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APOGEE

PEAK OF FLIGHT

NEWSLETTER

Creating Foam Parts in RockSim

APOGEE COMPONENTS
1130 Elkton Drive, Suite A
Colorado Springs, CO 80907 USA
www.ApogeeRockets.com
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phone 719-535-9335 fax 719-534-9050

Simulating the effect of foam fillers on the Center of Gravity of rockets in RockSim

By Bruce S. Levison

Bruce S. Levison has asked us to share this article with other RockSim users. It describes a method that he feels will help to foam filled parts of a model rocket. Bruce feels that the CG will be in the right location on the rocket. Please note: The user assumes all risk for the information obtained with this method.

This article contains links to download the RockSim version 7.03 designs. (www.ApogeeRockets.com/education/downloads/foam.zip) After downloading, place these files in the Design folder within the RockSim Folder on your hard drive. These files cannot be viewed using the demo version of the RockSim software because the materials database in the demo cannot be altered. You'll need to use the full version of the software which is available from Apogee Components at:

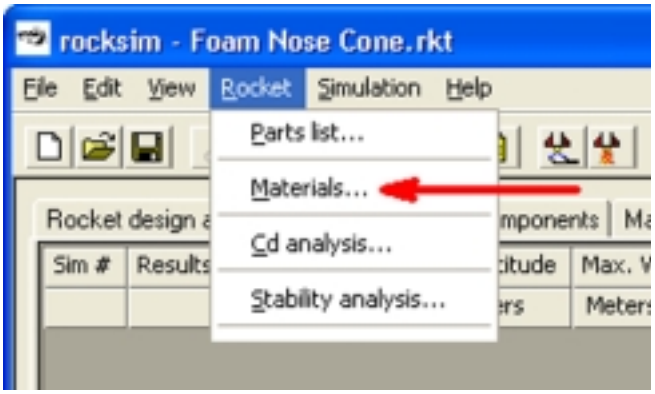

Figure 1: Alter the material database, select the "Materials..." option from the "Rocket" Menu.

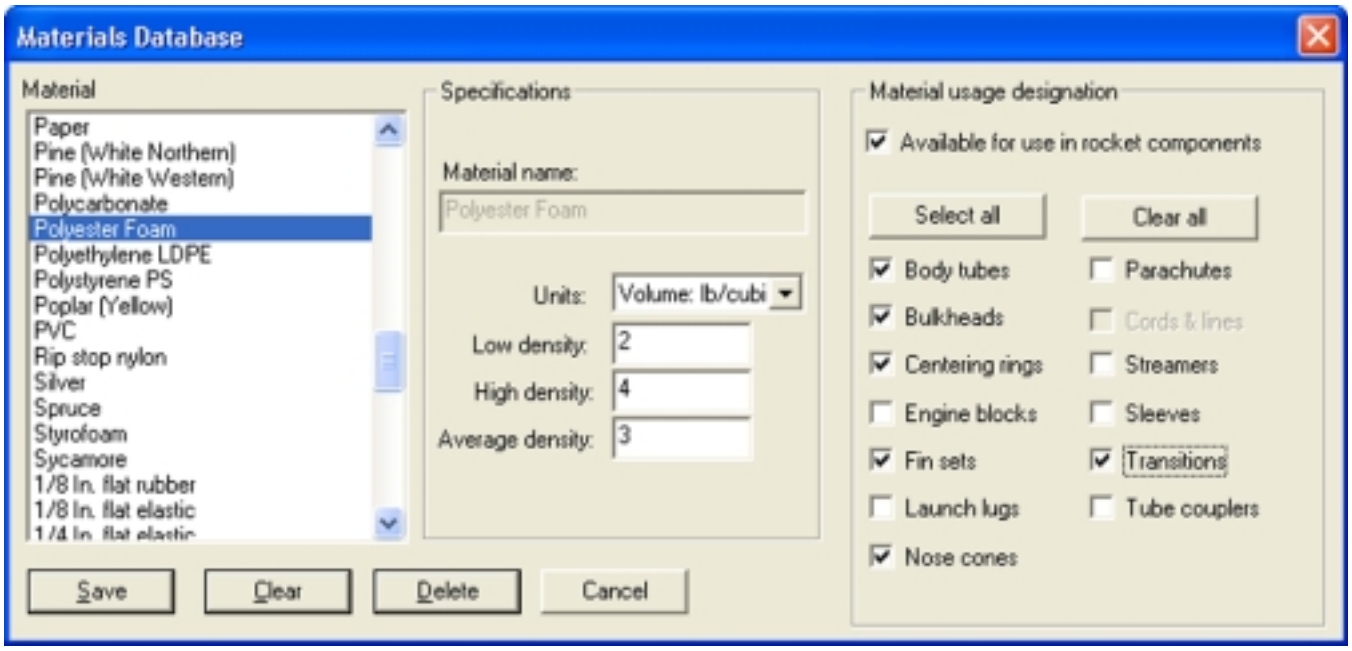

Figure 2: In the Materials database, create the foam material using the info from a MSDS sheet.

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www.ApogeeRockets.com/rocksim.asp.

You can simulate the effect of foam filler such as Polyurethane or two-part polyester expanding foams on the CG of your rocket if you know the density of the cured material.

Most foam manufacturers will provide documentation that gives the density of the cured product. You might also find the density on the material safety data sheet (MSDS) if one is available or on documentation came with the shipment of chemicals used in the foam. Alternatively, you can calculate the density of the foam; cast or cut several 10 cm (about 4 inches) on edge cubes of it. The weight of the cubes in grams divided by 1000 will be the density of the foam in g/cm^3. Typically, the two part polyester foams have a density between 2 to 4 pounds per cubic foot (0.034 to 0.08 g/cm^3). Styrofoam that you can purchase typically has a density of 1.8 pounds per cubic foot (0.029 g/cm^3). Since there are many types and formulations of plastic foams it is ultimately up to you to determine the density of the foam and enter the correct value in the RockSim simulation program. An interesting link on the

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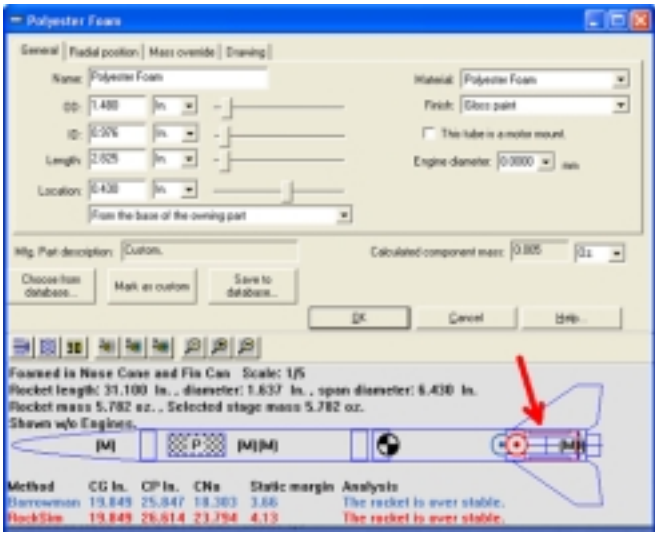
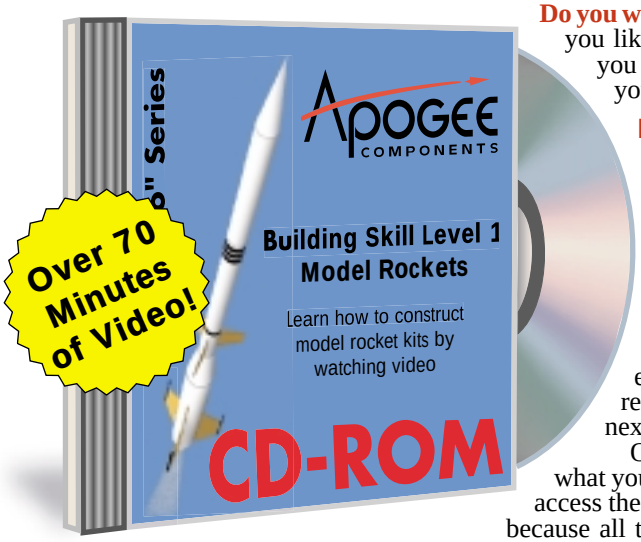


Figure 3: To fill an area between rings with foam, use an "Inside Tube." Make the material out of your new foam.

How To Make Better Looking Rockets:

Discover The Secret Techniques Used By Master Craftsmen



Do you want to "really" know how to build better looking rockets? Would you like stronger rockets? Do you want your rockets to fly higher? Are you pressed for time and looking for ways to build rockets faster? If you answered 'yes' to any of these questions, please read on.

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Figure 4: Add the foam part after you've added all the other internal items, so you can get the correct dimensions.

Internet that gives some general guidelines as to the density of these materials is:

http://irc.nrc-cnrc.gc.ca/cbd/cbd168e.html

You will then need to create a new material in the materials database for the expanding foam. Open RockSim then from the main screen under Rocket, select materials Figure 1. Add the foam as a material in the database enter the density data For this example see Figure 2 with polyester foam I entered 2 for the low density and 4 for the high density with the units set to Volume: lbs/cubic ft. RockSim will automatically calculate

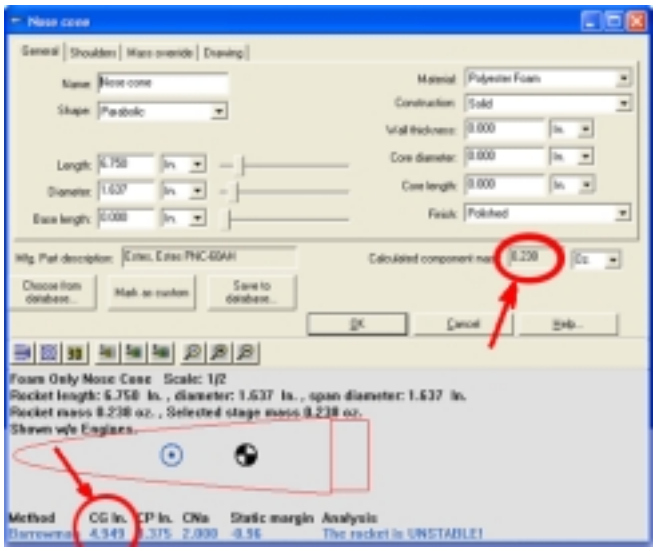

Figure 5: To create a nose cone filled with foam, first start by making a solid nose cone made from the foam material. Note the weight and the CG position.

the average density; be sure to get the units and values correct for the material's density or else the simulation will be wrong. Check the box to make the material "Available for use in rocket components" and click on body tubes and anything else that might contain foam in the selection fields. Click the Save button to save this material to the materials database. Then close the materials menu with the X at the upper right corner of its panel.

For foams inside body tubes and fin cans, simulate the foamed in area as an inside tube with the appropriate inside and outside diameters and length (between centering ring or bulkheads) see Figure 3. This inside tube construct should be added last to allow you to place motor mounts thrust ring and fin tabs within it see Figure 4.

Simulate the foam inside a nose cone by first copying the

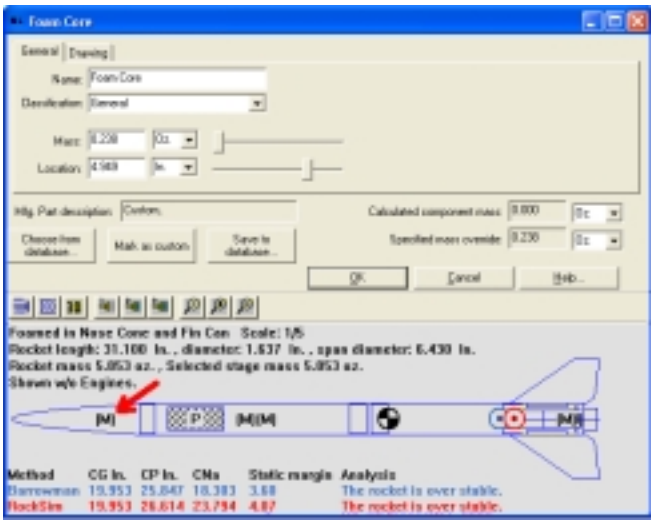

Figure 6: Using the data collected in figure 5, create a "Mass Object" and position it inside the real nose cone.

original nose cone to a new file then change the material to polyester foam and the construction to solid; see Figure 5. Note the new CG and weight of this nose cone (be sure there are no mass overrides selected). Next add a mass object to the original design that has the weight of the foam cone at the same location as the CG of the foam; see Figure 6. If you know the thickness of the cone, the cone shape and shoulder diameter can be adjusted accordingly to give a more accurate weight and CG of the cone interior. The same thing can be done with transitions and boat tails.

For foam core fins, first simulate a set of foam fins that are the actual profile and thickness of the fin (be sure to select the foam as the material they are made of) see Figure 7. Then

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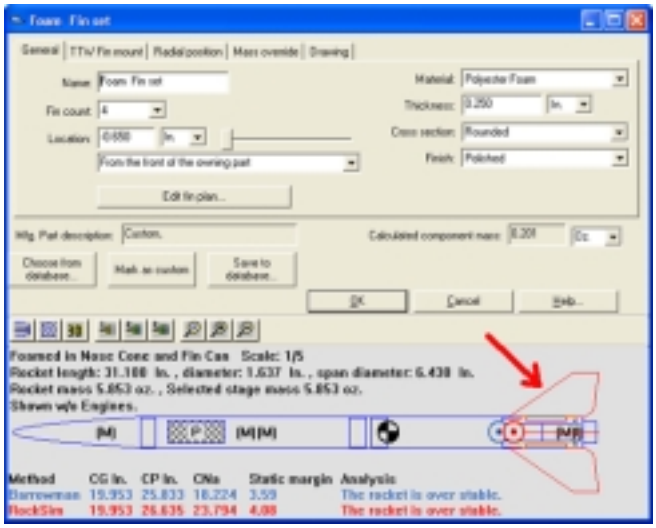

Figure 7: To create foam-filled fins, start by making the core. These are made from foam.

simulate the skin of the fins at twice the total thickness of the skin, since there is a skin panel on each side of the fin, made of the material in the skin of the fin; see Figure 8. Notice the additional weight and change in CG due to these added skin fins. Now delete the skin fins and add a mass object to the body tube with the foam fin construct that weighs the same as the skin fins at a location to give the same CG as when the skin fins were in place; see Figure 9 . This technique should also work for foam core centering rings and bulkheads. Foam core poster board material could also be cut and weighed then

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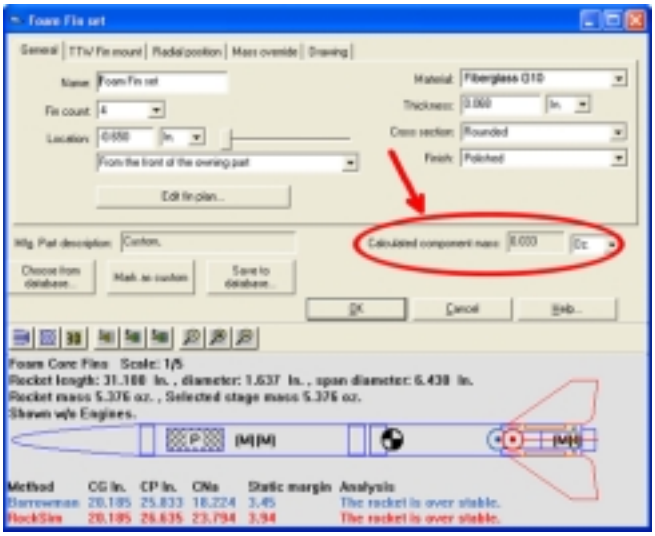

Figure 8: The fin's skins are made next. To find out how much they weigh, create a new fin set. Double the thickness of the skin, because there is one on each side.. Note the mass.

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entered into the materials database with the units of area (g/sq. cm) or (oz/sq. in).

I always check the CG of the completed rocket using a loop in a piece of string (static balance test) to see if I got everything entered into RockSim correctly. I have caught myself more than once mistakenly selecting things like solid polystyrene nose cones!

If the RockSim CG agrees with the balance point found with the loop of string, then you know you have simulated the foam containing parts correctly.

About the Author:

Bruce S. Levison (NAR #69055, MTMA #606) is a rocketeer from Ohio, and a member of the National Association of Rocketry (NAR). He has published numerous articles on model rocketry, related to the many practical aspects of the hobby. Bruce enjoys tricking the RockSim software into performing simulations of non-standard rocket designs. You can usually find him helping other people with their simulation problems in "The Rocketry Forum" at: http://www.rocketryforum.com/ (be sure mention RockSim in the title of you post). Bruce earned an advanced degree in chemistry, and works as a research scientist at the Cleveland Clinic Foundation.

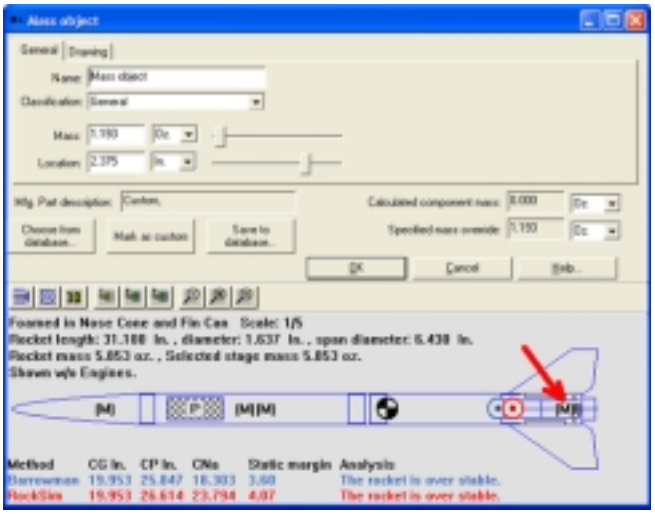

Figure 9: Once the weight of the skins is know, delete them, and use a "Mass Object" to account for the weight.