RhinoCAM Works by Solo

Bernie Solo of Ortonville, Michigan took his passion for photography and digital graphics and in 1993 turned it into a thriving business, Solo StudioWorks creating some of the most compelling CGI (digital graphics imagery) in the automotive industry.

Some of the CGI imagery Bernie creates requires the use of physical props and/or prototype mockups. To assist him in this effort, Bernie chose RhinoCAM CNC software from MecSoft Corporation and has been using it exclusively for the past six years.

Today, Bernie also has his own YouTube channel, WorksbySolo that encompasses the essence of the maker movement - those special individuals, dedicated to the art of making things that work, using the latest digital fabrication tools like RhinoCAM. We recently sat down with Bernie to discuss his use of RhinoCAM, and he agreed to share one of his interesting projects with us.

Here is just a small sample from Solo StudioWorks.

Bernie loves RhinoCAM so much that he actually puts it as a hashtag in his social media posts!

Why do I do that? I guess it's just that I'm the kind of a guy that says: Hey, this is what I use, I like it and it works really well!

- Bernie Solo | WorksbySolo

The Quikrete USB Challenge

One of the things that Makers like to do is post challenges to each other online. When Bernie saw the USB Challenge from Michael Lawing on YouTube he just had to take it on! So, what was the challenge? To build a USB adapter that incorporates concrete into its design!

Now electronics and concrete usually don't mix well (thus the challenge) and Makezine magazine Senior Editor (and fellow YouTuber) Caleb Kraft picked up on the story as the challenge started gaining momentum. That's when Quikrete® stepped up and decided to sponsor the event!

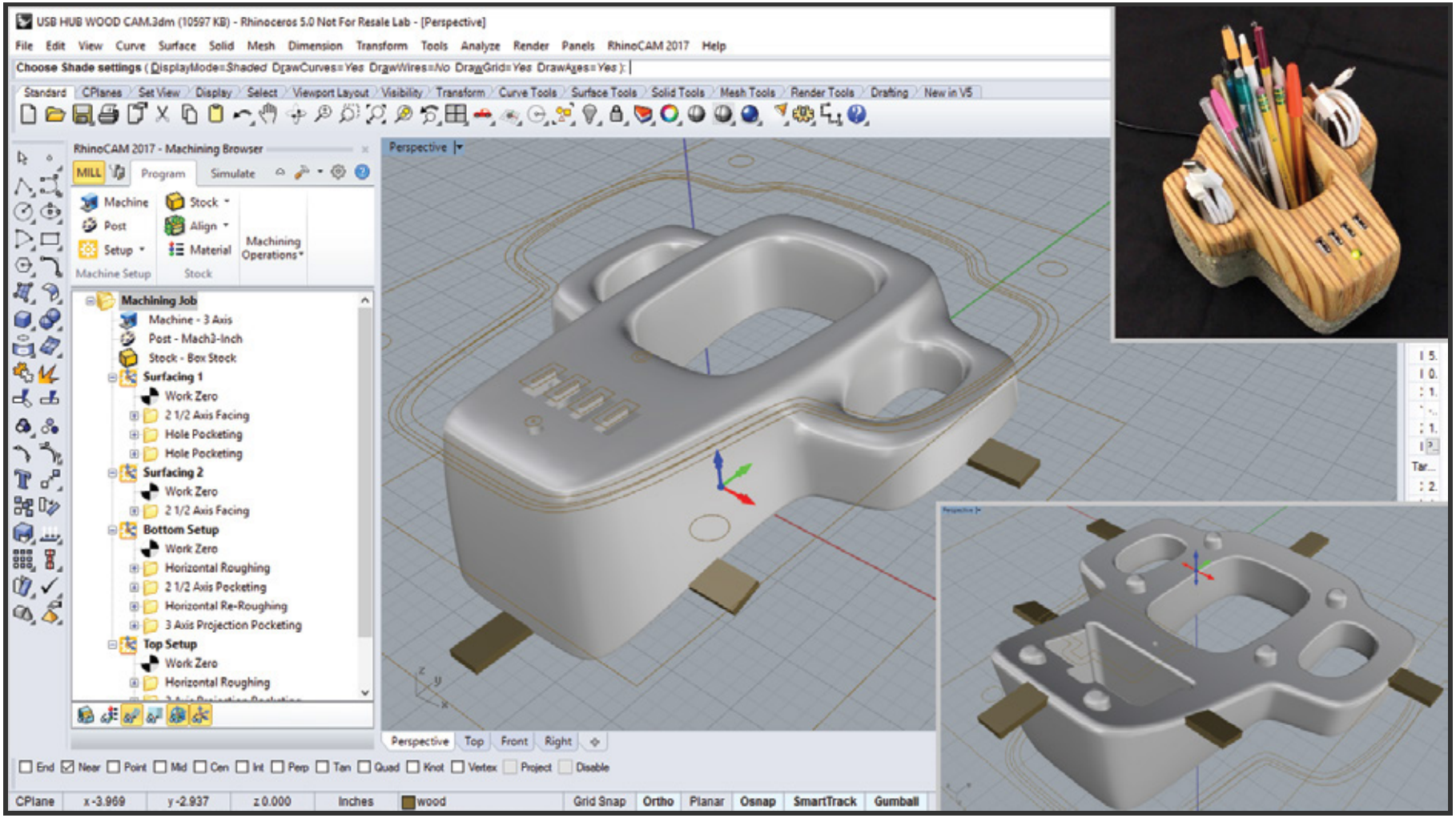
Needless to say, Bernie won this challenge with a USB hub that weighed in at only 5 lbs (remember the concrete). We're excited (and a bit proud) to show you how RhinoCAM helped Bernie do it!

The USB Hub Cover

Bernie designed and modeled his USB hub in Rhino, creating all of the 3D surfaces that RhinoCAM needed for machining. The top cover is machined from laminated sheets of wood containing the access openings for the USB ports as well as pockets for desk accessories, all within an aesthetically pleasing design.

The cover is shown in Rhino 5 below. Since it is a 2-sided part, Bernie modeled tabs that will serve as anchors that will keep the part attached to the stock during machining. The 2D curves that you see above the part will serve as containment boundaries for the various machining operations.

The bottom side of the part is shown in the bottom right of the image. On the left you see the 4 separate Setups that Bernie uses to machine the part. Setups named Surfacing 1 & Surfacing 2 are used to prepare the stock for 2-sided machining (measuring 8”x10”x2.875”) using wooden dowel pins for alignment. The Top Setup and Bottom Setup are used for machining both sides of the part respectively.

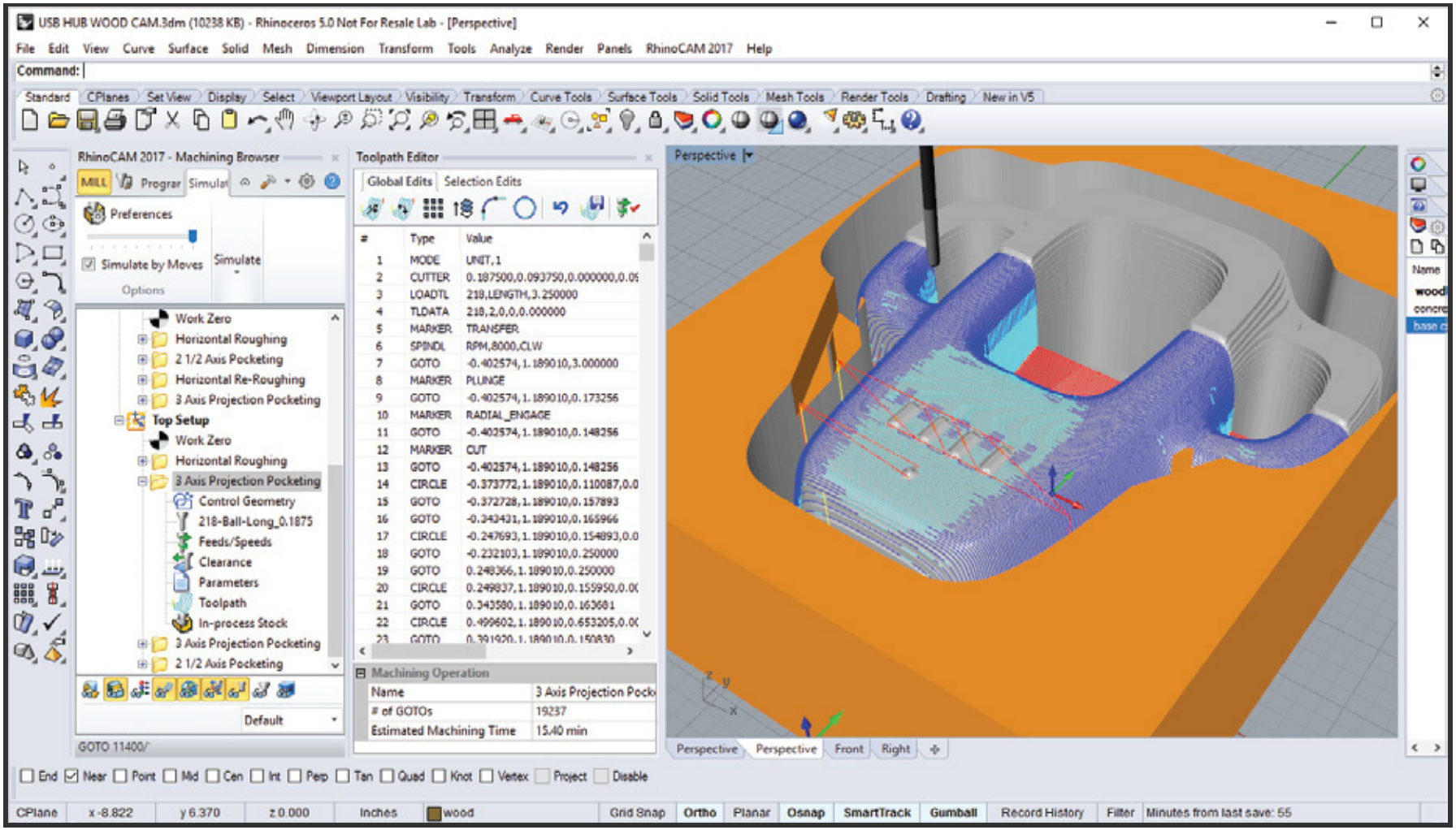


Here we see the top cover of the USB hub that Bernie modeled in Rhino. In the main display, you also see the 2D reference curves that he has drawn as containment regions. Bernie has also modeled tabs on the part that he wants to use to anchor it to the stock during machining. The multiple Setups are listed under the Machining Job tree in the RhinoCAM Machining Browser on the left.

Inset Bottom Right: The bottom side of the part is shown. **Inset Top Right:** The completed USB hub design is shown.

Machining the Top Side

The Top of the Cover consists of four machining operations. These include 3 Axis Horizontal Roughing with a ¼" End Mill leaving 0.025" of stock remaining. This is followed by two traversing 3 Axis Projection Pocketing operations using a 3/16" Ball Mill. Each traverses in opposite directions, one at zero degrees (along the X Axis) and the other at 90 degrees (along the Y Axis) using a 15% stepover that serves to finish the top side down to the part's surfaces. The remaining toolpath is a 2½ Axis Pocketing operation that cuts out the rectangular access holes for the USB ports.

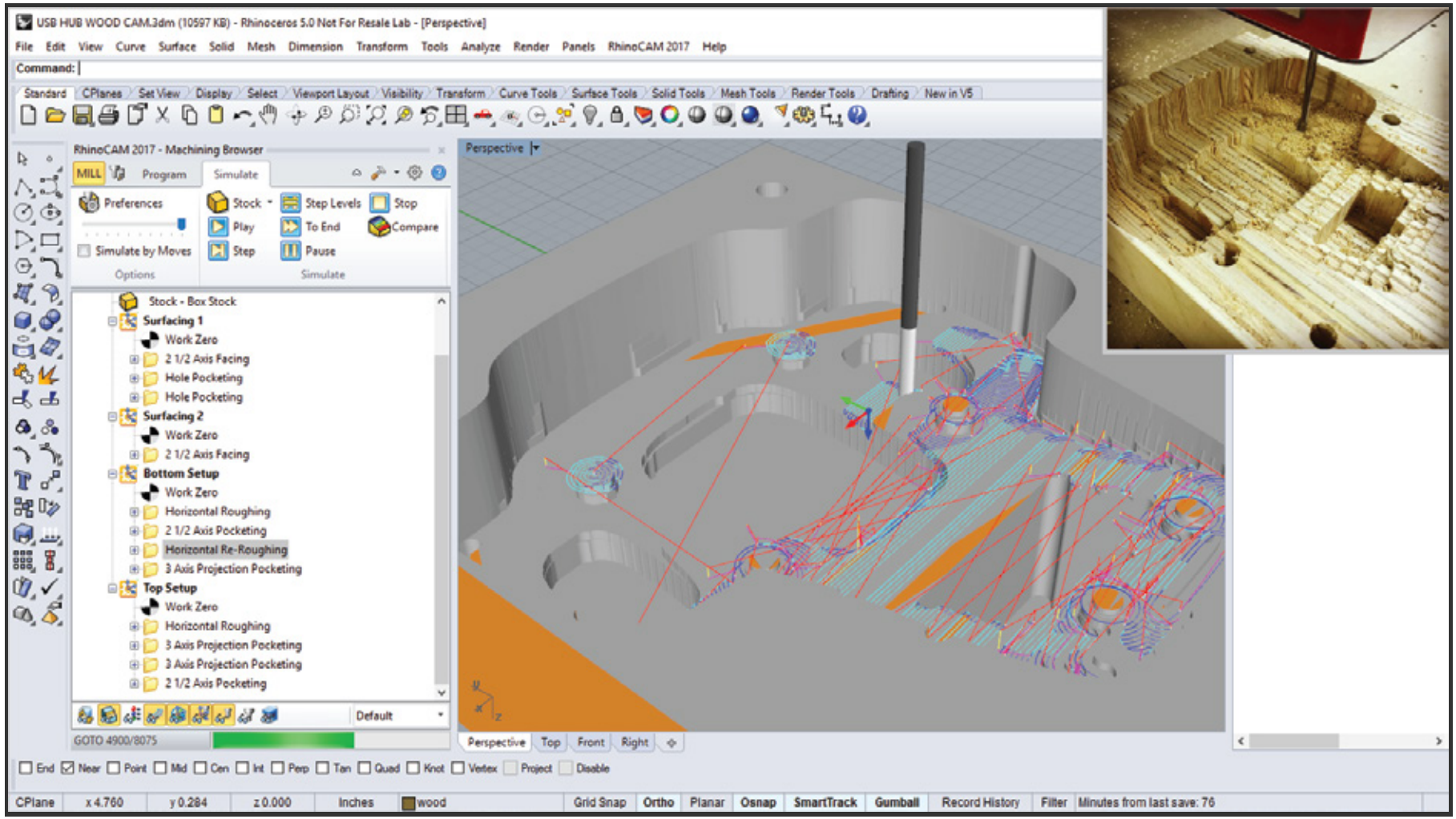


In the Top Setup, we see the cut material simulation being performed for the 3 Axis Projection Pocketing operation. The Toolpath Editor is also displayed showing the GOTO motions for the toolpath. For color coding purposes, the dark blue paths are arc motions, the light blue are linear motions, and the red are transfer motions.

Machining the Bottom Side

After the Top Side is done, Bernie then flips the stock over, using the wooden dowels ensuring proper alignment during machining. The Bottom side of the Cover also consists of four machining operations. Since there is more material to remove from the bottom, Bernie uses 3 Axis Horizontal Roughing with a ¼" End Mill and a 3 Axis Re-Roughing using a smaller 3/16" End Mill. Re-Roughing automatically calculates the excess material that can be removed using the smaller cutter.

However, prior to re-roughing, Bernie uses a Pocketing operation to remove material reserved for the USB port's electronics. He then concludes with a 3 Axis Projection Pocketing operation to finish off the bottom side. The image below shows the 3 Axis Horizontal Re-Roughing toolpaths in RhinoCAM as well as the actual part being machined.

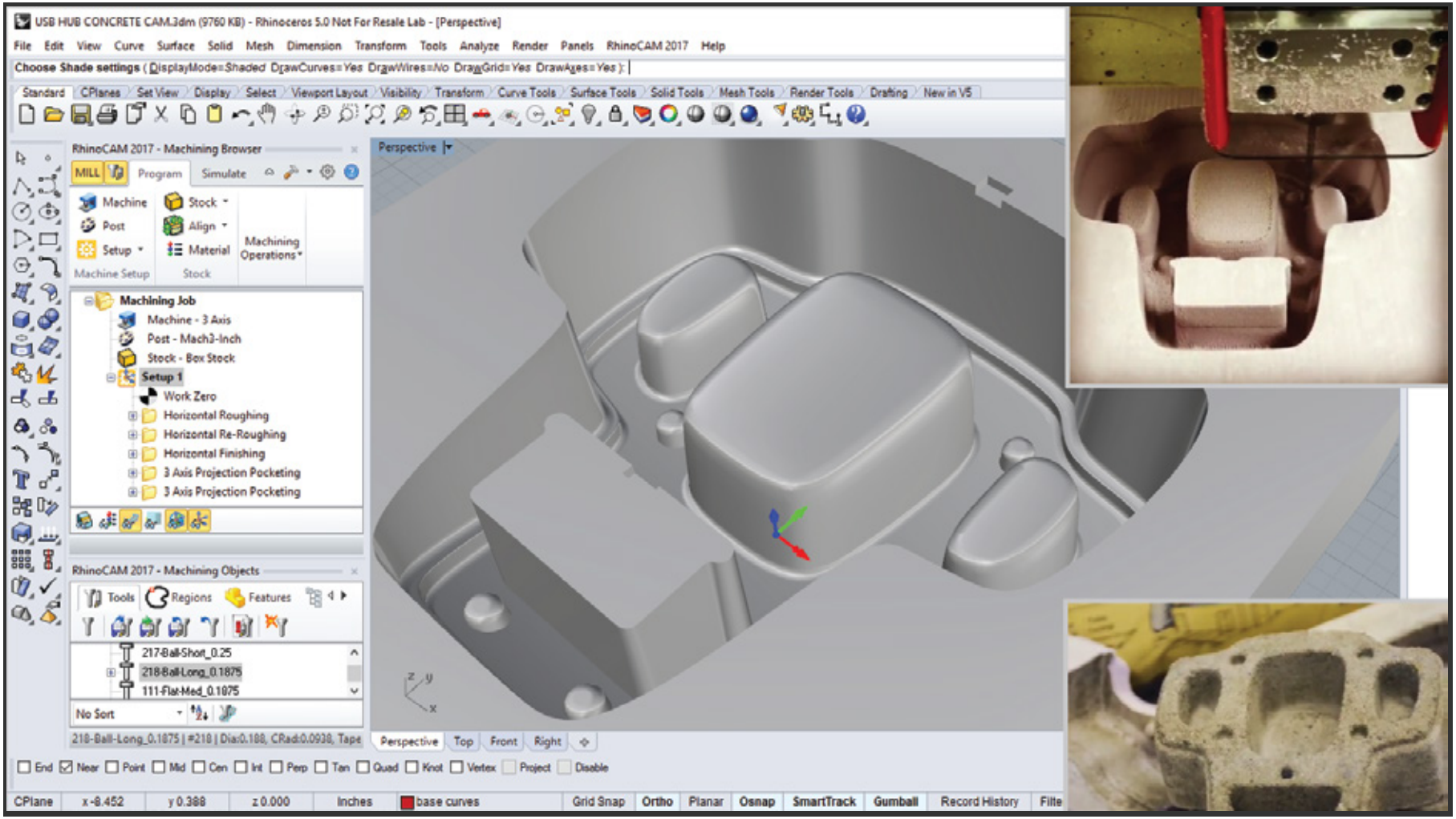


In the Bottom Setup, we see the cut material simulation for the 3 Axis Horizontal Re-Roughing operation. Notice that only excess material is being removed using a smaller 3/16” Flat Mill. **Inset Top Right**: The Re-Roughing operation is shown being machined.

The USB Hub Base

This is where it gets interesting. The base of the USB Hub will be made of concrete to meet the terms of the challenge. To achieve this, Bernie models the base in Rhino and then extracts it from the stock, also modeled in Rhino, to form a cavity. The cavity is then machined from insulation foam using RhinoCAM toolpaths, filled with Quikrete® that is then removed when set to form the base.

While the cavity only needs to be machined from one side, it still has some interesting toolpaths. Again, Bernie starts out with 3 Axis Horizontal Roughing (¼" End Mill) followed by Re-Roughing (3/16" End Mill) leaving 0.025" of stock remaining. Then 3 Axis Horizontal Finishing is used. This operation does an excellent job of finishing side walls that are nearly vertical just like the sides of this cavity. Then again, Bernie uses two traversing 3 Axis Projection Pocketing operations using a 3/16" Ball Mill. Each traversing in opposite directions, that serve to finish the cavity's surfaces.



The base of the of the USB hub is made from concrete. In the main image, we see the mold cavity Bernie has designed for this purpose. **Inset Top Right**: The mold cavity is being machined from insulation foam.
Inset Bottom Right: The concrete USB hub base is extracted from the mold cavity.

In the series of images below we see the sequence of toolpaths Bernie uses to cut the mold cavity. Each is also described here:

A. The mold cavity part is shown.

B. 3 Axis Horizontal Roughing is used to remove the bulk of material using a ¼" Flat Mill, an Offset Cut Pattern and a 50% Stepover leaving 0.025" of stock left on the part. The Stepdown for each cut level is set to 100% of the tool diameter.

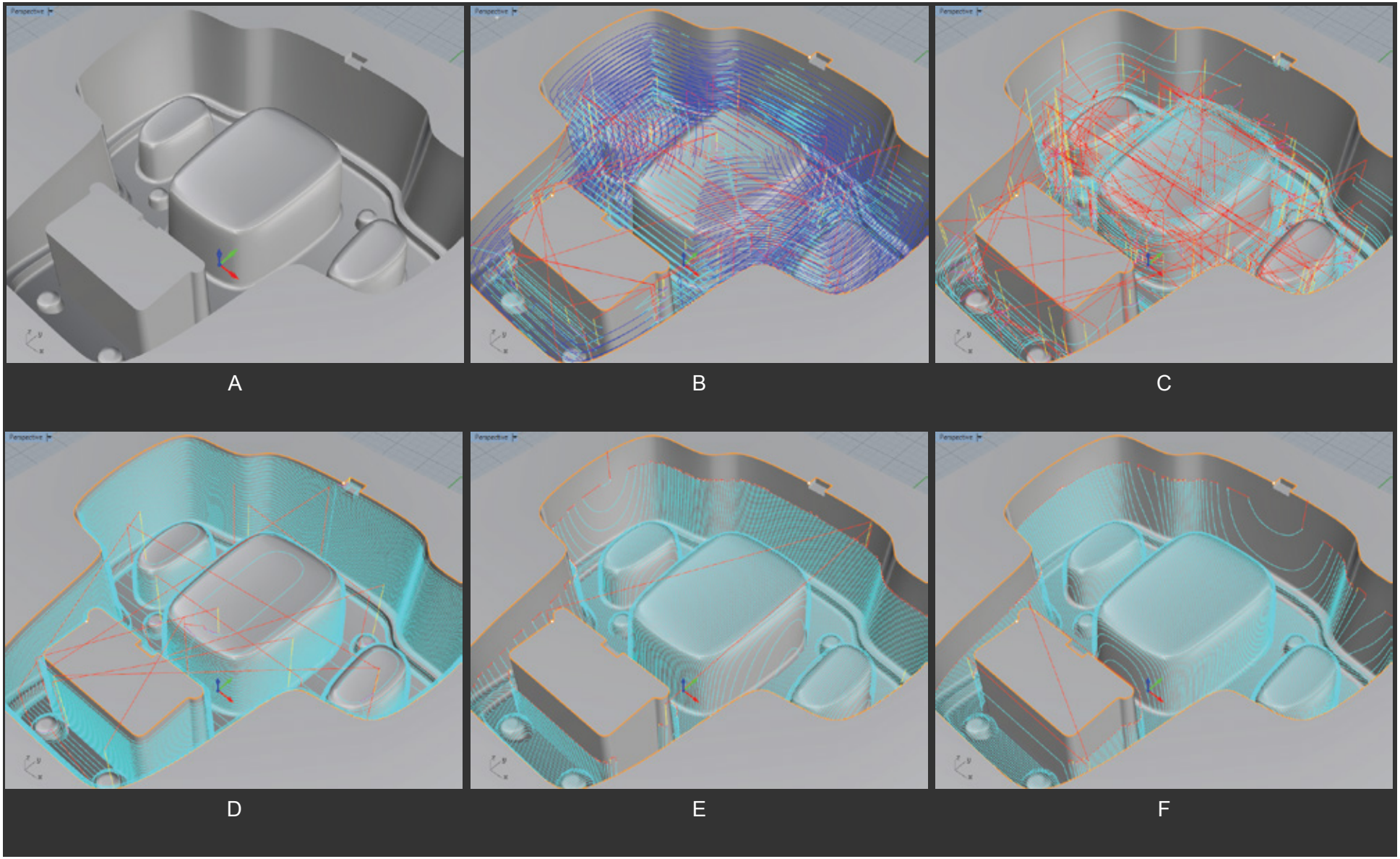
C. Here we see the 3 Axis Horizontal Re-Roughing operation. It calculates the areas for material removal based on a smaller 3/16" diameter cutter. This is calculated from the cat material simulation of the previous Roughing operation using an Offset Cut Pattern, a Stepover of 25% and Stepdown of 50%.

D. For the first finishing operation, we see a 3 Axis Horizontal Finishing toolpath using a 3/16" Ball Mill. This strategy is great for side walls that are nearly vertical because it finishes in levels using the side of the tool. In this case, each stepdown level is 20% of the tool diameter.

E. The second finishing operation is a 3 Axis Projection Pocketing toolpath. In this strategy, a linear path is projected down onto the part. In this case the Angle of Cut is set to 90 degrees using a Stepover of 20%.

F. Similar to (E), a second 3 Axis Projection Pocketing toolpath is used, this time changing the Angle of Cut to zero. These three finishing operations (D,E,F) together result in a good surface finish for the cavity.

Click here to see a video of this cavity being machined from RhinoCAM toolpaths!


A
B
C
D
E
F

As you can see, Bernie loves his RhinoCAM! To learn more about Bernie's winning entry in the Makezine USB Hub Challenge and his other amazing projects, we invite you to visit his YouTube channel WorksbySolo, Facebook or Instagram. We would like to extend a special thanks to Bernie Solo from WorksbySolo for allowing us to share his RhinoCAM success story.

RhinoCAM is the GO TO choice of Makers worldwide for its accuracy, affordability, ease of use and wide range of configurations from Express to Premium, encompassing 2 through 5 Axis milling as well as turning modules. All completely integrated into Rhino 5. Don't have Rhino? No problem, download VisualCAD/CAM, the stand-alone version with all of the same features as RhinoCAM!