RhinoCAM
at Designer Grains Inc.

Designer Grains Inc. (Watsonville, CA) is an established fine cabinetry and custom manufacturing business successfully operating in Santa Cruz County for over thirty years. Founded by Sean Sinnott in 1989, Designer Grains is known for providing clients with unique designs, excellent craftsmanship and personal attention. Sean's ability for creative problem-solving has garnered him an industry reputation of being the "Go-to-Guy" for demanding clients.

Sean's work has included many private estates and luxury residences throughout the greater San Francisco and Monterey Bay Areas. Commercial projects have been installed in numerous locations throughout the United States. His client list includes well-known Silicon Valley CEO's, famous Wall Street analysts, car dealers, Fortune 500 CEOs, Las Vegas casinos, and real estate billionaire developers!

We recently sat down with Sean Sinnott to discuss his work with RhinoCAM CNC Software and to take a closer look at some of his cool RhinoCAM projects!

The RhinoCAM Difference

Sean has been a dedicated RhinoCAM user since he purchased his first Multicam CNC machine back in 2005. He then added a second Multicam CNC machine in 2014. Sean's goal was to streamline his CNC process so that anyone in his shop could run any g-code file on any of his CNC machines without pause. To help achieve this goal, Sean turned to MecSoft Corporation to customize a single post-processor that would seamlessly run any of his Multicam CNC machines! Here is some of what Sean had to say about RhinoCAM.

"RhinoCAM works so well for us and I'm very familiar with it. We have a working group of RhinoCAM colleagues around the world and share ideas and work as much as possible. MecSoft support also provided us with a customized Multicam post-processor. Now anyone on our team can take any g-code file and run it on any of our CNC machines without pause!"

Sean Sinnott,
Principal Designer Grains, Inc., Watsonville, CA

The Acanthus Curved Crown Molding Project

This project will cut one curved Acanthus Crown Molding section, front and back. What is Acanthus? It is a herbaceous plant or shrub native to Mediterranean regions with bold flower spikes and spiny decorative leaves. In architecture, it is used especially as a decoration for Corinthian column capitals. The Rhino part geometry is shown in the illustration below.


Acanthus Crown Molding section
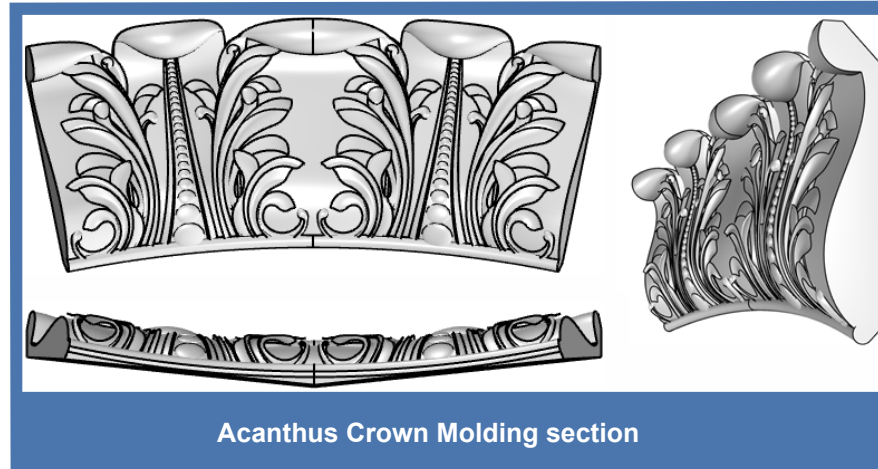
The part consists of a solid curved base with "floating" surfaces representing each acanthus leaf. The leaf surfaces are free-floating one upon another giving the pattern both depth and a physical vitality that other flat patterns cannot achieve. Be sure to check out the closeup of this effect in the illustrations below. The stock dimensions are 15" x 14" x 1.75".
In this setup, the Back is machined first and the Front is machine second, One complete set can be machined in the same setup, flipping the stock over and positioned with ¼" alignment pins as needed.
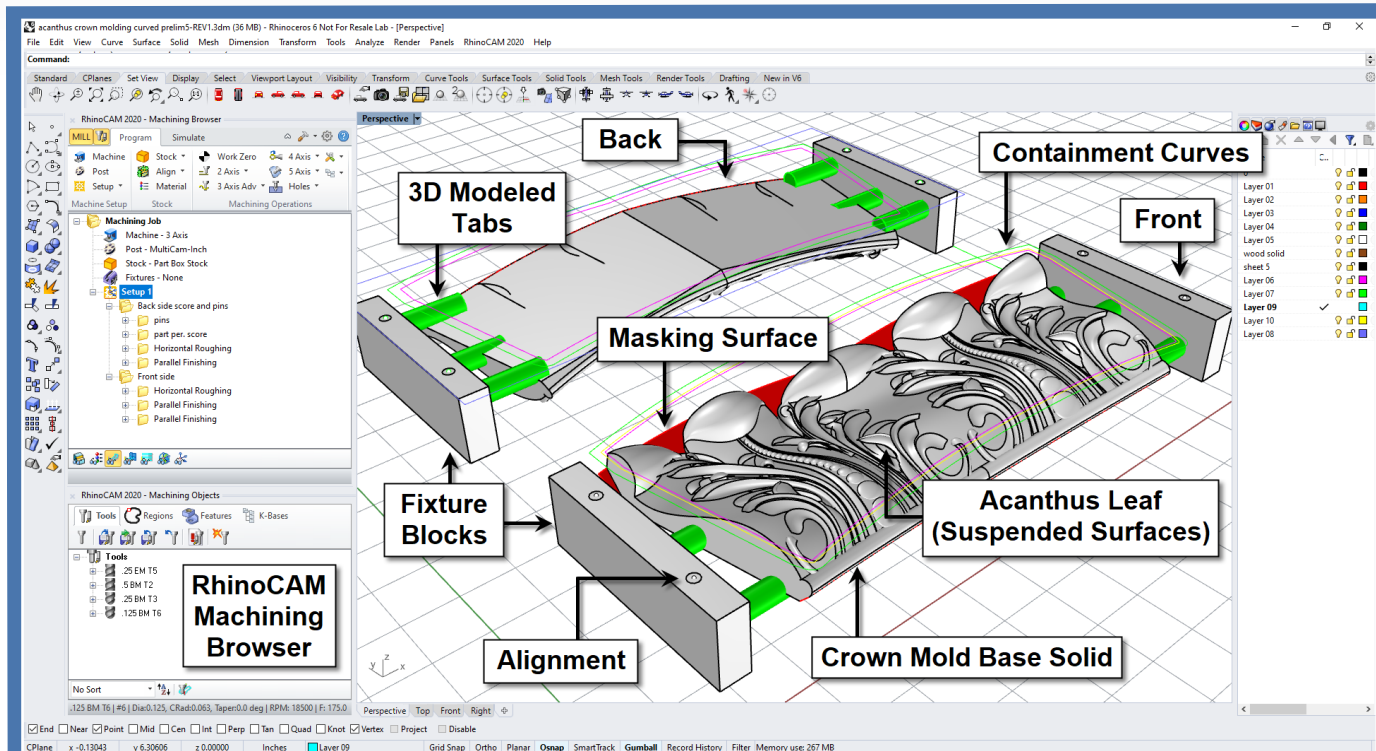
Here we see the Acanthus Crown Molding part geometry prepped for CAM programming as it appears in Rhino. It consists of free floating surfaces representing each acanthus leaf, a curved solid base, in-stock fixture blocks and two 3D modeled cylindrical tabs traversing the length of the part. There are two identical parts, one front facing and the other back facing.

Want to see how RhinoCAM can help you? Click Here to download a demo!

# Operation Set for the Back Side

RhinoCAM allows you to group operations into what we refer to as MOpSets (i.e., Machine Operation Sets).
The MOpSet for the back side is shown below. It includes a total of 3 machining operations, 2½ Engraving, 3 Axis Horizontal Roughing and 3 Axis Parallel Finishing. Each is illustrated below.
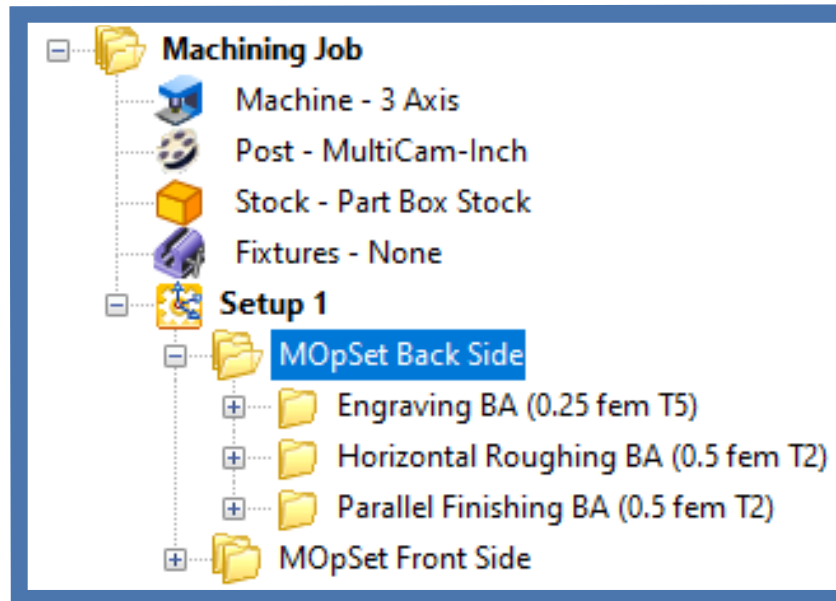
2½ Axis Engraving (4 Holes)

To machine the 4 alignment pin holes a 2½ Axis Engraving operation is used with a ¼" diameter flat end mill cutter. Engraving is a very versatile operation that can be used anytime you need the tip of the cutter to follow the containment geometry exactly. In this case the containment geometry is 4 points located on the top face of the stock. Tolerance for this operation is set to 0.001", cut geometry is located At Top with a Total Cut Depth of 0.5" and Rough Depth/Cut of 0.25".

Entry and Exit are both set to None and Sorting is set to Minimum Distance Sort. Cut Feed: 75 in/min, Spindle Speed: 7,500 RPM, Estimated Machining Time: 0.9 mins. Below on the left we see the part geometry and the resulting 2½ Axis Engraving toolpath. The resulting cut material simulation is shown on the right.
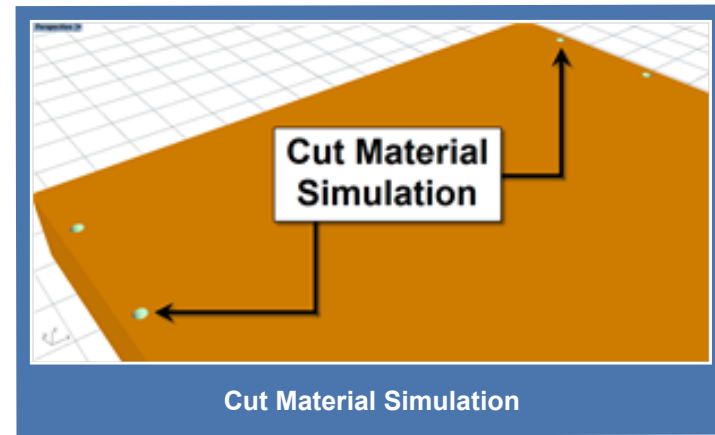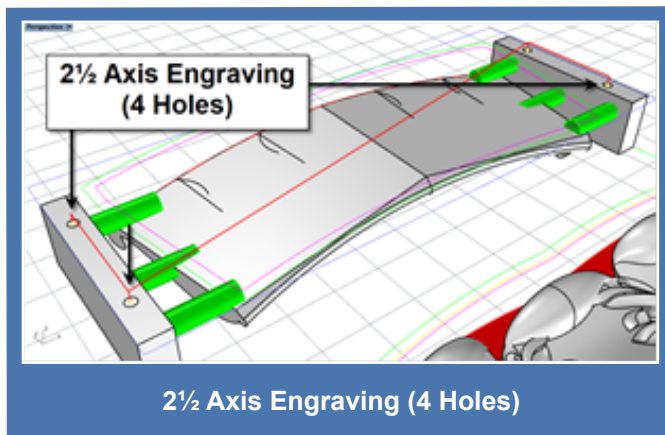
2½ Axis Engraving (4 Holes)

Cut Material Simulation

3 Axis Horizontal Roughing

For removing bulk material a 3 Axis Horizontal Roughing operation is used with a ½" diameter flat end mill cutter. The operation is contained to the perimeter boundary curve shown in the part model above. Cut Parameters include an Intol/Outtol of 0.01", Stock allowance of 0.03" an Offset cut pattern for both Cavity/Pocket and Core/Facing regions, a Mixed cut direction, an Inside start point and a Stepover distance of 0.25".

The stepdown control is set to 25% of the tool diameter or 0.125" resulting in a total of 7 cut levels. Engage/Retract is set to Path with Angle (A) set to 10 degrees and Height (H) set to 0.05". Arc Fitting is also enabled with a Fitting tolerance (t) of 0.02". Cut Feed: 125 in/min, Spindle Speed: 18,500 RPM, Estimated Machining Time: 8.18 mins. Below on the left we see the part geometry and the resulting 3 Axis Horizontal Roughing toolpath. The resulting cut material simulation is shown on the right.

3 Axis Horizontal Roughing
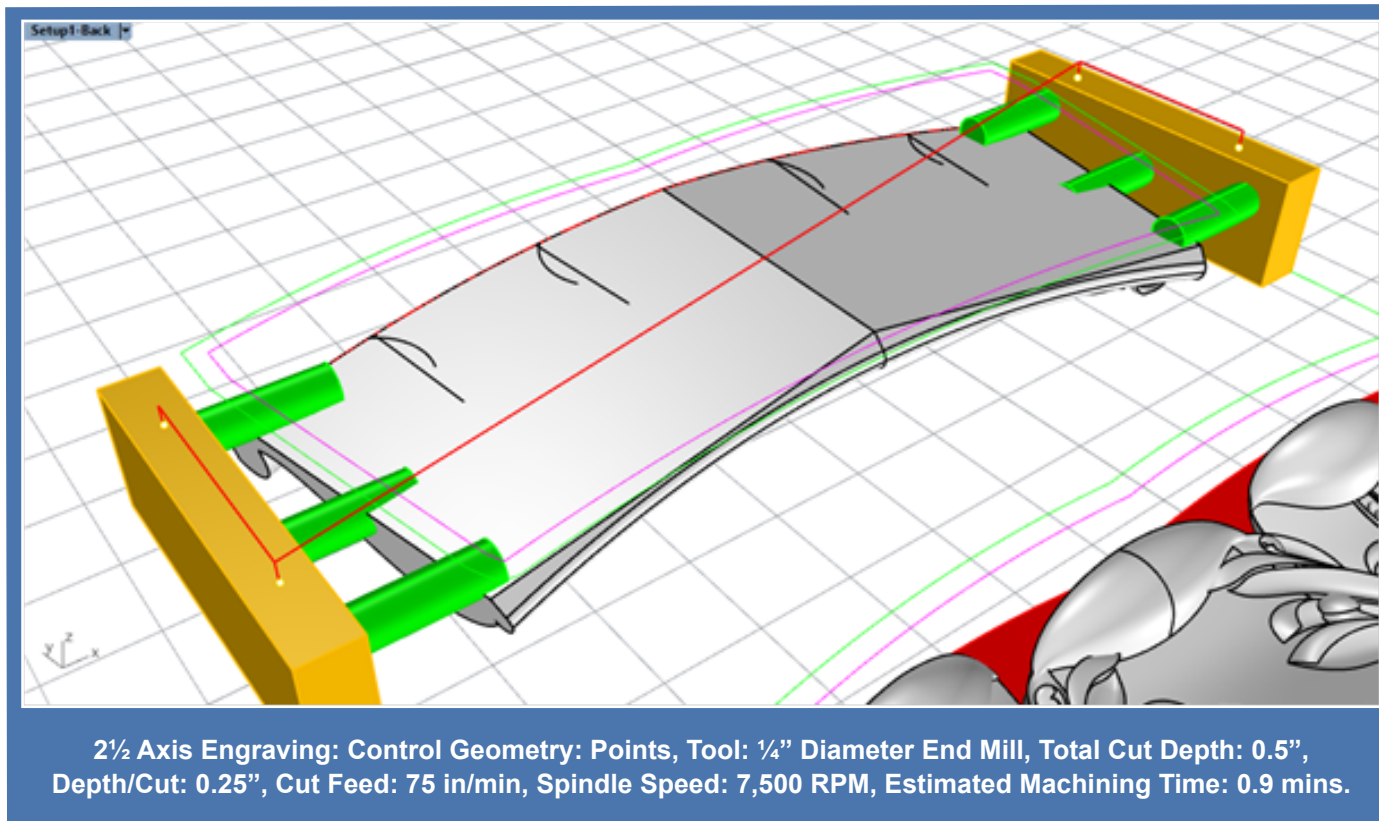

Cut Material Simulation
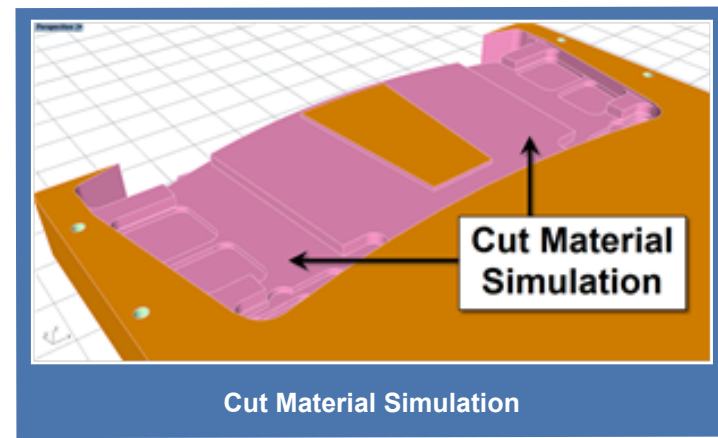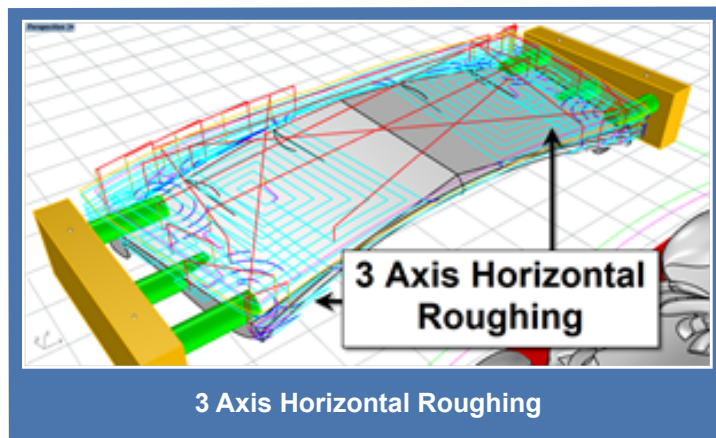
3 Axis Parallel Finishing

A 3 Axis Parallel Finishing operation is used with a ½" diameter flat end mill. Again the operation is contained to the perimeter boundary curve shown in the part model above. Cut Parameters include an Intol/Outtol of 0.001", Stock allowance of 0" a Mixed cut direction, Angle of Cuts is 90 degrees and Stepover Control set to a distance of 0.06".
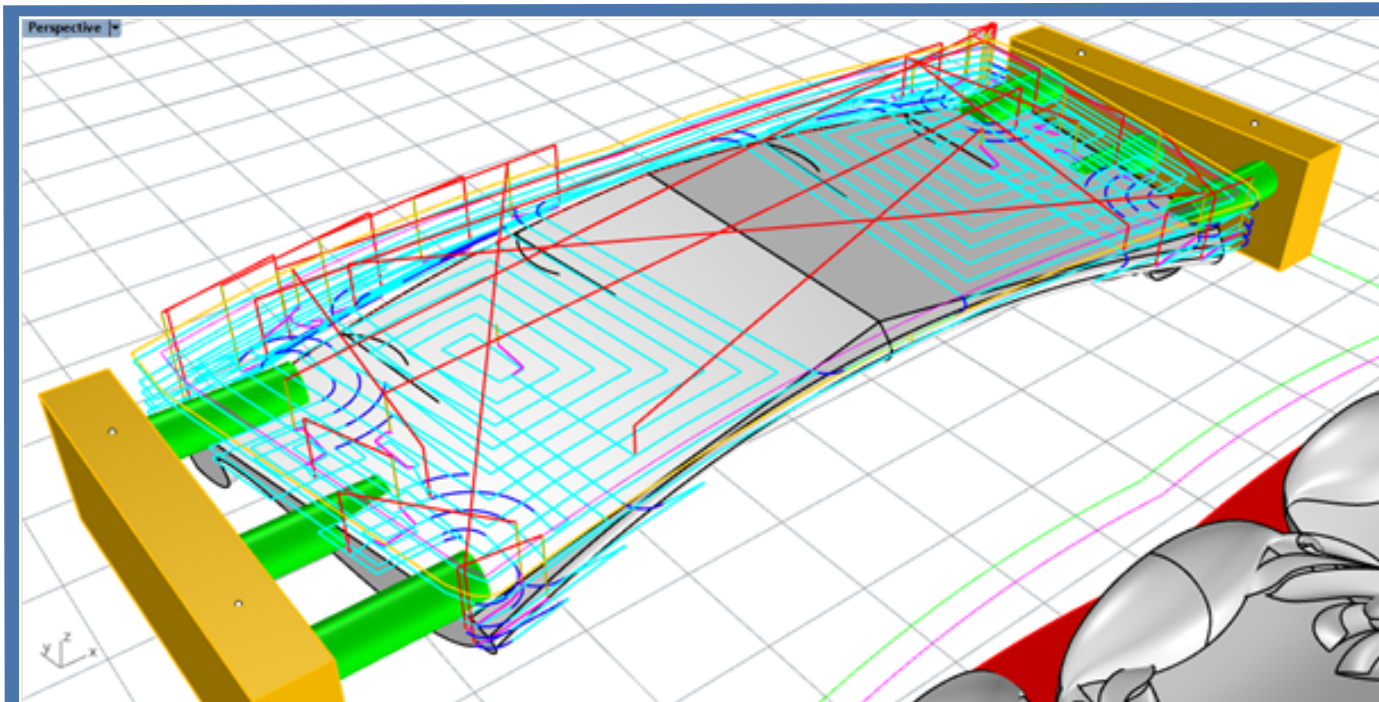
Entry consists of a Linear Engage motion with both Angle (A) and Length (L) set to zero which eliminates the entry motion and forces the tool to plunge directly above the cut start point. The same is true for the Linear Retract Motion. Again, Arc Fitting is enabled with a Fitting tolerance (t) of 0.002". Cut Feed: 175 in/min, Spindle Speed: 18,500 RPM, Estimated Machining Time: 6.39 mins. Below on the left we see the part geometry and the resulting 3 Axis Parallel Finishing toolpath. The resulting cut material simulation is shown on the right.
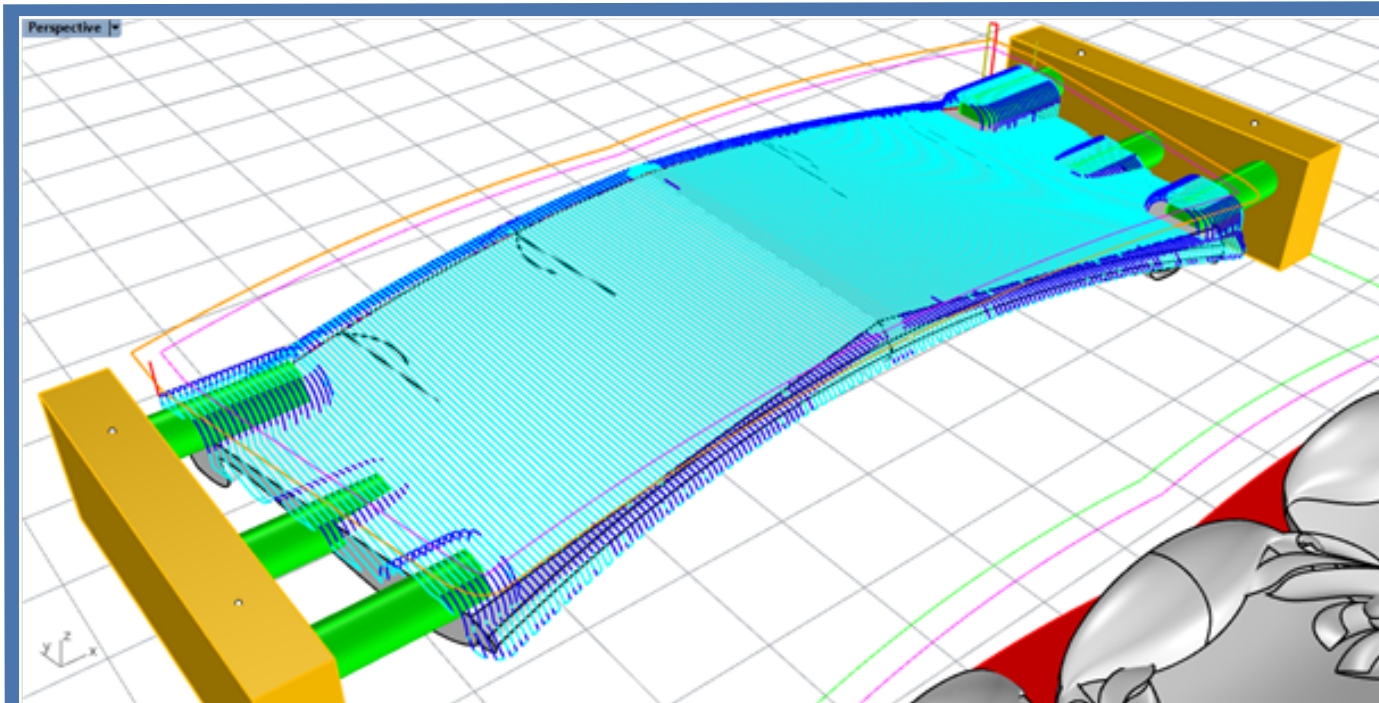

3 Axis Parallel Finishing

Cut Material Simulation
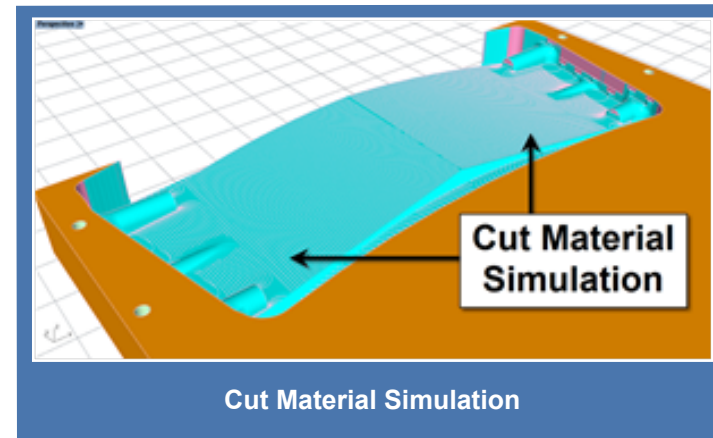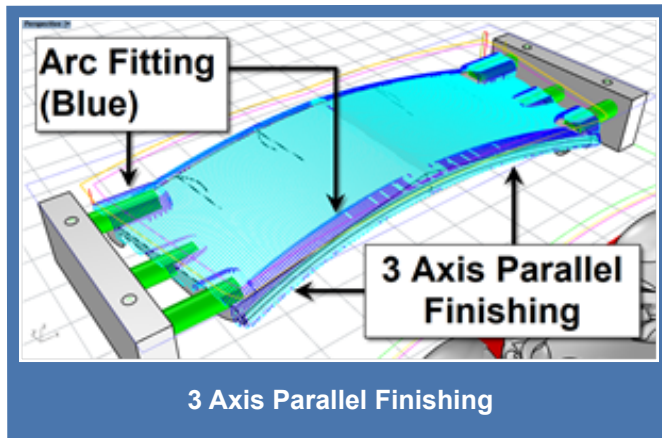
Let's Take a Closer Look

Here is a closer look at each toolpath method illustrated above for the back side.

2½ Axis Engraving: Control Geometry: Points, Tool: ¼" Diameter End Mill, Total Cut Depth: 0.5", Depth/Cut: 0.25", Cut Feed: 75 in/min, Spindle Speed: 7,500 RPM, Estimated Machining Time: 0.9 mins.

3 Axis Horizontal Roughing: Control Geometry: Closed Curve, Tool: ½" Diameter End Mill, Stock: 003, Cut Pattern: Offset, Cut Direction: Mixed, Stepover: 50% (0.25"), Cut Levels: 25% (7 Levels), Engage/ Retract: Path (10 deg x 0.05"), Cut Arc Fitting: Enabled, Arc Fitting Tolerance: 0.002", Cut Feed: 150 in/ min, Spindle Speed: 18,500 RPM, Estimated Machining Time: 8.18 mins.

3 Axis Parallel Finishing: Control Geometry: Closed Curve, Tool: ½" Diameter Flat End Mill, Tolerance: 0.001", Cut Direction: Mixed, Start Side: Bottom, Angle of Cuts: 90, Stepover: 0.06", Entry/Exit: Linear, zero length, Cut Arc Fitting: Enabled, Arc Fitting Tolerance: 0.002", Cut Feed: 170 in/min, Spindle Speed: 18,500 RPM, Estimated Machining Time: 6.39 mins.

Want to see how RhinoCAM can help you? Click Here to download a demo!

MOpSet (Front)

The MOpSet for the Front Side set of operations is shown below. It consists of a total of 3 machining operations, one roughing and two finishing. Each operation is explained and illustrated below.
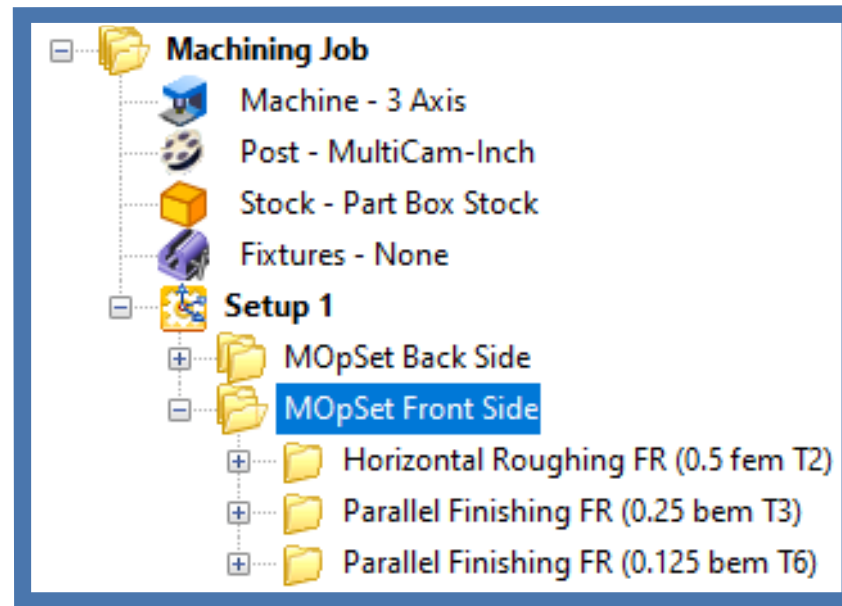
3 Axis Horizontal Roughing

For removing bulk material a 3 Axis Horizontal Roughing operation is used with a ½" diameter end mill cutter. The operation is contained to the closed perimeter boundary curve shown in the part model above. Cut Parameters include an Intol/Outtol of 0.01", Stock allowance of 0.03" an Offset cut pattern for both Cavity/Pocket and Core/Facing regions, a Mixed cut direction, an Inside start point and a Stepover distance of 50% (0.25").

Step Minimization Roughing

This 3 Axis Horizontal Roughing operation includes Step Minimization that allows you to perform a re-roughing operation at the same time. In this case the primary Stepdown Control (dZ) is set to 50% (0.25"). You can then enable the Minimize Stair Steps option that activates an additional field called Intermediate Stepdown % (idZ) that in this case is set 25%. The operation will insert additional cut levels where possible to remove additional stock using the same tool. The step minimization is illustrated in the image below.
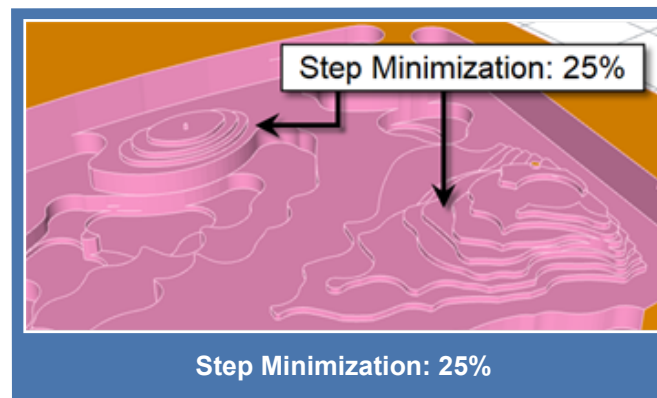

Step Minimization: 25%

Engage/Retract is set to Path with Angle (A) set to 10 degrees and Height (H) set to 0.05". Arc Fitting is also enabled with a Fitting tolerance (t) of 0.02". Cut Feed: 125 in/min, Spindle Speed: 18,500 RPM, Estimated Machining Time: 18.88 mins. Below on the left we see the part geometry and the resulting 3 Axis Horizontal Roughing toolpath. The resulting cut material simulation is shown on the right.

3 Axis Horizontal Roughing

Cut Material Simulation
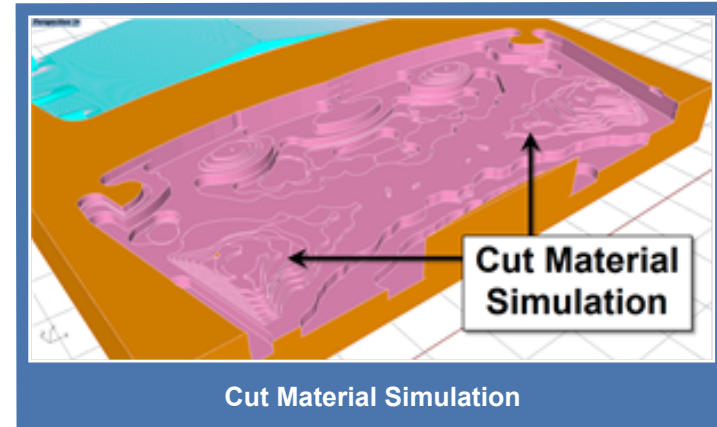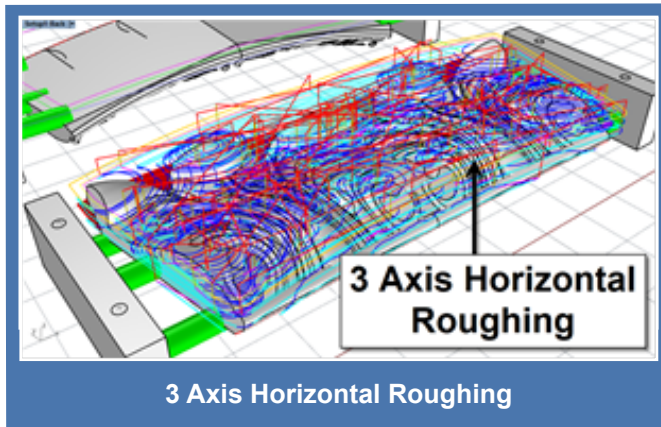
3 Axis Parallel Finishing

For finishing the front side two 3 Axis Parallel Finishing operations are used. They are identical except for the Stepover Control. The first operation is set to a Stepover of 0.03" and the second is set to a Stepover of 0.01". This operation uses a ⅛" diameter ball mill cutter. Again the operations are contained to the closed perimeter boundary curve shown in the part model above. Cut Parameters include an Intol/Outtol of 0.001", Stock allowance of 0" a Mixed cut direction, Angle of Cuts is 90 degrees and Stepover Control set to a distance of 0.03" and 0.01" respectively.

Entry consists of a Linear Engage motion with both Angle (A) and Length (L) set to zero which eliminates the entry motion and forces the tool to plunge directly above the cut start point. The same is true for the Linear Retract Motion. Again, Arc Fitting is enabled with a Fitting tolerance (t) of 0.002". Cut Feed: 150 in/min, Spindle Speed: 18,500 RPM, Estimated Machining Time for both operations is 49.4 mins. Below on the left we see the part geometry and the resulting 3 Axis Parallel Finishing toolpath. The cut material simulation of the 0.01" stepover path is shown on the right.

3 Axis Parallel Finishing
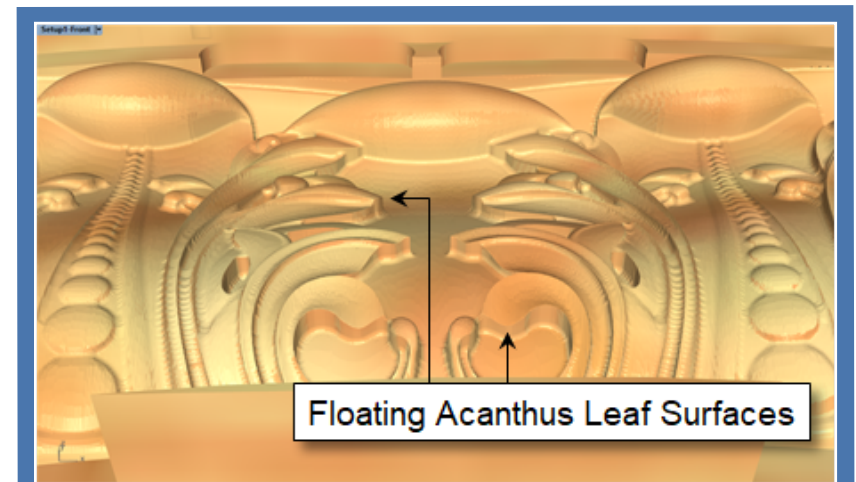

Cut Material Simulation
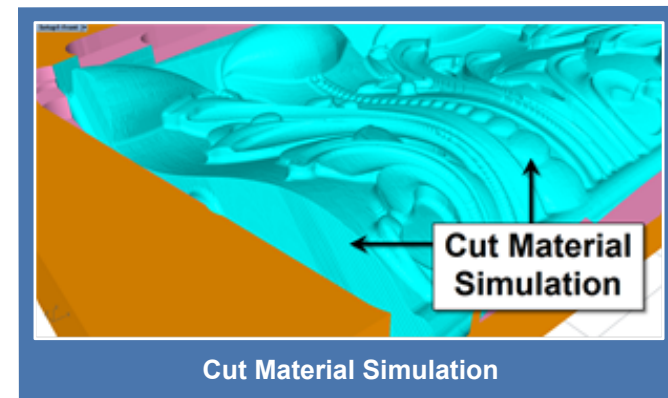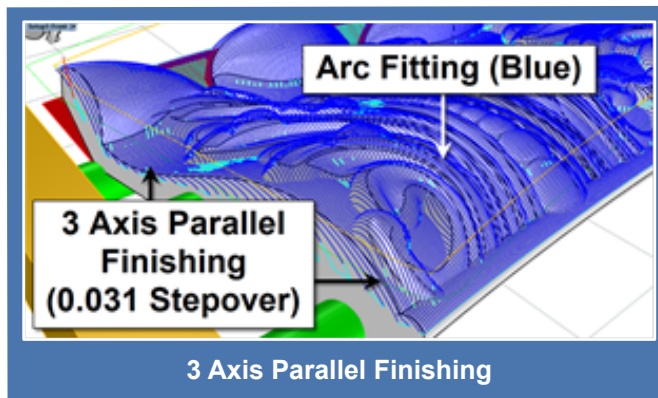
The Effect of Floating Organic Acanthus Leaf Surfaces

We mentioned above that the acanthus leaves are modeled using free floating organic NURBs surfaces, one for each leaf. This organic modeling approach can be seen in the closeup image below of the left. The 3 Axis Parallel Finishing cutter path easily follows the part model dropping where needed from leaf to leaf. On the right we see the corresponding cut material simulation.
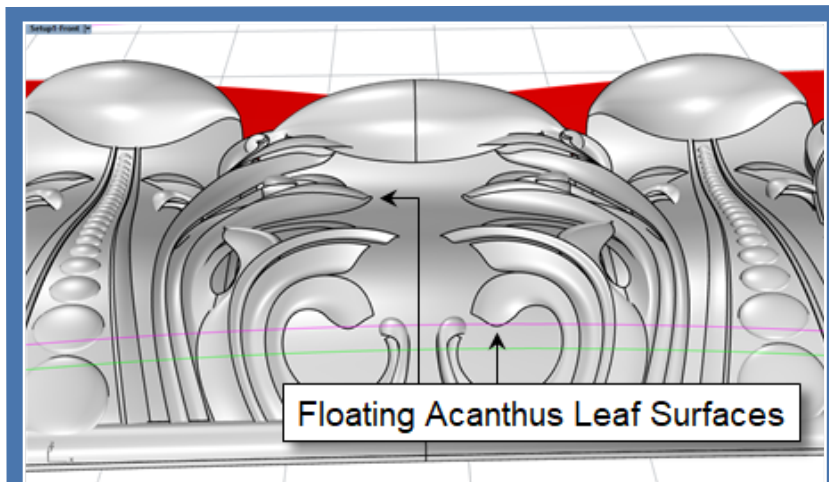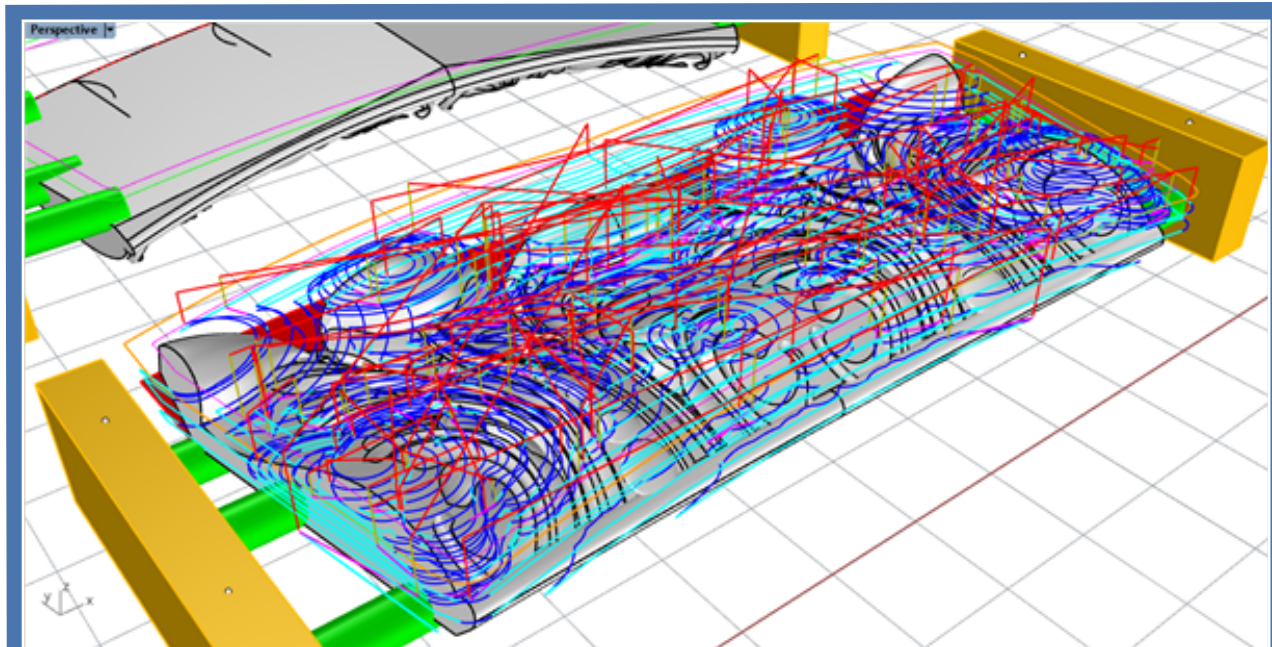

A close up the *floating* acanthus leaves.

**The corresponding cut material simulation
with wood texture applied.**

Let's Take a Closer Look

Here is a closer look at each toolpath method illustrated above.

3 Axis Horizontal Roughing: Tool: ½" Diameter End Mill, Tolerance: 0.001", Stock: 0.03", Cut Pattern: Offset, Cut Direction: Mixed, Stepover: 50% (0.25"), 0.2", Stepdown: 50% (0.25"), Intermediate Stepdown: 25% (0.125"), Cut Levels Ordering: Depth First, Engage/Retract: Path (10 deg x 0.05"), Arc Fitting Tolerance: 0.002", Cut Feed: 150 in/min, Spindle Speed: 18,500 RPM, Estimated Machining Time: 18.88 mins.
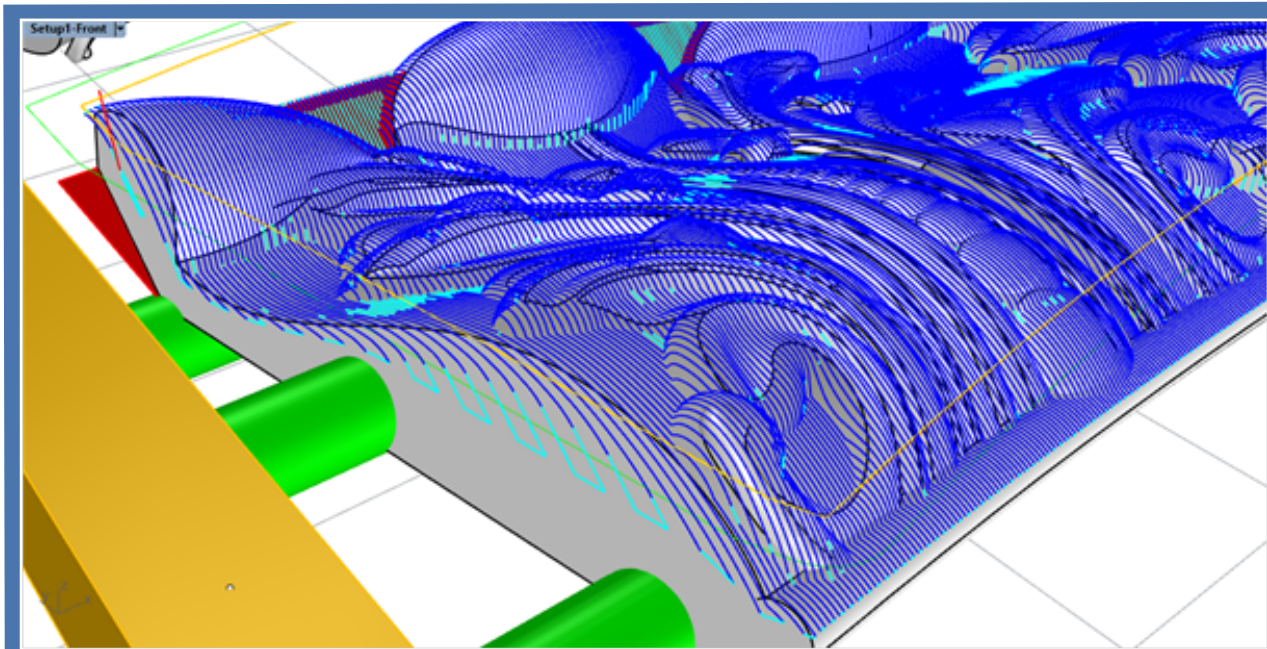
3 Axis Parallel Finishing: Tool: ⅛" Diameter Ball Mill, Stock: 0", Cut Direction: Mixed, Angle of Cuts: 90, Stepover: 0.01", Entry/Exit: Linear, Cut Arc Fitting: Enabled, Arc Fitting Tolerance: 0.002", Cut Feed: 150 in/min, Spindle Speed: 18,500 RPM, Estimated Machining Time (both finishing operations): 49.4 mins.

The Completed Project

Directly below we see an example of a partially completed part. 3 Axis Roughing is shown on the right while 3 Axis finishing is shown on the left with gold leaf appliqué. Below this we see the actual components installed in the client's home.

Finished w/Gold Leaf

3 Axis Roughing

Example in-process stock of curved Acanthus Crown Molding section.

On site completed project showing the curved Acanthus Crown Molding sections installed.

The Iconic Butterfly House

You can see some of Sean's architectural elements as they appear in the iconic northern California *Butterfly House* redesigned by world renowned interior designer Jamie Bush as showcased here in Architectural Digest's 2018 issue. The original 1951 home by architect Frank Wynkoop was so named for the structure's signature winged roof design. Perched atop a rocky coastal outcropping, the residence was one of only a handful of oceanfront properties in the area.

Sean's elements all manufactured from MecSoft Corporation's RhinoCAM toolpaths can be seen in the Kitchen, Lanai Built-Ins (couches, bookcases), Curved Built-In Couches in Great room, Daughters Vanity & Built-In Bed with storage drawers in stairs and play area below, Kevin's Office and the Laundry Room. Have a look at some of the images below.


-- Cool work indeed Sean!! --

The iconic northern California Butterfly House redesigned by famed interior designer Jamie Bush. The original 1951 home by architect Frank Wynkoop was so named for the structure's signature winged roof design.

RhinoCAM Success at Designer Grains, Inc.

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RhinoCAM, MecSoft Corporation
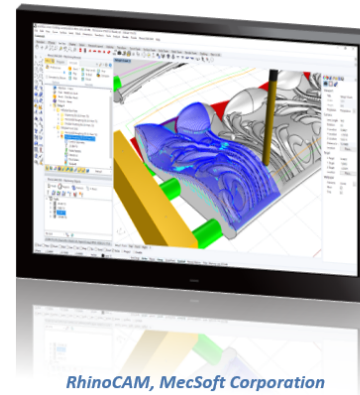
We want to thanks Sean Sinnott of Designer Grains for allowing us to showcase their work!

More about Designer Grains

Established in 1988, Designer Grains Inc., located in Watsonville, CA consists of professionals that draw upon experience in traditional woodworking, cabinet building, CNC milling, door fabrication, software programming, and complex tool path creation to produce the products provided to their clients. It is this cross-functional team's experience that enables them to design and build a variety of custom products that are beautiful, functional and long lasting. For more information about Designer Grains, Inc we invite you to visit them online, on Facebook, on Pinterest and Instagram.

See all of the cool projects completed at [Designer Grains Inc](). with the help of RhinoCAM!

Wine Cellar (Left) and tasting station (Right)

**(Left) Curved powder room vanity and (Right) island with curved elements**

(Left) Misc carved architectural elements (Right) Custom Exterior window casing

More about RhinoCAM Configurations

RhinoCAM - MILL is available in 5 different configurations (Express, Standard, Expert, Professional and Premium). The parts shown here were programmed using the Professional configuration. Here are some additional details about each of the available configurations. For the complete features list, visit the RhinoCAM Product Page.

- **RhinoCAM MILL Express**: This is a general purpose program tailored for hobbyists, makers and students. Ideal for getting started with CAM programming. Includes 2 & 3 axis machining methods. Includes ART & NEST modules as well!

- **RhinoCAM MILL Standard**: This configuration includes everything that is in the Express configuration and additional 2-1/2 Axis, 3 Axis & Drilling machining methods.

- **RhinoCAM MILL Expert**: Suitable for 4 Axis rotary machining. Includes the Standard configuration plus 4 Axis machining strategies, advanced cut material simulation and tool holder collision detection.
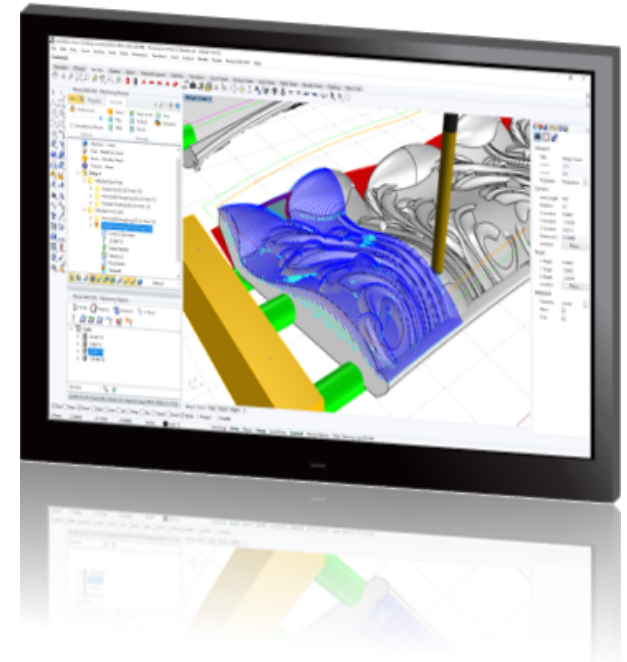
- **RhinoCAM MILL Professional**: Ideal for complex 3D machining. Includes the Standard and Expert configuration plus advanced 3 Axis machining strategies, 5 Axis indexed machining, machine tool simulation, graphical toolpath editing and a host of other features.

- **RhinoCAM MILL Premium**: Tailored for complex 3D machining with both 3 Axis and full 5 Axis methods. Includes the Standard, Expert and Professional configurations plus 5 Axis simultaneous machining strategies.

For the complete features list, we invite you to visit the
RhinoCAM Product Page: mecsoft.com/rhinocam

Try RhinoCAM Today!

Powerful production CAM for Rhino users!

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