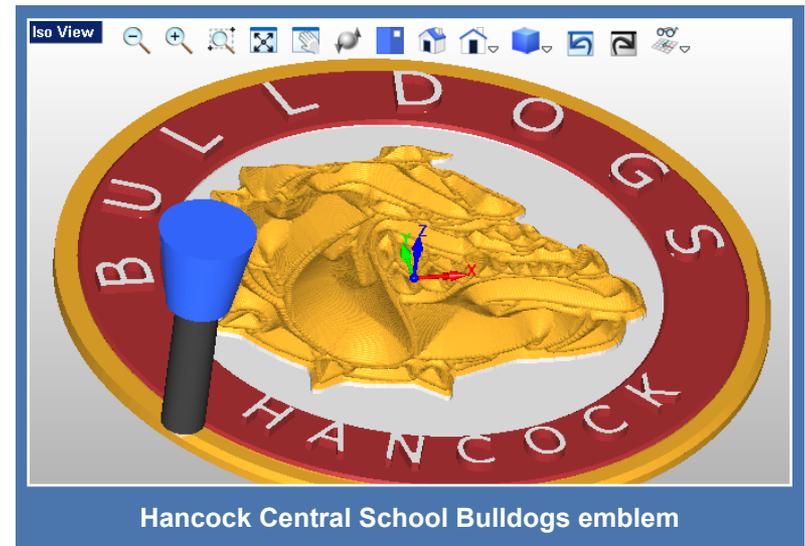


VisualCAD/CAM with the Hancock Central School Bulldogs!

[Hancock Central School](#) (Hancock, MI) is located in Houghton County on the Keweenaw Peninsula of upper Michigan. The HCS Bulldog mascot represents the tenacity of the town's early immigrants who worked the deep shaft mines in the area. Today the high school offers students hands-on woodshop, metalworking, welding and drafting classes. More recently a CNC machining class was added for some of the more advanced junior and senior students.

Doug McIntosh is a retired Surfcam user and toolmaker from Ford Motor Company with 30 years of experience in the trade. Today Doug works with Garry Mishica, the HCS Industrial Arts teacher as a volunteer instructor, introducing CNC machining and the fundamentals of g-code programming to small groups of dedicated HCS students. We recently sat down with Doug to discuss the HCS Bulldogs and to learn how VisualCAD/CAM from MecSoft Corporation is being integrated into the HCS curriculum.



The VisualCAD/CAM Difference

For the past two semesters Doug has been slowly integrating [VisualCAD/CAM from MecSoft Corporation](#) into his class curriculum. Students first learn the basics of programming g-code manually from simple VisualCAD drawings. In the school's upcoming semester Doug will be introducing the VisualCAD/CAM ART and MILL modules into the metal working class. The class boasts a complete foundry where students learn the basics of sand casting molten aluminum. Students can choose from many aluminum casting projects, the HCS Bulldog mascot plaque project and the Nashville Predators® mascot plaque project are illustrated here.



“When looking for a CAM program for Hancock Central School I started off using Fusion 360 but didn’t like it at all. That’s when I downloaded VisualCAD/CAM and really liked it! While at Ford Motor Company I used Surfcam exclusively. Today I find VisualCAD/CAM much easier to draw in and certainly much easier to program toolpaths in than Surfcam!”

*Doug McIntosh, Volunteer Instructor
Hancock Central School, Hancock MI*

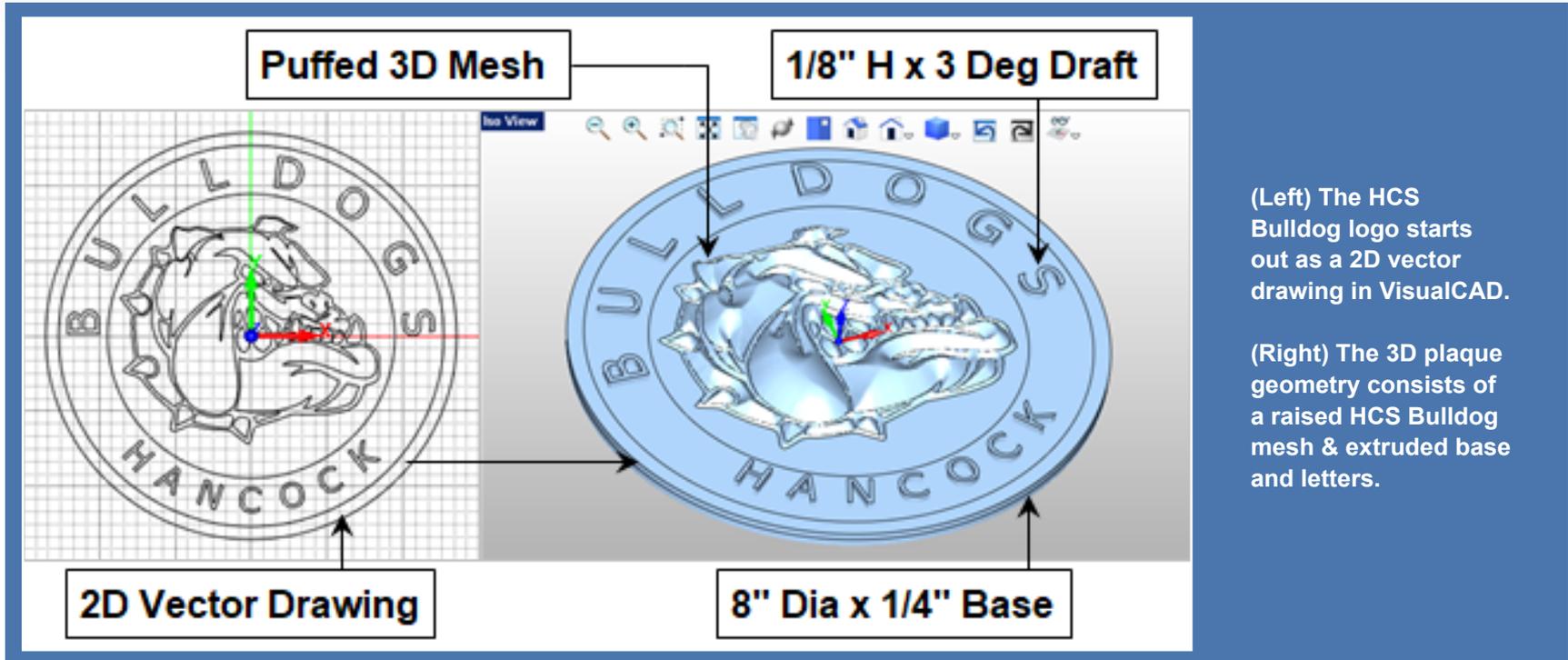
The HCS Bulldog in Sand Cast Aluminum

In this project, a proof of the HCS Bulldog plaque is first machined from cherry wood stock measuring 8" x 8" x 1/2". A positive mold core is then machined from 6061 aluminum. The core is then used to press a hollow cavity into sand that has been treated with a strength bonding agent. The core is then removed leaving a negative cavity. The cavity is then filled with molten aluminum that is left to cool. The base of the 1/2" plaque is the parting line of the casting. [Click here to learn more about the sand casting process.](#)



The CAD Geometry

The CAD geometry for this project includes both 2D and 3D geometry. To begin the process a 2D vector drawing of the HCS Bulldog is created from the mascot image file. This can be done in VisualCAD by loading the picture file as a background image and then drawing border and detail curves over it like a template. 2D lettering and various diameter curves are also added. The resulting 2D drawing is shown below on the left. A 3D cylindrical extruded base and raised letters are also added using VisulCAD commands.

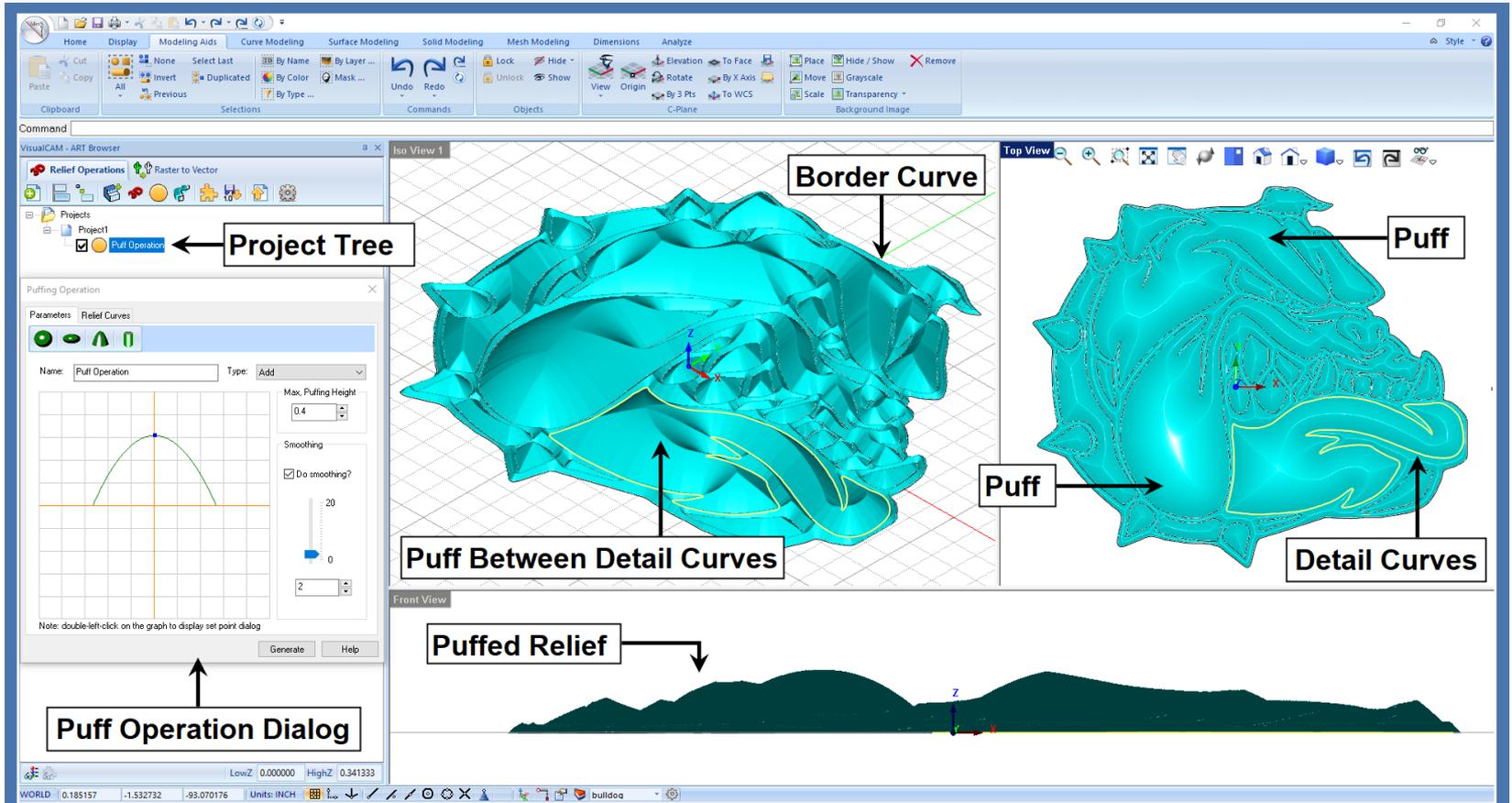


(Left) The HCS Bulldog logo starts out as a 2D vector drawing in VisualCAD.

(Right) The 3D plaque geometry consists of a raised HCS Bulldog mesh & extruded base and letters.

Raising the HCS Bulldog in VisualART

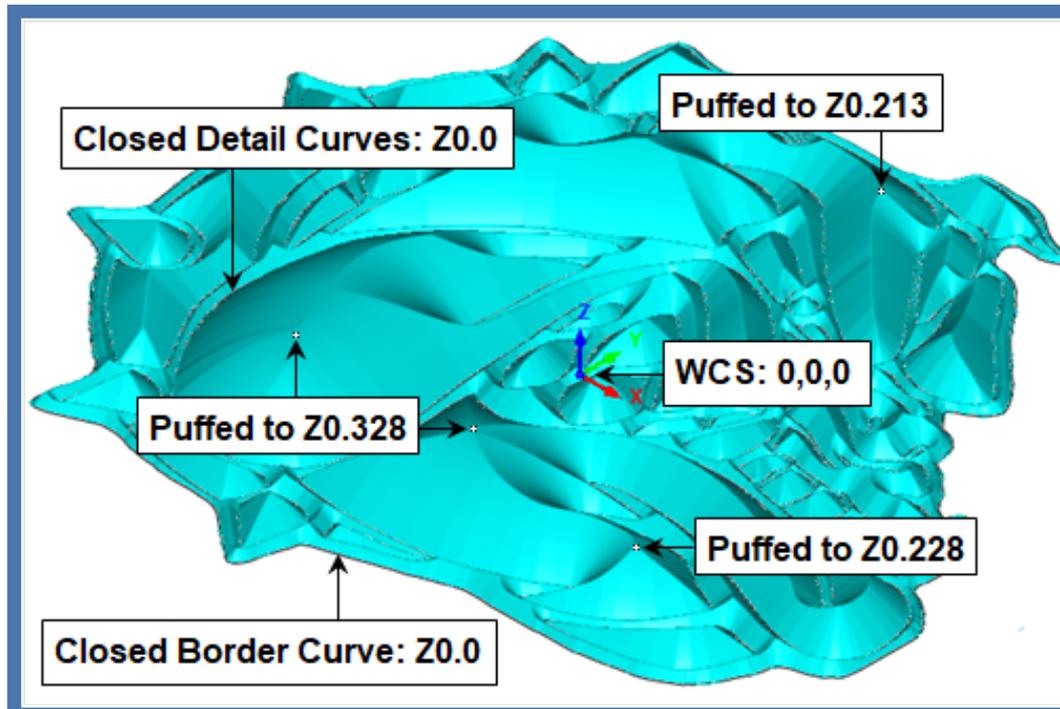
The raised 3-dimensional mesh representation of the HCS Bulldog is created in [VisualCAD/CAM-ART](#) (also called VisualART), a free module that is included in MecSoft's [VisualCAD/CAM](#) and [RhinoCAM](#) products. Using VisualART the 2D drawing (shown above on the left) is transformed into a raised 3D mesh.



The raised relief of the HCS Bulldog is shown in the VisualCAD/CAM-ART module (VisualART). The Puff operation in VisualART uses the existing 2D geometry to create the raised relief and converts it into a polygonal mesh.



The [VisualART module](#) with the puffed Bulldog operation is shown in the display image above. On the left we see the ART Browser with the Project tree and the Puff Operation listed. Also on the left we see the Puffing Operation dialog. The Parameters tab of the dialog allows you to set the Puff Type, Height and Smoothing controls. The Relief Curves tab allows you to specify the perimeter Border Curves as well as the interior Detail Curves used in the puffing operation.

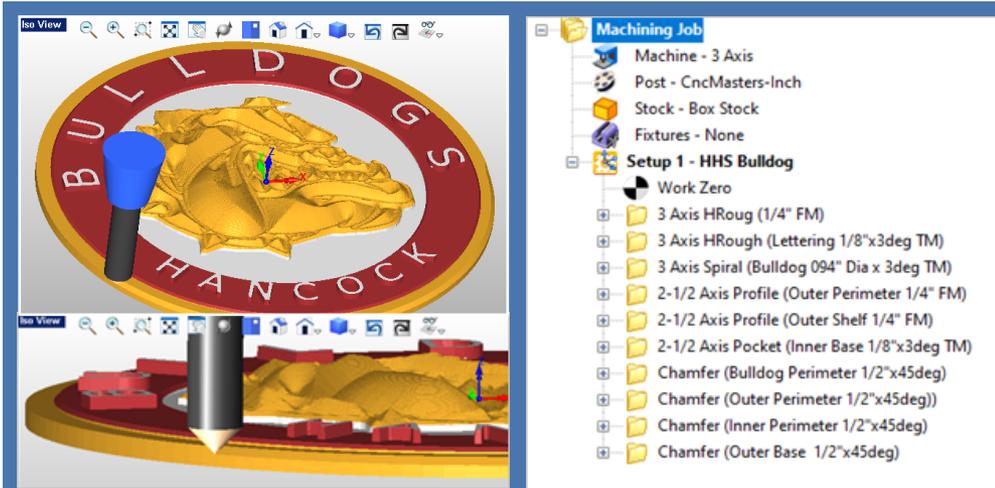


In this enlarged image we see the resulting 3D mesh geometry created from 2-dimensional curves in VisualART. The 2D curves are located at the base of the HCS Bulldog on the XY plane at Z zero. The puffed volumes are raised to a maximum of 0.4" above Z zero.

A closeup of the Puffing operation is shown above. All border and detail curves lie on the XY plane. During the Puffing operation, the space between each detail curve is given a volume and raised (i.e., puffed) upward in the positive Z direction. The greatest distance between detail curves is raised to the full Height specified for the operation.

The HCS Bulldog MILL Setup

Once all 2D and 3D geometry is created you can proceed to the MILL module where toolpaths are created and the G-Code posted that will run the CNC machine at Hancock Central School. In the left side image below we see the resulting cut material simulation of all toolpaths in the HCS Bulldog Machining Job. On the right we see the Machining Job tree with each toolpath strategy listed in the order it is performed. The Work Zero (i.e., machine zero) is located at the top center of the stock geometry.



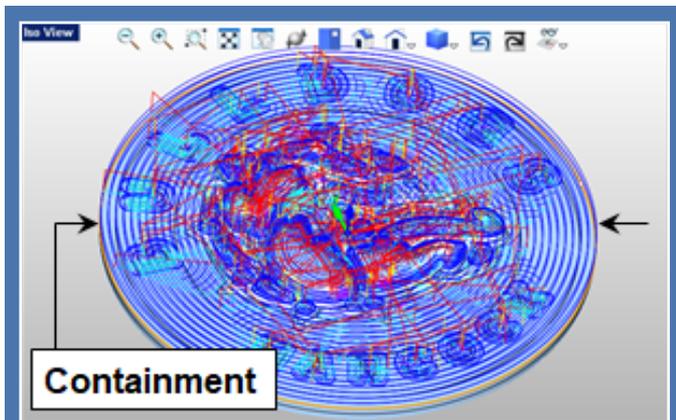
The HCS Bulldog plaque is shown in the MILL module Cut Material Simulation window.

The HCS Bulldog machining job lists the toolpath strategies used for this setup.

- Machining Job
 - Machine - 3 Axis
 - Post - CncMasters-Inch
 - Stock - Box Stock
 - Fixtures - None
 - Setup 1 - HHS Bulldog
 - Work Zero
 - 3 Axis HRoug (1/4" FM)
 - 3 Axis HRough (Lettering 1/8"x3deg TM)
 - 3 Axis Spiral (Bulldog 094" Dia x 3deg TM)
 - 2-1/2 Axis Profile (Outer Perimeter 1/4" FM)
 - 2-1/2 Axis Profile (Outer Shelf 1/4" FM)
 - 2-1/2 Axis Pocket (Inner Base 1/8"x3deg TM)
 - Chamfer (Bulldog Perimeter 1/2"x45deg)
 - Chamfer (Outer Perimeter 1/2"x45deg))
 - Chamfer (Inner Perimeter 1/2"x45deg)
 - Chamfer (Outer Base 1/2"x45deg)

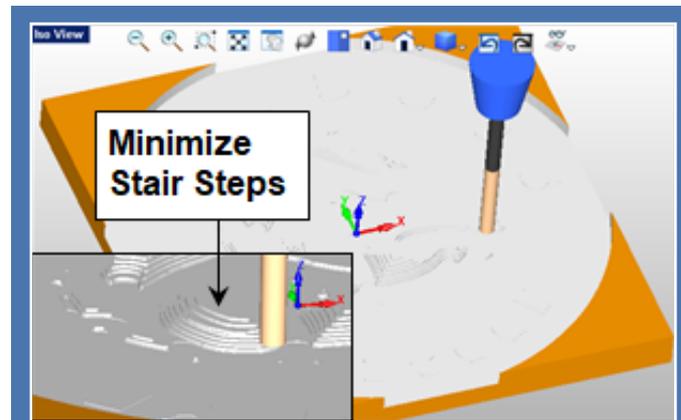
Rough & Finish Toolpaths (3 Axis)

The machining job begins with two 3 Axis Horizontal Roughing toolpath strategies to remove excess material. The first removes material from the top of the stock down to the top of the lettering using a ¼" diameter flat end mill. This toolpath is contained to the outer perimeter diameter of the base of the plaque. Step Minimization is enabled allowing the single toolpath to serve as both a roughing and then a re-roughing operation. The toolpath and cut material simulation is shown below.



(A)

The 3 Axis Horizontal Roughing toolpath is displayed and is contained to the diameter of the base.



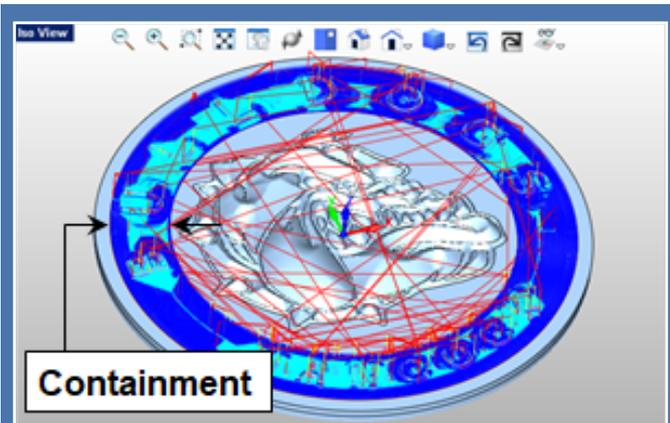
(B)

The cut material simulation for the 3 Axis Horizontal Roughing toolpath is shown in multiple cut levels.

The second 3 Axis Horizontal Roughing toolpath begins at the top of the lettering and ends at the bottom of the lettering and uses a 1/8" diameter x 3 degree taper or "Vee" mill. The toolpath is also contained between two concentric 2D circles that lie on the XY plane. Refer to [The CAD Geometry](#) section above for the location of the geometry. Each letter is located between these two concentric circles. This operation removes a total of 1/8" of material in Z. With a stock allowance of zero, this is considered the finishing operation for the lettering.

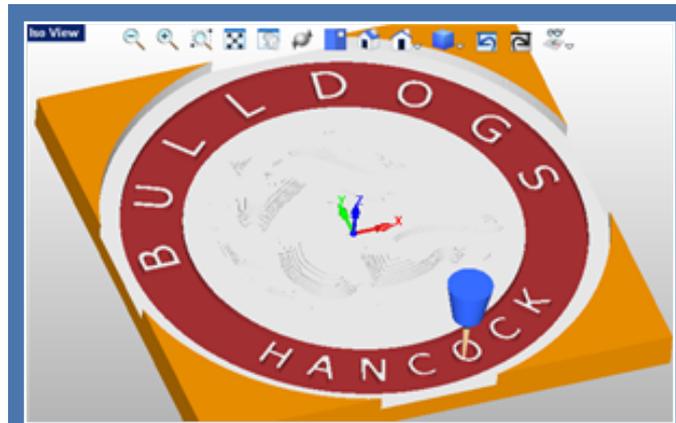


This project is illustrated using the VisualCAD/CAM Standard configuration. In the Professional configuration this second Roughing toolpath can be replaced with the 3 Axis Horizontal Re-Roughing toolpath that calculates the required stock to remove from the previous cut material simulation, saving machining time.



(A)

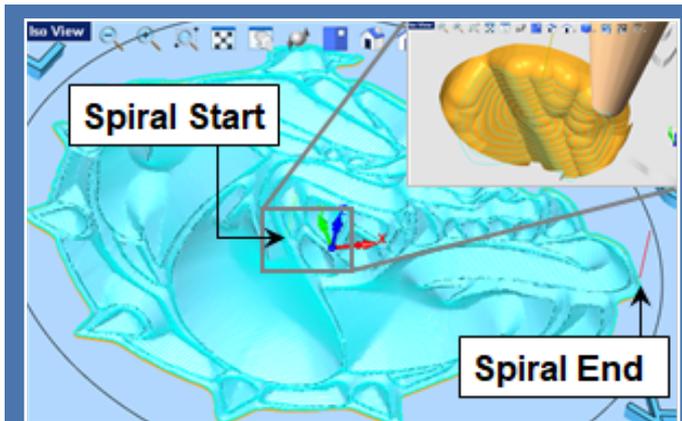
The second Horizontal Roughing toolpath is contained between two concentric circles that lie on the XY plane.



(B)

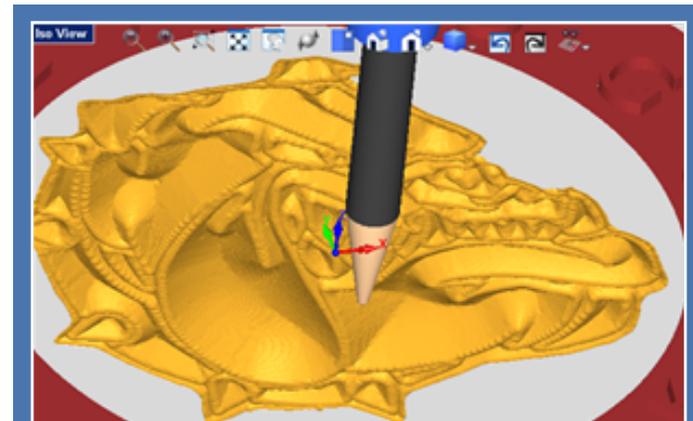
The cut material simulation for the second Roughing operation is shown in Red. The first Roughing operation is shown in White.

The third operation in the Machining Job is referred to as 3 Axis Spiral Machining. It is one continuous toolpath motion that begins at the center of the Bulldog and spirals outward by an offset distance that is 50% of the cutting tool diameter. The outer perimeter curve of the Bulldog is used as containment for this operation. The cutting path is shown in the left side image below. The resulting cut material simulation is shown on the right.



(C)

The 3D Bulldog mesh is machined using a 3 Axis continuous Spiral toolpath.

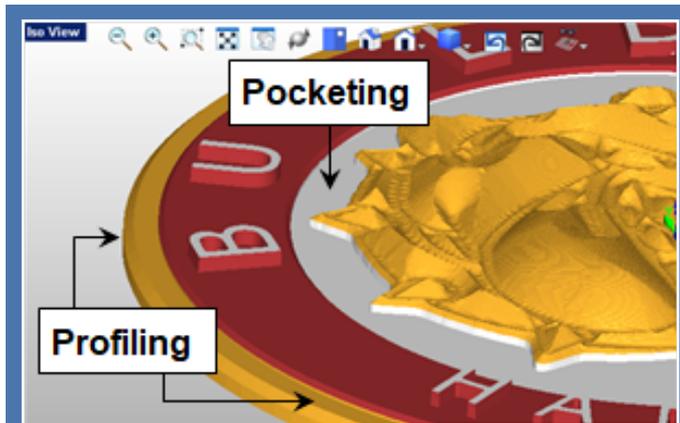


(D)

The cut material simulation for the 3 Axis Spiral Finishing toolpath is shown.

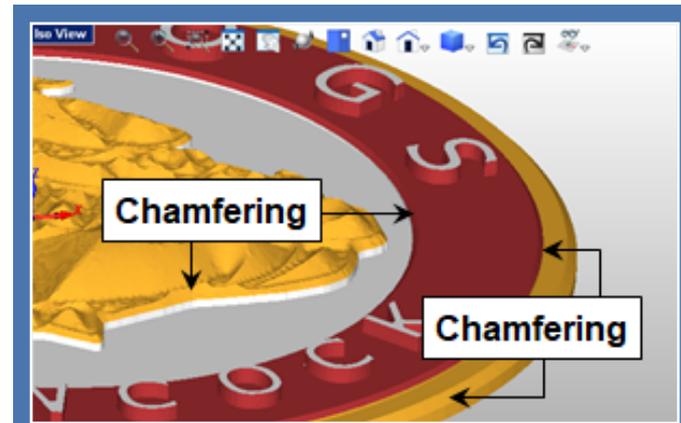
Detailing Toolpaths (2½ Axis)

The remaining toolpaths in the Machining Job tree consists of 2½ Axis Profiling, Pocketing and Chamfering operations. The first Profile cuts the outer perimeter in two levels. The second Profile cuts the outer shelf in one level and two stepover passes. The Pocketing operation cuts between the outer perimeter of the Bulldog and the inner circle perimeter of the lettering. The last four operations in the Machining Job tree are 45 degree Chamfer toolpaths. These include the upper outer perimeter, the inner and outer lettering diameters and the outer perimeter of the Bulldog. These detailing operations are shown in the images below.



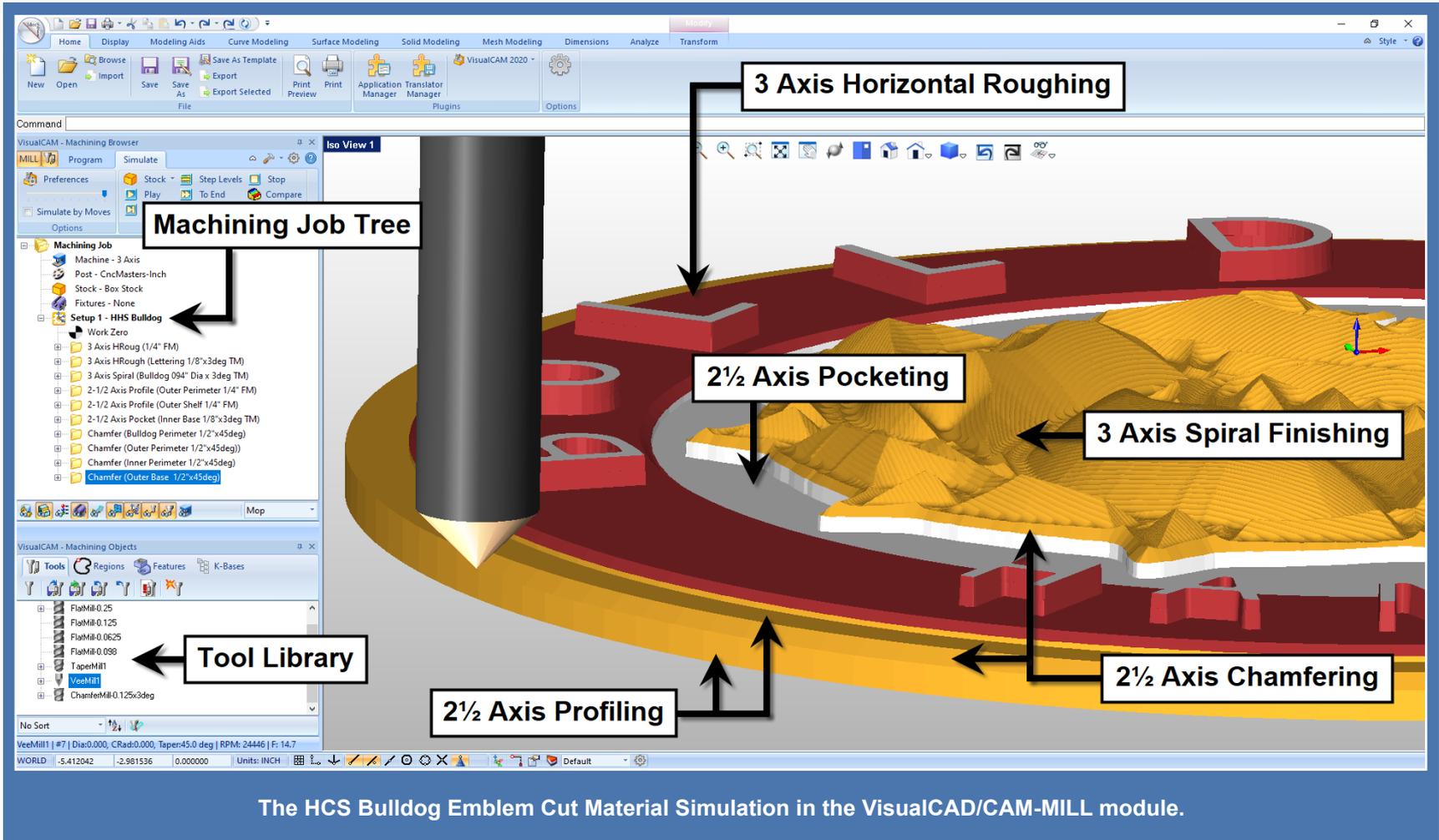
(A)

2½ Axis Profiling and Pocketing toolpath operations are used for finish detailing.



(B)

2½ Axis by 45 degree Chamfer operations are used to detail break the sharp edges shown.



3 Axis Horizontal Roughing

Machining Job Tree

- Machining Job
 - Machine - 3 Axis
 - Post - CncMasters-Inch
 - Stock - Box Stock
 - Fixtures - None
 - Setup 1 - HHS Bulldog
 - Work Zero
 - 3 Axis HRough (1/4" FM)
 - 3 Axis HRough (Lettering 1/8"x3deg TM)
 - 3 Axis Spiral (Bulldog 094" Dia x 3deg TM)
 - 2-1/2 Axis Profile (Outer Perimeter 1/4" FM)
 - 2-1/2 Axis Profile (Outer Shelf 1/4" FM)
 - 2-1/2 Axis Pocket (Inner Base 1/8"x3deg TM)
 - Chamfer (Bulldog Perimeter 1/2"x45deg)
 - Chamfer (Outer Perimeter 1/2"x45deg)
 - Chamfer (Inner Perimeter 1/2"x45deg)
 - Chamfer (Outer Base 1/2"x45deg)

2 1/2 Axis Pocketing

3 Axis Spiral Finishing

2 1/2 Axis Chamfering

2 1/2 Axis Profiling

Tool Library

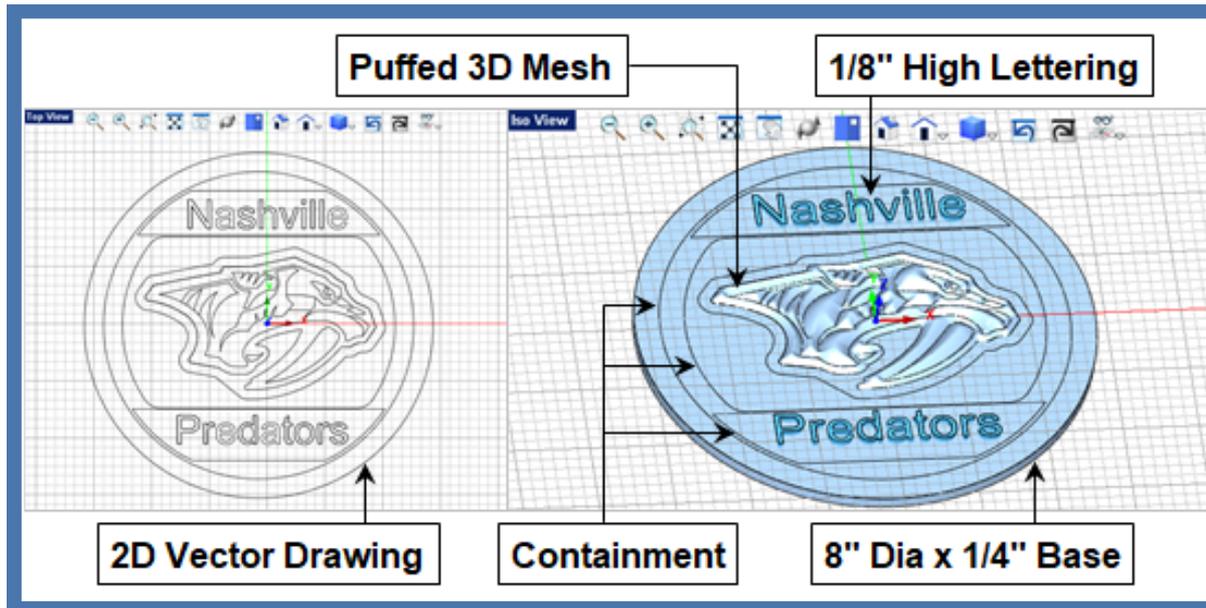
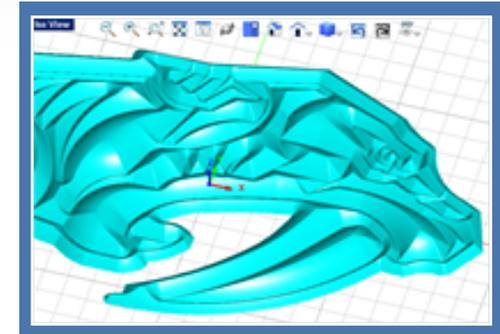
- FlaMil#0.25
- FlaMil#0.125
- FlaMil#0.0625
- FlaMil#0.030
- TaperMill
- VeeMill
- ChamferMil#0.125x3deg

The HCS Bulldog Emblem Cut Material Simulation in the VisualCAD/CAM-MILL module.

Want to see how VisualCAD/CAM can help you? [Click Here](#) to download a demo!

The Predators® in Sand Cast Aluminum

Similar to the HCS Bulldog plaque, this project begins with a [VisualCAD](#) drawing representing the Predators® outline and detail curves as well as additional perimeter and containment curves. This geometry is shown in the left side image below. All are 2D curves that lie at Z0 on the XY plane. The Predators® border and details curves were then “Puffed” up to create a 3D mesh in [VisualART](#). The additional extruded diameter base and raised lettering were modeled in [VisualCAD](#).



The Predators® emblem starts out as the 2D vector drawing in VisualCAD shown on the left. The ART module Puff operation is used to create the raised Predators® 3D mesh shown on the right. The remainder of the geometry consists of extrusions for the raised lettering and circular base.

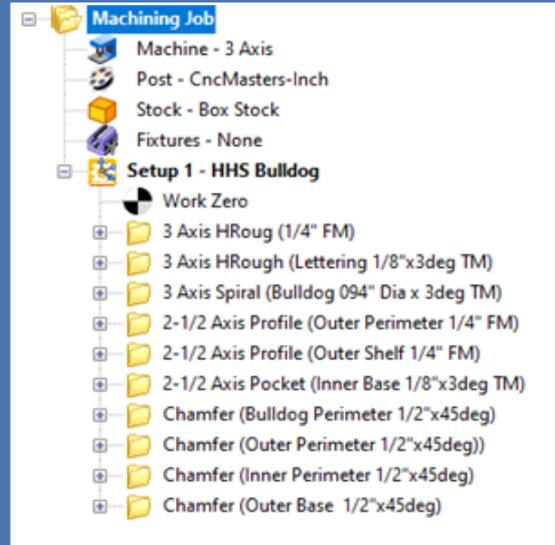
Similar to the HCS Bulldog, the Machining Job tree and resulting cut material simulations are shown below. Beginning with a 8" x 8" x 1/2" stock material, 3 Axis Horizontal Roughing, 3 Axis Parallel Finishing and 2 1/2 Axis Profiling and Chamfering toolpath strategies are used. The Work Zero (i.e., machine zero) is located at the top center of the stock geometry. Again, the emblem is first cut in cherry wood as a proof of concept. It is then cut in aluminum. The aluminum emblem is then used to impress a cavity into the treated casting sand. This cavity is then poured with molten aluminum.



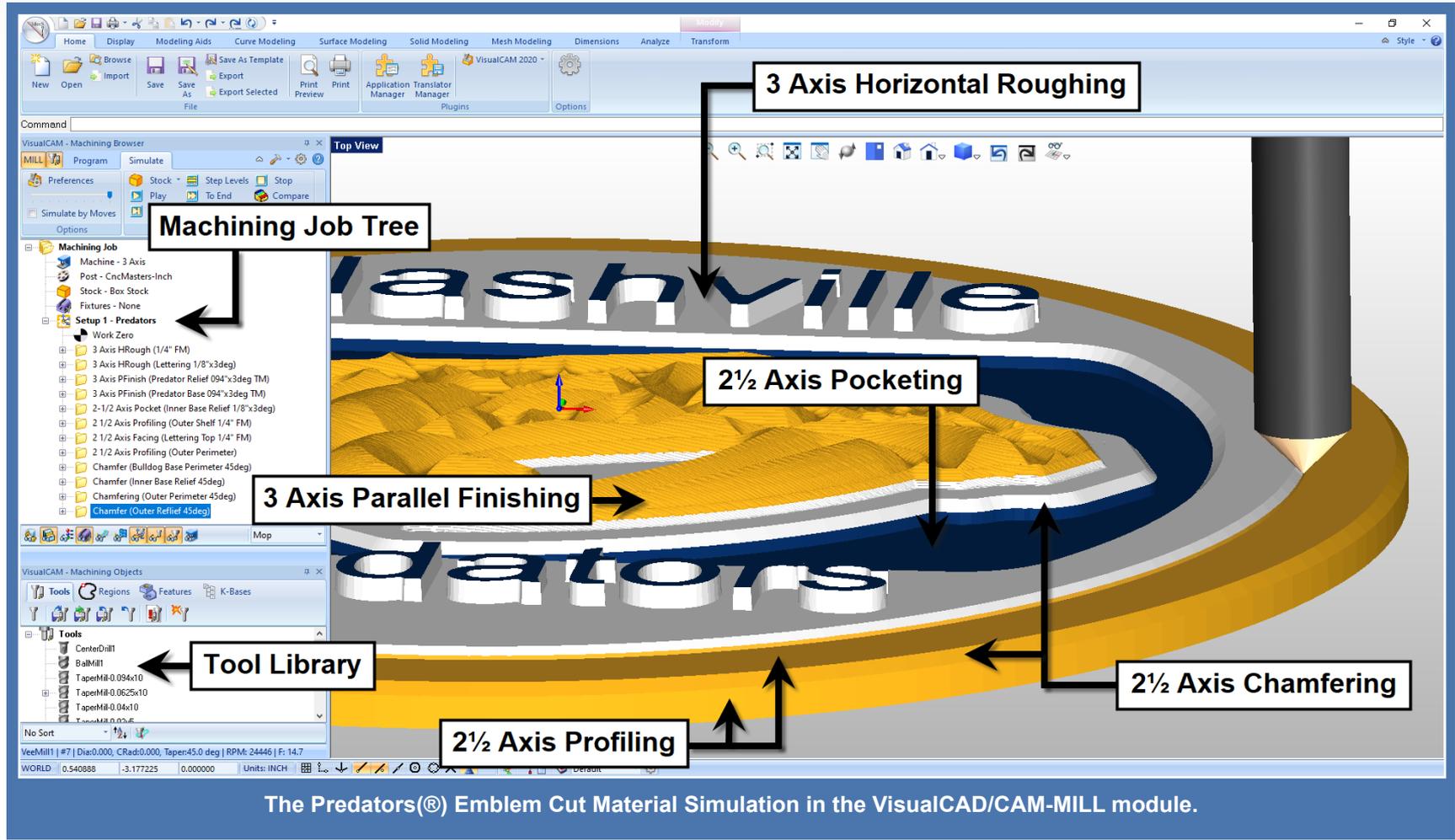
You may be wondering how the custom coloring was applied to the cut material simulations shown in this case study. From the Machining Job tree, right-click on an operation and select Properties to assign a color to that operation. Then from the bottom right corner of the Simulate tab set the Simulation Display State dropdown menu to MOp and then simulate the entire Machining Job.



The resulting cut material simulation of all toolpath strategies in Setup 1 for the Predators® casted core.



The Machining Job tree for the casted core consists of 2 1/2 Axis and 3 Axis toolpath strategies.



3 Axis Horizontal Roughing

Machining Job Tree

2 1/2 Axis Pocketing

3 Axis Parallel Finishing

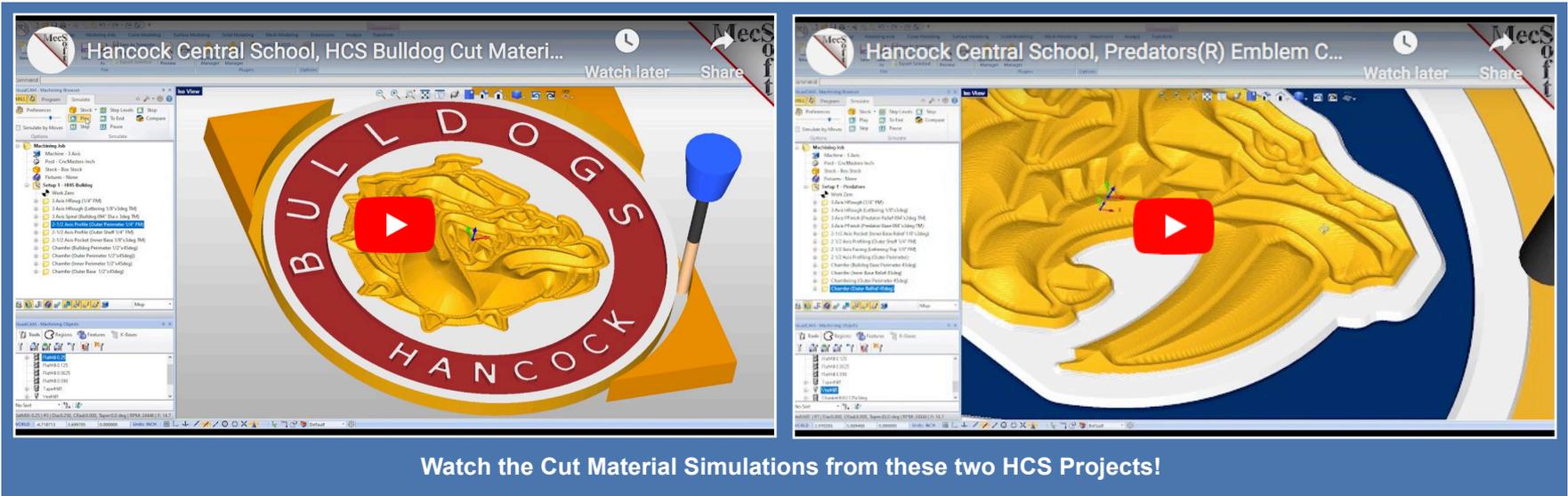
2 1/2 Axis Chamfering

2 1/2 Axis Profiling

Tool Library

The Predator's[®] Emblem Cut Material Simulation in the VisualCAD/CAM-MILL module.

Want to see how VisualCAD/CAM can help you? [Click Here](#) to download a demo!



More about Hancock Central School

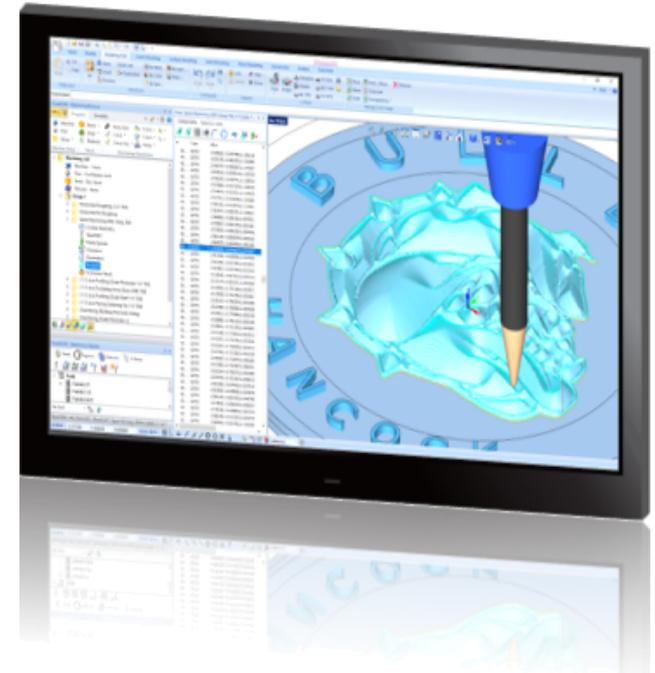


[Hancock is a city in Houghton County in the U.S. state of Michigan.](#) It is located across the Keweenaw Waterway from the city of Houghton on the Keweenaw Peninsula. The city has been consistently ranked as the third-snowiest city in the United States. The [Hancock Public Schools](#) was created to serve the descendants of the hardworking immigrants who worked the mines in the area. The Bulldog pride in the Hancock community stems from the values of this diverse community. To learn more about Hancock Central School we invite you to [visit them online here.](#)

More about VisualCAD/CAM

VisualCAD/CAM is available in five different configurations (Express, Standard, Expert, Professional and Premium). The part shown here was programmed using the Standard configuration. Here are some additional details about each of the available configurations. For the complete features list, visit the [VisualCAD/CAM Product Page](#).

- **VisualCAD/CAM 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!
- **VisualCAD/CAM MILL Standard:** This configuration includes everything that is in the Express configuration plus additional 2-1/2 Axis, 3 Axis & Drilling machining methods. Also now includes 2½ Axis Turning!
- **VisualCAD/CAM 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.



- **VisualCAD/CAM 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.
- **VisualCAD/CAM 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.

Try VisualCAD/CAM Today!

Powerful 2½ - 5 Axis machining capability on your desktop!

Follow MecSoft Corporation Online at:



18019 Sky Park Circle, Suite KL | Irvine, CA – 92614 | www.mecsoft.com | 949-654-8163

Want to see how VisualCAD/CAM can help you? [Click Here](#) to download a demo!