**

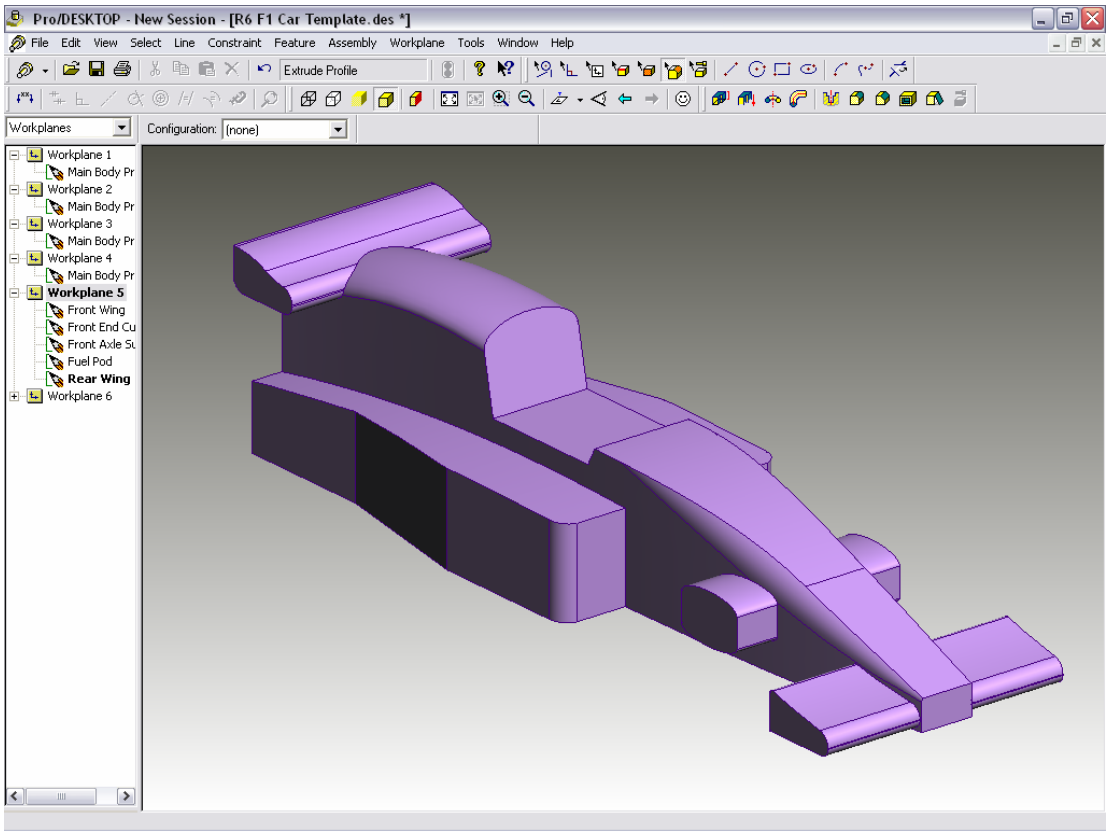
Designing the F1 Car Tutorial

Instructors Notes

1. Create a directory to store your Pro/DESKTOP template.
2. Copy the R6 F1 Car Template.des file from the CD into the newly created folder.
3. The tutorial is written in metric so you will need to ensure that Pro/DESKTOP is configured correctly. To do this, select the **Tools** drop down menu, then select **Options**, then select **Units** and set both Model distances and Paper distances to mm.
4. The student will be asked to save his/her work, please provide them with a location to do this.
5. We recommend the instructor works through this tutorial before issuing it to the students, to insure you have a full understanding of what is required.

Designing the R6 F1 Car in Pro/DESKTOP 8.0

Using the 223MM X 65MM X 50MM Balsa Blank



JAGUAR F1 TEAM IN SCHOOLS

CAD/CAM DESIGN CHALLENGE

Task 1 Creating the Fuel Pods

Open Pro/DESKTOP V8. Check to make sure that you are using metric. To do this go to the **Tools** drop down menu and select **Options**, then select **Units**.

1) Open the file named R6 F1 Car Template.des

   To do this, from the menu bar, click **File**> **Open**. Select the R6 F1 Car Template.des file from the location defined by your instructor, and click Open. Your screen should look similar to the one shown in Figure 1.

2) Maximize the window by clicking the square at the upper right corner of the screen. Then zoom to view the full template in Figure 2.

   Helpful Hints:

   - To Rotate: Use the center mouse button
   - To Pan: Hold down the Shift Key and the Center mouse button.
   - To Zoom: Hold down the Ctrl Key and the Center mouse button.

3) In the Object Browser, click the + symbol next to each Workplane folder to display the sketches that you will be using.

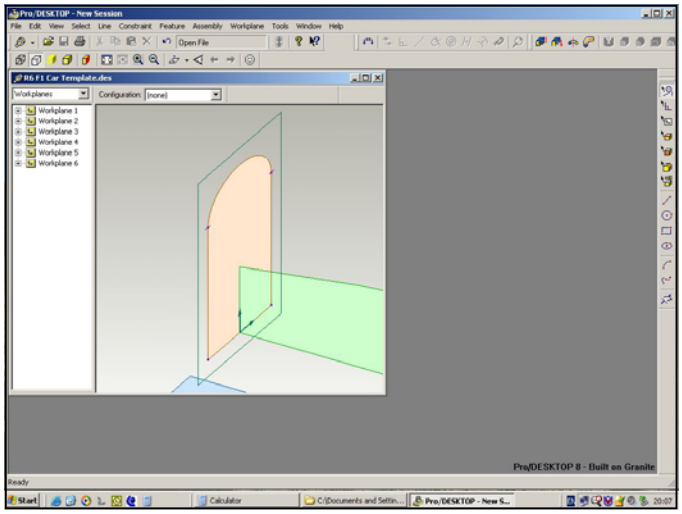


Figure 1 - The R6 F1 Car Template.des file

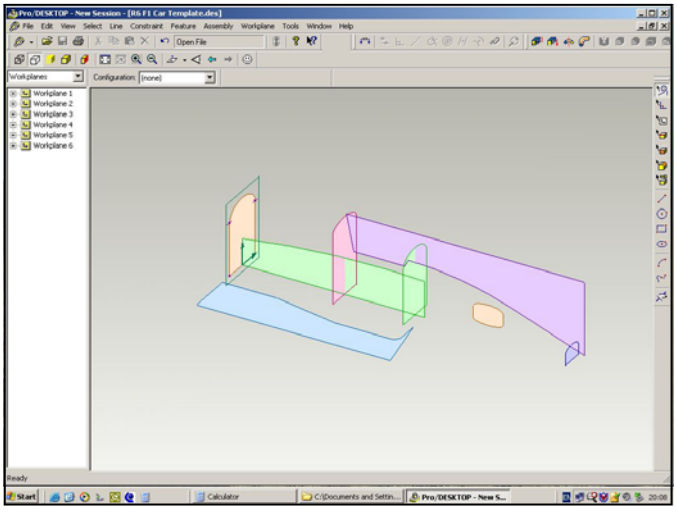


Figure 2 - The Car Template View

Unit 1 Designing the Car

Task 1 Creating the Fuel Pods

4) From the menu bar, click **Feature > Extrude Profile**.

5) Enter the following information in the Extrude Profile window.

- Feature name: Fuel Pod Extrusion
- Sketch to use as profile: Fuel Pod
- Select - Add material
- Type 32.5 for the Distance
- Select - Above workplane
- Click OK

6) Your screen should now look like the model in Figure 4.

7) Left mouse click to accept.

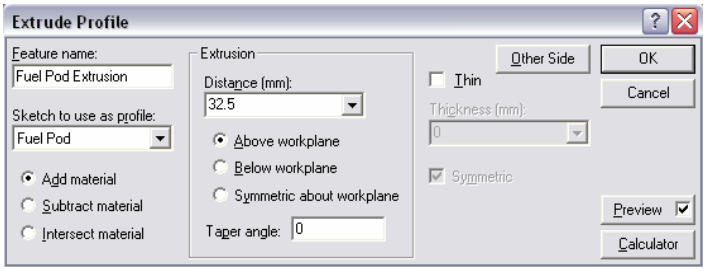


Figure 3 - Extrude Profile Window

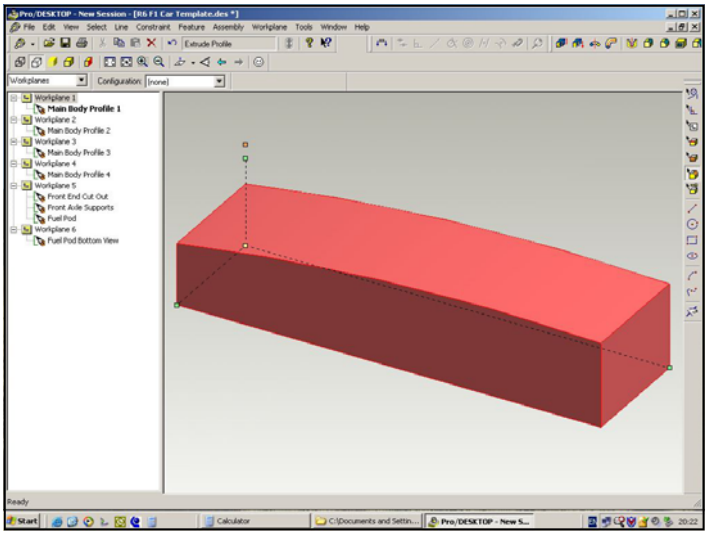


Figure 4 - Right Fuel Pod Extruded

Helpful Hint: When you are either Extruding a Profile or Projecting a Profile, you will notice a green arrow and a yellow arrow next to the vectors that you are trying to Extrude or Project. The green arrow represents the direction you will be Extruding or Projecting either above, below or symmetric about the workplane. The yellow arrow represents the area you will be adding or sub-tracting.

For example, on the fuel pod, the green arrow is pointing away from the center of the car, this represents adding material above the workplane. The yellow arrow is pointed towards the center of the fuel pod. This represents the area inside the fuel pod will be Extruded.

You are now going to shape the Fuel Pod by subtracting the profile sketch from the Fuel Pod feature.

8) From the menu bar, click **Feature** > **Project Profile**.

9) Enter the following information in the Project Profile window.

- Feature name: Fuel Pod Projection
- Sketch to use as profile: Fuel Pod Bottom View
- Select - Subtract material
- Select - Above workplane
- Select - Thru to next face
- Click OK

10) Left mouse click to accept.

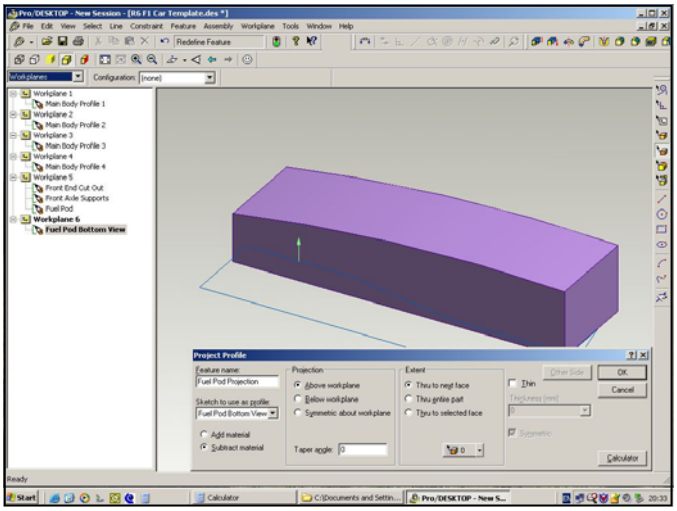


Figure 5- The Fuel Pod Projection Feature.

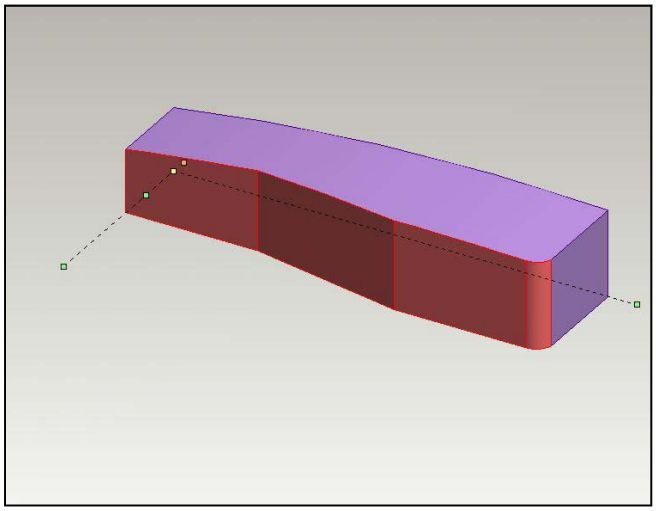


Figure 6- The Fuel Pod rendered.

Unit 1 Designing the Car

Task 1 Creating the Fuel Pods

8) You will now mirror the Fuel Pod that you have just created around Workplane 5. Go to **Feature**> **Modify Solids**> **Mirror Solids**.

9) In the Mirror Solids window, change the Feature Name to **Fuel Pod** and make sure Keep original solid is checked. Left Click on Workplane 5. (This is to select the mirror plan) Your model should now look like the one in Figure 7. Press OK.

10) Left mouse click to accept.

11) You have now completed Task 1 Creating the Fuels Pods. Go to **File**> **Save Copy As**> Now save the file as a unique name. Example: Coree F1 Car. Click on Save.

12) Now that you have saved a copy, go to **File**> **Close.** (This is to prevent the software from overwriting the template file.) Go to **File** > **Open**, and select the file that you just saved. Click Open. Your file name should now appear at the top left of the screen. You are now ready to move onto Task 2.

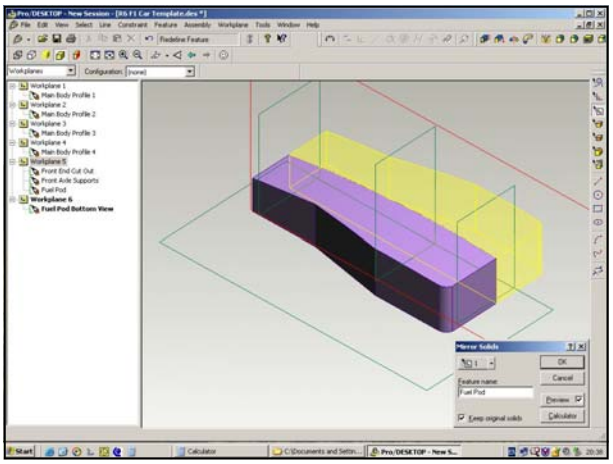


Figure 7 - Mirrored Fuel Pod Preview

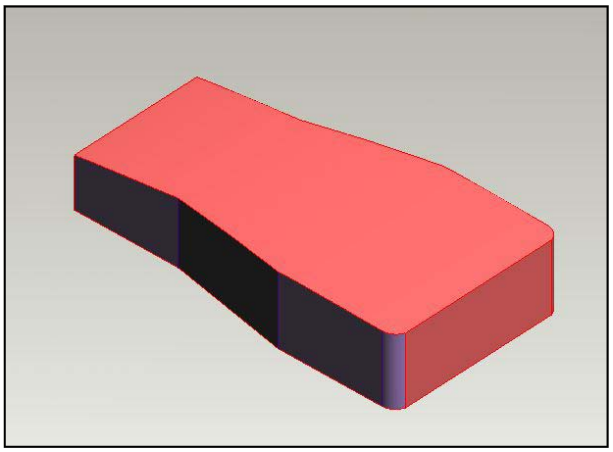


Figure 8 - Mirrored Fuel Pod

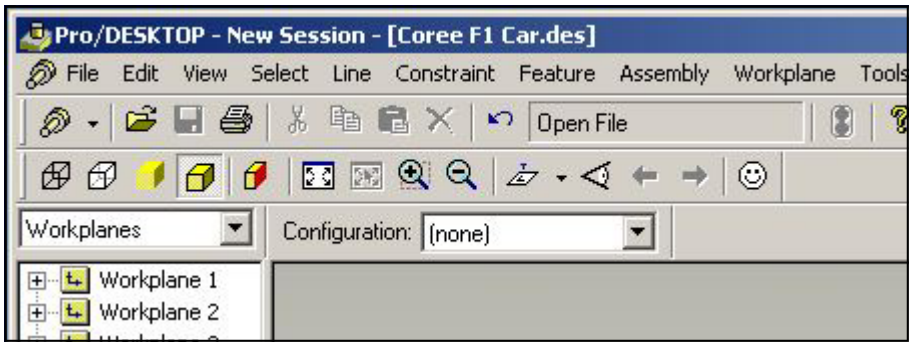


Figure 9 - Check title screen

Task 2 Creating the Main Body Profile

1) In the Object Browser, click the + symbol next to each Work-plane folder to display the sketches that you will be using.

2) With the new file open, From the Menu bar, click **Feature**> **Loft Through Profiles**.

3) Select Main Body Profile 1 from Workplane 1 in the Object Browser.

4) Repeat step 3 for **Main Body Profile 2, 3, and 4.** See Figure 11.

5) Make sure the following are selected in the Loft Profiles Window:
- Feature Name: Main Body Profile
- Add Material is Selected

6) Click OK.

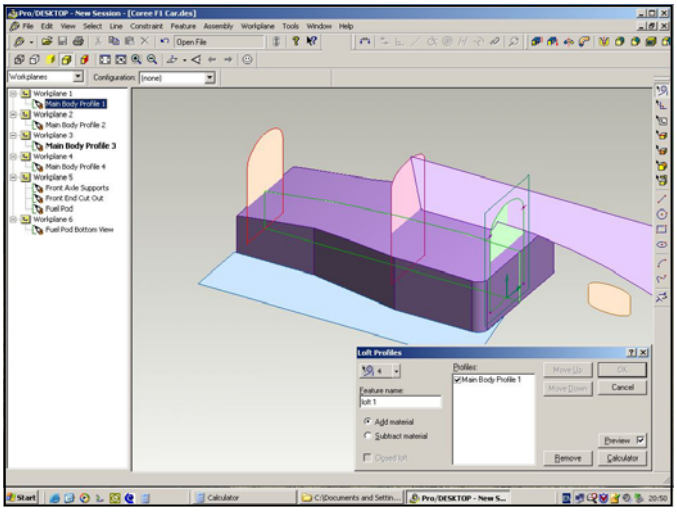


Figure 10 - Lofting Main Body Profiles .

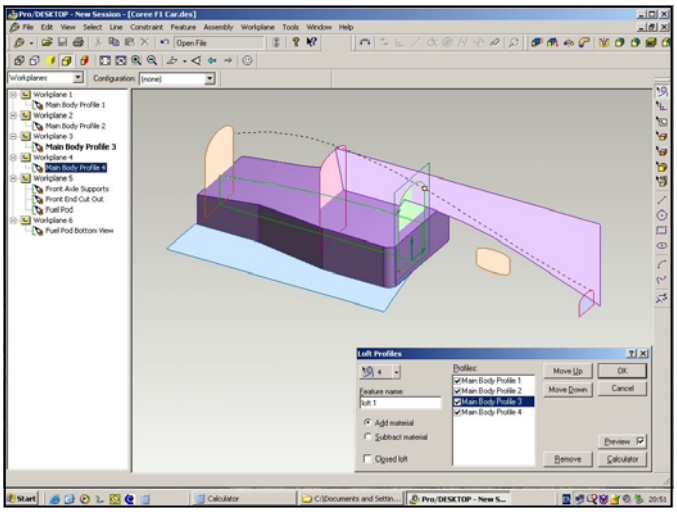


Figure 11 - All 4 Main Body Profiles Selected.

Task 2 Creating the Main Body Profile

7) You have now created the Main Body Profile and Task 2 is complete.

8) Go to **File**> **Save**.

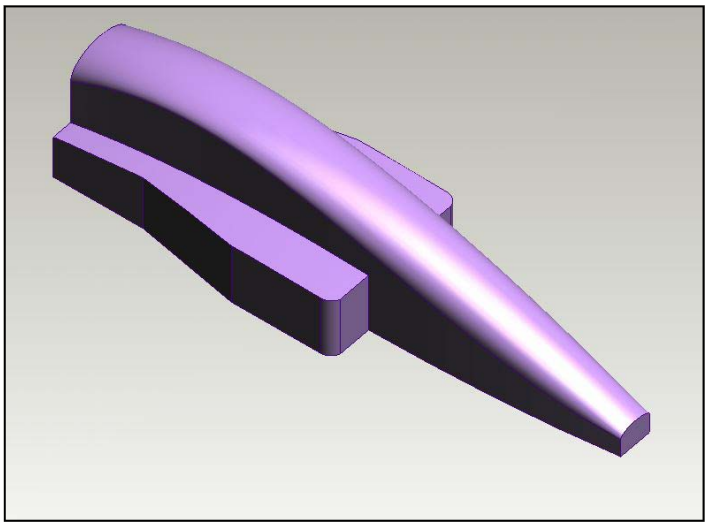


Figure 12 - Main Body Profile completed.

Task 3 Front End Cut Out

By using the Project Profile Tool, you will now create the Front End Cut Out.

1) Go to **Feature**> **Project Profile**.

2) Enter the following information in the Project Profile window.

- Feature Name: Front End Cut Out
- Sketch to use as profile: Front End Cut Out
- Select - Subtract material
- Select - Symmetric about the workplane
- Select - Thru entire part

Click OK

3) Your model should now look like the one in figure 14.

4) Left mouse click to accept.

4) Task 3 is complete and you may now save your Car file.

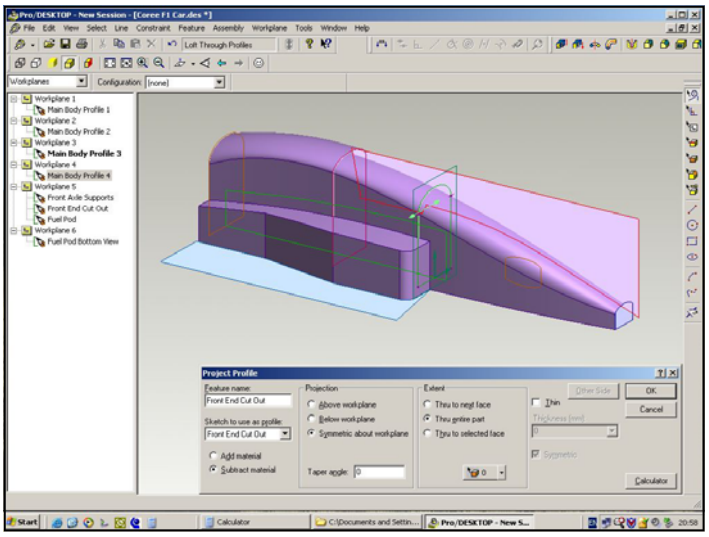


Figure 13 - Project Profile Window for Front End Cut Out.

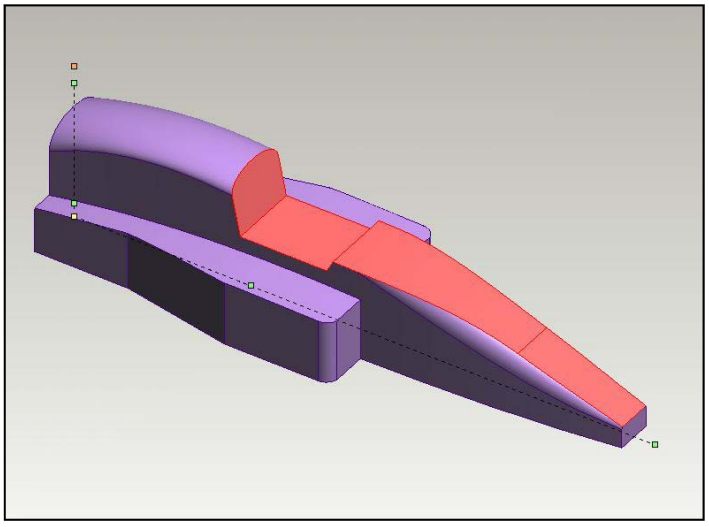


Figure 14 - Updated front end

Unit 1 Designing the Car

Task 3 Creating the Front Axle Supports

1) From the top menu select **View** > **Go To** > **Isometric View**.

2) From the top menu select **Feature** > **Extrude Profile**.

4) In the Extrude Profile window, set the following:

- Feature Name: Front Axle Supports
- Sketch to Use as Profile: Front Axle Supports
- Select - Add Material.
- Change the Distance to 45.
- Select - Symmetric About Workplane.
- Your screen should look like the one shown in Figure 15. Click OK.

5) Left mouse click to accept.

6) The third task is now complete. You can now save your file.

Helpful Hint:
You may also change the distance on a extruded object by holding down the left mouse button on the center of the yellow square and drag the mouse to the desired distance on screen.
(Refer to Figure 16.)

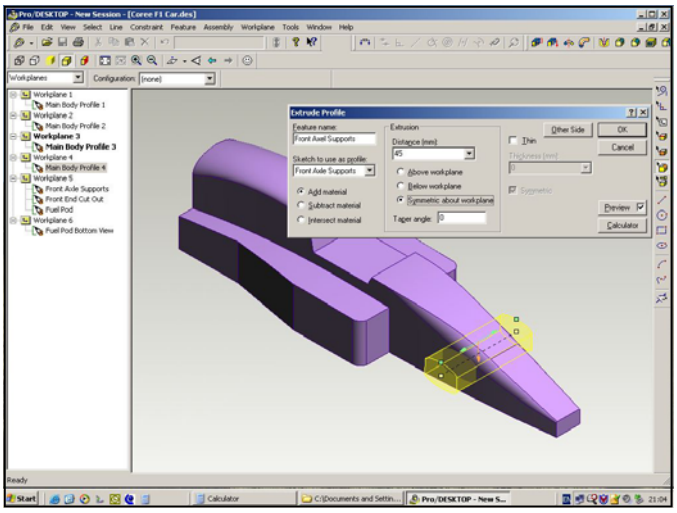


Figure 15 - Creation of the Front Axle Support.

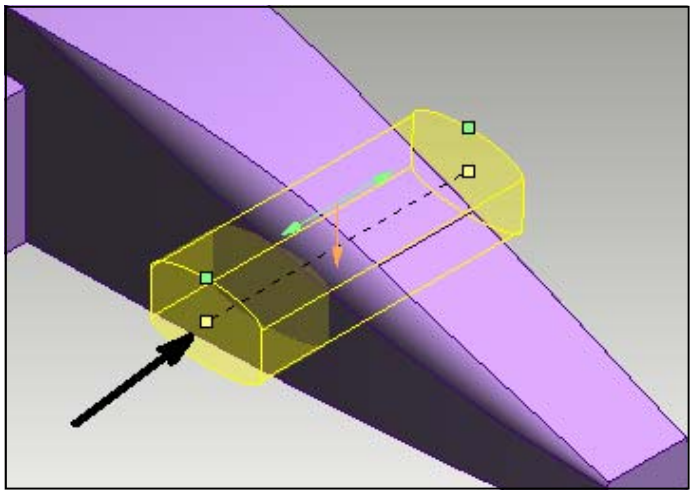


Figure 16 - Manual Extrusion

1) In this task, you will start by creating the shape of the wing, then extruding it. This task is different than previous tasks, because you are going to first create you own design.

2) Right Click on Workplane 5 and select new sketch. Change the sketch name to “Front Wing” and click OK

3) From the **View** menu select **Go To**> **Onto Workplane**. Using the mouse, zoom in on the front of the car.

4) You will now use the line tool to create the profile of the front wing.

5) From the **Line** menu select **Straight**. To create a line, move the cursor to the position you want to start your line and hold down the left mouse button. While pressing the mouse button, drag the mouse to the desired location for your line. To create a straight line, simply hold down the shift button while you create the line.

6) Using the line tool, create a side view of the front wing. Figure 19 shows you an example of one.

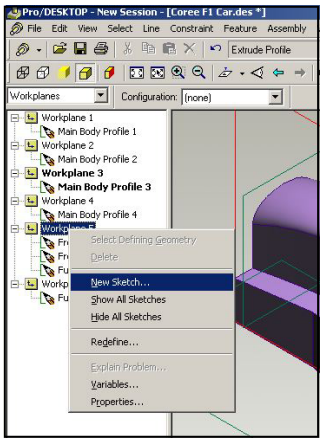


Figure 17 - New Sketch window

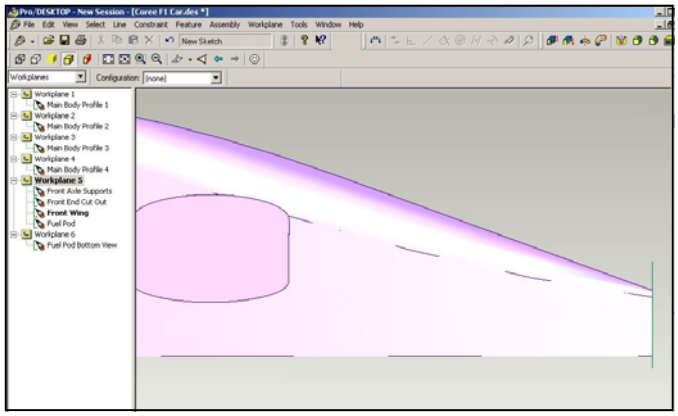


Figure 18 - Up close look of front end

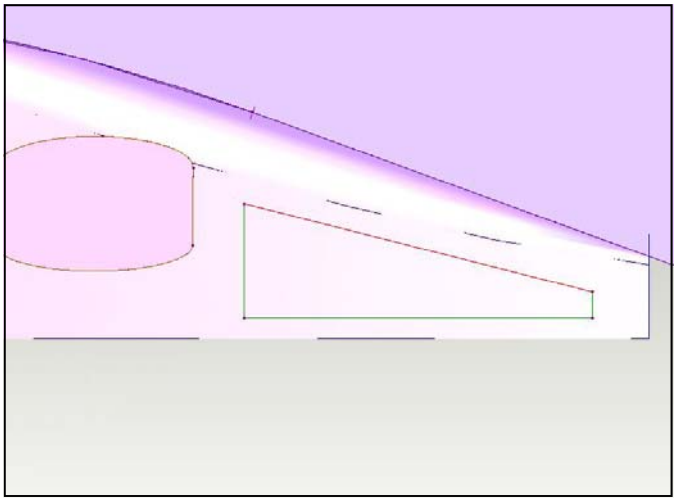


Figure 19 - Front Wing Shape

Unit 1 Designing the Car

Task 4 Creating the Front Wing

7) Next, select the **Arc** tool from the **Line** menu and create a few fillets on your wing. Refer to Fig 20 on creating fillets. Fillets are another term for radius.

   Helpful Hint: Position the cursor so it intersects the two lines. Ensure the lines are pre-selected (blue) before dragging the mouse away.

   If the sketch is not shaded, it is not valid. Use the undo key or delete the lines and start again.

8) Once you have created some fillets on your wing, you are now ready to extrude it.

9) Change your view to Isometric. From the **View** menu, select **Go To, Isometric.**

10) From the **Feature** menu, select **Extrude Profile**.

11) Enter the following information in the Extrude Profile window.

- Feature name: Front Wing Extrusion
- Sketch to use as profile: Front Wing
- Select - Add material
- Distance: Refer to the rules to make sure your wing conforms to the regulations, with regard to the maximum width and length.
- Select - Symmetric about workplane
- Click OK

12) You have now created the front wing. You can now save your file.

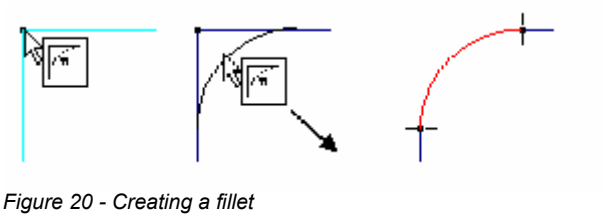


Figure 20 - Creating a fillet

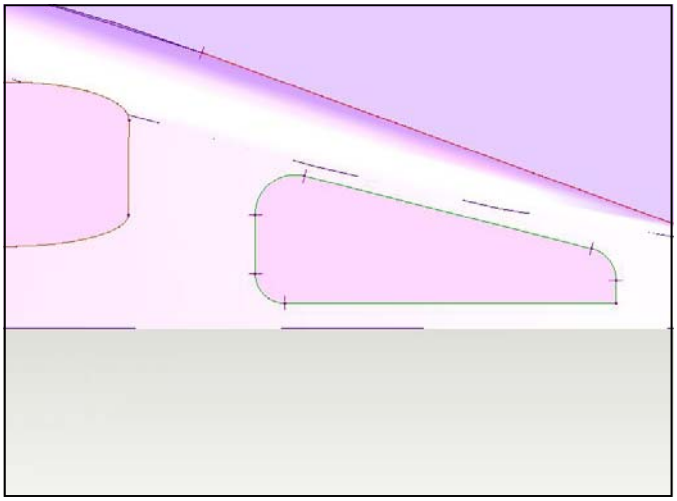


Figure 21 - Front Wing Design

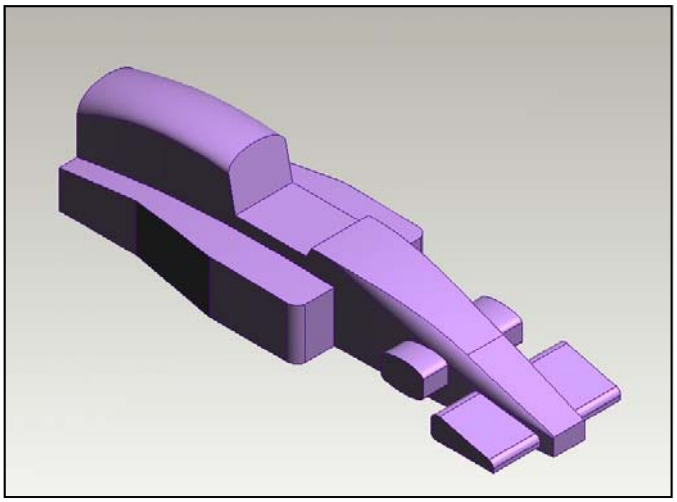


Figure 22 - Front Wing Extrusion

1) You will now create the Rear wing just like you created the front wing, so start off by right clicking on Workplane 5 and selecting New Sketch.

2) Change the name to “Rear Wing” and click OK.

3) Using what you learned in Task 4, create the rear wing. Remember to ensure the sketch is valid (shaded) before extruding. Also keep in mind to pay attention to the rules with regard to wing dimensions.

4) The Balsa Blank is 50 MM high, so when you are creating the vectors, refer to the coordinates to make sure you don’t exceed the boundaries of the Blank. In Figure 23 the Blue circle is highlighting the origin, and the Red circle is highlighting your coordinates of the cursor.

4) Once you have designed your wing, you can now use the **Extrude** tool, keeping in mind the Balsa Blank is 65 MM wide.

5) Task 5 in now complete and you can now save your model.

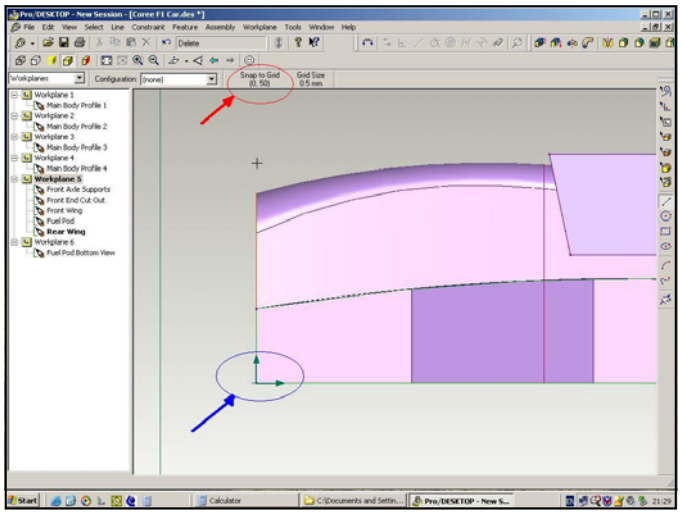


Figure 23 - Drawing Coordinates

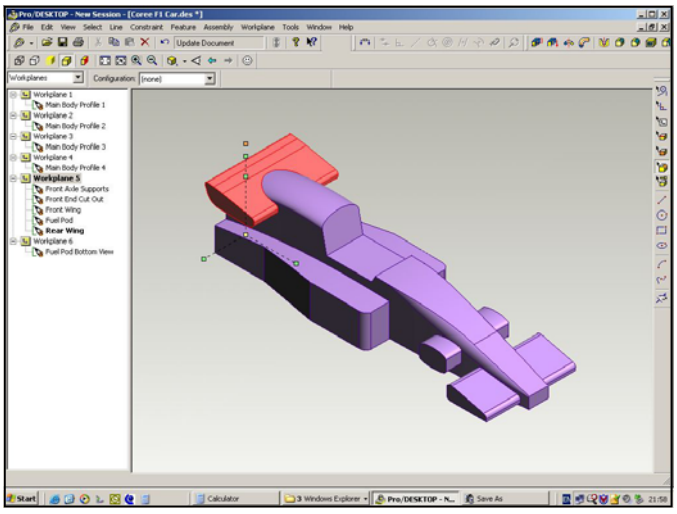


Figure 24 - Rear Wing Extrusion

1) From the menu bar click **File** > **Export** > **Stereo Lithography File**.

   Stereo Lithography (STL) is a 3D surface map of the model defined by triangles. The STL format is the universal transfer file for 3D models.

2) A window will appear as shown in Figure 26. Click Browse and change the path to a specified location, given by your instructor.

3) Select the ASCII Output mode. Binary Output mode can also be selected if you wish to create a smaller file size.

4) Set the Chordal tolerance to 0.1

5) Click OK. The software will create an STL file for your car model which will be used later in QuickCAM 3D.

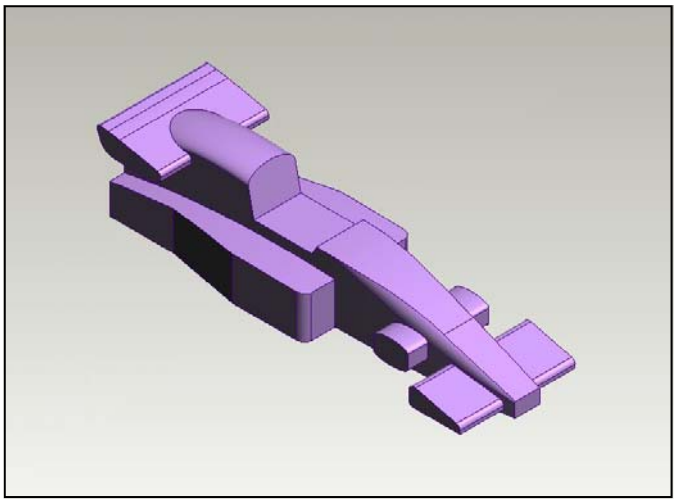


Figure 25- The Completed F1 Car

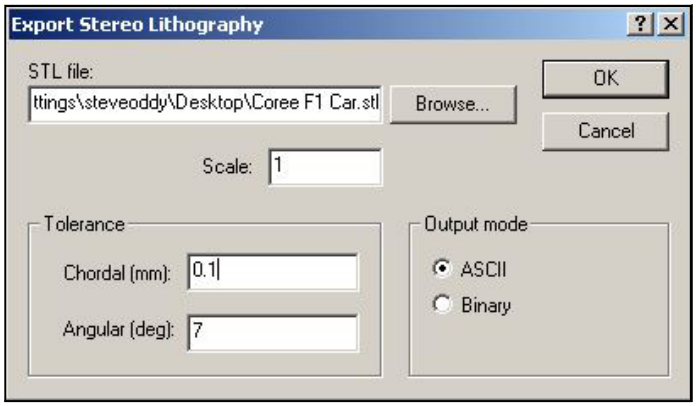
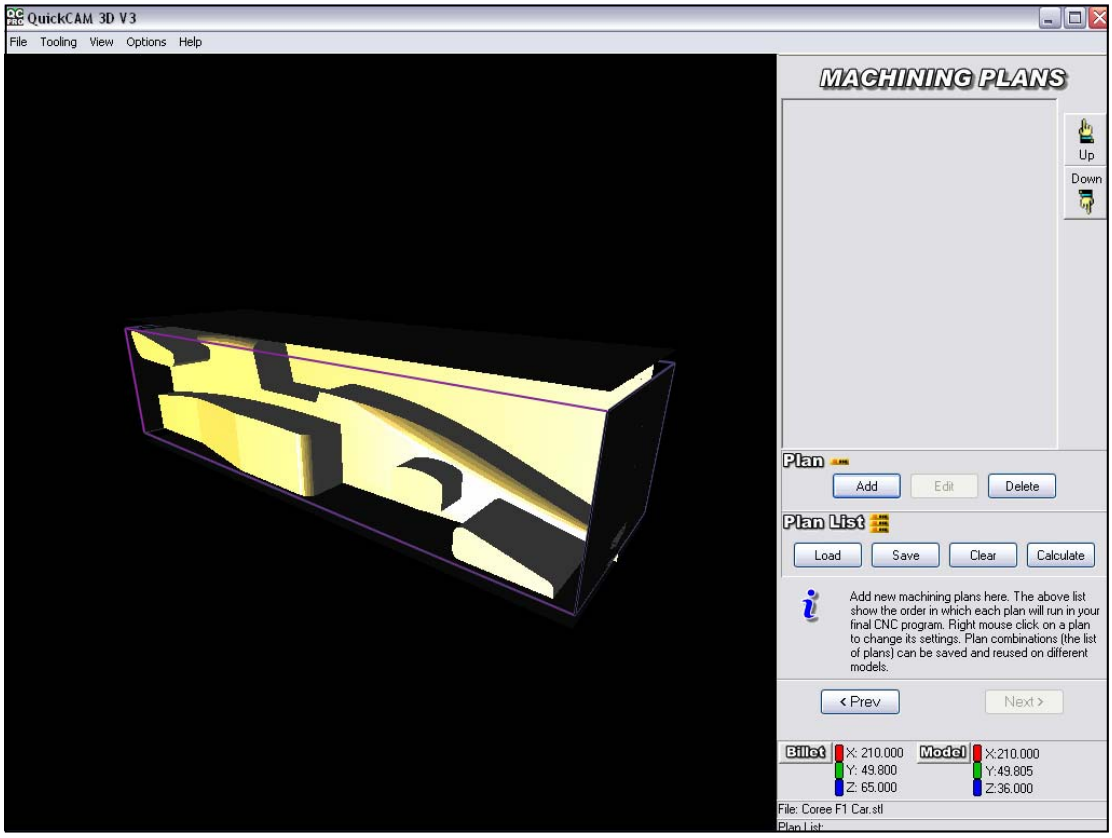


Figure 26 - The Export Stereo Lithography window.

Congratulations! You have now completed the Designing the Car in Pro/DESKTOP F1 Car Tutorial.

QuickCAM 3D F1 Car Tutorial



JAGUAR F1 TEAM IN SCHOOLS
CAD/CAM DESIGN CHALLENGE

Make sure you have the Quick-CAM 3D Wizard open on your screen.

1) Setting Units of Measurement

- From the menu bar, click **Options** > **Units**.
- A check mark should be shown before Metric. If necessary, change to Metric units by clicking the Metric option.

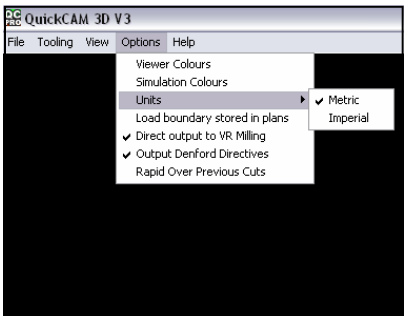


Figure 1 - Setting the Units

Please note.. Your model may vary to the model shown in the following figures.

2) OPEN MODEL PAGE

- Click the 3D Model button.
- Locate the STL file you created earlier and Click Open.
- You can rotate and zoom on the model using the mouse. See details below as to how to do this.
- Note the 3 colored arrows in the bottom left hand corner of the model relate to the axes configuration. Red = X Green = Y and Blue = Z.
- Click Next

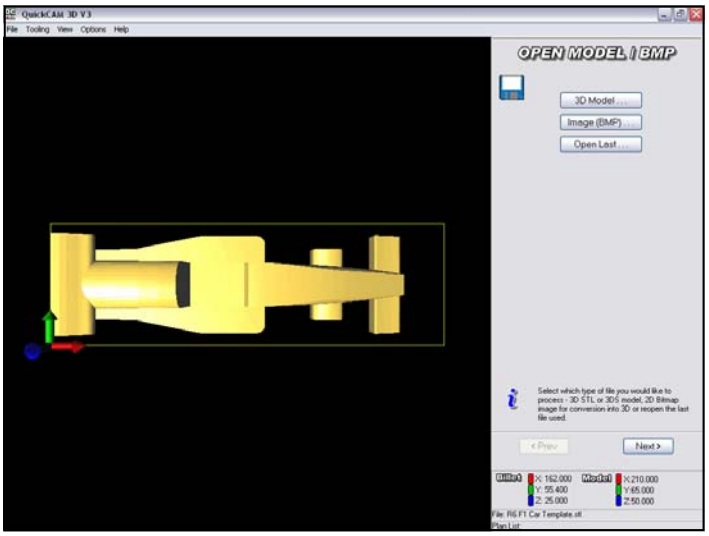


Figure 2 - Imported Model

To zoom in…
Using the mouse, hold down the right mouse button on the 3D model while moving the cursor upwards. This enlarges the view of the 3D model. Moving the cursor down will make the 3D model smaller.

To rotate the model…
You can also tilt the 3D model front to back and left to right. Using your mouse, left-click on the 3D model. While holding the left mouse button down, move the cursor upwards. This tilts the back edge of the 3D model down. Moving the cursor down will tilt the front edge of the 3D model.

3) ORIENTATE MODEL

- In this section of the wizard you will rotate your model into the correct orientation for it to be machined.
- The large red arrow indicates the tool cutter direction
- You need to rotate the model so that you can machine down the sides of the car when it is fitted in the F1 fixture.
- The car must be rotated so that the rear of the car is to the left and the floor is to the bottom of the screen as shown in Figure 4.
- In this case the model has been rotated 90 degrees in the X axis.
- Click on the X value and enter 90
- Click Next

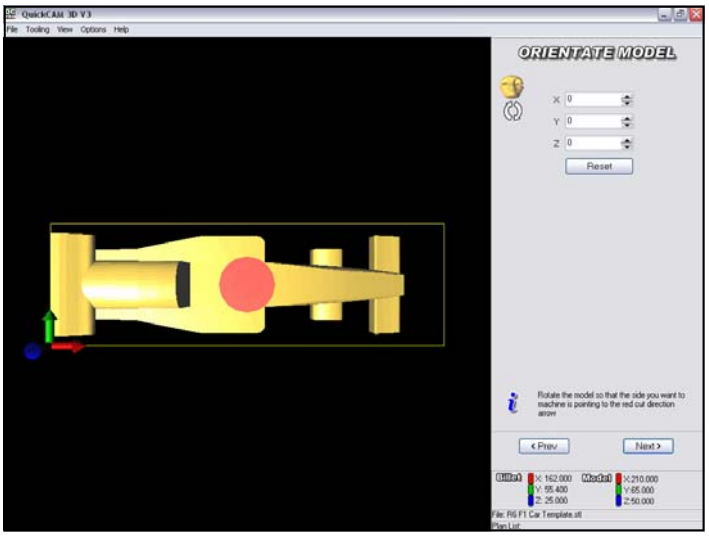


Figure 3 - Top view of car

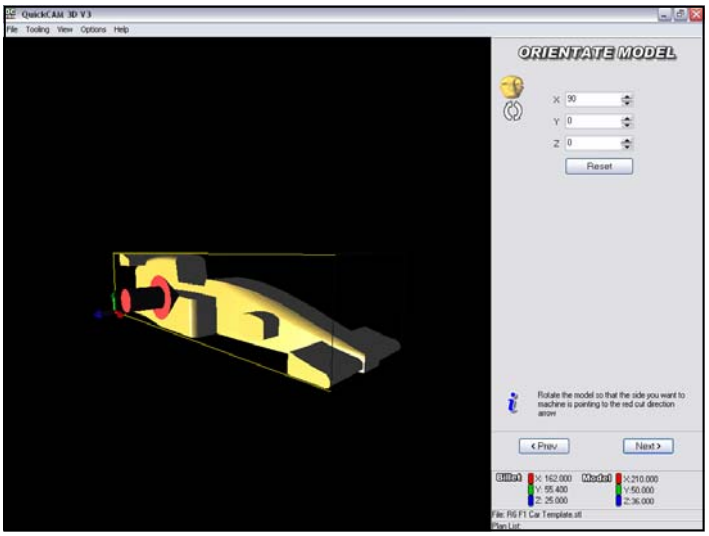
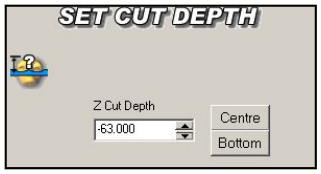


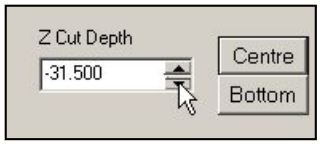
Figure 4 - View of Orientated Model

4) SET THE CUT DEPTH

- In this page of the wizard you will set the depth of the model that you want to be machined
- The blue plane is called the cut plane and can be moved to control the maximum depth the cutter is allowed to machine to.
- Click on the bottom button



- ***Write down the Z Cut depth as this is the maximum width of your model. You will need this value latter in the tutorial.***
- Click on the Centre button and the blue cut plane will move to the centre line of the model.
- The tool needs to cut below the centerline of the model so as to ensure the tool paths overlap and there is not a ridge left after machining.
- Take the cut depth 4mm further down by clicking on the down arrow 4 times. In this case set to –35.5



- Click Next

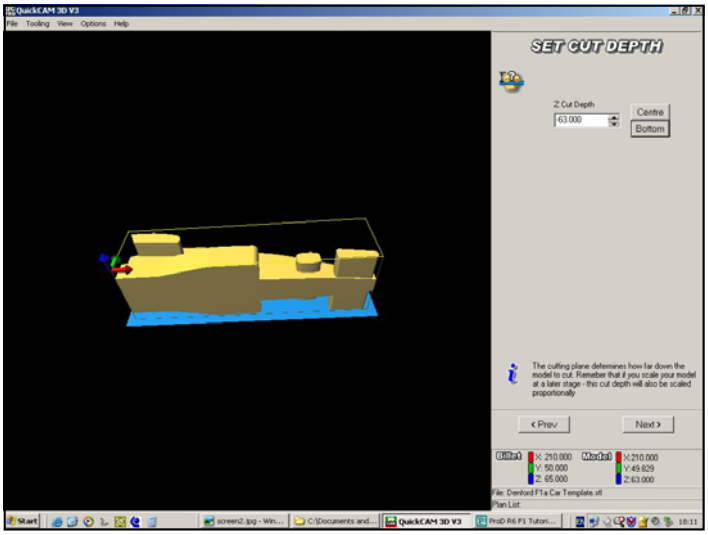


Figure 5 - Finding maximum model width

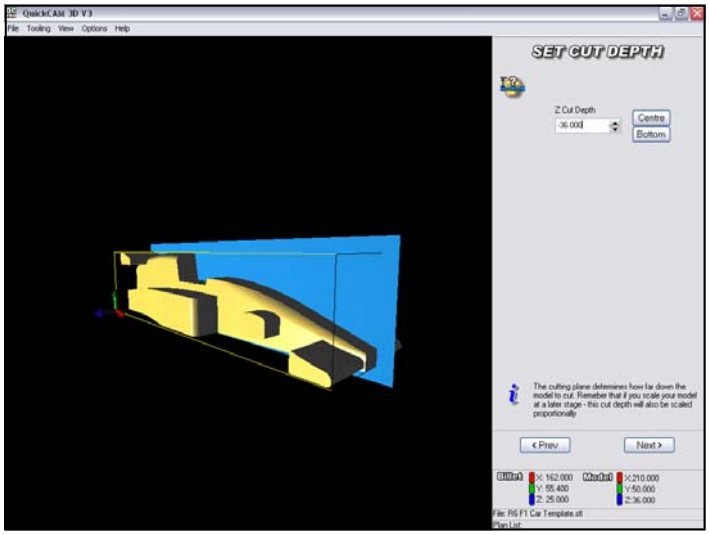


Figure 6 - Setting Cut Depth

5) SET BILLET SIZE

- This page of the Wizard allows you to define the block size that you want to be able to machine.
- As you will be clamping the block at one end with the fixture you do not want to include this part of the Balsa Blank in the Billet area.
- Enter the values as shown below
  X 210
  Y 50
  Z 65

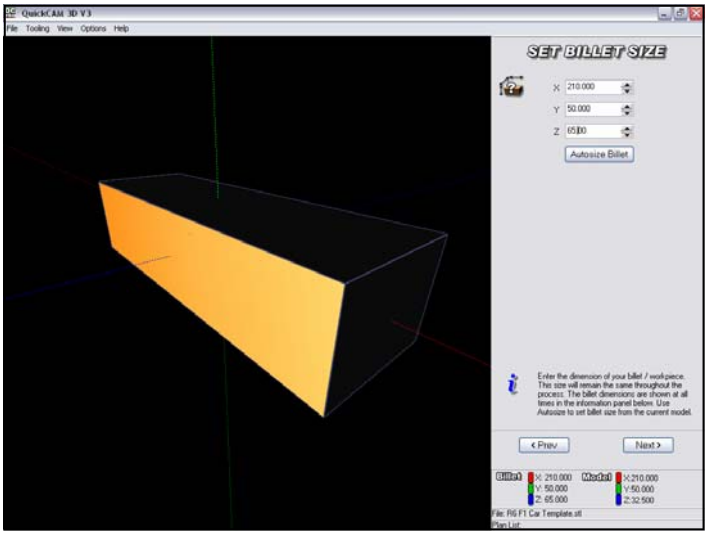


Figure 7 - Set Billet Size

Note:

- The actual size of the billet is X =223mm Y=50 and Z=65.
- Having entered a value of X=210 will leave 13mm to hold the end of the billet.
- Click Next

Figure 8 - Enter Billet Values

6) SET MODEL SIZE

- In this page of the wizard you will ensure your model is sized to 100% and that it is positioned correctly within the Billet.
- The Model Dimensions will match the area of the model previously designed from the cut plane upwards.

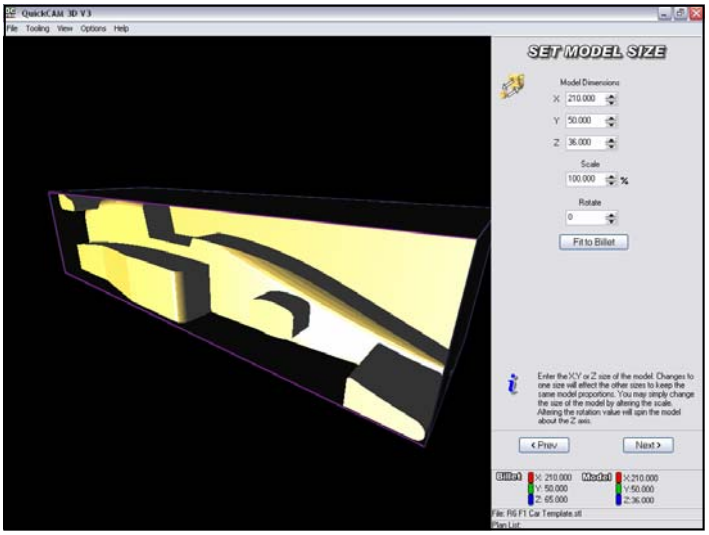


Figure 9 - Set Model Size Window

- Check the scale is set to 100%
- Check the Z value is half the width of the model plus 4
- Click Next

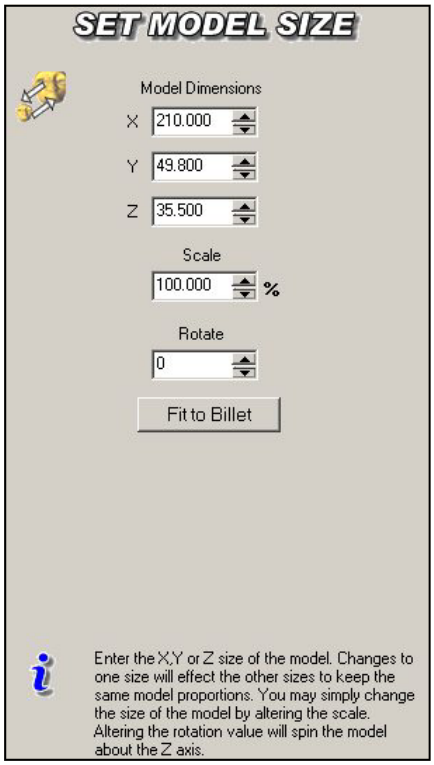


Figure 10 - Model Dimension Values

7) SET MODEL POSITION

- In this page of the Wizard you will position the model within the billet. If the model is not as wide as the billet you will have to center the model in the block by lowering it below the surface of the billet by half the difference in the sizes.
- In the example shown the Block is 65mm wide and the model thickness (which was noted in step 4) of this tutorial) was 63mm. As a result the model needs to be positioned below the surface of the block by 1mm on both sides of the car.
- The Z position should be set to half of 65mm - Actual Model width (recorded in section 4)
- In this case (65-63)/2=1
- Example for a model 60mm wide the Z position would be (65-60)/2=2.5
- X Y Position should be set to Zero.
- Click Next

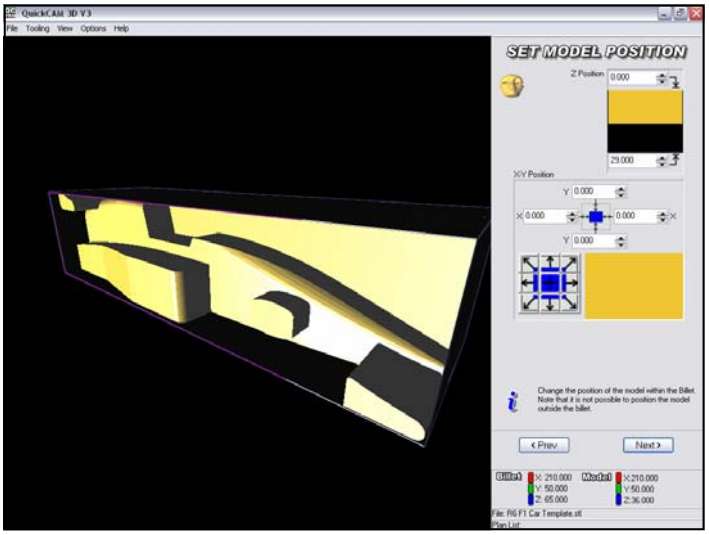


Figure 11- Model Position window

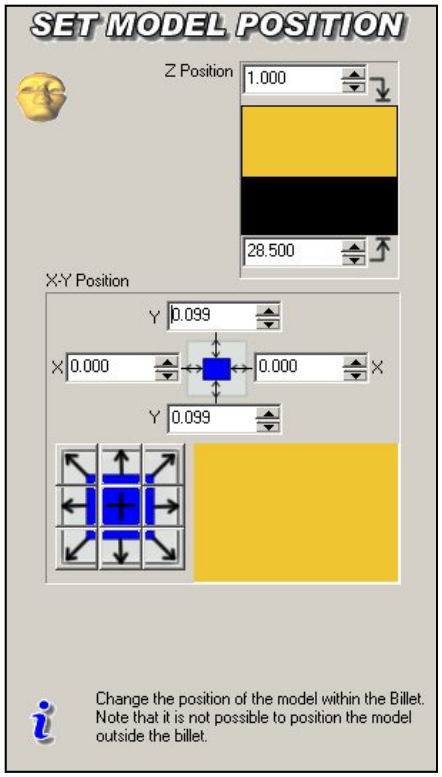


Figure 12- Model Position window

8) SET BOUNDARY

- In this page of the Wizard we are setting the boundary for the tool travel.
- To allow the tool to travel outside the model boundary so the tool tip can move down the model sides you have to Extend the Model boundary by more than the Diameter of the cutter.
- You do not want the cutter to machine the fixture at both ends of the model so you only need to extend the Boundary in the Y axis. DO NOT SELECT BILLET as this could cause the tool to collide with the fixture.
- Select the Model Button
- Enter an Y value of 7
- Click Next

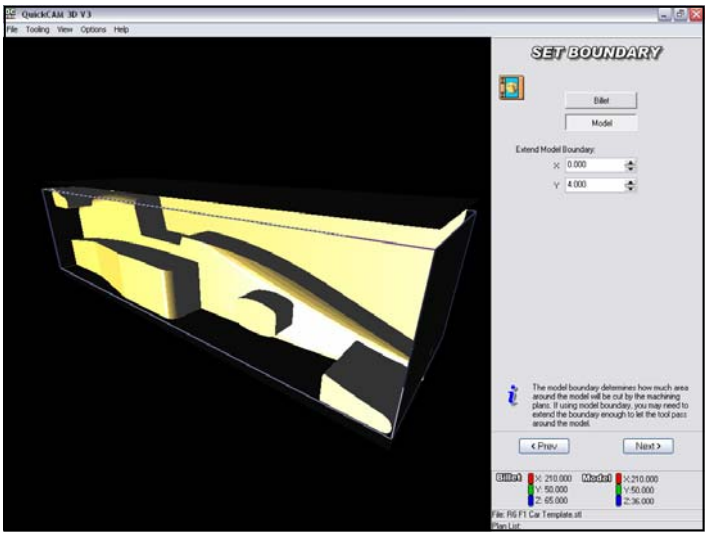


Figure 12 - Set Boundary window

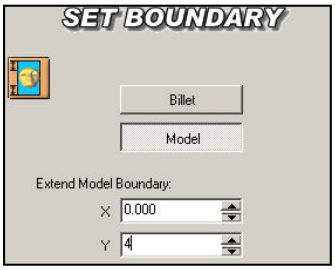


Figure 12a- Boundary set to 4mm

9) SETUP TOOLS

- In this page of the wizard you must ensure that the 1/4" ball nose cutter is available.
- Check if the cutter is shown in the list. If so select it.
- If the 1/4" Ball nose cutter does not appear in the list, Select Edit..
- Go to the choose standard tool dropdown and select the 1/4" Ball nose cutter.
- Select OK.
- Select Next

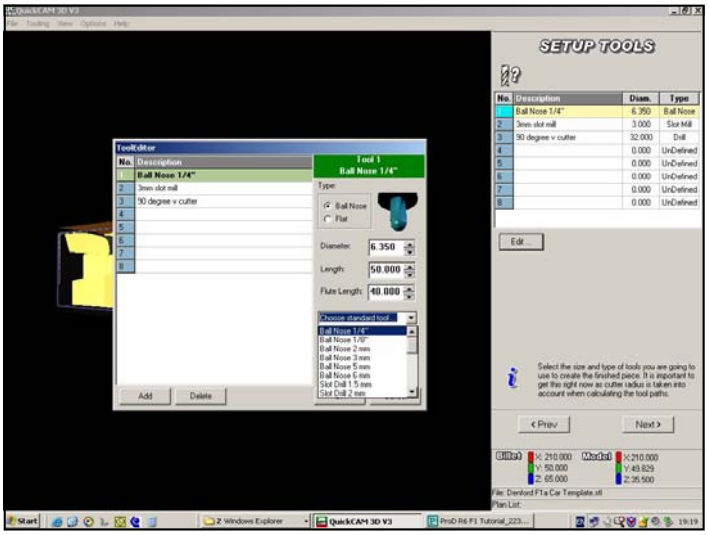


Figure 13 - Select the 1/4" Ball Nose cutter

10) MACHINING PLANS

- This page of the wizard allows you to select the correct machining Strategy to cut your car.
- Under the Plans menu click Add
- You do not need to rough the model as the 1/4" ball cutter is capable of cutting 40mm deep in Balsa wood in one pass.
- Select the Raster finishing plan from the list.
- The other cutting plans shown colored grey are unavailable in Quick CAM 3D but can be selected from Quick CAM PRO.
- These additional Strategies allow more complex cutter paths to be created which can create a better finish on the model.
- Select the Raster Finishing Plan by left clicking on it.

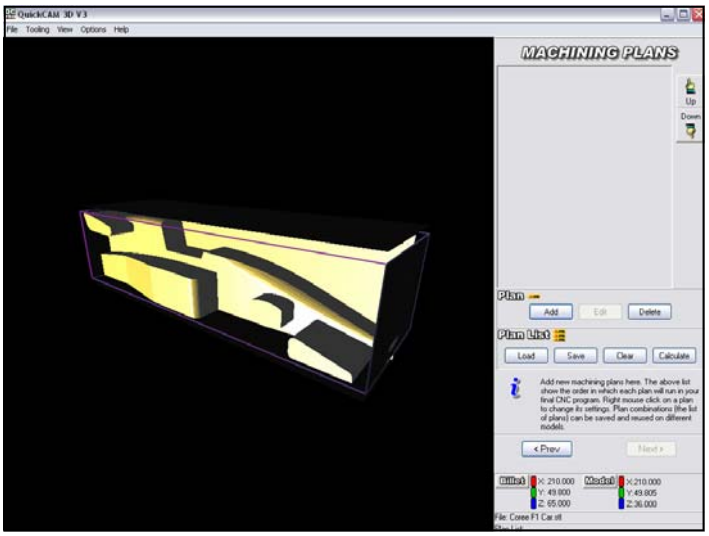


Figure 14 - Machining Plans window

Figure 15 - Machining Strategies

- When you have selected the Raster Finishing Machining Plan you must make sure the following information is selected.
- The tool selected is the 6.35mm—Ball Nose 1/4". If not select it from the dropdown
- The Step Over must be set to 15% (you can decrease this value if you want to improve the quality of your model)
- The Feedrate must be set to 4000. (you can reduce this if you have a model with fine wings that may be delicate)
- The Spindle speed must be set to 23000
- The Raster Angle must be set to 90
- Click OK
- The toolpath will be calculated. This may take some time .
- Once the toolpath calculation is complete, click Next.

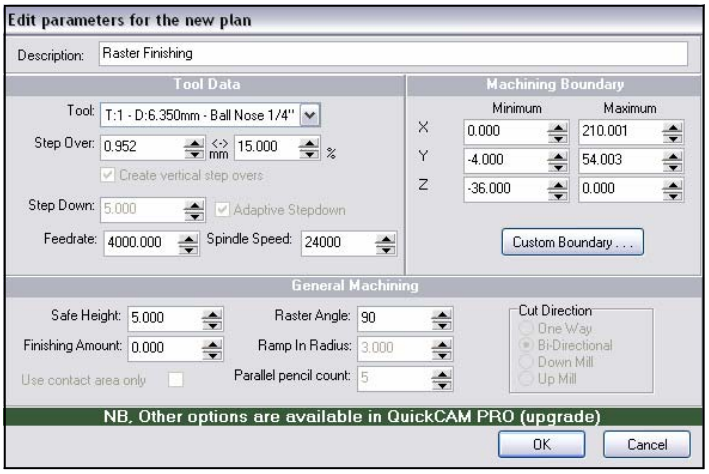


Figure 16 - Raster Finishing plan parameters

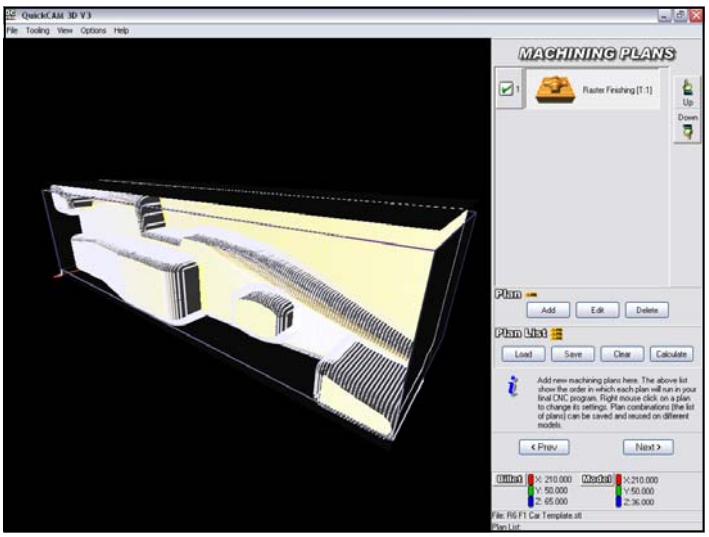


Figure 17- Toolpath Calculation window

11) TOOLPATH SIMULATION

- The simulation page of the wizard will show you what your finished part will look like. You can go back and change the settings in the machining plan then recalculate to see what the resulting tool path will look like.
- Click the Play button to simulate the cutting action.
- The slider bar can be used to speed up simulation.
- Turbo mode updates the simulation every 10 program lines. When Off each line of code is simulated.


Play


Stop


Turbo - speeds up simulation


Pauses Program


Takes a snapshot of the simulated car and saves a bitmap file.

- When you are happy with your simulation you can continue.
- Click Next to Proceed

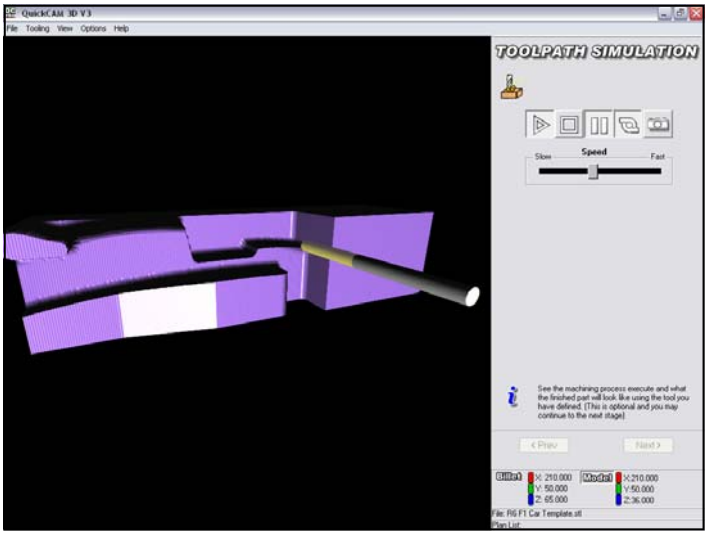


Figure 18 - Toolpath Simulation window

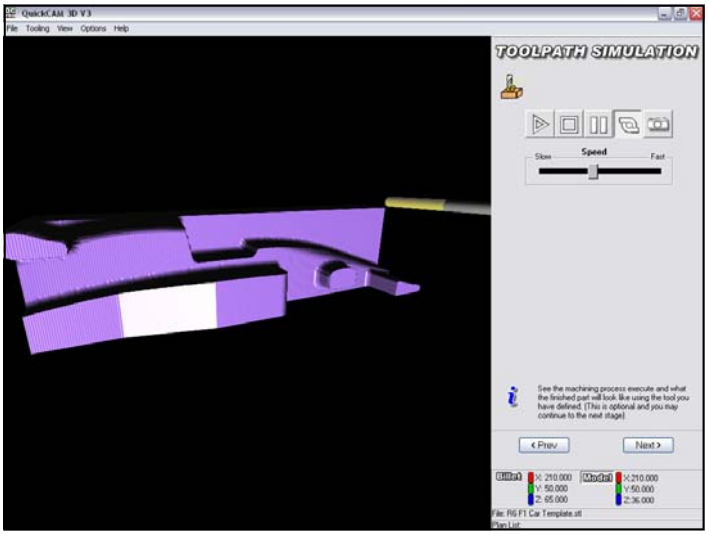


Figure 19 - Toolpath Simulation Complete

12) CNC FILE OUTPUT

- In this page of the Wizard we set the origin for the program. We also export the machine cutter path as an FNC file
- As the car revolves around the bore for the CO2 cartridge the centerline of the bore is used as the origin.
- The Bore centerline in 29mm above the base of the car.
- Use the up arrow next to the Y Datum position to set the value to 29.00
- Leave X and Z set to 0
- Left mouse click on Create FNC file.
- Select the directory where you want to save your CNC file.
- Name your file and Save.
- You have now saved the CNC file so you can close Quick CAM 3D.

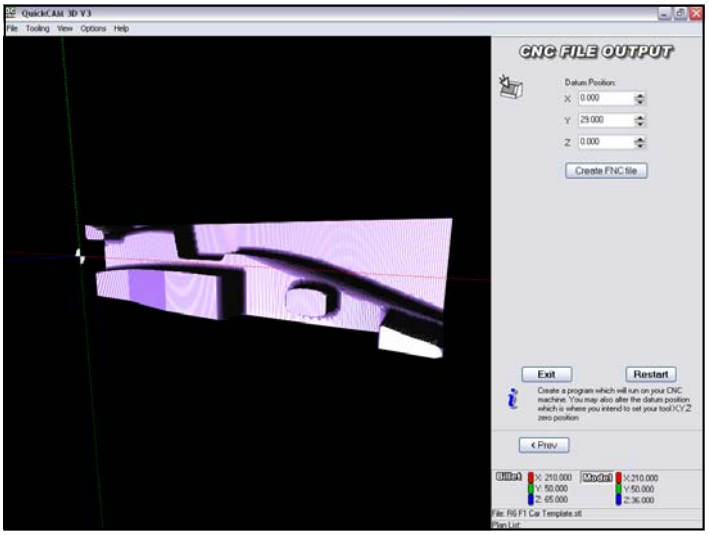


Figure 20 - CNC File Output window

* The Datum Position is where you will set the Zero point for the Machine offsets on the CNC Machine. In this case, it is 29 MM from the bottom of the Balsa Blank to the center of the cartridge hole. If you want to machine the left side of the car, the Y value would be 21 MM, because from the top of the Balsa Blank to the center of the cartridge hole, it is 21 MM. If you were to machine the top or bottom of the car, the Y value would be 32.5 MM because the cartridge hole is centered in the blank left to right.

13) Editing the CNC File

- You have saved the program to cut the Right hand Side of the car.
- It is possible to run through Quick CAM again with the model rotated as shown in Figure 21 to make a program for the Left Hand Side of the Car.
- It is simpler however to edit the G&M code program you have created and add a mirror command.
- The next section of the tutorial covers editing your program and then setting up the fixture and manufacturing the Car.
- The Machine operating software will be either VR Milling 2 or VR Milling 5. You should ask your instructor which version you have then follow the instructions for the version you are using.

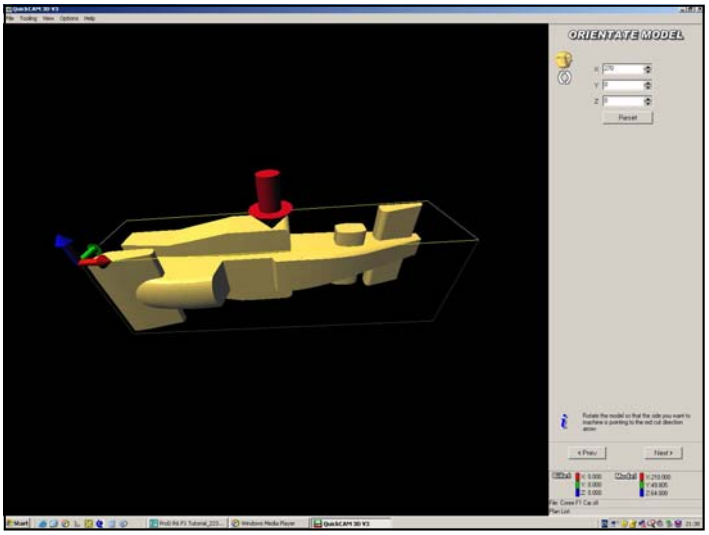


Figure 21 - Model Rotated to cut LHS

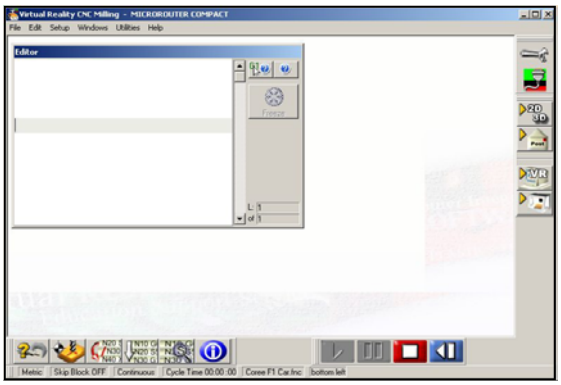
Manufacturing the Car

JAGUAR F1 TEAM IN SCHOOLS
CAD/CAM DESIGN CHALLENGE

Creating the Left Hand Side Machine File

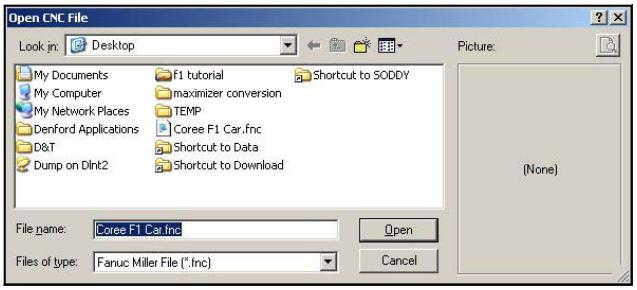
Open the VR Milling Software

- It does not matter if you are using VR Milling V2 or V5 at this stage. Your screen shots may not match exactly.
- The default directory is in **Program Files > Denford**
- **Select VR Milling and the Software will open. There will be an empty Editor box open at start up.**



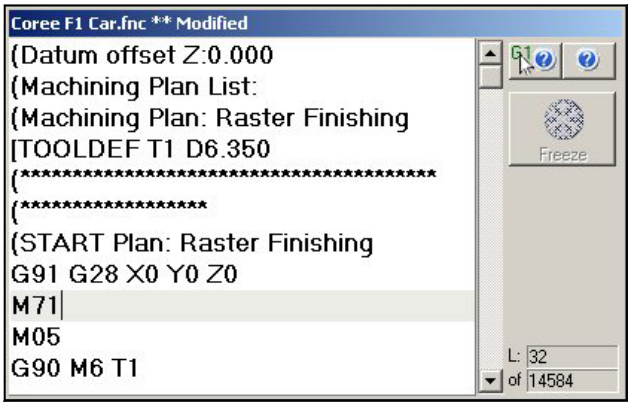
VR milling with empty editor

- **Select** File > OPEN then locate your saved car (FNC) file.
- Select Open
- This is the file you will manufacture to cut the RHS of your car.



File open Window

- Scroll down the program to the point where you can see the G91 G28 X0 Y0 Z0 line.
- Press Enter on this line and a new blank line will appear in the program under the original.
- Type M71 which is the mirror Y about origin command.
- Select the file SAVE AS command and save this file with your cars name and LHS.
- This will be the file you use to cut the second half of the car.



Edited file for LHS

Unit 3 Machining the Car

Task 1 Setting up the Fixture

Note… The following tutorial will guide you through the process of setting up the F1 Fixture, setting the offsets, and machining the car. It has been written with the understanding that you are already familiar with the machine and have gone through the Quick Start Guide. If you have any questions, please refer to the Microrouter Compact Manual.

1) Before installing the fixture, make sure the following things are completed.
- 1/4” Long Reach Ball Nose End Mill is installed in the Spindle.
- VR Milling is running and you are connected to the machine.

2) Mounting the Fixture Base Plate.
- Using the T Nuts and the screws, mount the Fixture Base Plate in the second T Slot centered on the table. Do not tighten the screws yet.

3) Place the F1 Fixture onto the Fixture Base Plate and tighten the thumb screws.

4) Aligning the Fixture.
- Align the fixture by jogging the X axis between the two grooves located on the F1 Fixture. When jogging the machine, the ball nose endmill should be centered in each of the grooves. Once that is done, carefully loosen the thumb screws and remove the fixture from the base plate.
- Tighten the screws in the base plate.

  * This is the most important part of the setup. It is critical to have the fixture aligned properly, and parallel to the T Slot Table, so take your time in setting this up.

Figure 1 - The Fixture Base Plate.

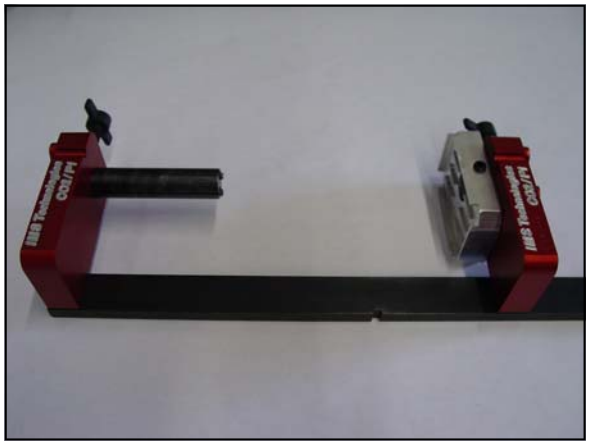


Figure 2- The F1 Fixture.

1) Align the front of the block into the groove on the nose plate of the fixture and insert the Cartridge pin into the rear of the car.

2) Tighten the two screws on the nose plate to secure the blank to the fixture.

3) Rotate the blank so the right side is facing up and tighten the two thumb screws.

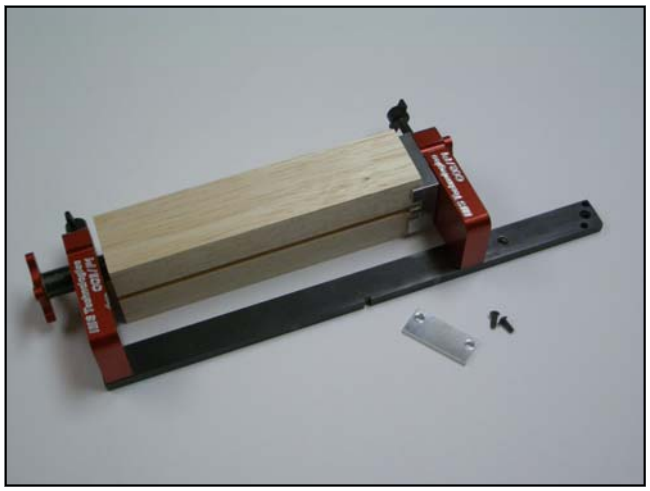


Figure 3 - Billet loaded into fixture.

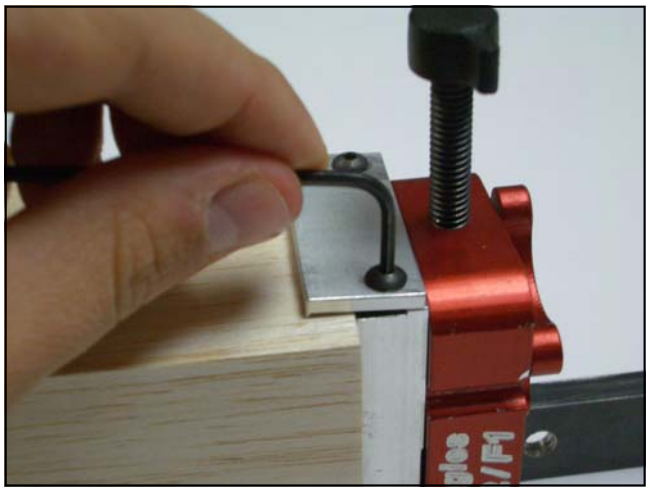


Figure 4 - Nose plate and blank.

Unit 3 Machining the Car

Task 3 Setting the Offsets Using VR Milling V2

If you are using VR Milling Version 2 you will set your offsets using the following instructions on this page. If you are using VR Milling Version 5 you need to move on to the next page.

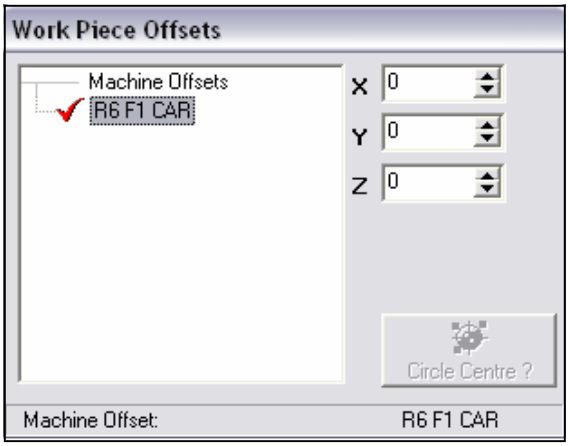


Figure 5 - Offset Window

1) In VR Milling, click on the Offset button at the bottom of the screen. A window similar to the one in Figure 5 should appear.

2) Create an offset called, F1 Car and make it current by right clicking on the offset and selecting Make Current. If you are unsure how to do this, refer to your VR Milling Manual.

3) **Setting the Y offset for the right hand side**

- Jog the machine so the ball nose endmill is centered in the groove of the fixture as shown in Figure 6. Click on the datum point in the offsets window and select the default.

4) **Setting the X offset for the right hand side**

- Jog the machine so the center of the ball nose endmill is on the edge of the left side of the blank. Refer to Figure 7. Click on the datum point in the offsets window and select the default.

5) **Setting the Z offset for the right hand side**

- Jog the machine so the ball nose endmill is just touching the top of the balsa blank. Click on the datum point next to the Z in the Work Piece Offset window and then click OK.

Figure 6 - Y offset position.

Figure 7 - X Offset Position.

1) In VR Milling V5, click on the Offset button at the bottom of the screen. A window similar to the one in Figure 8 should appear.

2) Create an offset called, F1 Car and Activate it current by right clicking on the offset and selecting Activate. If you are unsure how to do this, refer to your VR Milling Manual.

3) **Setting the Y offset for the right hand side**

- Jog the machine so the ball nose endmill is centered in the groove of the fixture as shown in Figure 9. Click on the Y datum button in the offsets window. Your Y Offset is now set.

4) **Setting the X offset for the right hand side**

- Jog the machine so the center of the ball nose endmill is on the edge of the left side of the blank. Refer to Figure 10. Click on the X datum button in the offsets window. Your X offset is now set.

5) **Setting the Z offset for the right hand side**

- Jog the machine so the ball nose endmill is just touching the top of the balsa blank. Click on the Z datum button in the offsets window. Your Z offset is now set.

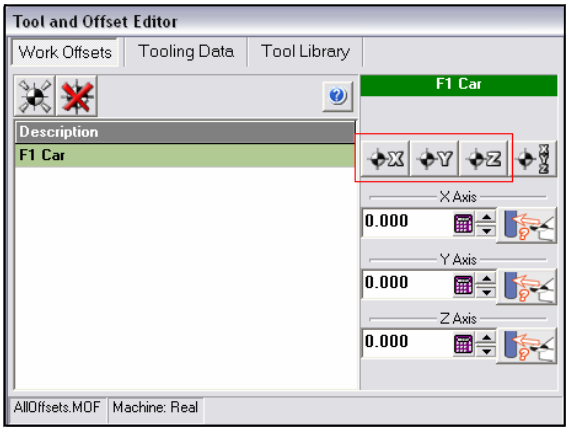


Figure 8 - Offset Window

Figure 9 - Y offset position.

Figure 10 - X Offset Position.

Unit 3 Machining the Car

Task 4 Executing the Program

1) Make sure the following tasks are complete:
- Blank is rotated in the fixture as shown in Figure 11.
- VR Milling has the RHS car file loaded.
- F1CAR Offset is active.
- Machine is in Home Position
- Go to File, Source, and Left click on File. This will give you better performance when machining large FNC files.

* To make sure that your balsa blank is square to the fixture, use a steel square before tightening the thumb screws. Figure 12.

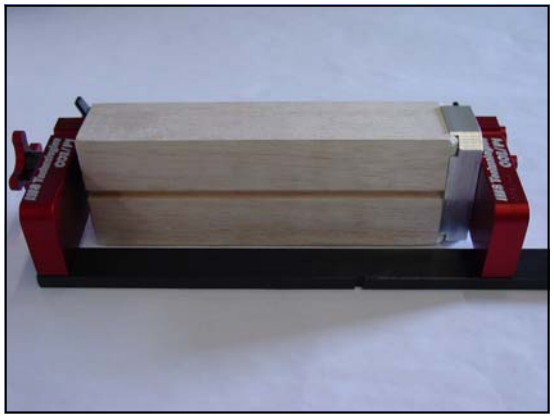


Figure 11 - Right Hand Side Position

2) Select Auto Mode
- Make sure Turbo button is checked.
- Click Run

3) Once you have machined the right hand side, loosen the thumb screws on the fixture base and remove the fixture.

4) You will now machine the left hand side of the car.
- Rotate the blank 180 degrees and place the Fixture back in the Fixture Base making sure the thumb screws are tight.
- Load the LHS file that was created into VR Milling.
- You will be using the same offset that was used for the RHS.

6) Select Auto Mode
- Click Run

Figure 12 - Square Alignment

1) Place the machined F1 Car on the Drilling fixture as shown in Figure 13.

2) Drill the Axle holes using the Drill Press.

Figure 13 - Axle Drilling Fixture

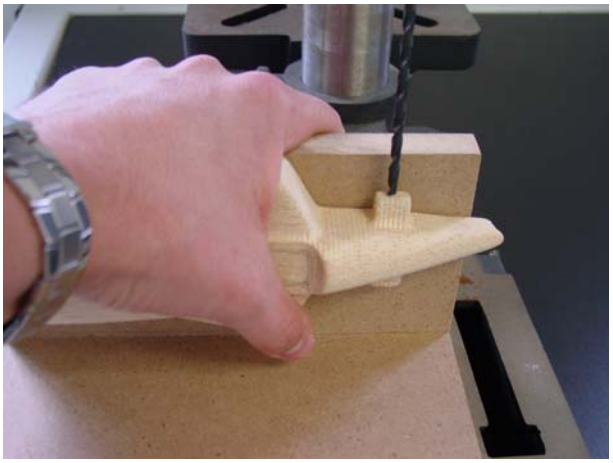


Figure 14 - Drilling the Axle Holes

Unit 3 Machining the Car

Reference Section

Q: What do I do when there is a ridge down the center of the blank?

A: It is possible that there is going to be a small ridge down the center. However, if it is greater than a millimeter, you will have to change your Y offset.

- If the Right Hand Side of the car is higher than the left, subtract half the difference of the ridge from your Y offset value.
- If the Left Hand Side of the car is higher than the right, add half the difference of the ridge to your Y offset value.