ISSUE 74 - FEBRUARY 8, 2002

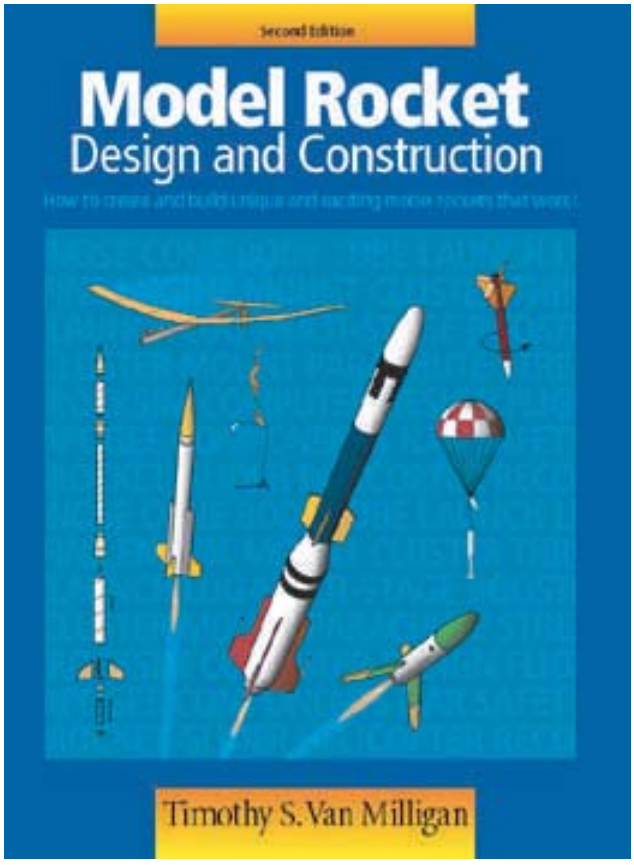
APOGEE PEAK OF FLIGHT NEWSLETTER

Let us help you design your next rocket!

We want modelers to experience all the feelings that come with designing a successful rocket. We want you to grow as a modeler, and that mainly comes through making your own rocket creations. This has been the underlying theme of Apogee Components since our beginnings in 1988.

Designing a rocket from scratch has one similarity with "building" a rocket. It is much easier, and you get far better results if you have the correct tools. Having good tools, and knowing how to use those tools is the key to building a exceptional rocket. You won't build a rocket without a sharp hobby knife; would you?

Designing a rocket is the same. You need good tools. Tools help to make the job easier, and you get better results. But I bet you didn't know what those tools are.



I invite you to visit the Apogee Components web site and see the design tools that we have available to help you design rockets. In fact, I've got a page on my web site that lists all the design tools that Apogee has available. There are two main design tools that every modeler should have. The first is the book ***"Model Rocket Design & Construction."*** This book gives you the foundations of rocket design. If this were a educational course, it would be "Rocket Design 101." Actually, it is far more than that. It is more like levels 101, 201, and 301. The book is just packed with all types of excellent design information.

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Apogee's catalog on CD/ROM! CLICK HERE

Apogee's RockSim and AeroCFD Software CLICK HERE

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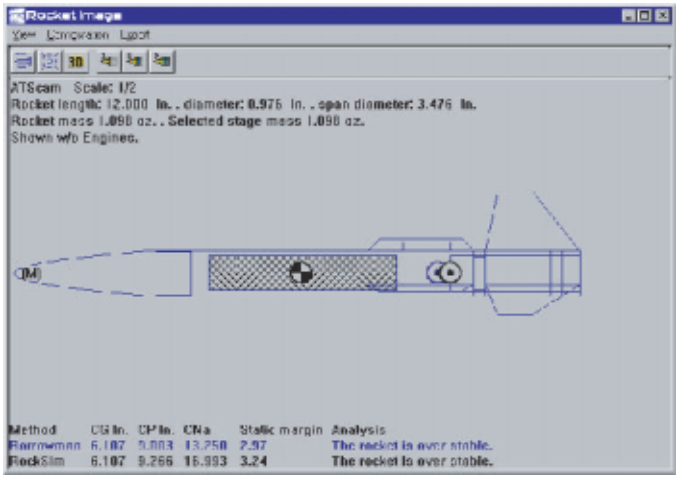
Let us help you design your next rocket! - cont. from cover

The design process is begins with developing a overall shape for the rocket. This is what gives the rocket its stylistic and visual appeal. Then you fill it with the necessary parts to make it structurally sound and aerodynamically stable. Finally, you add the properly sized recovery device to bring the rocket safely back to the ground to be flown again and again.

The book ***"Model Rocket Design and Construction"*** gives you that information to get through the beginning phases of the design. But to flush out the necessary parts and to make sure your design is aerodynamically stable, you need the second design tool.

This second tool is the ***RockSim*** software. RockSim allows you to test your design and tweak it for optimum performance. And you can do this before you put the rocket together. If your design doesn't test well in RockSim, you can adjust the arrangement of the components or the shape of the rocket so you can get that design that is perfect to you.



These are the two basic tools you need. But in many cases, you'll find that to design some unusual shaped rocket, you may need more tools. It is like needing a razor say to cut through some heavy wood; where a hobby knife is just not getting the job done. Apogee Components does have these advanced tools to help you out.

You can find more tools for designing rockets at the Apogee web site. Visit:
http://www.apogeerockets.com/designing_rockets.asp

If you can't find the tool that you're looking for, you can email me at: tvm@apogeerockets.com

READER COMMENTS!

We received several comments from readers about the new format of the Apogee e-zine newsletter. Here are a few of them:

"The new format for the magazine is awesome! I'm sure this will attract more people to the magazine and your company. AeroCFD sounds fascinating! I'm not quite back into rocketry, but I am certainly interested."

- Jimmy Slife

"I just wanted to send you a quick note saying the new format looks good. I own a small business myself, and can appreciate the focus it takes to stay positive and upbeat in what you do every day. I love what i do (small motorcycle shop), but it takes work to keep your customers interested and excited. I think you do a great job in coming across this way."

- Bill Viney

"Love the new e-zine ! It has something of the flavor of the old Centuri newsletters. Keep up the good work!"

- Steve Decker

"I just wanted to knock off a quick note and let you know that my son and I really like the new format of your news letter. We found the new format colorful and engaging without being tacky. The Shrox plan will be used for our March flying day! We also continue to use the "Model Rocket Design and Construction" book as a valued reference source."

- Everett E. Reilly III

"Wow! Beautiful newsletter! I've always thought your newsletters were thoughtful and very informative. Issue #73, however, cracks the inspiration barrier. Gorgeous layout, the ads are beautiful and inspiring, and the free plan at the end is a beauty as well. Hoo, I've got to send some money your way!"

- Dwayne Surdu-Miller

Write us at: tvm@apogeerockets.com
We appreciate your comments, observations and suggestions.

What is "CNa?"

Part 2 of 2

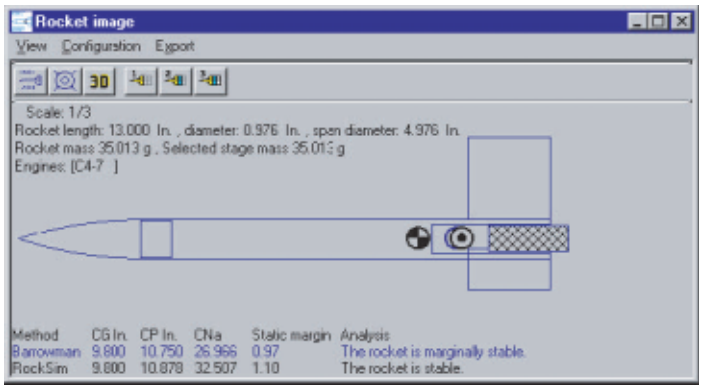
by Tim Van Milligan

In the last article, we talked about the term CNa, and why it appears on the main screen in RockSim. In this article, I'll continue the discussion by going through a simple comparison of CNa in both ***RockSim*** and ***AeroCFD***. Then, I'll give a little discussion of the RockSim stability method, and how it differs from the Barrowman Equations.

Let's go through a simple example, so you can get a feel for the numbers, and how the CNa changes with angle of attack.

I whipped up a simple model and found the CNa value in both RockSim (the Barrowman Method), and in AeroCFD.

The model I created was very simple. It used a 10 inch long, BT-50 size tube, with a 3 inch long nose cone (tangent-ogive shape). The three fins were simple square shapes, 2 inches on a side and positioned flush with the back edge of the body tube.



The Barrowman Method Computed the CNa value at: 26.966

In AeroCFD, I input the same parameters for the rocket. I ran the simulations at 200 mph and changed the angle of attack:

At 0 degrees, the CNa = 166.179
at 1 degree, CNa = 82.592
at 2 degrees, CNa = 41.981
at 3 degrees, CNa = 29.512

You can see, that by 3 degrees angle of attack, that AeroCFD is computing number that is pretty close to the values predicted by the Barrowman Method.

But, beyond the point, it is important to note that the Barrowman Equations break down, and no matter what angle of attack you use, the CNa value will remain at 26.966. This is not what happens in real life.

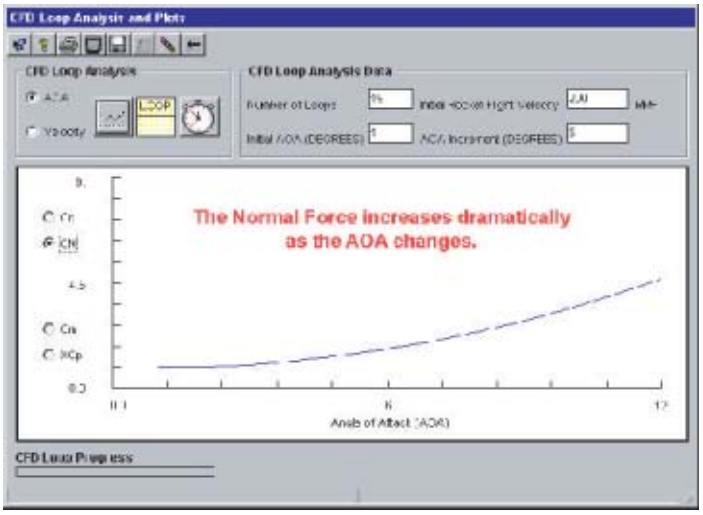
Continuing with the simulations, I kept incrementing the angle of attack of the rocket:

at 4.5 degrees, the CNa = 22.564
at 5 degrees, the CNa = 16.021
at 10 degrees, the CNa = 21.411
at 30 degrees, the CNa = 47.181

Pretty meaningless... isn't it?

It is important to remember that we do not use CNa directly, so it's value isn't as important to us as the CN value. If you recall from what was discussed previously, that CN is the Normal Force Coefficient. This is the aerodynamic forces acting on the rocket.

We'll use CN to directly find the normal force acting on the rocket. With AeroCFD, we derive CN and then CNa from the Normal Force; which is opposite of the way the Barrowman Equations are used. In the Barrowman Equations, we have to find the CNa first, so that we can get to the CN and finally the Normal Forces acting on the model. And as you might expect, if the CNa is wrong, the final Normal Forces acting on the rocket will be wrong too.



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About this Newsletter - Apogee Components Rocketry E-Zine Newsletter is a FREE optional newsletter about model rocketry. We have, and we'll continue to discuss a lot of different rocketry topics, including: rocket design philosophy, computer simulations, construction techniques, rocketry in education, happenings in the rocket industry, competition strategies, and new product announcements.

What is "CNa?" - cont from pg 3

And it is this normal Force which is actually the most important to us anyway. From it, we can compute the trajectory of the rocket. That is what we want RockSim to do for us.
That is why I've been really excited about the AeroCFD software. It does not have the limitations imposed on us by the Barrowman Equations. Once we know the Normal Forces acting on the rocket at higher angles of attack, we can get a better indication of the model's flight path. That is what AeroCFD can do for us. It may not ever be perfect, but we desire to make it closer and closer to reality.

The RockSim Stability Method

I need to mention one other thing about CNa. That concerns the "RockSim Stability Method." If you compare the RockSim CNa value to that of the Barrowman Equations, they are slightly different. The RockSim method is very similar to the Barrowman Method, but has a few corrections that we think makes it a little more accurate.

The first difference is the way RockSim calculates the 1/4 chord location on the fins. The 1/4 chord location needs to be found so that the location where the CP of fin can be determined. The Barrowman Equations rely on simple fin shapes which makes it easier to compute the 1/4 chord location.
RockSim allows any shape fin, so the 1/4 chord location must be computed differently. This procedure is described in Apogee Technical Publication #17
(http://www.apogeerockets.com/technical_publications.asp)

The next difference between the RockSim method and the Barrowman Equations is a correction for the body tube in the presence of fins. If you read the Barrowman report, he chose to leave this out because it is small and complicated to compute (see page 36 of the Barrowman Report at http://www.apogeerockets.com/education/downloads/Barrowman_report.pdf).

RockSim does add this correction back into the calculations of CNa, because it can be significant for rocket with small fins.

The formula for this correction factor can be found in a report by Edward LaBudde: "Extending the Barrowman Method for Large Angles of Attack." This report (see page 8) can be downloaded from the Apogee web site at:
http://www.apogeerockets.com/education/rocket_stability.asp

These are the main differences between the RockSim method, and the Barrowman Equations. For simple rockets, this is why the two values are slightly different.

There is one other difference than can be seen on some "complex" models where the fins are mounted on a transition section (such as a curved boattail). The Barrowman Equations do not allow the fins to mounted on a transition, because it makes it difficult to define a tube diameter. Especially when the transition has curvature to it. RockSim does modify the equations to account for the varying diameter where the fins are attached.

In my humble opinion, I think RockSim is making a good estimation of the body tube diameter for calculating the fin's CNa value. The example of a German V2 type rocket is a good one. Whenever I've launched a V2 model using the RockSim stability criteria, the model always seems to fly straight, even though the Barrowman Equations say it should have more nose weight to make it stable.

Many modelers see this result too, and are starting to trust the RockSim stability method more and more. But if they ask me which one to use, I always tell them to use the method they trust. If they trust the Barrowman Method because it is more conservative, then they should ignore the RockSim method. Until you gain experience and learn to accept the RockSim Stability results, it makes sense to add more nose weight -- which is what the Barrowman method will tell you to do. You can gradually remove nose weight over a number of flights to see if the RockSim method will work for your model. That's how I'd do it if I was unsure of the RockSim stability method.

Conclusions

Is it important that we know the actual CNa number? If you're designing simple rockets, you don't really need to know it. If RockSim says the model is 'stable,' then it should fly just fine. The number is used to help RockSim find the Normal Forces acting on the rocket. From these, we can predict the trajectory of the model more accurately. So the CNa number by itself is not important to us; but how it is used to predict the flight path of the rocket is.

Author Information:

Tim Van Milligan is the owner of Apogee Components (http://www.apogeerockets.com) and the new rocketry education web site:
http://www.apogeerockets.com/education/index.asp

He is also the author of the books: ***"Model Rocket Design and Construction," "69 Simple Science Fair Projects with Model Rockets: Aeronautics"*** and publisher of the FREE e-zine newsletter about model rockets. You can subscribe to this e-zine at the Apogee Components web site, or sending any message to: ezine@apogeerockets.com with "SUBSCRIBE" as the subject of the message. *-APOGEE*

SATURN 1B UPDATE

The Saturn advertisement in the last issue has sparked a few requests about the status of the Saturn 1B kit. I have been working on it, but we did hit a few set-backs along the way.

The biggest delay was that the Postal Service lost the molds for the vacuum form wraps at the beginning of January. This cost us a month delay as we did everything we could think of to find the package. The end result was that the molds had to be rebuilt from scratch.

Not having the molds was a ordeal. Without the first molds, we didn't know whether or not the molds would have to be modified. As it turned out, they did need some slight modification. The ullage rocket fairings were causing some major webbing onto the back part of the wrap. The plastic was also difficult to remove from the molds, so the ullage motor fairings will eventually be removed from the wraps. On the model, they'll be replaced by cast resin parts. For the modelers perspective, this will be better because they'll look much crisper on the edges.

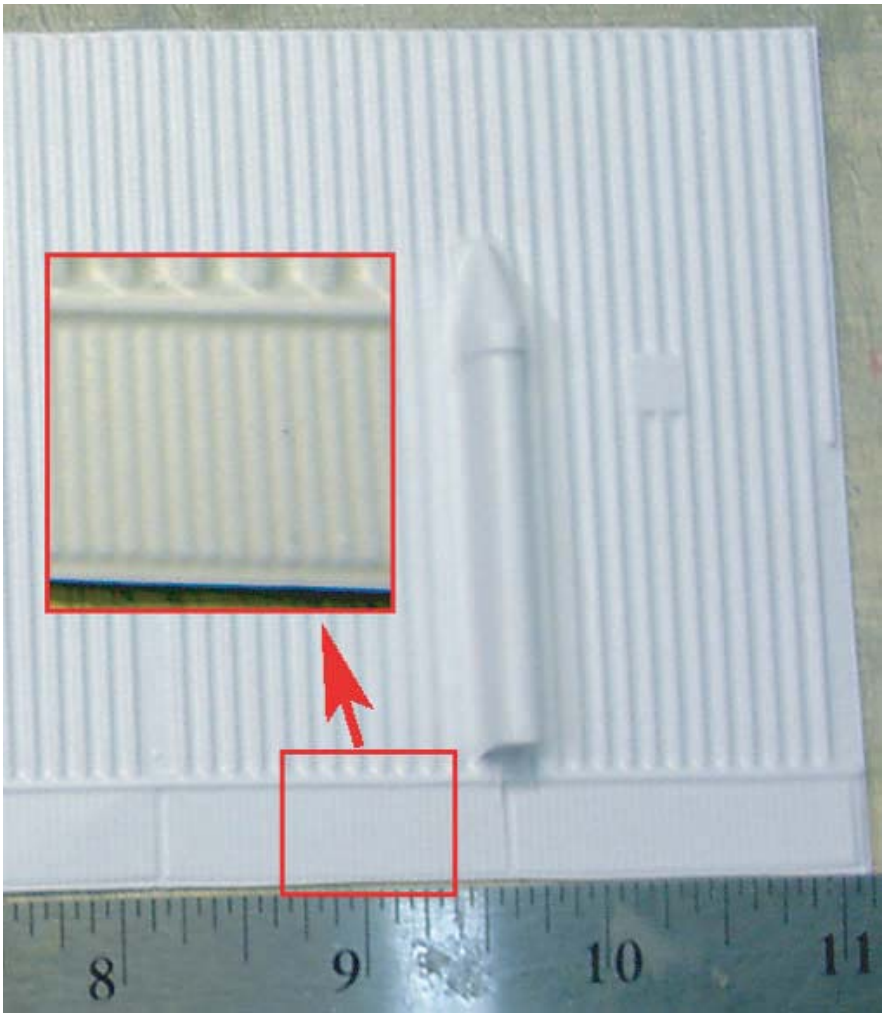
Some people have wondered whether or not the model will have the stringers at the forward part of the first stage. These are very tiny corrugations. On most Saturn 1B models, the builder chooses to leave them off. But they do show up very well in our test parts, as the photo shows. You're going to love the detail!

There was one mold that I decided to build here at my own shop. That was the base of the rocket. The bottom of the Saturn 1B has some very nice detail, and I wanted to incorporate this into the kit. As you can see in the photo, the vacuum form base is looking very nice. Especially good looking once the injection molded nozzles are installed.

There is still a lot of work to do on the kit. I have to wait for the wrap mold to be modified so that I can continue to make the video instructions. But these should be pretty easy to finish up once I have all the pieces in house.

I don't know when the ship date will be yet, but I am continuing work on the project. But if you decide to pre-order the kit, you can be assured that you are not buying vaporware. As the Saturn V has proved, I do keep my word that I will get you the kits.

Tim Van Milligan
President - Apogee Components, Inc.



Note the fine detail of the vacuum wraps. The ridges in the detail photo are almost hair-thin.

The attention to detail is evident in the display piece business end of the model. It is sweet to behold.

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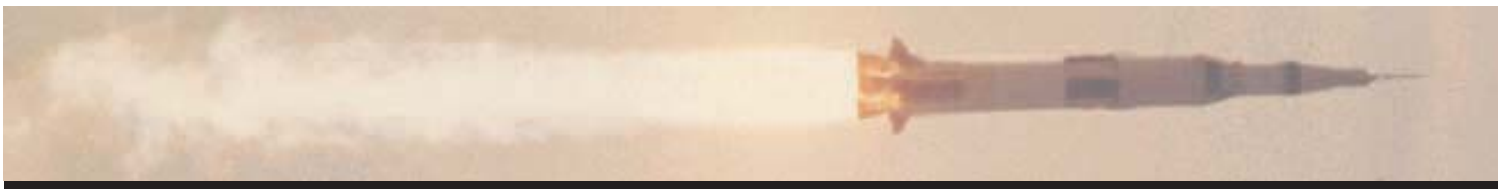
APOGEE

PEAK OF FLIGHT



The first step into space is a model rocket.

Bring the space race to your neighborhood order your APOGEE SATURN V and SATURN 1B TODAY!

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SHX/TVM01 ROCKET PLAN ANALYSIS

Brent Lillesand writes:

Hi,

I built a model from the plans in your most recent newsletter. It flew very well, but it did need a little nose weight. My question is how does one determine the stability for a rocket with this fin configuration?
I have RockSim 5.0 and your book Model Rocket Design and Construction. I could not figure out how to model the rocket in RockSim, nor was I able to find sufficient information to determine the lift and the aerodynamic center of the lift forces. I would like to write an article for our club newsletter describing how to determine stability/balance for a rocket such as the SHX/TVM-01.

Thank you for your assistance,

Brent Lillesand

Tim replies:

In actuality, this design was probably "guessed at." The only way that this is possible is with experience of the designer. Shrox has designed, built, and flew many asymmetrical fin configurations. This is a tried-and-true method of designing rockets. I can tell you with 100% certainty that Estes designs rockets this way too. I can say that because I was taught to use this technique by other designers.
If you lack the experience, you can do trial-and-error designs. Built it, fly it, crash it, rebuild, recrash, redesign -- until you get it where it flies right.

But if you want to be theoretical about it, these types of models should be tested in a wind tunnel to find their CP location.

Shrox replies:

In actuality, Tim is right! After literally hundreds of rockets, one can develop an eye for what will work, what will work with a little nose weight, and what just won't work at all. (You caught me on the nose weight, I would add a little bit as well.) Like Tim said, you would need a wind tunnel to accurately test these types of designs.

Werner Von Braun used an ingenious method to "guess" at stability. A small model of the shape was fired through a series of closely spaced paper sheets held taut on frames. If a small hole has made by the model as it flew through the paper, it was flying straight. If big jagged holes resulted, then the model must have tumbled in flight. Pretty cool, ehh?

SHX/TVM01 ROCKET