Institute for advanced architecture of Catalonia

DIGITAL TOOLS

GROUP 1 STUDENTS
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ASSIGNMENT 2

DESCRIPTION

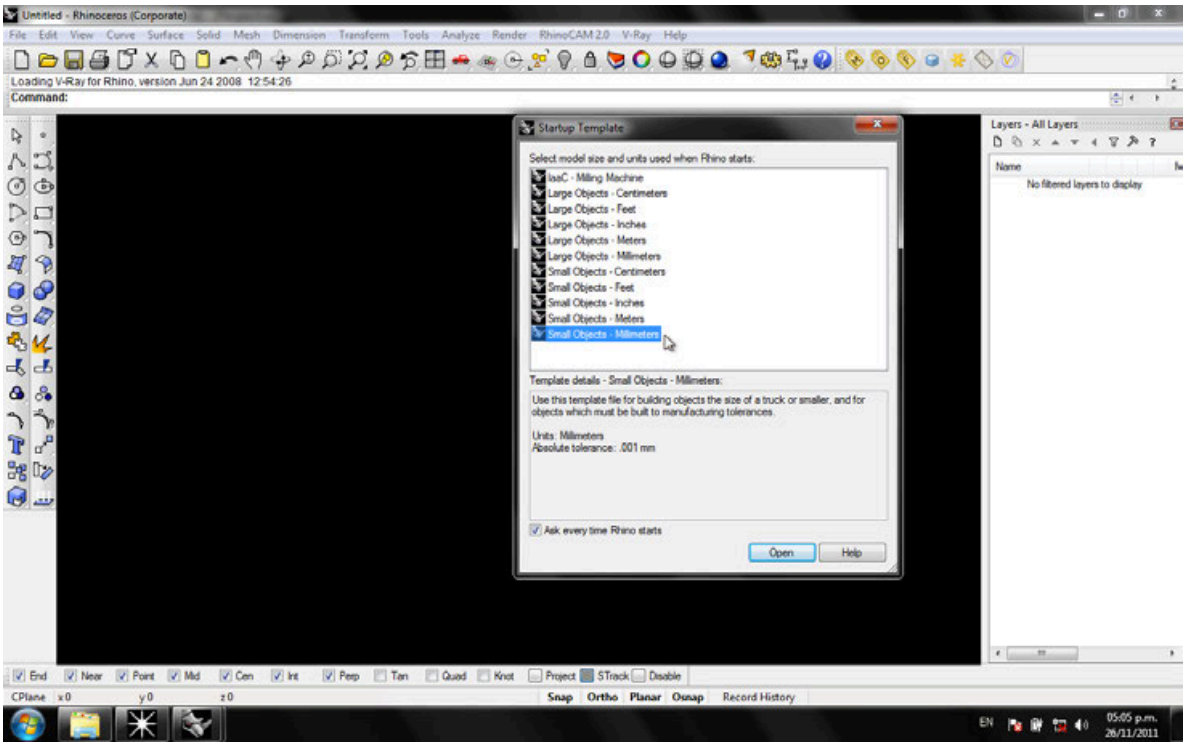
This project was developed to explore the CNC milling processes through different digital designs, materials and tools. The materials selected were the Valchromat (595 x 395 x 24mm) and the Polyurethane. For this exercise, we study the design possibilities between Rhino and Rhino CAM in order to calibrate them with the milling machine.

Specific parameters were given for the design of the pieces. First, for the Valchromat it was required to explore shapes that show the three layers within the board. On the other hand for the Polyurethane, it was requested to keep a curved base shape and explore geometries on the surface.

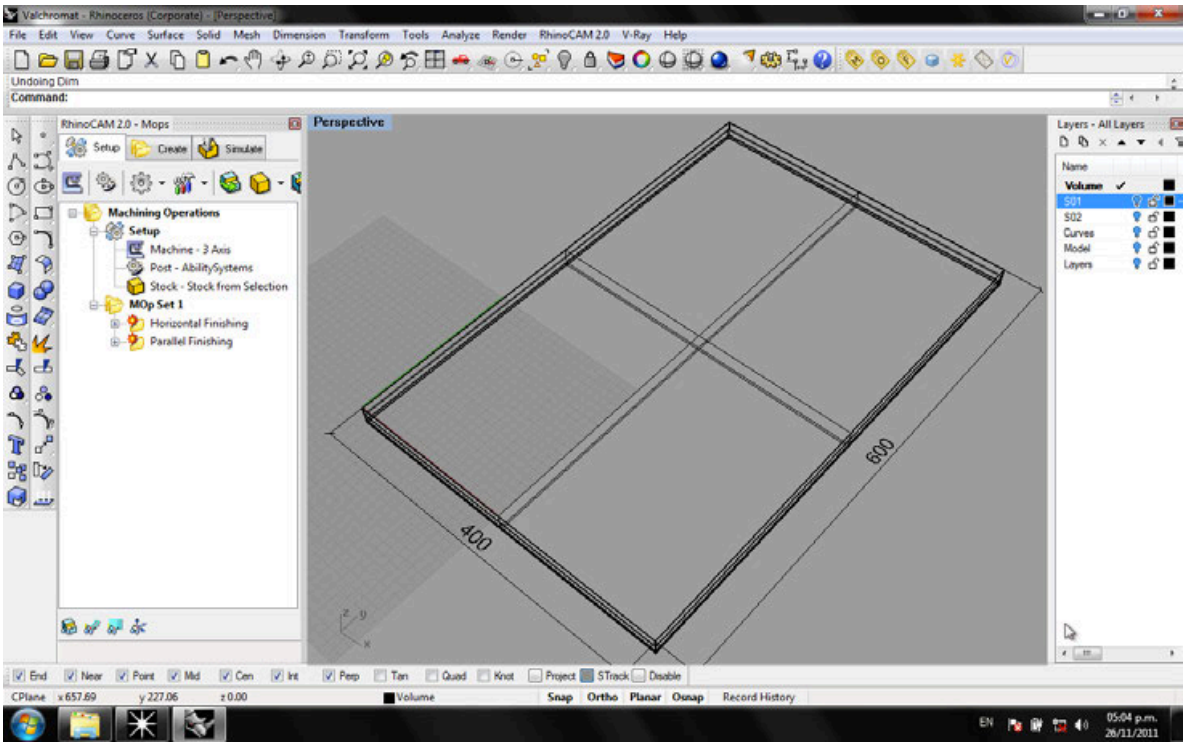
01 I VALCHROMAT PANEL PROCESS

Digital process documentation for the milling of the Valchromat Panel.

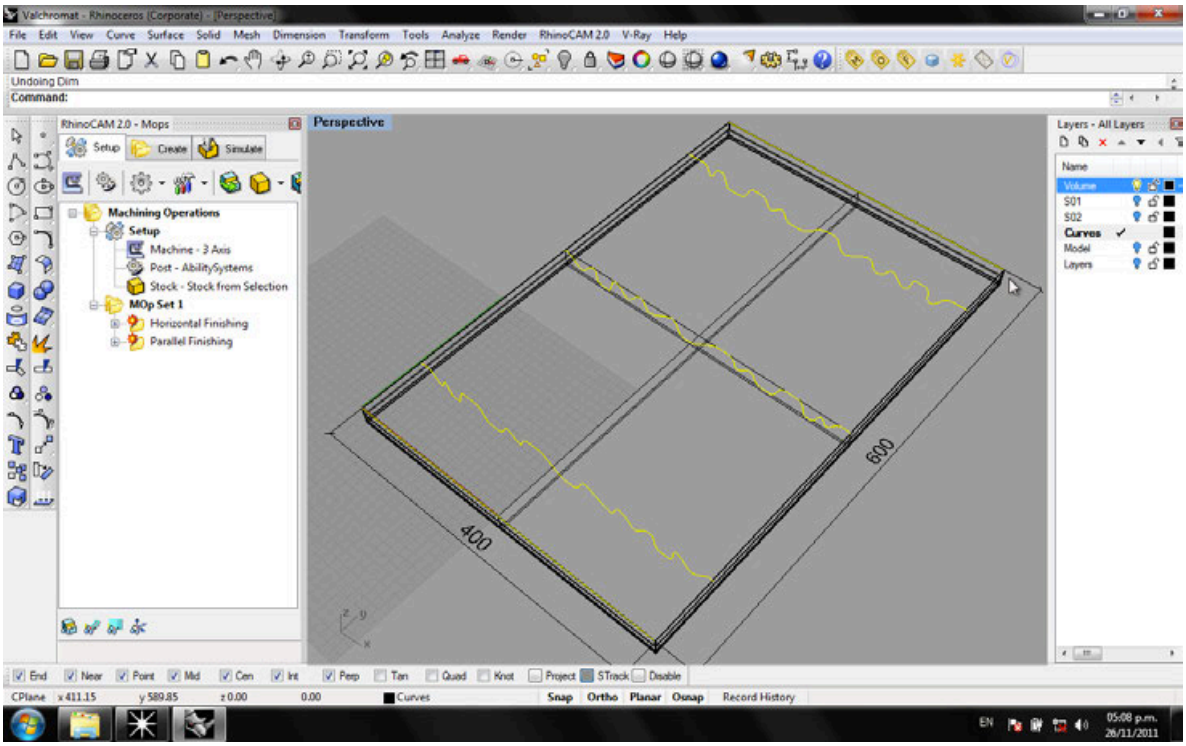
Step 1
Start setting the file to millimeters; this is the only unit that the RhinoCAM recognize.



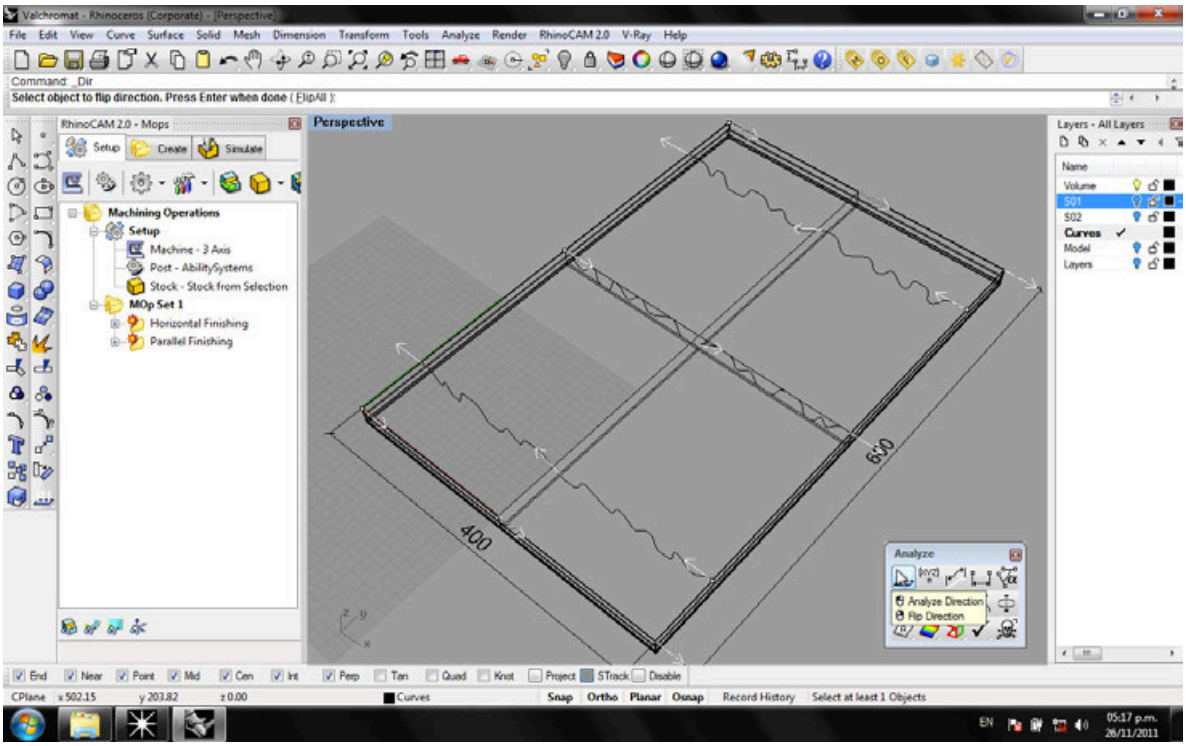
Step 2
Create a working volume with the size of the Valchromat panel (600 x 400 x 24mm).



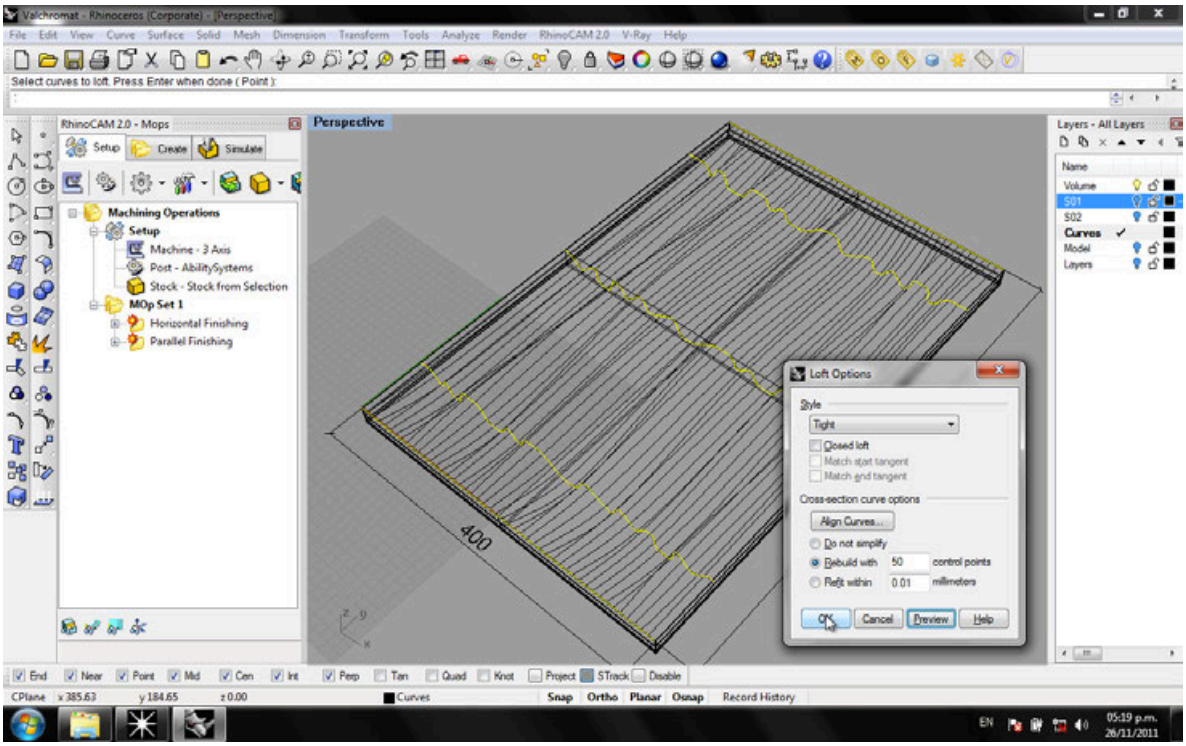
Step 3
Create a set of curves as a base for a loft surface.



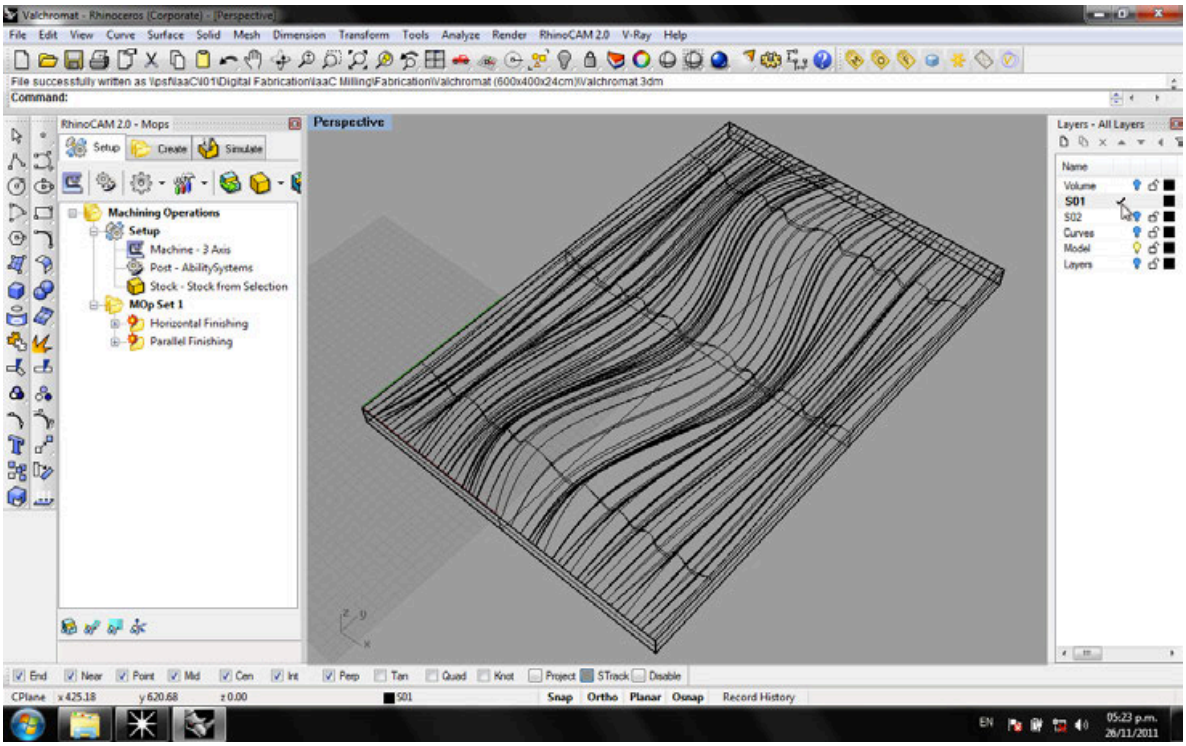
Step 4
Analyze and coordinate the direction of the curves.



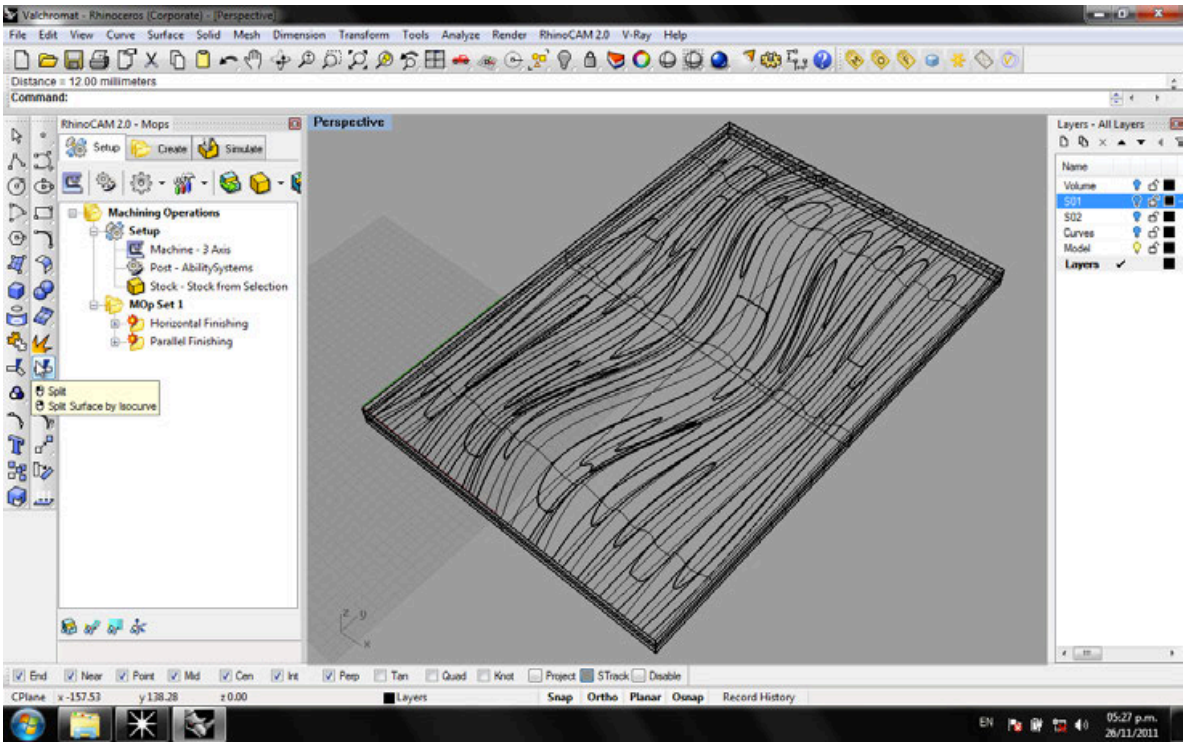
Step 5
Create a tight loft surface with 50 control points with the curves.



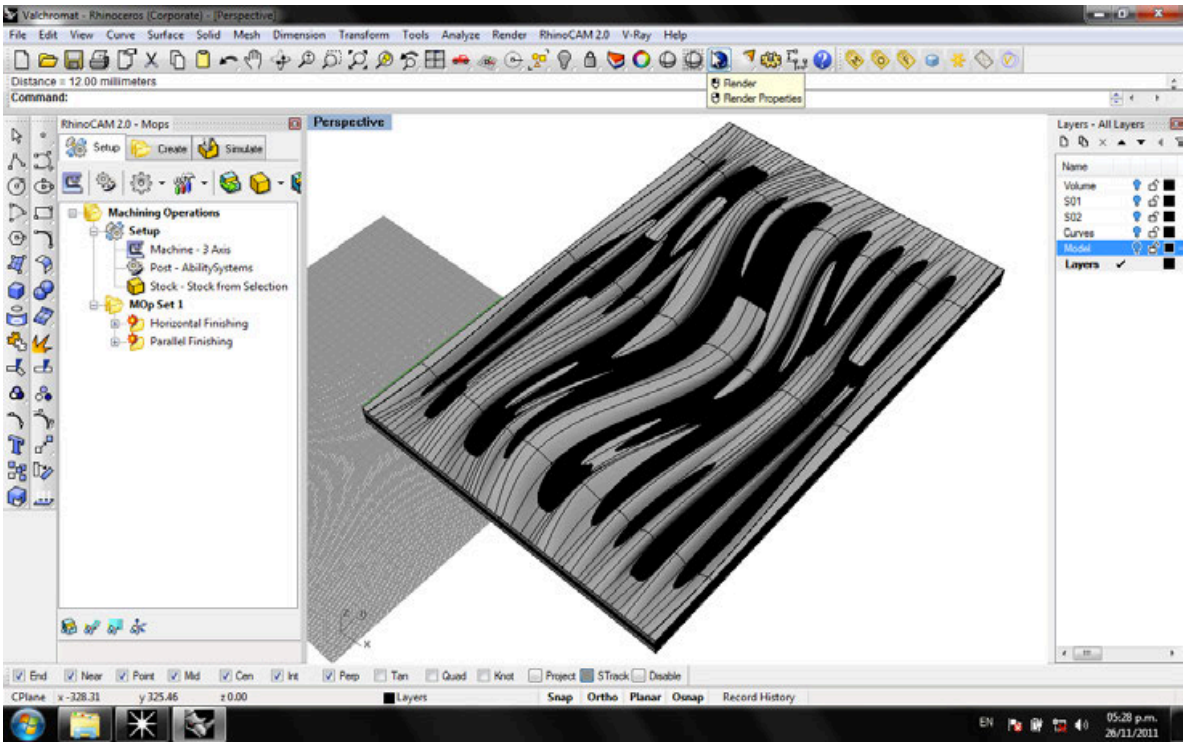
Step 6
Replace the upper face of the working volume with the new loft surface.



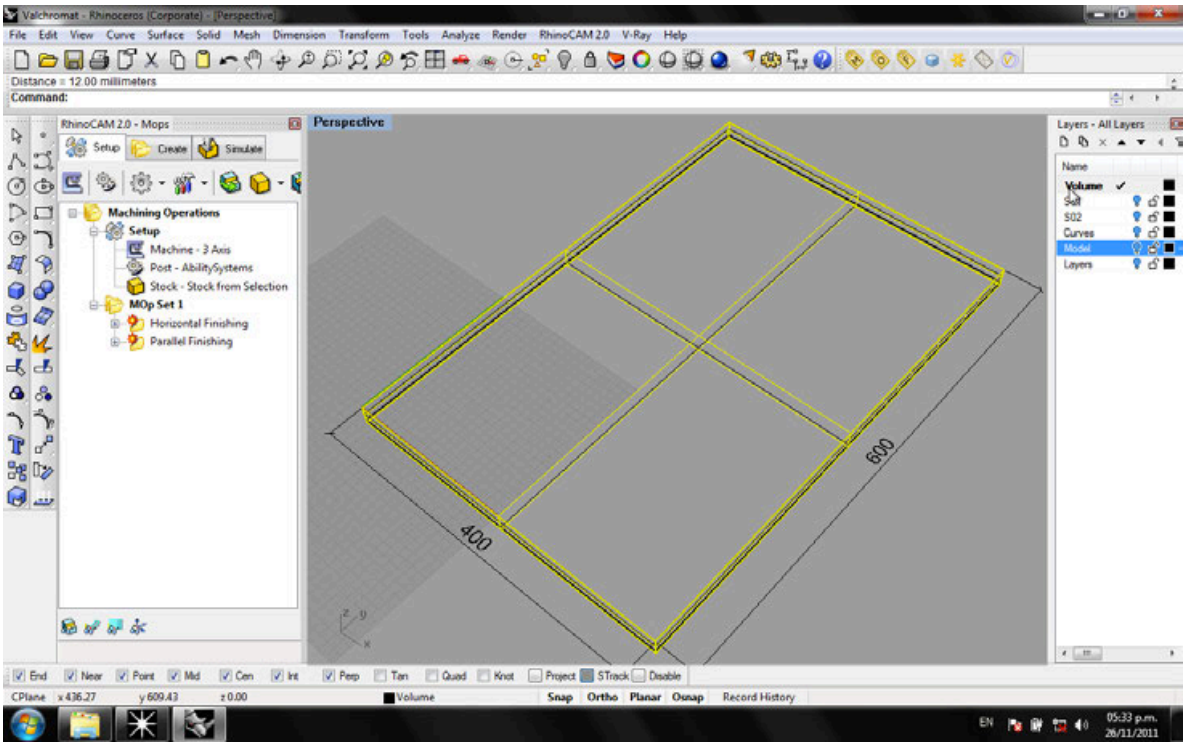
Step 7
Copy the model in a new layer and cut it in three 12mm layers using the split tool in the frontal view.



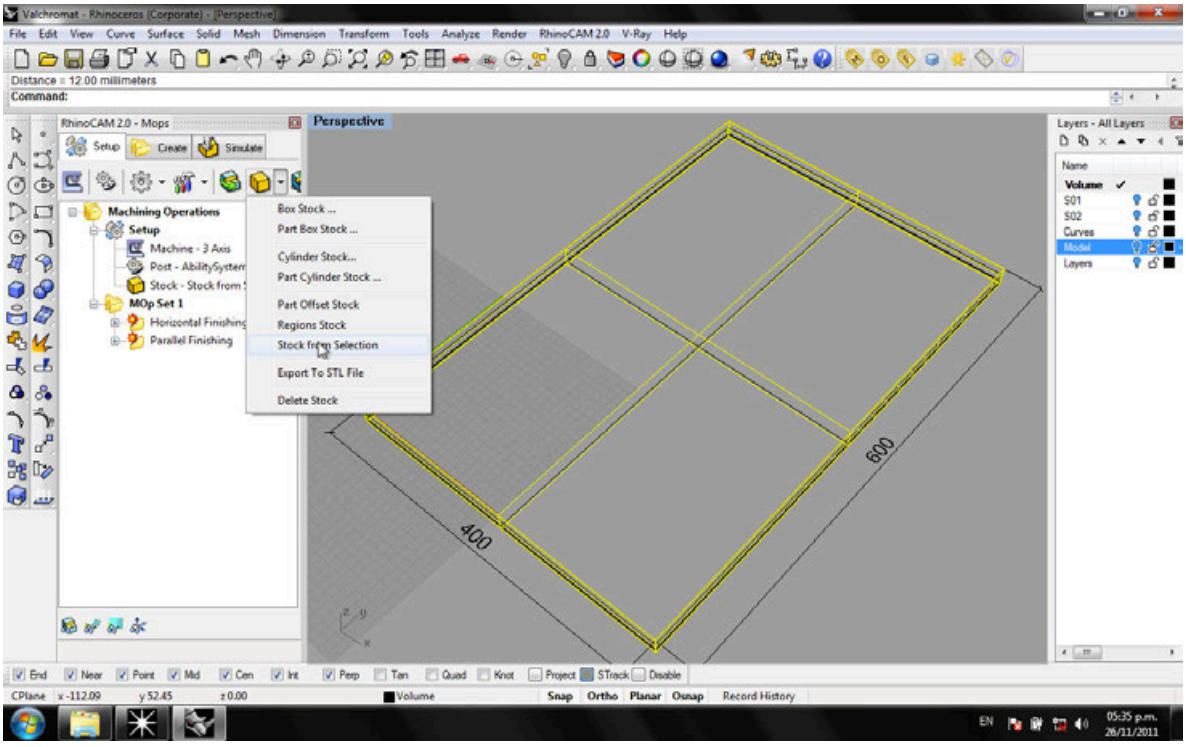
Step 8
Use the render visualization mode to check the proposed surface interacting with the real layered material.



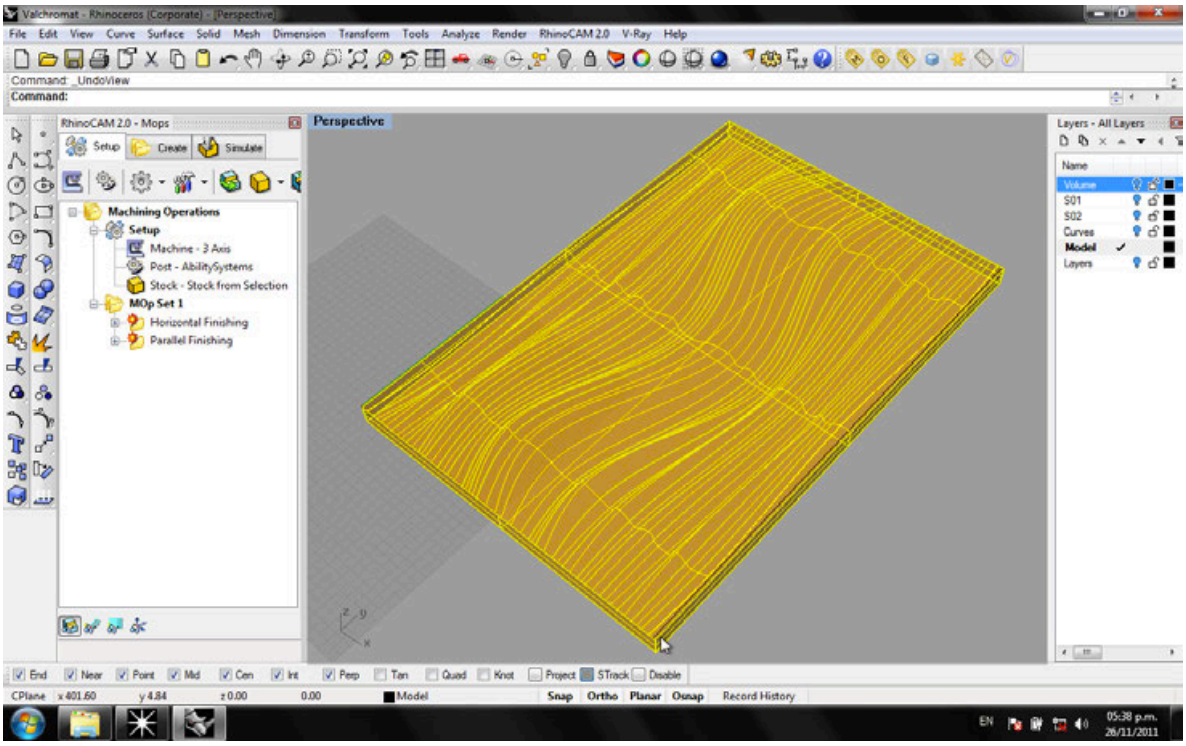
Step 9
Go back to the volume layer and select the working volume



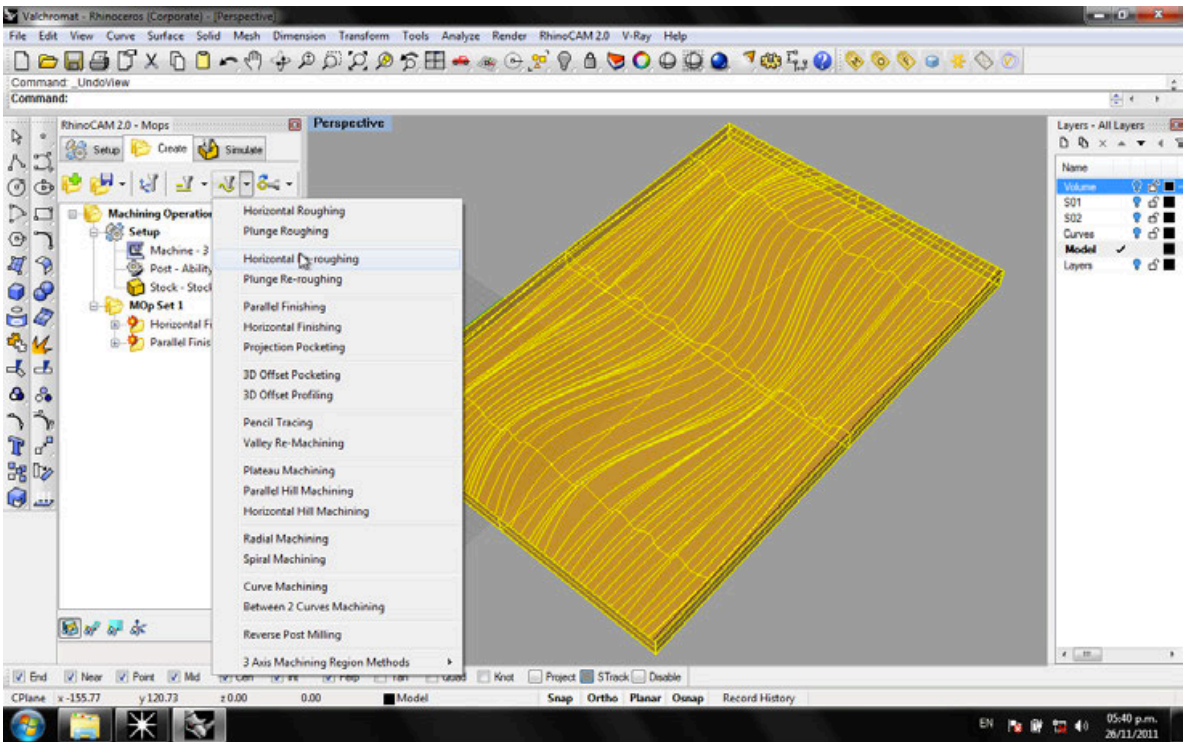
Step 10
Go to box stock in the RhinoCAM menu and select stock from selection.



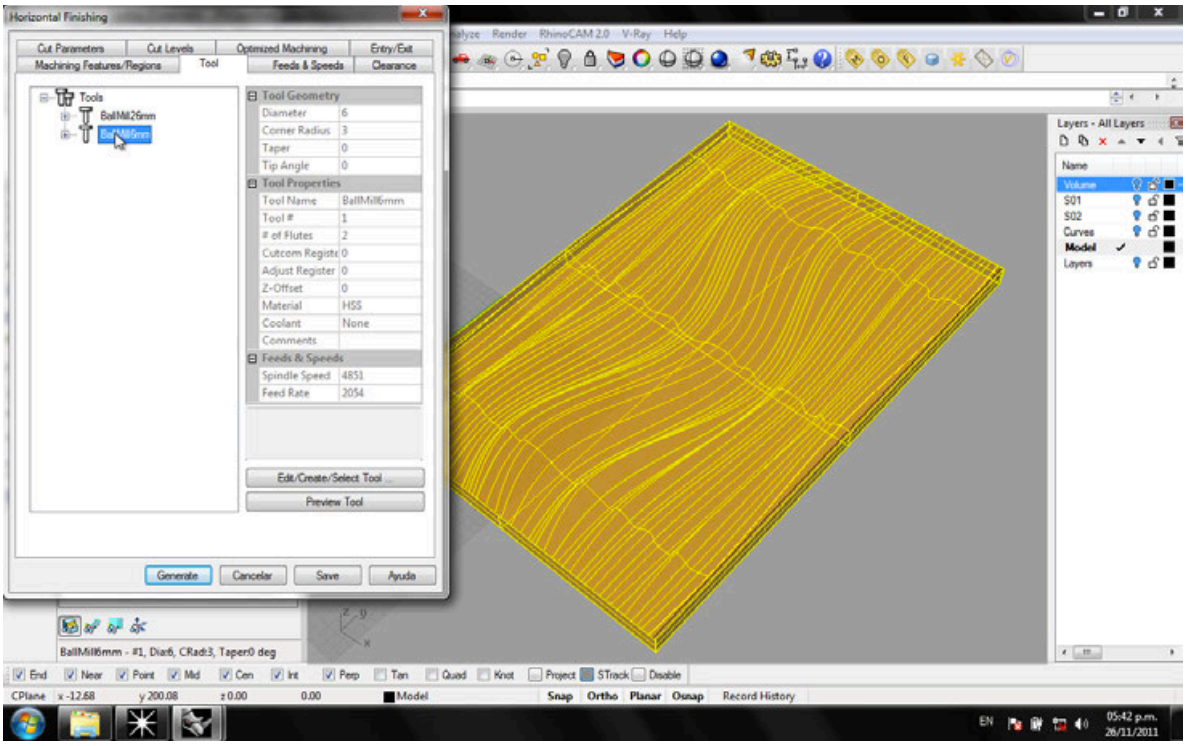
Step 11
Go back to the model layer.



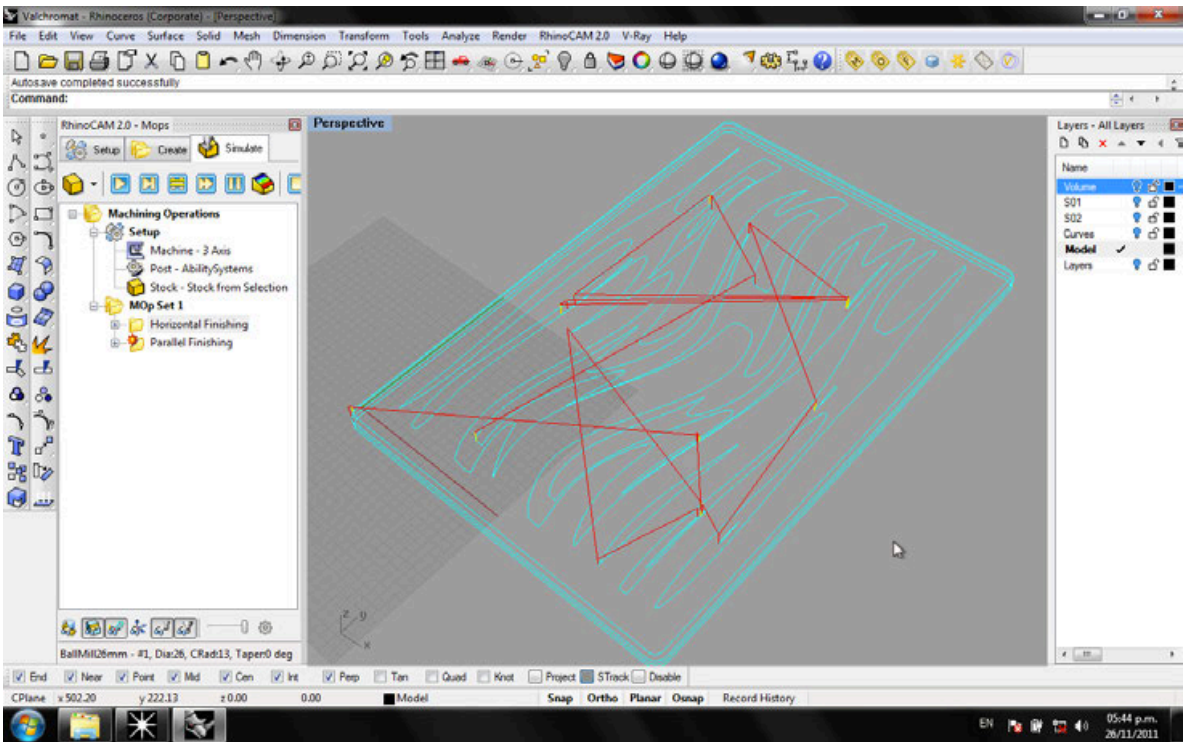
Step 12
Go to create, and create a horizontal finishing process.



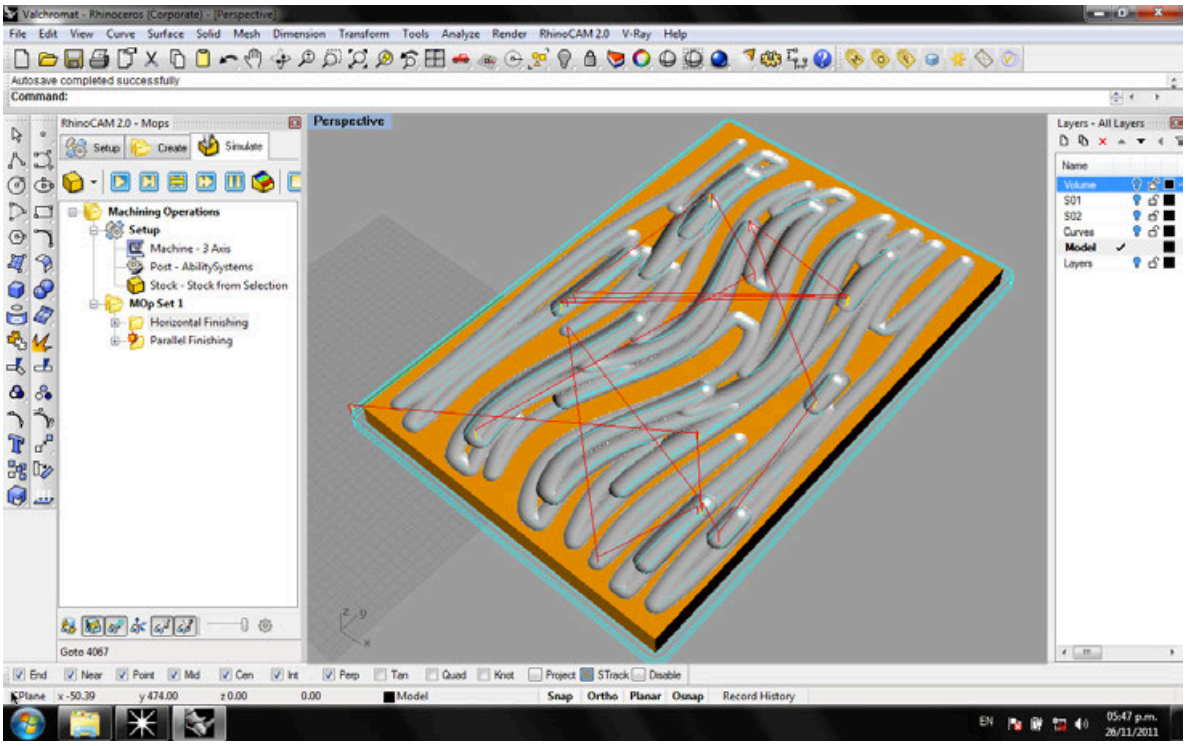
Step 13
Set the tool to the 26mm ball and press generate.



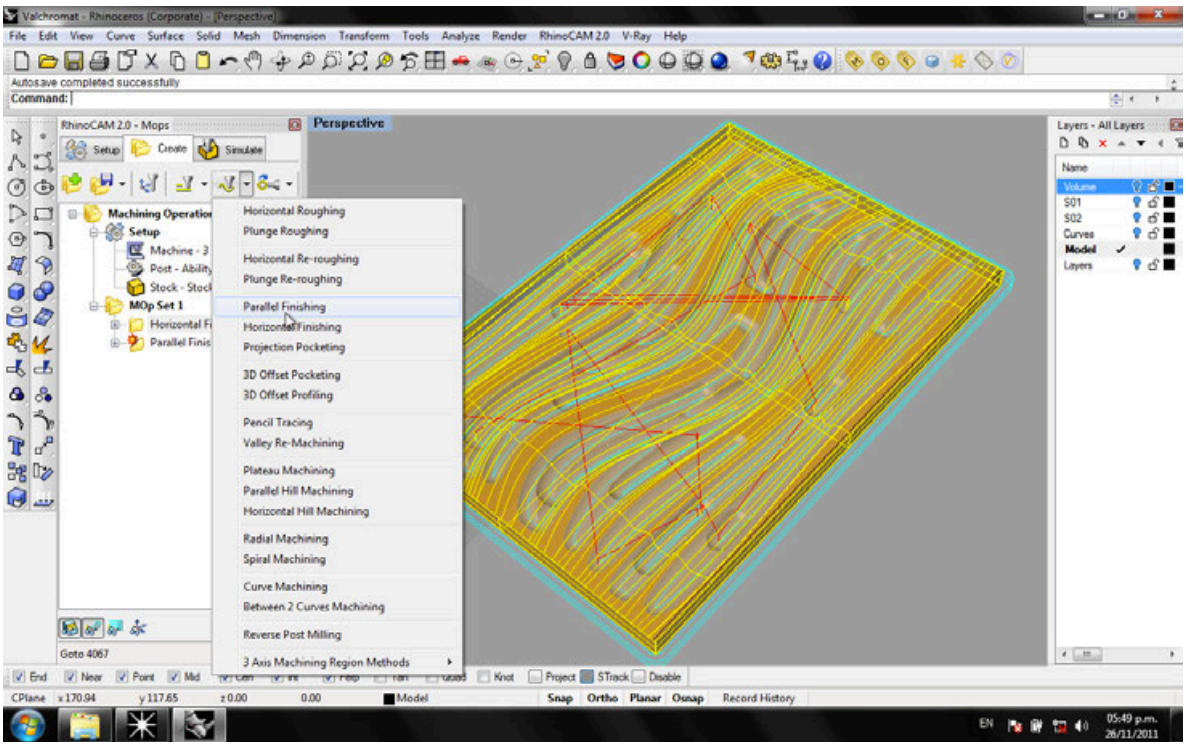
Step 14
Analyze the paths generated by the RhinoCAM and adjust the cut parameters to optimize the milling time.



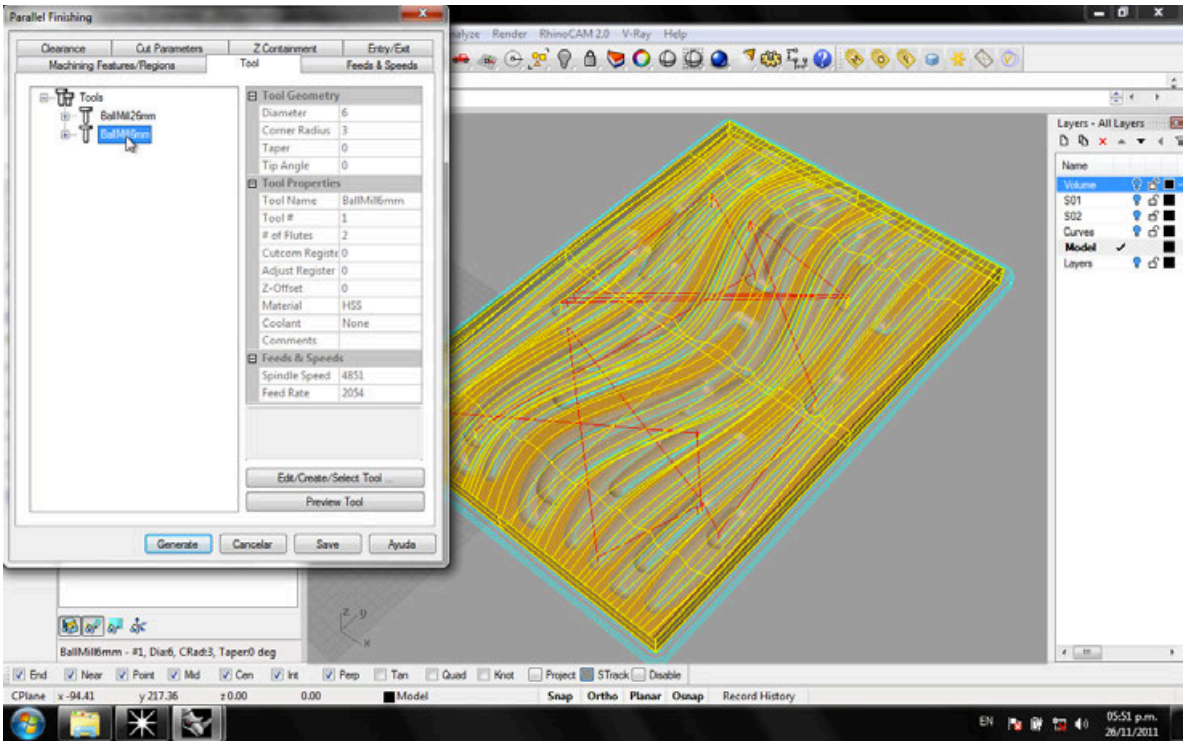
Step 15
Simulate the milling process and observe the results.



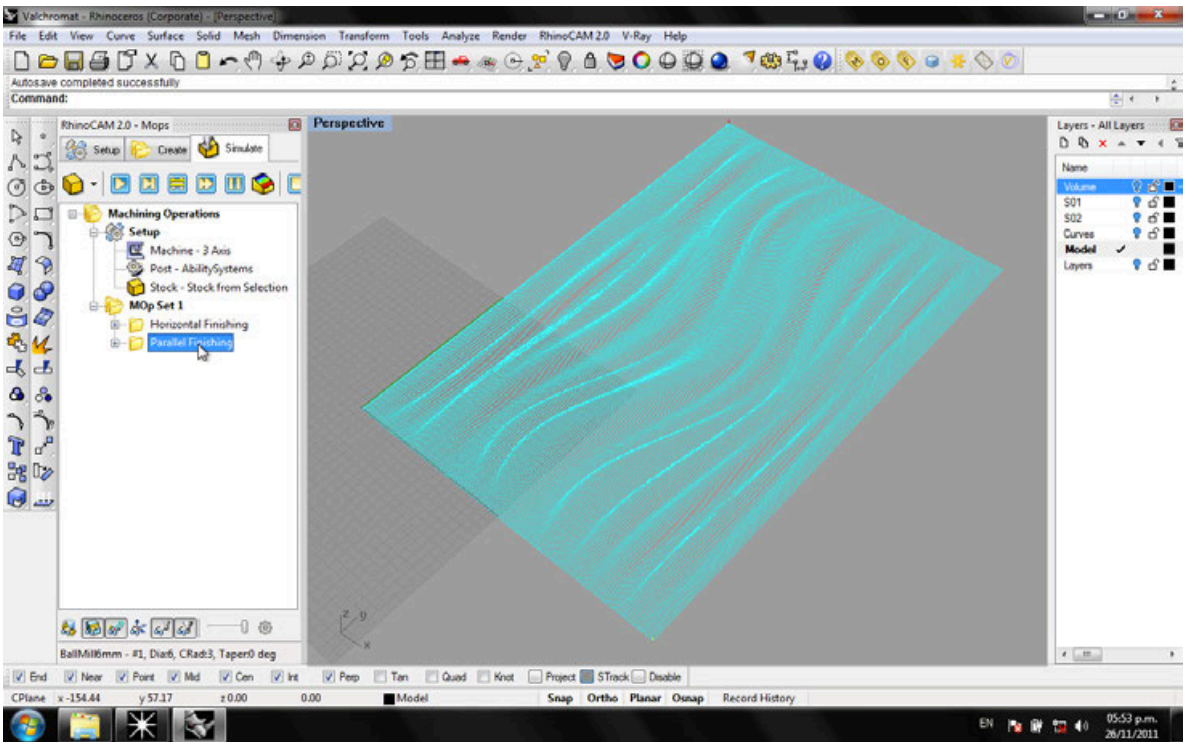
Step 16
Go to create, and create a parallel finishing process.



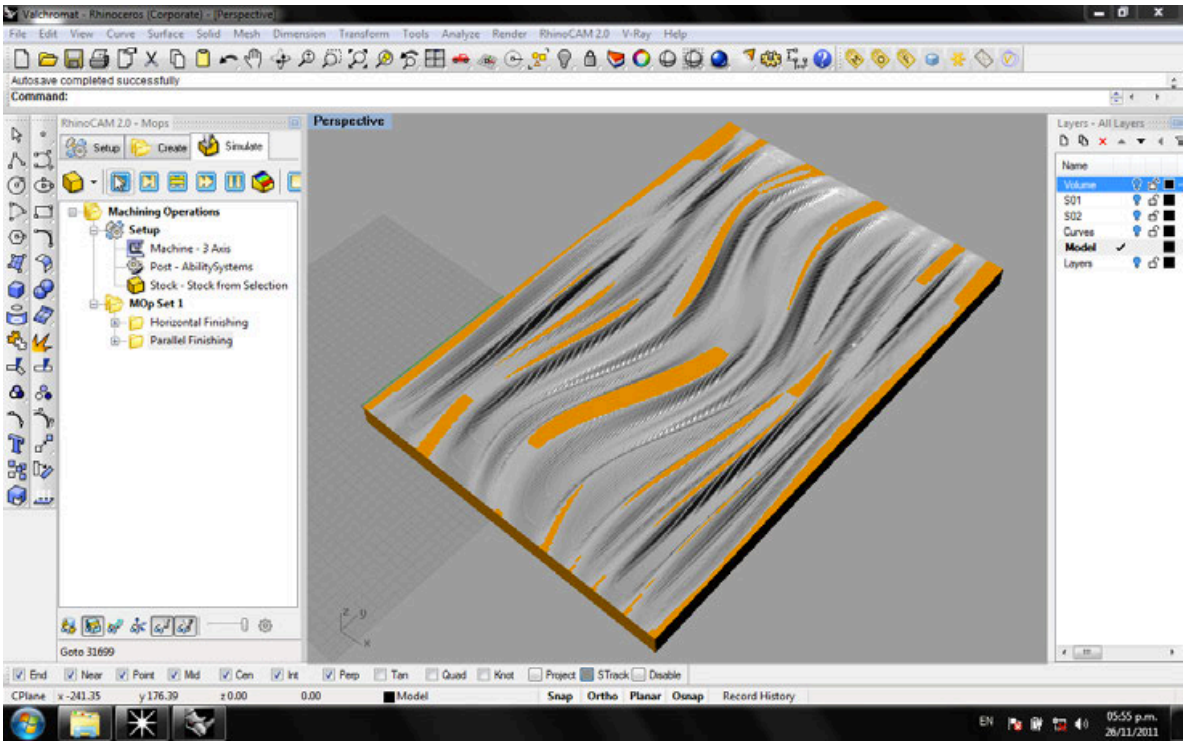
Step 17
Set the tool to the 6mm ball and press generate.



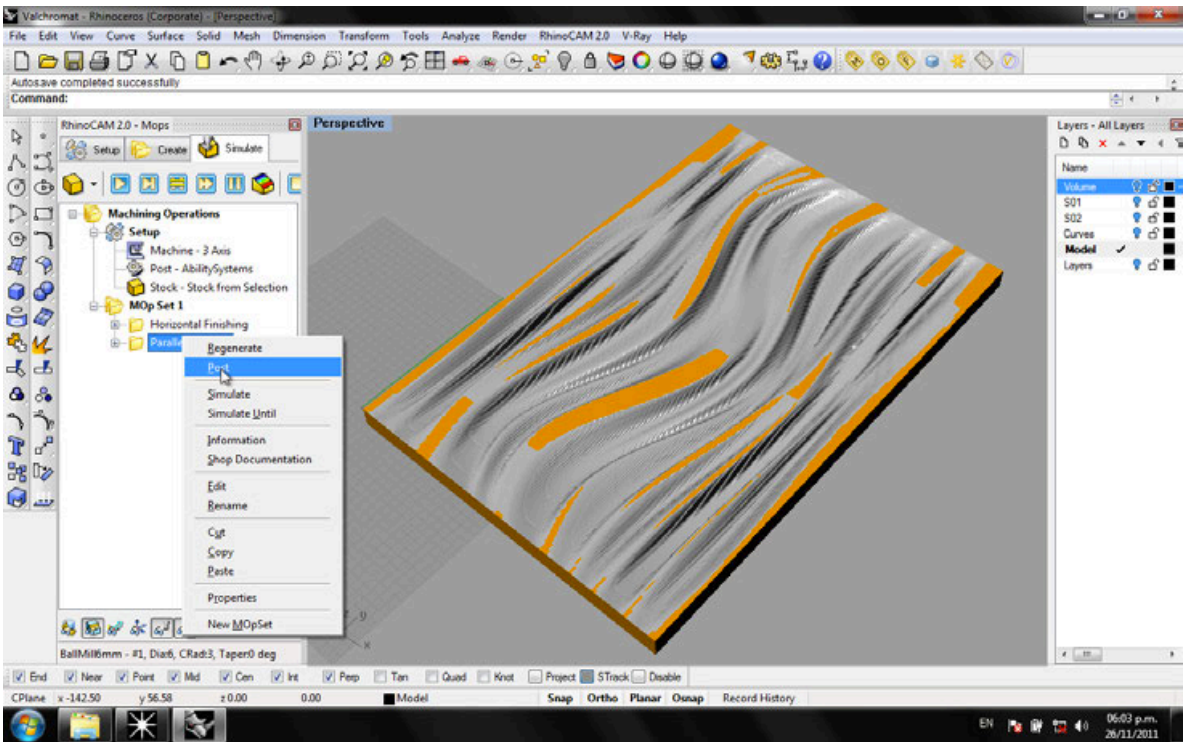
Step 18
Analyze the paths generated by the RhinoCAM and adjust the cut parameters to optimize the milling time.



Step 19
Simulate the milling process and observe the results.



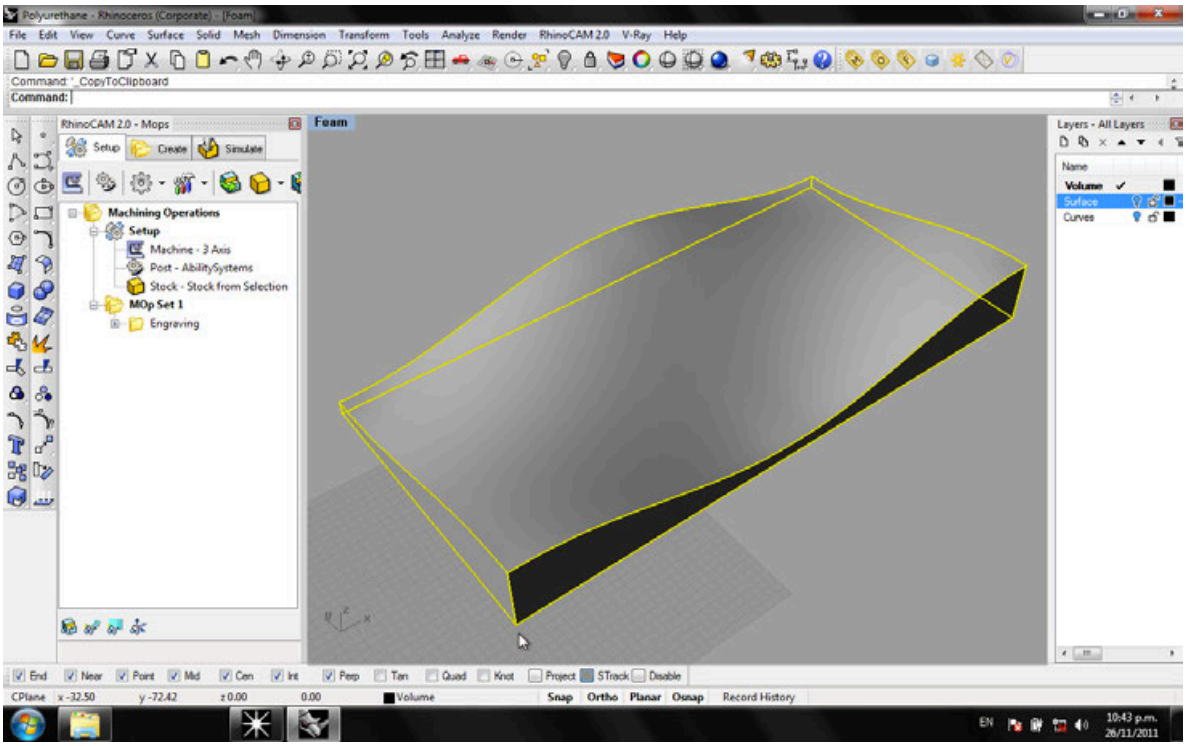
Step 20
Post the results of the horizontal and parallel finishing as individual sets of ".gc" files for the milling machine.



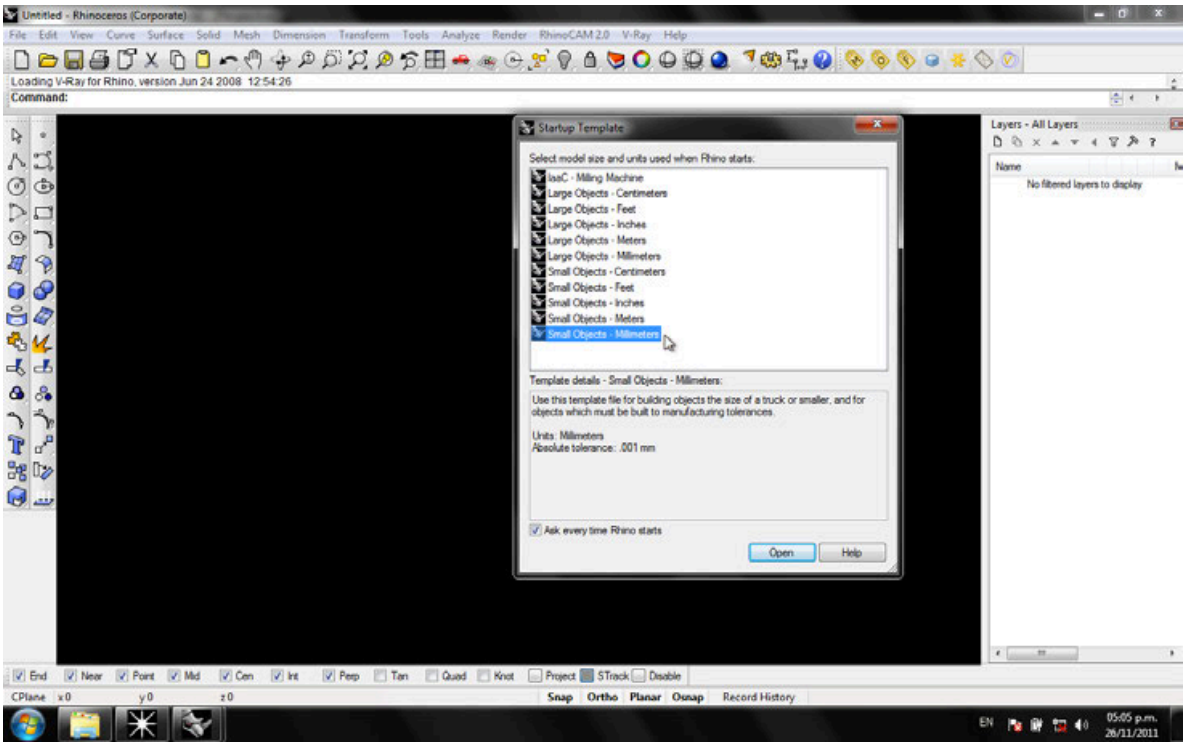
02 I POLYURETHANE FOAM PROCESS

Digital process documentation for the milling of the Polyurethane Foam

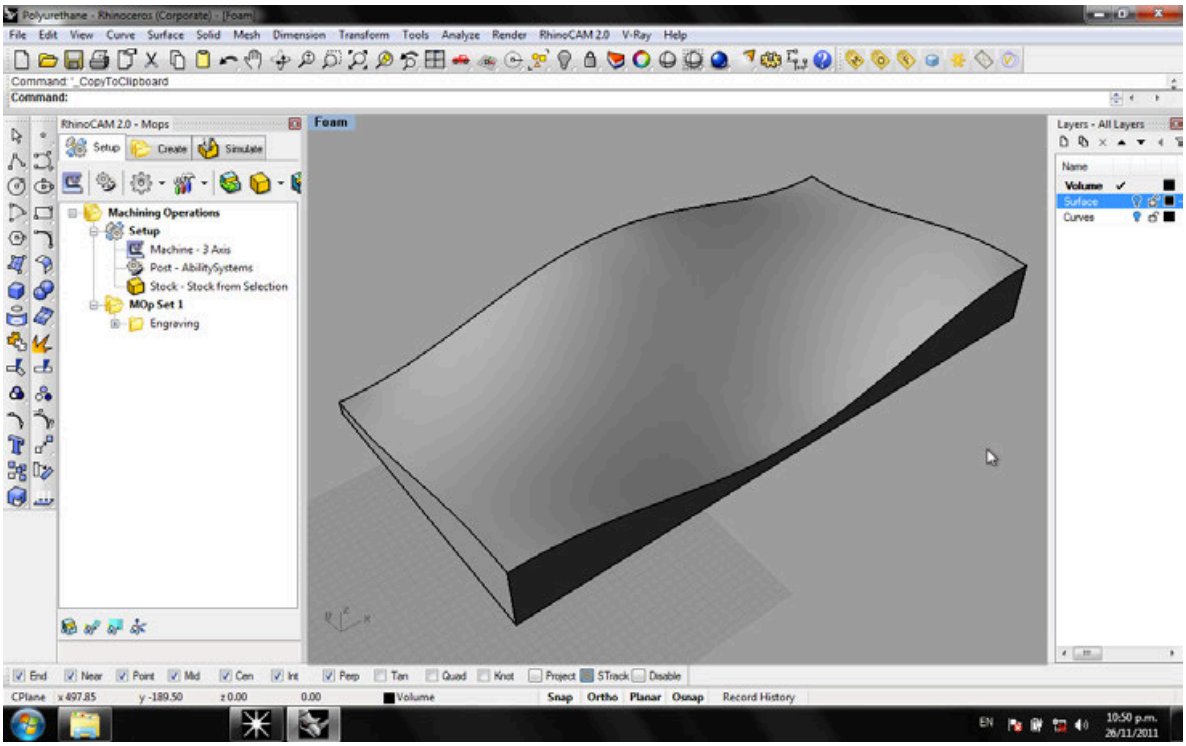
Step 1
Open the general project file and copy the model pre-designed for the polyurethane foam.



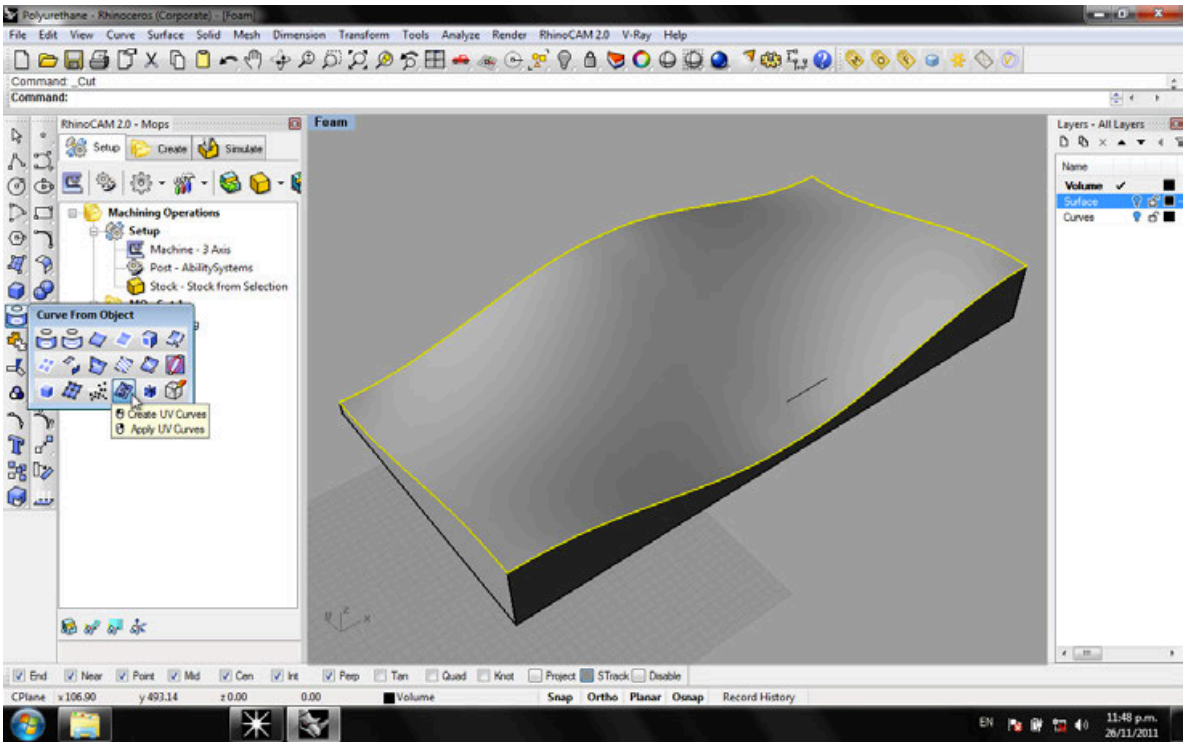
Step 2
Create a new file, select millimeters as the main unit.



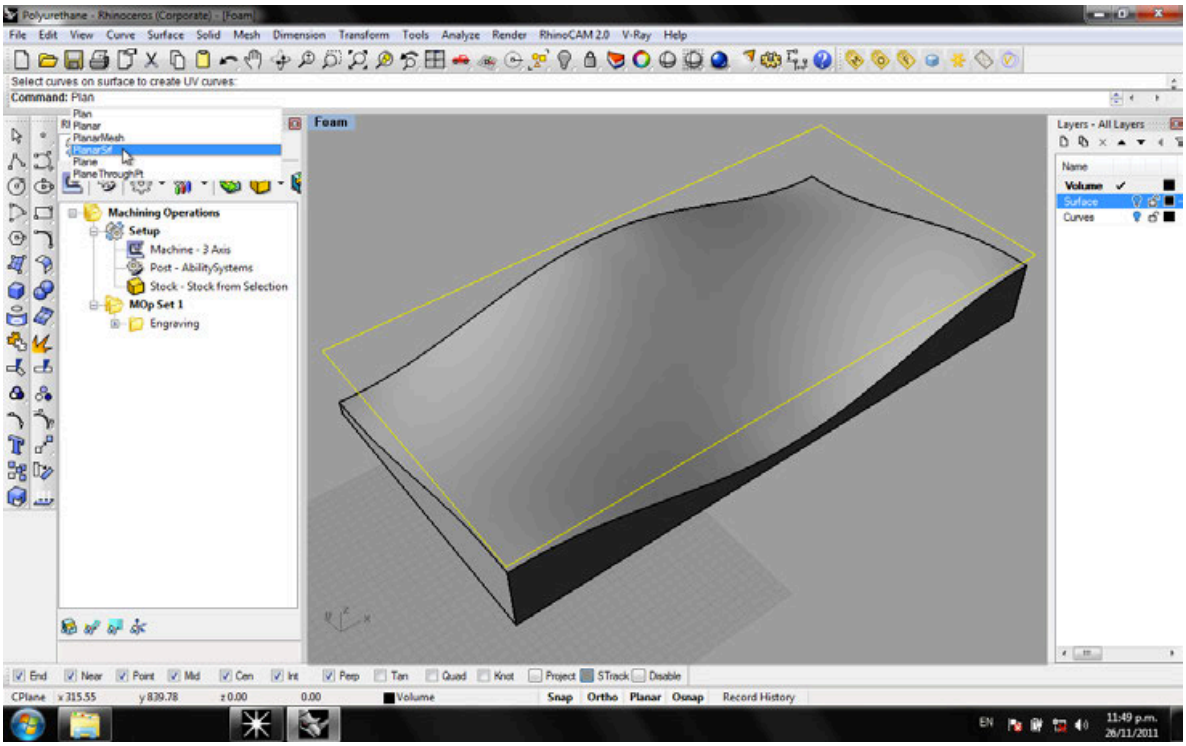
Step 3
Paste the pre-designed model in the new file to start working.



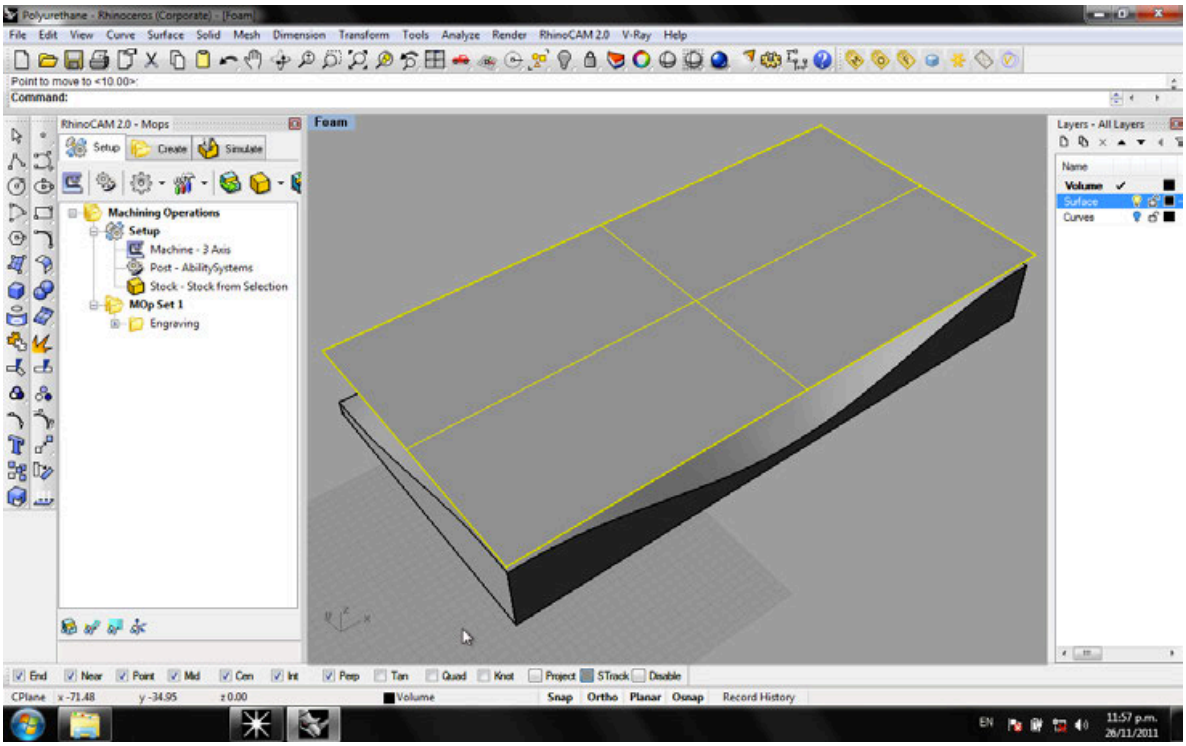
Step 4
Create a UV Curve from the working surface.



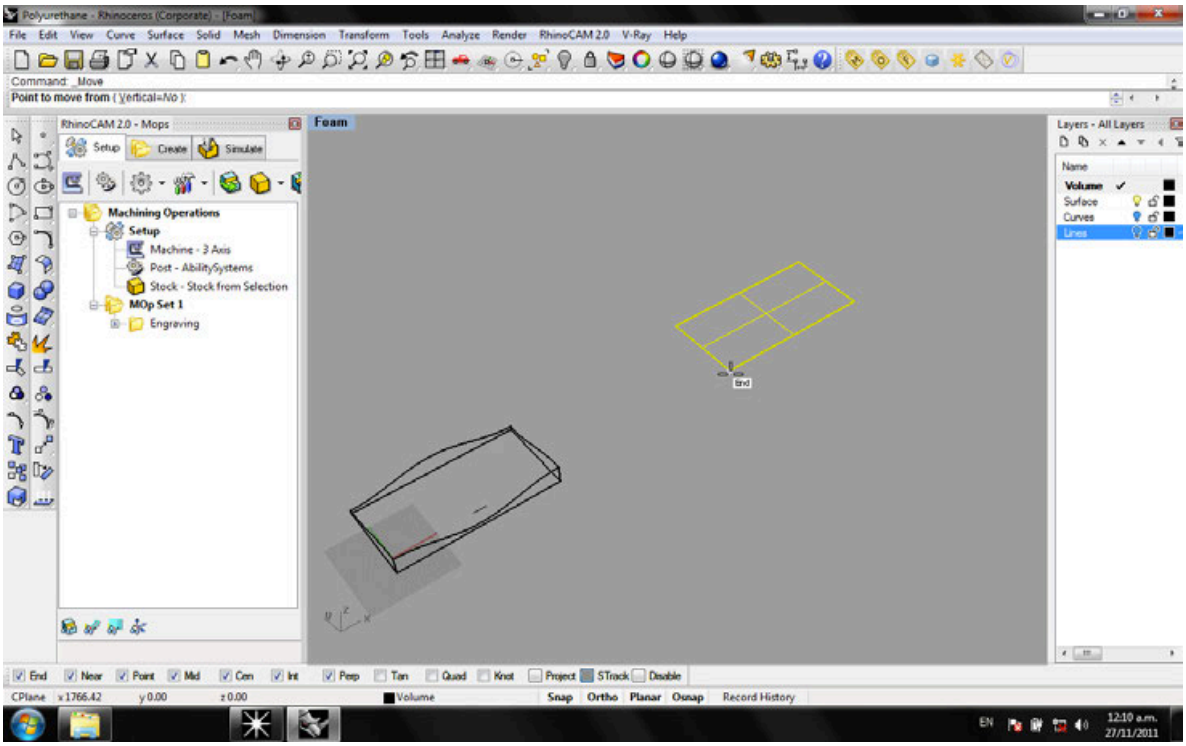
Step 5
Convert the generated UV Curve to a Planar Surface with the “PlanarSrf” command.



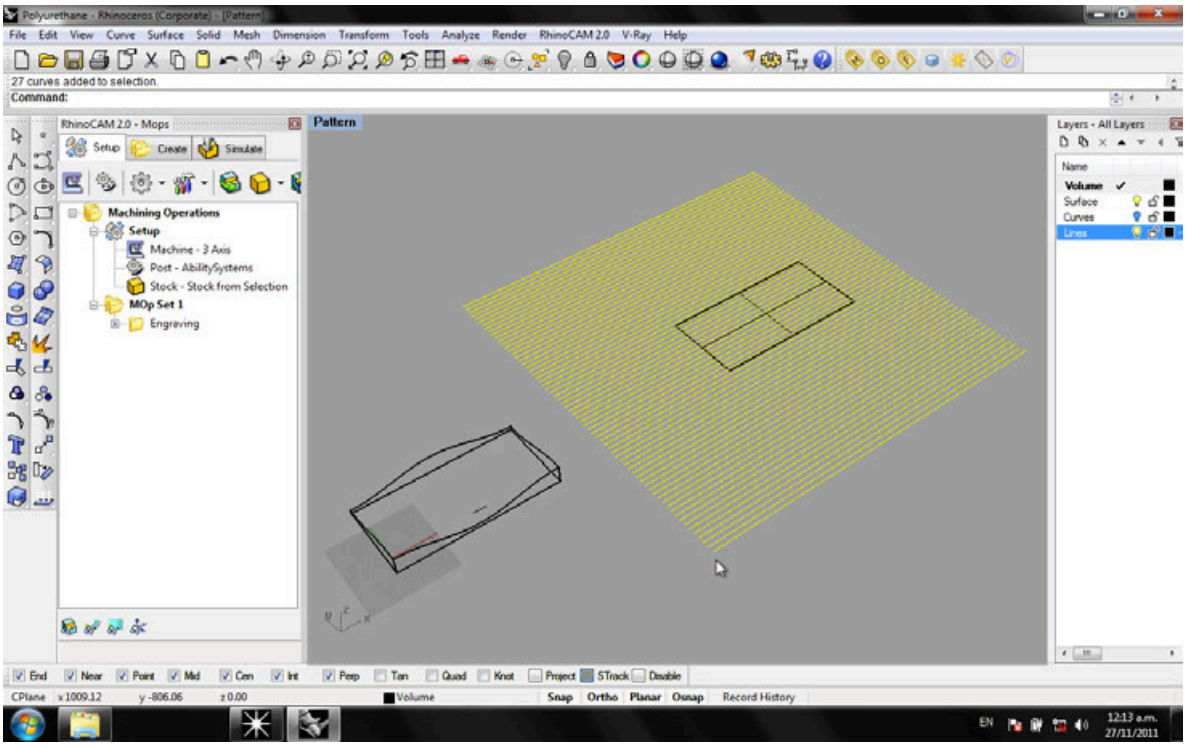
Step 6
Erase the UV Curve in order to start working on the surface.



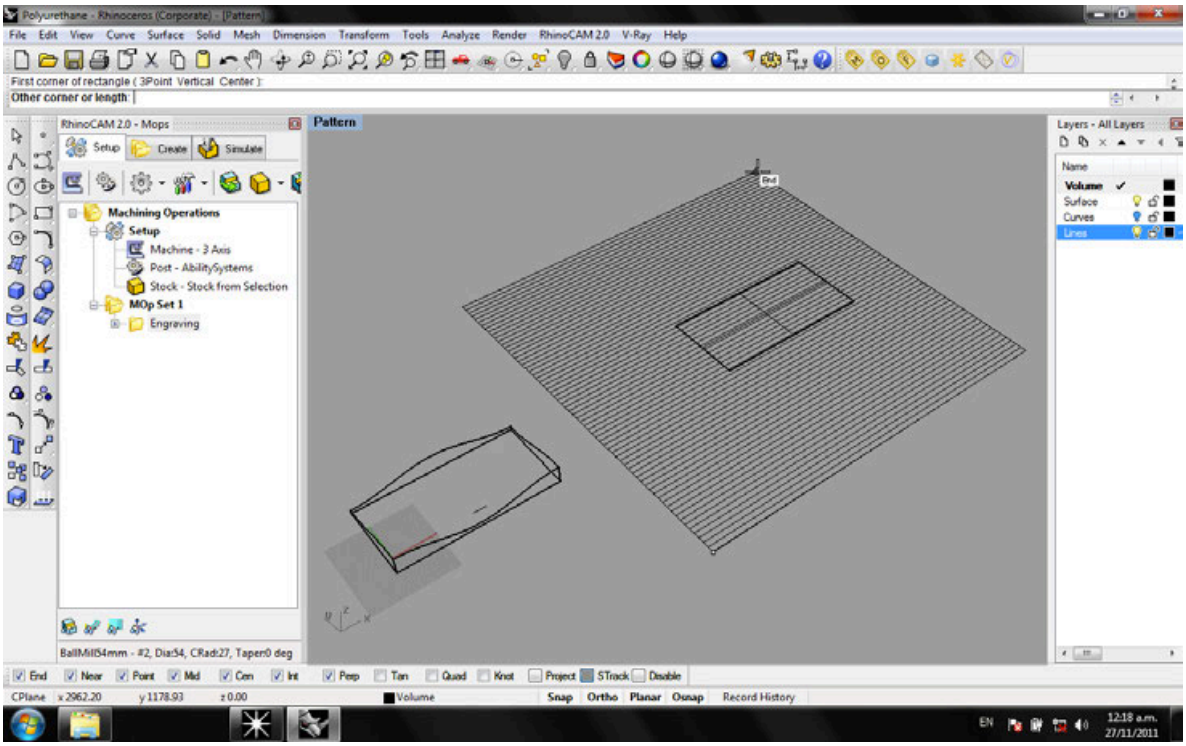
Step 7
Take the surface out of the model area, to make it easier to design the milling pattern.



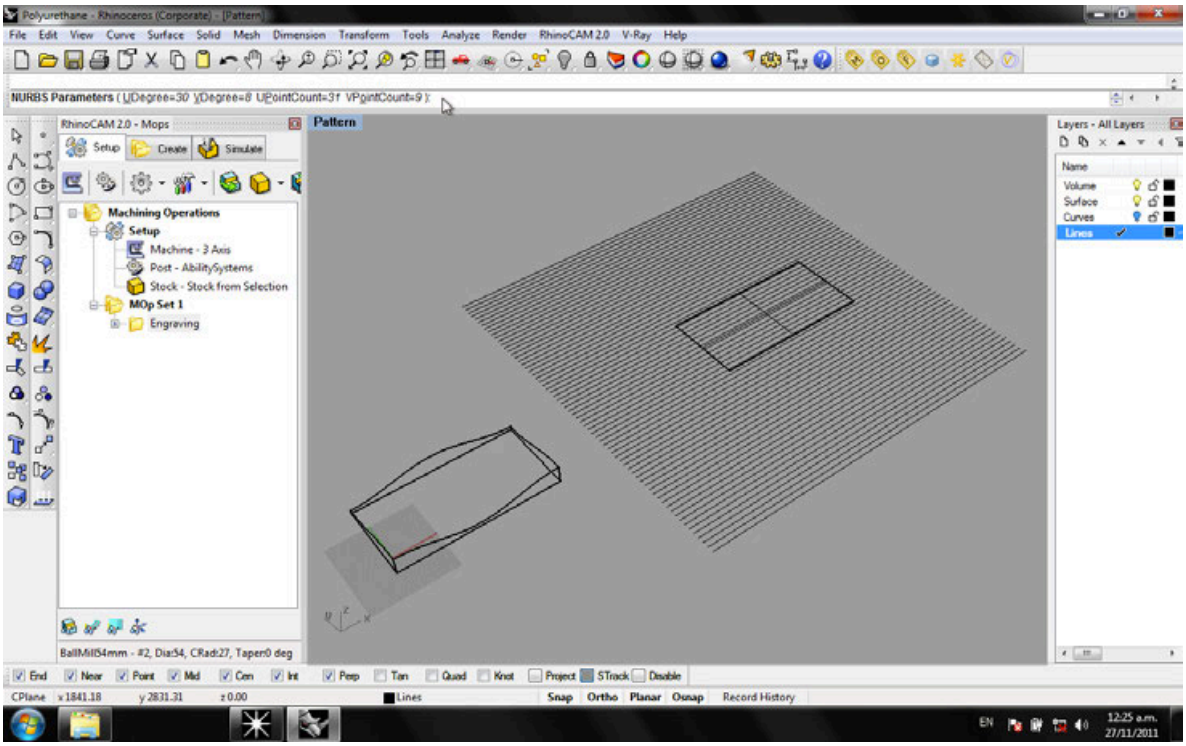
Step 8
Generate a set of lines. The distance between these lines is related to the size of the milling tool (54mm ball).



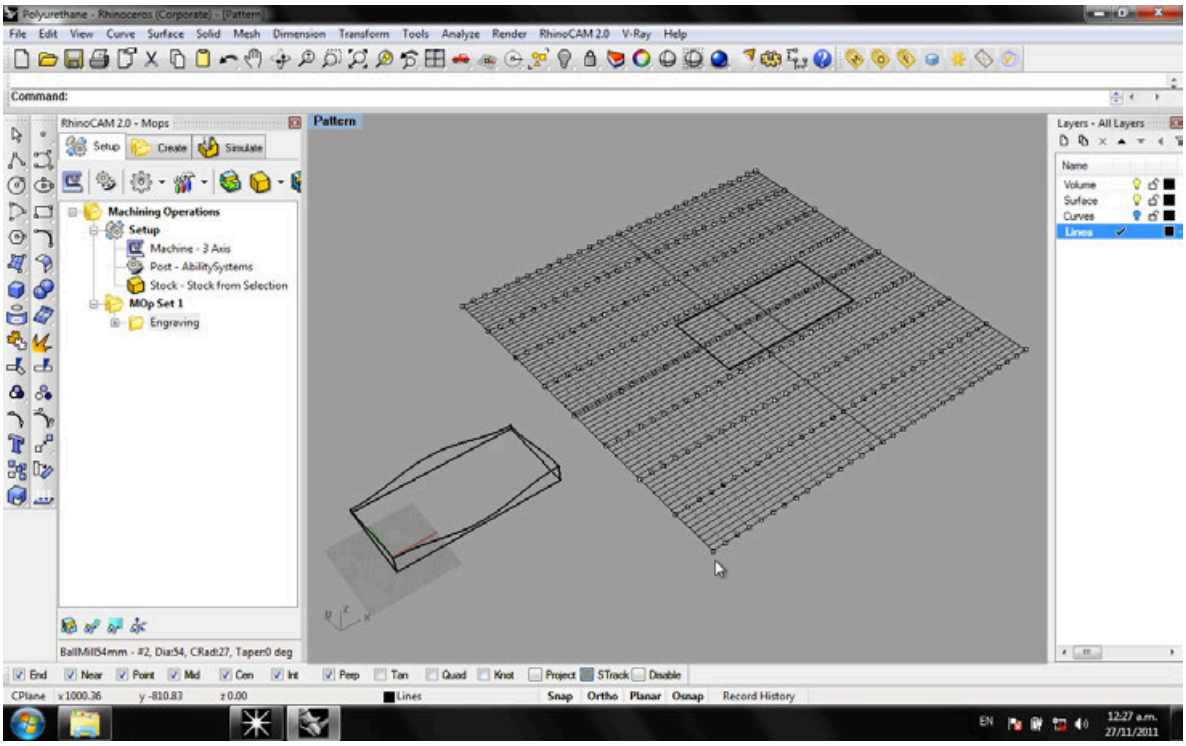
Step 9
Select all the lines and run the “CageEdit” command, select the rectangle option



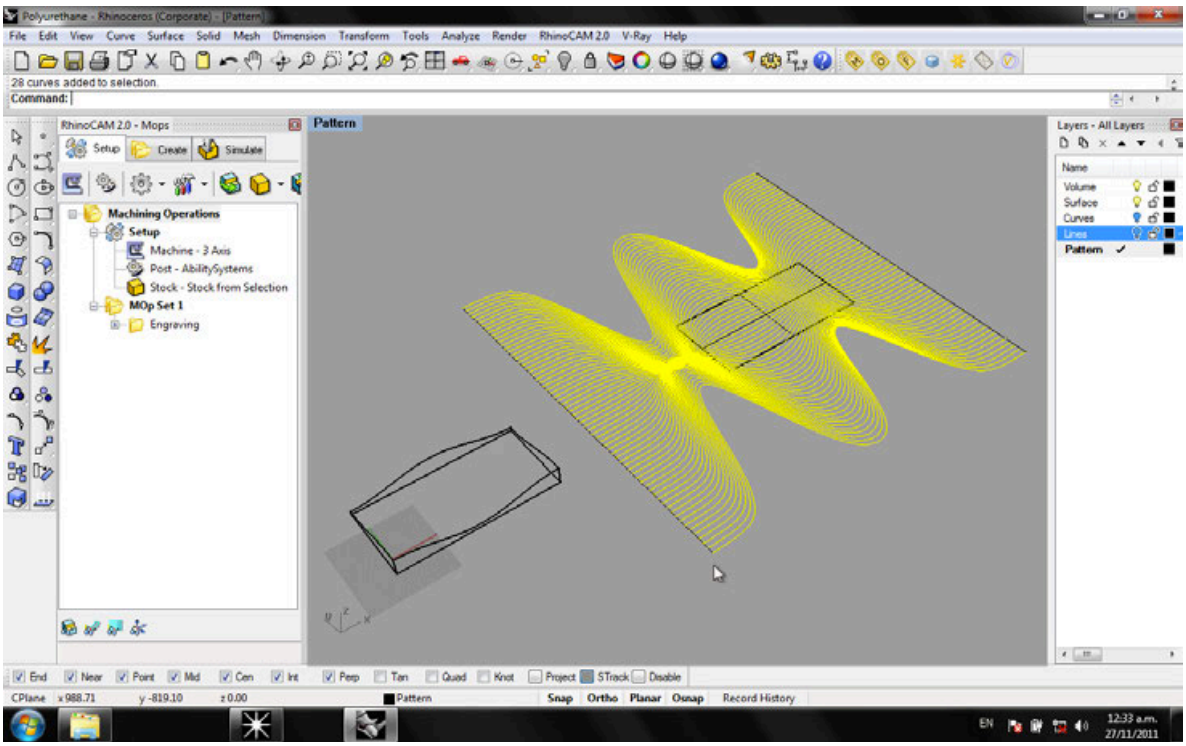
Step 10
Set the NURBS Parameters to the wanted amount of control points on the grid. Set the region to Global.



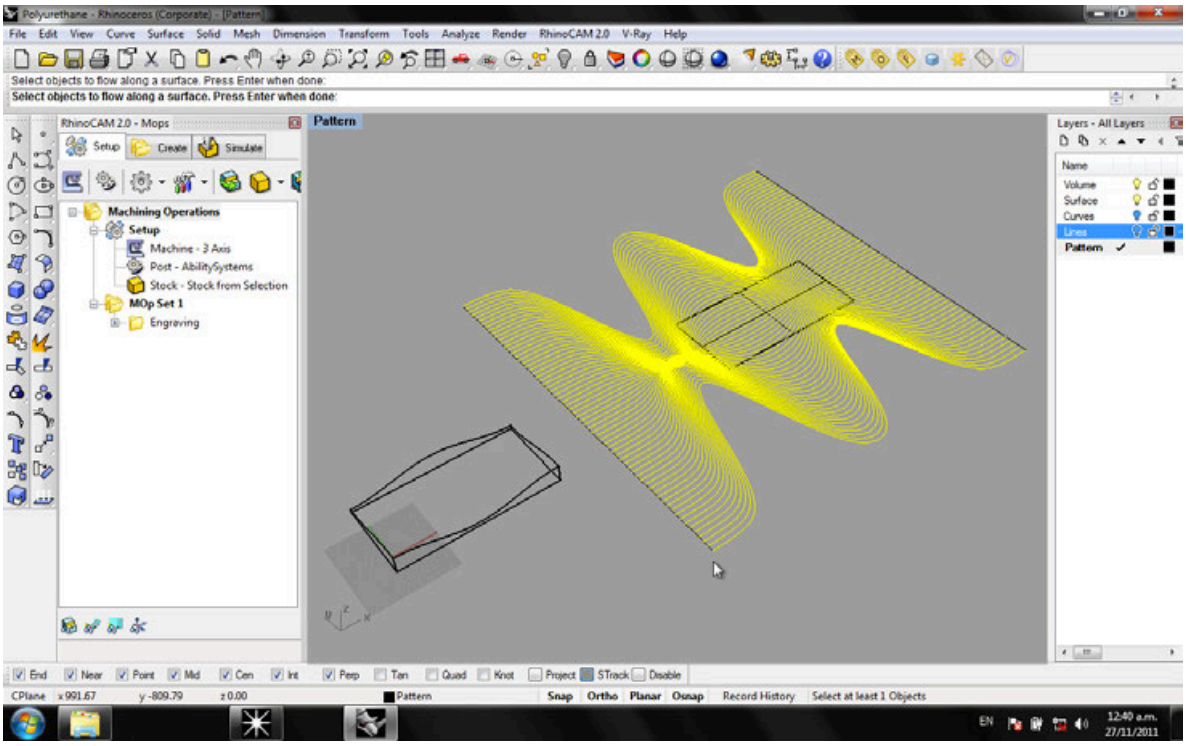
Step 11
Start editing the grid.



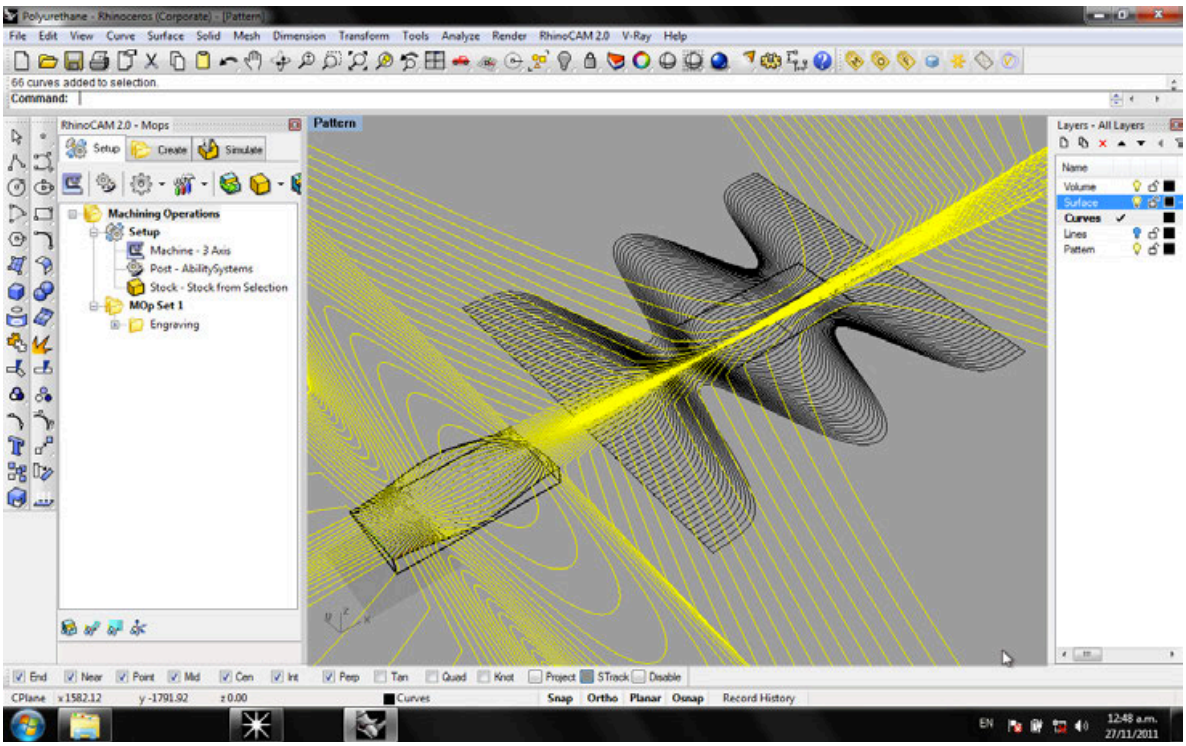
Step 12
Generate the milling pattern.



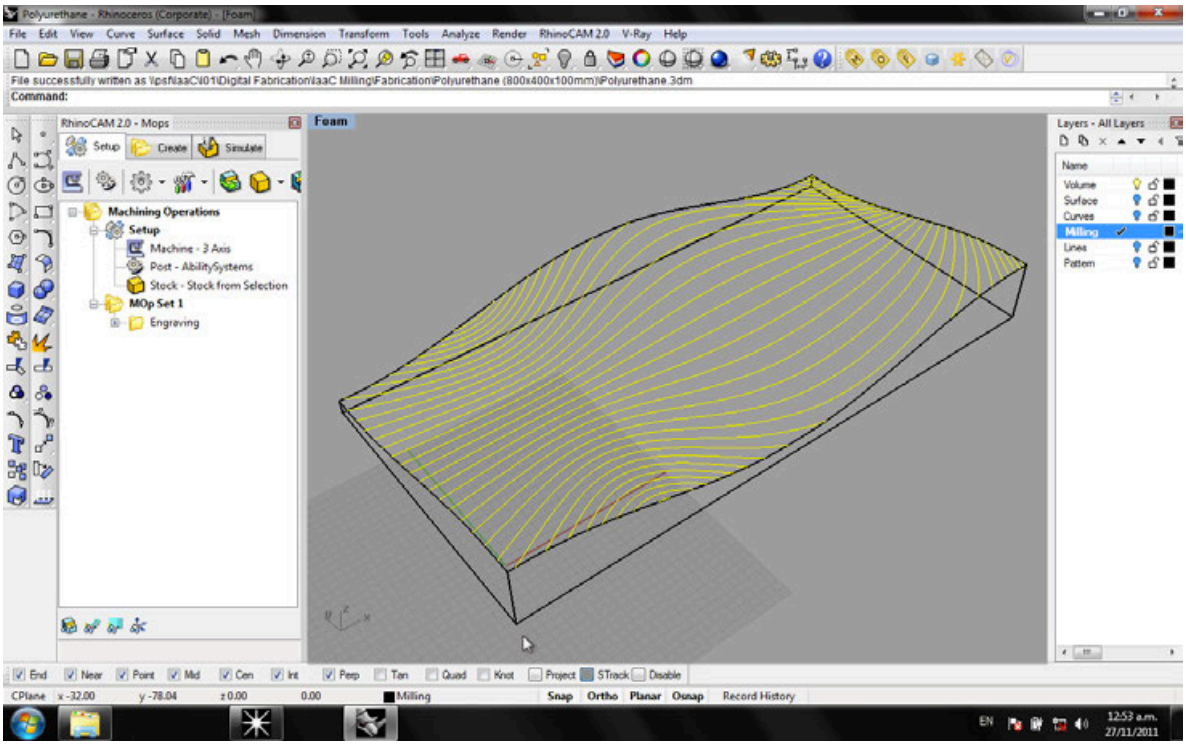
Step 13
Run the “FlowAlongSrf” command and select all the lines, then, select the base surface.



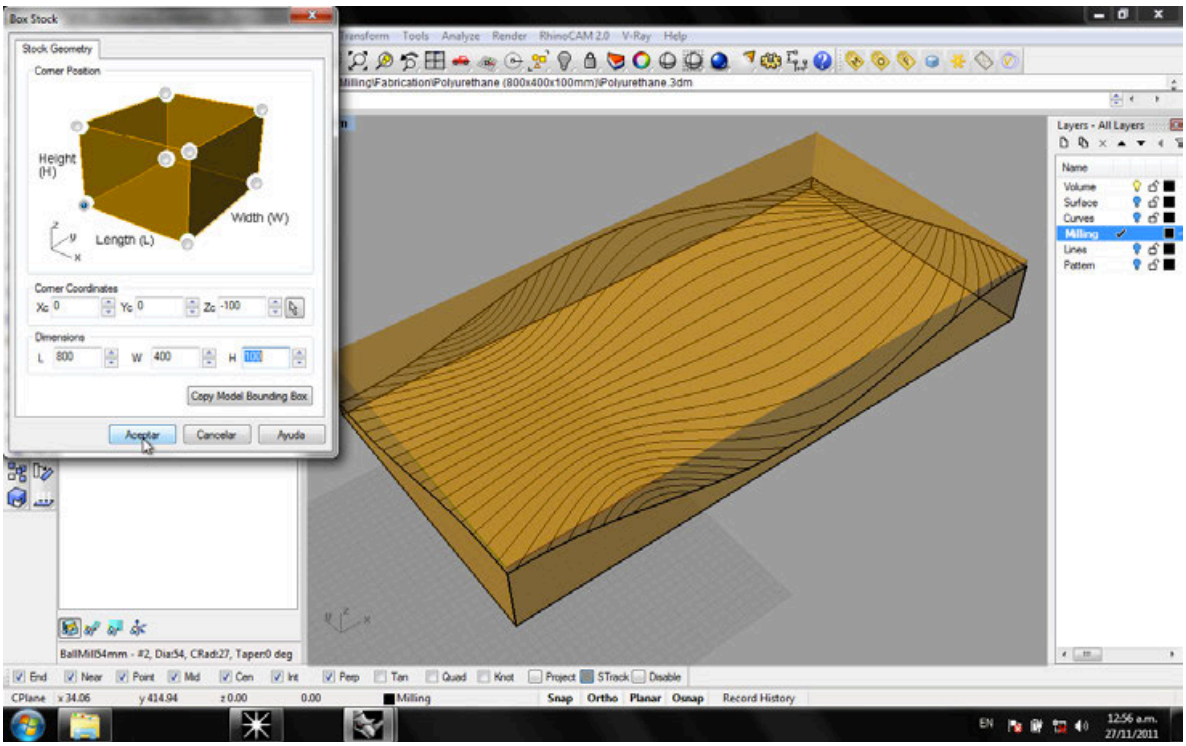
Step 14
Select the target surface, press the enter key and the lines will be projected on the model.



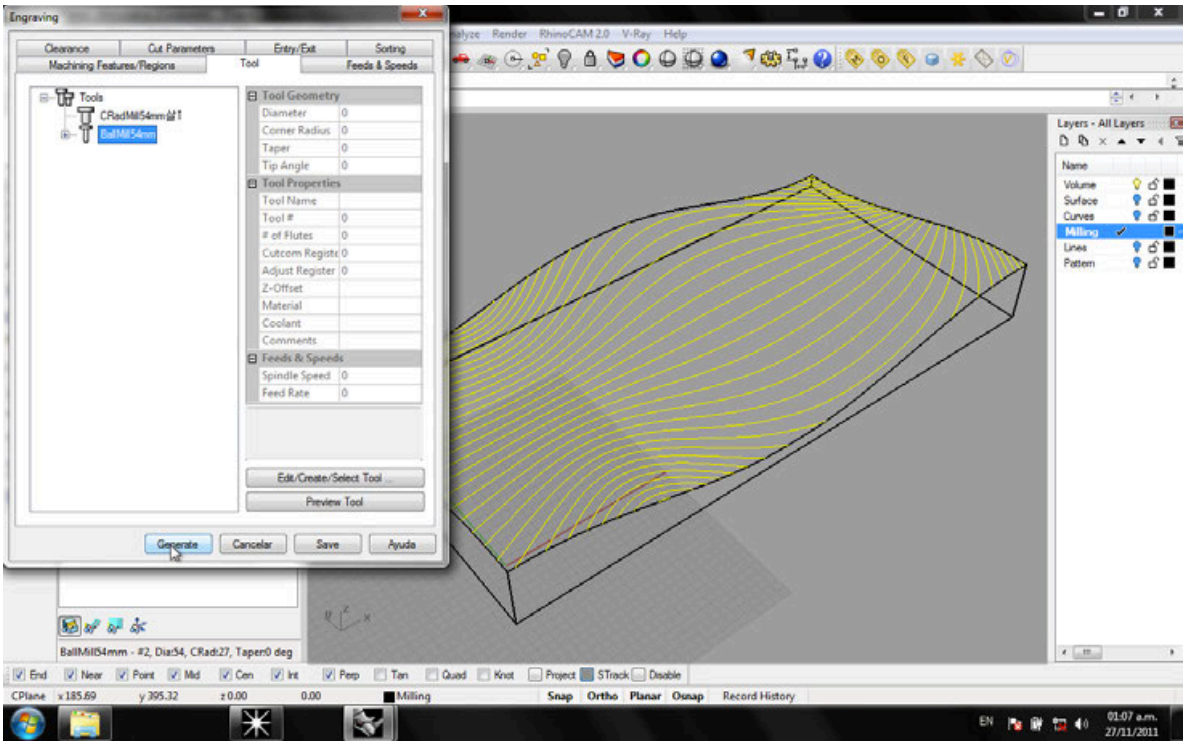
Step 15
Split the lines in order to clean the pattern to be milled onto the model surface.



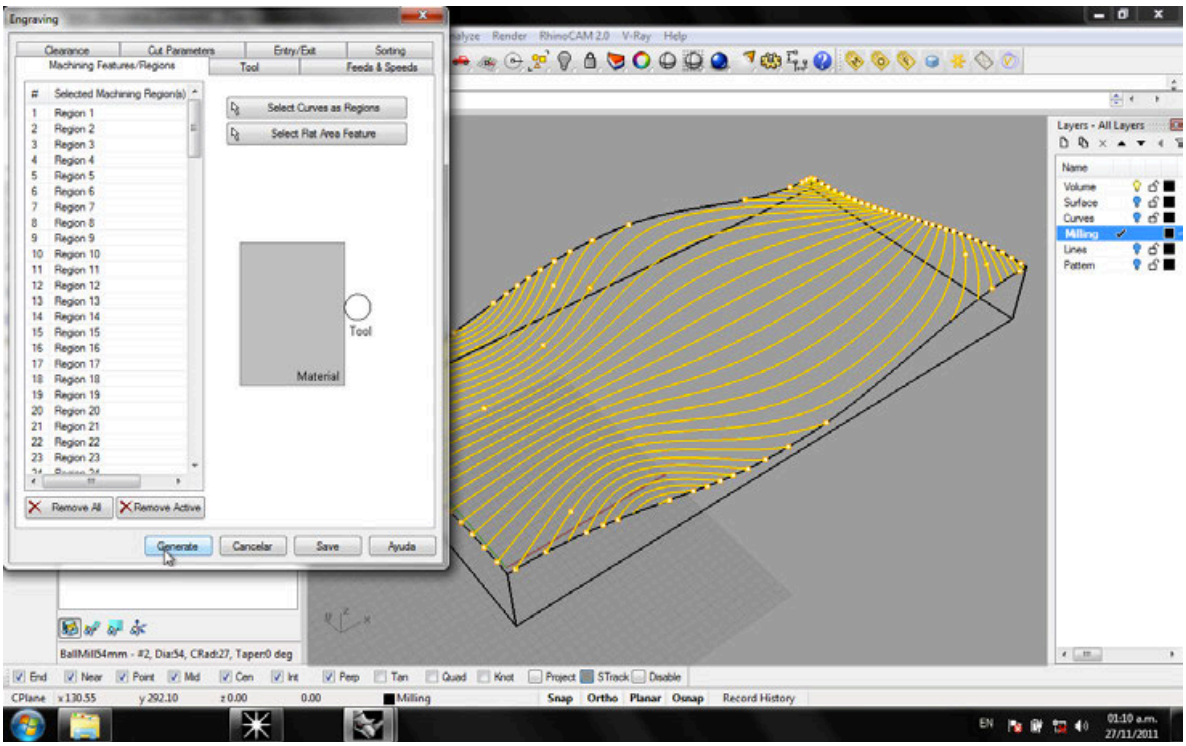
Step 16
Create a box stock, from the stock menu from the RhinoCAM application.



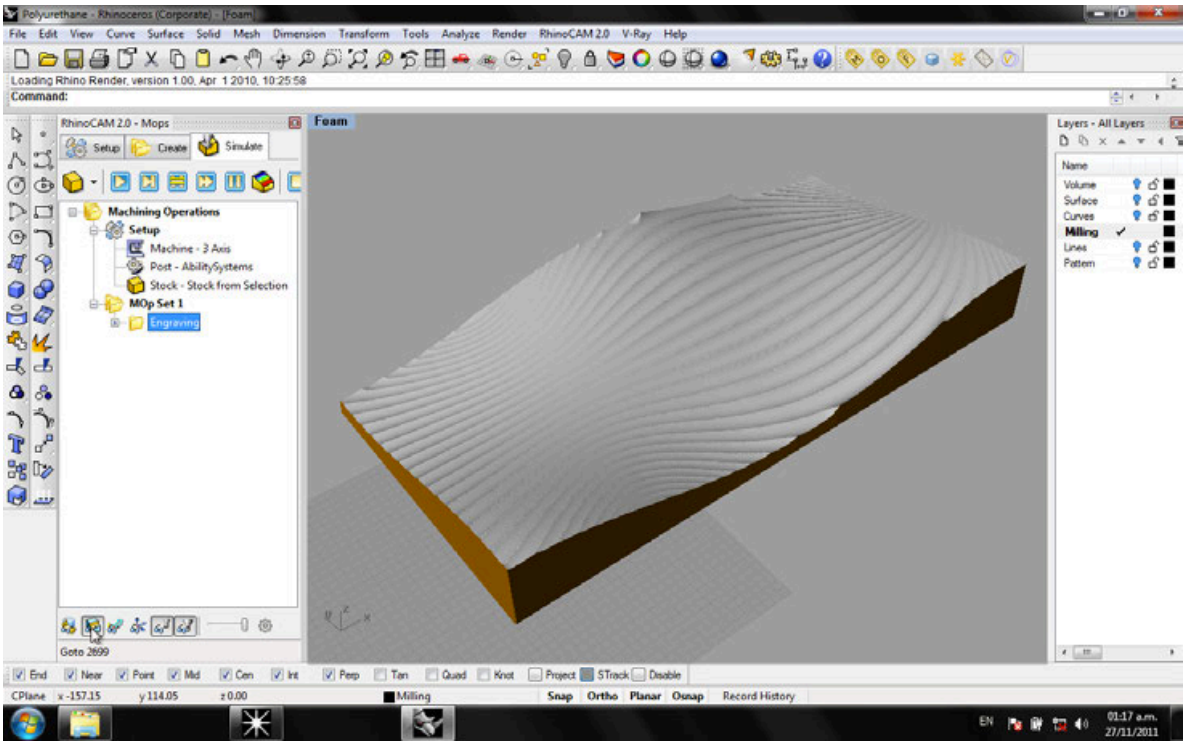
Step 17
Create an engraving pattern, in the 2-1/2 Axis menu. Set the tool to the 54mm ball.



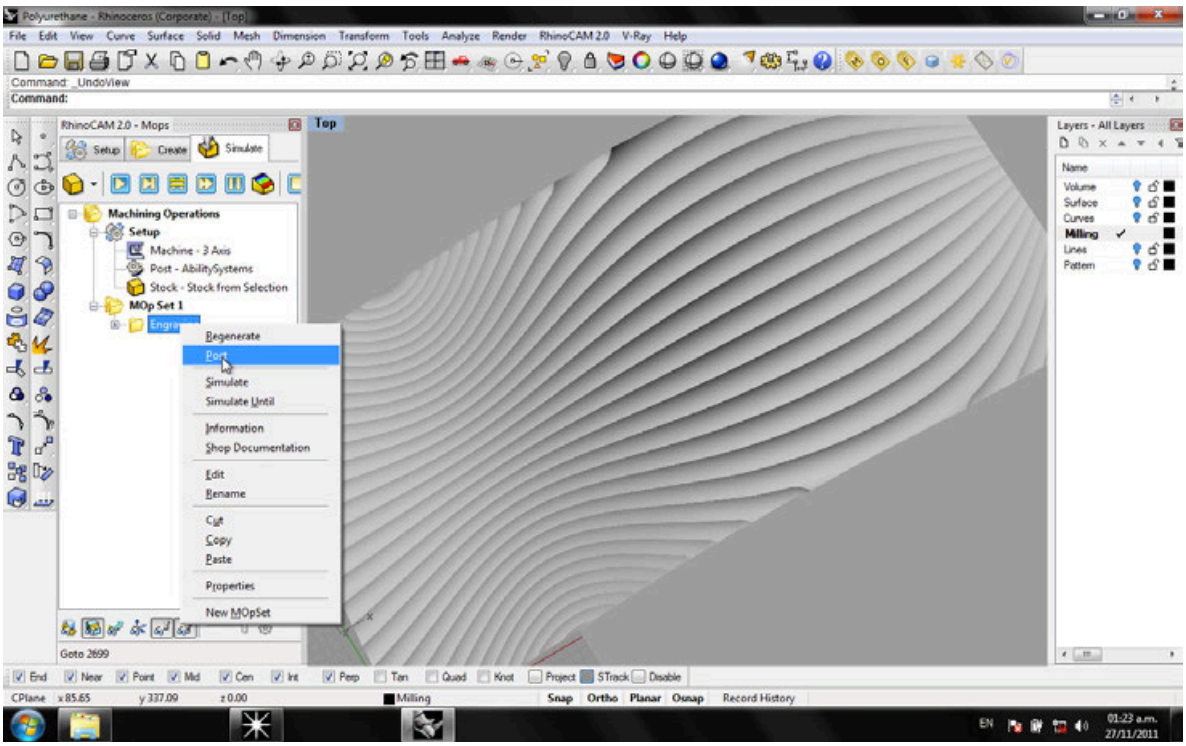
Step 18
Go to the Machining Features and select all the curves of the pattern as Regions, then press generate.



Step 19
Simulate the milling process and observe the results.



Step 20
Post the engraving results as a ".gc" files for the milling machine.



PERFORMANCE

The concept used for the Valchromat, was to create soft curves that allows the interaction between the layers of the board. In the case of the Polyurethane, the surface was worked with gentle shape in order to respect the characteristics of the material. The simulation process with Rhino CAM gave us the idea of tool path effect on the final pieces; so many shapes were explored to change the design and tool sizes.

The final shape for the Valchromat took 1 hour. But, this result could be more efficient if the tool size gets increased. Also, a big size to the tool path creates a softer finish on the piece, considering the features of the material. However; as the Polyurethane milling is on hold, the final review and comments for the design will be developed after the conclusion of the exercise.