

BUILD-IT

Cast Corn Sheller



This project is a low-cost device for removing corn kernels from the cob. It is cast in aluminum using a casting pattern made on the 3-D printer. This project is inspired by a plastic corn sheller from Malawi and a cast aluminum sheller from Ghana. In order to make it you will need to make a solid model of the part and print it on the 3-D printer. You will use this as a casting pattern to make a cast aluminum sheller. To make it, you will learn to use the 3-D printer, sand blaster and various hand tools.

Materials Needed

ABS and support material
for 3D Printer
Casting Flask
Sand
Aluminum

Tools/Machines Needed

Induction Furnace
3-D Printer
Solidworks Modeling Program
Sand Blaster
Hack Saw
File
Ruler
Calipers

Session 1

Edgerton Student Shop, 44-023

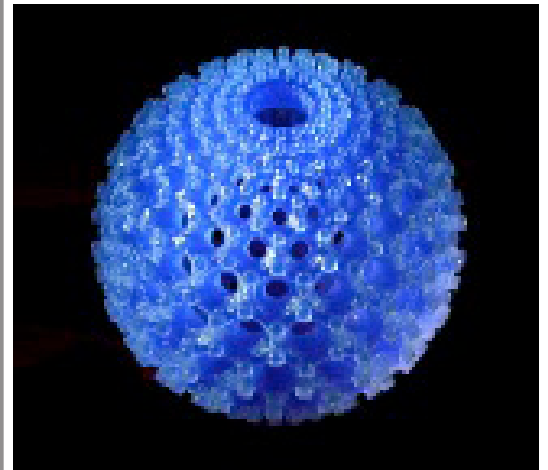
MechE Cluster, 3-462

3-D printers make three-dimensional parts by depositing material one layer at a time. Since each layer is put down independently of previous layers, it allows you to make very complicated parts with great ease.

Different types of 3-D printers use different materials for making the parts. The 3-D printer at the Edgerton Shop uses ABS (acrylonitrile butadiene styrene) which is a tough plastic and therefore the parts it produces can actually be functional. However there are some limitations on the level of detail that you can produce, furthermore the parts are not as strong as if they were printed from solid ABS. Other 3-D printers print starch, which produces parts that are more fragile, but have greater detail. We will be making a 3-D printed version of the corn sheller to use it as a casting pattern for an aluminum corn sheller.

Printing the sheller

A tutorial for making the SolidWorks model of the sheller can be found at the end of this handout. The tutorial instructs you in making a basic sheller you may also add ridges or other features to the outside surface of the sheller. The model should be completed before class so that it can be printed during class. You will need to sand the surface of the part to make it smooth so that the sand won't stick to it while making the mold for the casting. Sand paper is available in D-Lab.



Examples of objects made with a 3D printer.

Session 2

Foundry, 8-014

Sand cast parts are made by packing sand around a pattern, removing the pattern to form a cavity in the sand and then pouring molten metal into the cavity. The sand has been mixed with additives such as clay so that it retains the shape of the pattern. After the metal has cooled, the part can be removed.

Forming the cavity and pouring the metal

We will form the cavity in two parts, pressing the outside surface into one box of sand, and build up the inside surface on the other. Then we will join the two halves together. The molten metal can then be poured into the mold.



Molds for sandcasting a corn sheller at Suame Magazine, Ghana, Africa.

Session 3

Finishing the sheller

The excess metal from where the metal was poured in (the sprue) should be cut off, as should any metal that leaked out from the pattern cavity (the flash). In addition, the part can be sand blasted to give it a nice finish.



Pouring molten metal into the molds.



A cast corn sheller with sprues attached.

Solidworks Tutorial

by Jessica Leon, updated by Mike Kozlowski, February 2010

SolidWorks is installed on MechE computer clusters in the following labs: Ralph Cross Lab, der Torossian Lab, Ralph Cross Lounge, Papallardo Lab, Mechatronics Lab, AMP Lab. If you have never logged onto a computer in the ME system, use your Athena username as the username and your student ID as the password. You will be prompted to change your password after you first log on. Make sure you log onto ME and not the local computer.

Alternatively, you can install SolidWorks to your personal computer; go to (certificates required):

<https://web.mit.edu/mecheng/computing/Software/SW2007-8/>

and click NO and proceed to follow the instructions there.

Background Reading

Read through the tutorial on the 2.007 website: http://pergatory.mit.edu/2.007/index_2008.html Click on **Solidworks Training (zip)** under the **Resources** tab

Starting Solidworks

Open Solidworks 2007 SP5.0 by going to:

Start > All Documents > Solidworks 2007 SP5.0 > Solidworks 2007

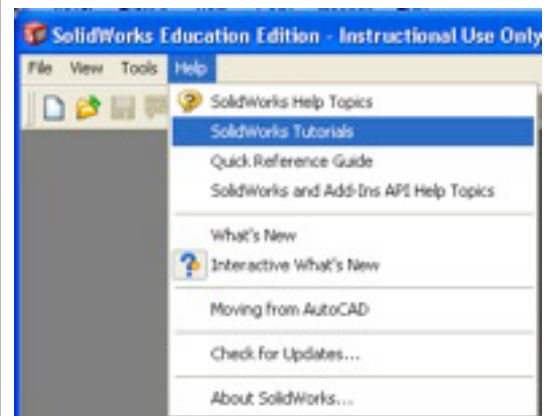
Start a new document by clicking on the new document button or **File > New Document**. In the menu click on **New Part – a 3D representation of a single design component**. Run through the Solidworks Tutorial lessons 1 and 2 to practice making simple objects and assemblies.



MIT computer cluster.



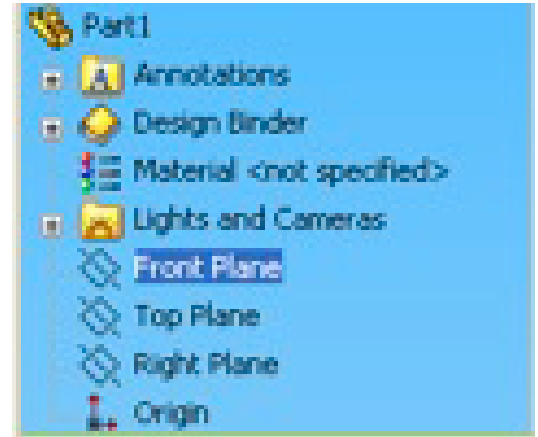
Dimension 3D printers.



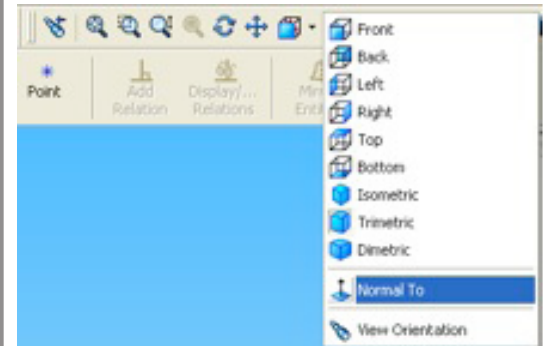
Making the Solid Model of the Sheller

Chose a plane to draw your object on

- Click on **Front Plane** in the left side tool bar, then **Sketch** in the toolbar.



- It helps if you draw while **Normal To** the plane



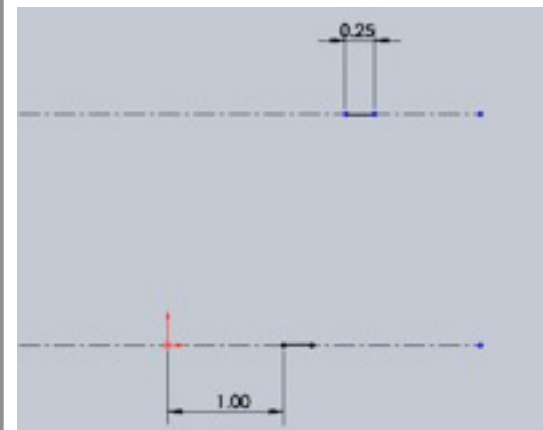
Draw the cross section of the cone

- Draw a **Horizontal Centerline** through the origin of the plane and another one 2 inches above it for drawing reference. This represents the height of the sheller.



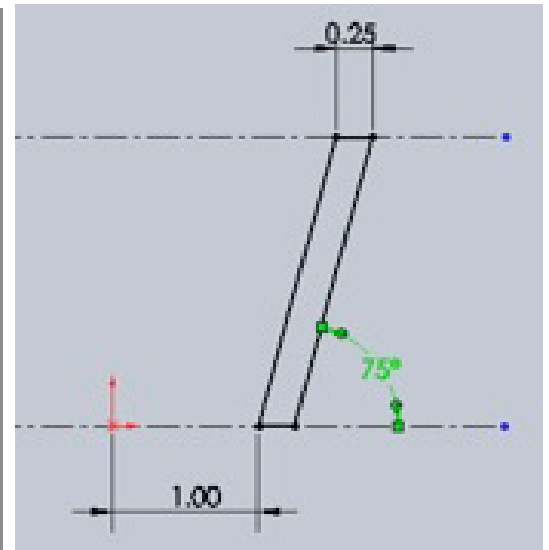
Draw the base lines

One on the bottom centerline and one on the top centerline. **Smart Dimension** the length of one line to be 0.25". Add a **Relation** to the lines to make them equal. **Smart Dimension** the distance between the origin and the inside edge to be 1 inch.



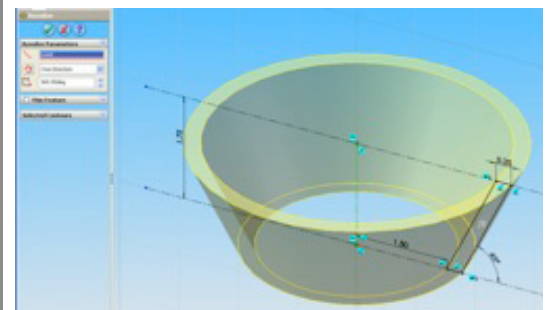
Connect the lines on each side and **Smart Dimension** one by clicking on the angled line and then the centerline to make the angle 85 degrees.

Your cross section is now done.



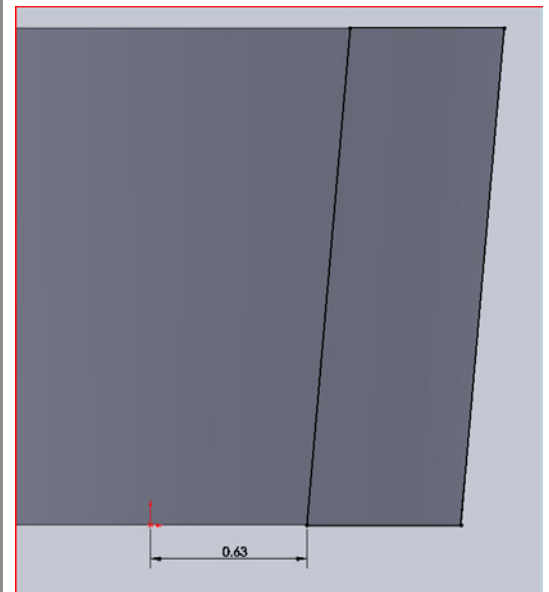
Revolve your piece

- Draw the line that will be the axis of rotation going from the origin to the top centerline.
- Go to the toolbar and click on **Features**. A new toolbar will appear. Click on **Revolved Boss/Base**.
- Choose the axis you just drew to be the center of rotation and rotate 360 degrees



Draw the cross section of the fin

In a new **Sketch** on the **Front Plane**, make the cross section of the fin. Trace the profile of the sheller body with lines. Add a **Relation** to make the lines parallel slanting. **Smart Dimension** the inside edge to be 5/8" (0.63") from the origin.



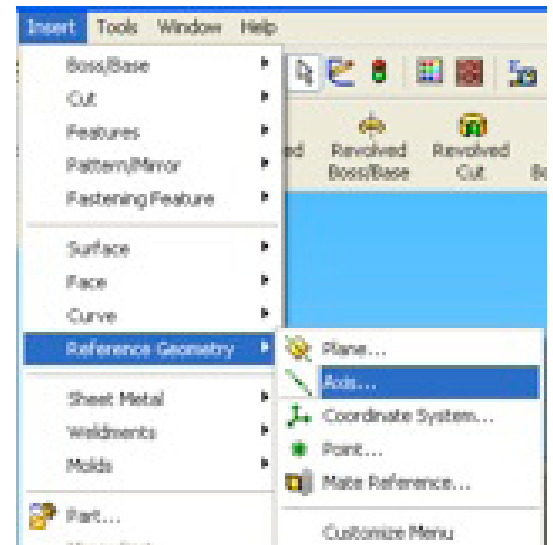
Rotate the fin

- Click **Revolved Boss/Base** and choose the angled line nearest to the origin as the center of rotation.
- Choose **Two Direction**, and set the rotation to 45 degrees for each

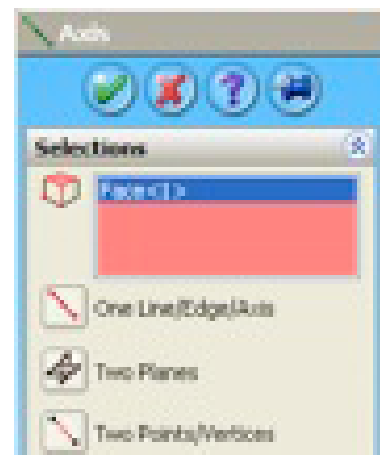


Add multiple fins

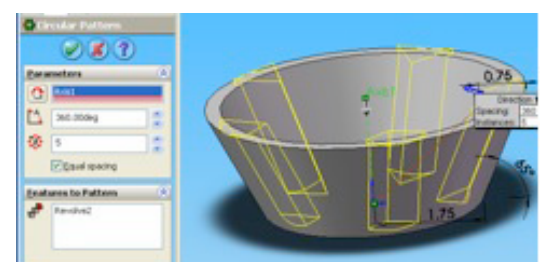
- Insert an **Axis** of rotation in the **Reference Geometry** window.



- Click on the **Cylindrical/Conical Face** option and choosing the inside face of the body of the sheller.



- Click on **Revolve 2** in the left-hand side bar to select the fin you just drew then select **Circular Pattern** in the top tool bar. Revolve around the **Axis** you added. Choose **5** fins with **Equal Spacing**.



Clean up the top surface

- Create a **Reference Geometry Plane** 2 inches from the top plane.

- Make a drawing on this plane of a circle the diameter of the sheller's outer edge.

- **Extrude cut** upwards **through all**.

You're Done!

Save the file as a Solidworks Part (.sldprt) and then **Save As** an STL (.stl) file since this is the format processed by the 3D printer.

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