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APOGEE

PEAK OF FLIGHT

NEWSLETTER

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NARCON 2002 We are so there...

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An old fashioned design with a new twist!

Heli-Roc

I like helicopter recovery models a lot. Can you tell? This is the second short article in two issues in which I've written about helicopter type models.

When I first took over running Apogee Components, I sat down and planned the types of kits I wanted in the product line. Wouldn't you know it; the helicopter kit was right up there on the top of the list.

The Heli-Roc kit really wasn't my first choice as the first Apogee helicopter type rocket. I had some different plans that I had drawn up. But an educator friend of mine had just written a book for schools called: "Liftoff!" The book was to be a two-part project. The first part was the typical rocketry educational stuff, and the second part was to include some more advanced rocketry projects. One of them -- of course -- was a helicopter design.

Since he didn't know too much about helicopters, I suggested a Rota-roc style helicopter, and I drew up a simple little design that he could use in his book. Rota-roc style helicopters have been around a long time, and they are pretty good from a competition standpoint (meaning: they descend nice and slow). They don't require a lot of fancy components, and nearly everything could be purchased for the design at a local hobby store.

My friend's book project started rolling along, and then the publisher decided it would be cool to offer rocket kits along with the book - sort of a package deal for teachers. So my friend told me to get the model into kit form, and wait for the orders to start rolling in. I had big dollar signs in my eyeballs!

To make a long story short, the publisher got cold feet, and canceled the second book. So the helicopter kits weren't needed. I didn't blame my friend, as his book deal fell apart too.

As a young inexperienced entrepreneur, I learned a pretty good lesson in business: don't put the cart before the horse. I had tooled up, and bought all the inventory for hundreds of helicopter kits; but I had no buyers, and no contract from the publisher.

But the Heli-Roc is a good design as far as helicopters go. Being an aeronautical engineer; when I design a rocket, I try to make sure it is well though-out and is easily implemented. I feel that I took the basic Rota-roc concept, and made it a little bit better and easier to put together.

I didn't make it too simple though. It was supposed to be for schools to challenge the kids. So there are still a few areas in the design that give the builder some feeling of accomplishment when they construct the model.

For example, you'll have to be able to bend a piece of wire with a pair of pliers to make the rubber band hooks. This is the type of things that makes the kit a Skill Level 4 type model.

One of the spiffy things that I noticed about this particular design is thatwhen you take it to a launch and show spectators; you really don't have tosay what it does. When they look at it, you can just see the light bulb flipon inside their heads... "It's a H-E-L-I-C-O-P-T-E-R!" they shout.

Once they make this connection, they have a whole different attitude aboutmodel rocketry. They no longer see rockets as just woosh-pop, but assomething with wide variation and style. They can't wait for you to prep andlaunch the whirly-bird. With this one rocket, you get them hooked on thehobby!

Speaking of anti-woosh-pop rockets; another thing this rocket does is tointroduce newer modelers to the neat concept of a "burn-string." What's a "burn-string" you ask?

In over ninety-nine percent of designs, the rocket engine's ejection charge is used to push out a parachute, or to slide a piston forward. Hence the "pop" sound in the term "woosh-pop."

We're talking about a completely different way to use the motor's ejection charge. In this model, the helicopter rotor blades are held down during launch by a thin thread. When the motor fires it's hot ejection charge, it burns the thread into two - thereby allowing the blades to spring outward.

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Heli-Roc

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It is a simple, elegant, and a "light-weight" rocketry concept. Strangely, it's almost totally foreign to most modelers.

However, if you think about it long enough, you start to wonder how else you might use the motor's ejection charge. That's one reason why the rocket kit is so educational in nature.

Although a "Skill Level 4" rocket may scare some newer modelers, those of you who are familiar with Apogee's kits know that we spend a lot of time to make sure are instruction sheets are clearly written, and contain lots of easy-to-follow pictures. I don't think I've met a person yet that wasn't able to complete an Apogee kit if they've read and followed the instructions. I'm confident that you'll be pleased with how nicely this rocket goes together from when you open up the bag, to when the rocket is launched. The building experience is almost as fun as the flights themselves.

A neat thing you'll discover as you build this kit is that you'll learn a lot of new building techniques. I mentioned previously about the bending the music wire with the pliers. You'll also learn about helicopters in general, and the "trick" to make the spin properly. What "trick" you ask?

When I started out in rocketry, for the life of me, I couldn't get my helicopter models to spin. Learning the "trick" didn't come until after about a dozen pretty catastrophic launches. You've probably gone through something similar: build -- shred; build -- shred; pull hair out...It gets pretty frustrating.

But I don't want you to go through the same nonsense that I went through. So you'll learn this trick as you're building this rocket, because the instructions clearly tell you about it. I want you to have as much fun flying helicopter rockets as I do.

Helicopter Launches Are Always Fun!

The Heli-Roc spins much more slowly in comparison to the Texas Twister model that I told you about in the Apogee e-zine newsletter #78. It is very graceful as it descends, and comes down a bit more gently. This is because it has large rotor blades, with a rotor diameter of over 20 inches. It doesn't exactly have a "whop-whop-whop" sound, but if you pretend hard enough you can imagine the sounds that other spectators are straining to hear from the model.

Occasionally, if you get the tension just right on the rubber bands that deploy the rotor blades, you can definitely hear a neat buzzing sound as the rocket takes off. With the three rubber bands, the rocket almost plays a tune of three notes as it zooms skyward.

There are lots of reasons you might decide to buy this kit. A high-power rocketeer might like it for its "something different" approach. You don't often see helicopters at local launches, so this will be something unique when it is flown.

Educators will like this model because it teaches new skills, new techniques, and how to look at rockets from a different perspective. It goes beyond simple parachute and streamer recovery models. And it has just enough complexity to show that attention to detail is important to the rocket functioning properly.

The Heli-roc is something you should try if you're tired of same-ole, same-old small rockets. Even though it is an older Apogee kit, it is still refreshing, unique, and does -- "something!" It is a model that spectators love to see you fly.

The model comes with light-weight die-cut balsa fins and rotor blades; which makes it light weight and competitive in rocketry contests. And if you paint it like the futuristic rendering that Shrox created here, you'll find that it looks like a neat floating space station. How's that for something out-of-this-world!

Heli-Roc
Product No. 5017

Specifications:
Skill Level: 4 - Slightly Challenging
Length: 35.56 cm (14")
Diameter: 13.8 mm (0.544")
Weight: 13.8 grams (0.77 oz)
Recovery Type: Helicopter
Recommended 13mm Diameter Rocket Motors: 1/2A3-2T (first flight), A3-4T, A10-3T, B7-6, Apogee 13mm C6-7

For quickest deliver of this kit, order now from Apogee's secure web site
at: http://www.apogeecomponents.com/Heli_Roc_Kit.asp

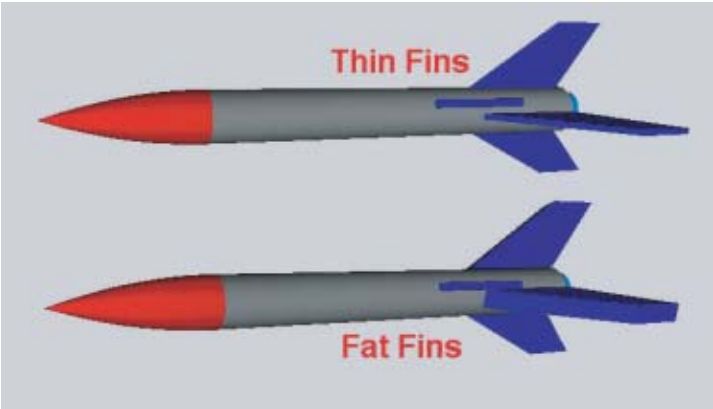
About this Newsletter - Apogee Components Rocketry E-Zine Newsletter is a FREE optional newsletter about model rocketry. We have, and we'll continue to discuss a lot of different rocketry topics, including: rocket design philosophy, computer simulations, construction techniques, rocketry in education,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

Does Fin Thickness affect the Rocket's CP?

Feature Article

Jonathan Elder writes:

"Why doesn't the "thickness" of a fin have an affect on the CP in RockSim? It seems to me that while the span of a fin is the larger factor in the induced CP reading that the thickness of a fin would also make a significant difference. If this is not the case and I've got my "fin physics" wrong I would appreciate your correction."



As we begin this discussion, we need to make modelers aware that we're talking about the RockSim computer program. The software is phenomenal, but it does have its limitations. These limitations are a result of the assumptions built into the program, and the formulas by which it operates. Most limitations imposed on the simulations are a result of the Barrowman Equations of rocket stability.

I'm not bad mouthing the Barrowman Equations. We rocketeers have been using them for decades, and for the most part, they've proved their worth. We've been designing and building stable rockets. That is a good thing!

But as Jonathan noticed, changing the thickness of the fin in RockSim does not have any bearing on the stability of the model. The question we need to ask ourselves is: "is this true in real life, or does fin thickness actually change the CP of the rocket?" And if it does, will making them thicker increase or decrease stability?

In the Barrowman equations, one of the assumptions made is that the ratio of the fin length to thickness is pretty large. In that case, they act like flat plate airfoils. The fin's local CP in that case is at constant location - on the 1/4 chord point of the fin. As long at the ratio of length to thickness is relatively large, you can change the thickness and the CP won't move much.

Fat fins violate the Barrowman Equations. That is why changing the fin thickness in RockSim will not change the CP location of the model.

If you want to play with fin thickness and see what it does to the CP and the Cd, you need to use a program like AeroCFD. It is designed for this type of thing. It doesn't rely on the Barrowman equations. It uses a different technique to find the forces on the rocket; and it is much more accurate when fine tuning the design.

When you do run flow analysis simulations in AeroCFD, you do in fact find that thicker fins move the CP of the rocket rearward when the model is flying at an angle-of-attack.

The table below shows a summary of how the CP shifts rearward with an increase in fin thickness.

Fin Thickness (inches)	CP/L	Overall Cd	Drag @ Fin's CP (lb.)	Lift @ Fin's CP (lb.)
0.03	.743	.518	.01	.062
0.07	.865	.655	.024	.155
0.15	.93	.930	.051	.339
0.25	.955	1.274	.086	.564
0.35	.967	1.618	.12	.783
0.45	.974	1.962	.154	.999
0.55	.978	2.305	.188	1.212

Estes Alpha rocket

AOA = 3º

Airspeed=150mph

Fin's cross sectional shape = rounded

AeroCFD grid size =20

Does this mean we want to make the fins on our rockets thicker?

Not really. To see why the CP moves back, you have to review what the CP of the rocket is. If you recall, the CP is the point on the rocket where all the aerodynamic forces are said to be balanced. This not only includes the lift forces, but also the drag forces.

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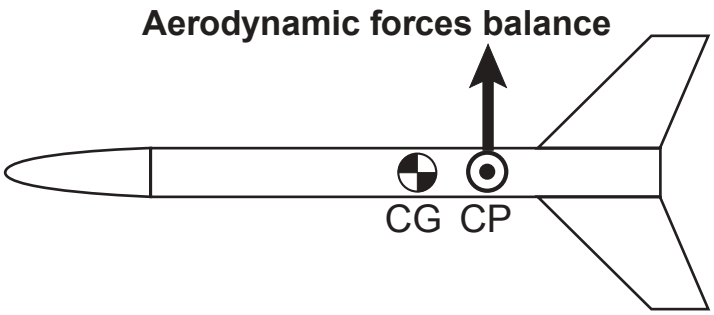
Does Fin Thickness affect the Rocket's CP?

- Cont. from pg 04



When we make the fins thicker, we not only increase the lift forces, but also the drag forces. So the CP is going to move aft when either of these forces increase.

If you look at the chart above, you see that both lift and drag on the fins increase. Actually, this is a best case scenario. AeroCFD computes the forces as long as the air flow remains laminar. When we increase the fin's thickness, eventually it will turn into turbulent flow.

At this time, it is difficult to estimate when the airflow will transition from laminar to turbulent. But when it does, the drag is going to go up dramatically. On the surface, this appears to be a good thing, since the CP will shift rearward making the rocket more stable.

But unfortunately, at the same time, the lift on the fins is going to go way down. This moves the CP forward. And since the lift force has a much greater affect on the CP position (due to the further distance it is from the CG), it moves forward quicker than can be compensated by the extra drag contribution.

Even if the airflow doesn't transition from laminar to turbulent, there is one other thing you have to notice when you increase the fin thickness. The Cd of the model goes up dramatically (see the chart above). So what gains you make in the stability of the rocket, you lose in altitude.

On the other hand, if you reduce the thickness of your fins, you do pick up big gains in altitude. For most modelers, this is a really good thing. And it leads us to a question: "How thin can we make our fins?"

The answer depends on a couple of things. First, you shouldn't make your fins too thin that it affects the stability of the rocket. Remember, as the fins get thinner, the CP is moved a little bit forward. Don't let it move so far forward that it is in front of the CG of the model. That would be unstable.

Second, as the fins get thinner, there is a greater likelihood that they can flutter. That's bad. First, the drag goes way up, counteracting the benefit of making them thinner. And if the flutter is extreme, the fins can be stripped off the model.

Fin flutter, and fin structural analysis is something that isn't taken into too much consideration when modelers build rockets. The reason is that there aren't any good tools to use to find when the fins will fail. The good news is that John Cipolla (www.AeroRocket.com) is working on a little computer program that will predict when fin failure will occur. The software is nearly done, and we hope to announce the release of the software soon. The neat thing about it is that it will read a RockSim design, and quickly tell you the conditions where the fins will flutter or be stripped off the model. It's really cool, and I can't wait to until it is done.

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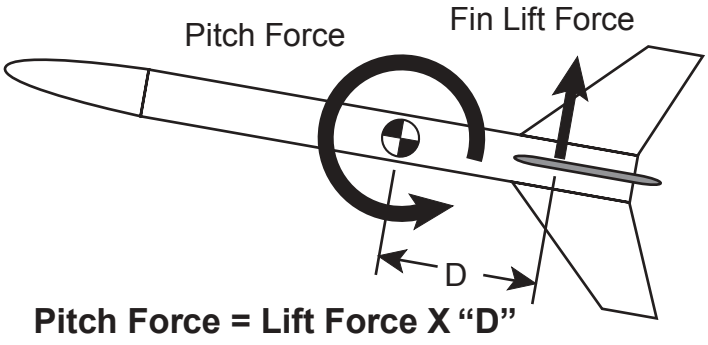
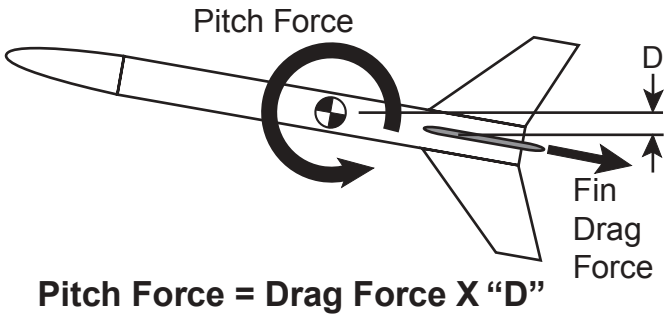


Pitch Force = Lift Force X "D"



Pitch Force = Drag Force X "D"

Does Fin Thickness affect the Rocket's CP?

- Cont. from pg 05

To sum up this discussion:

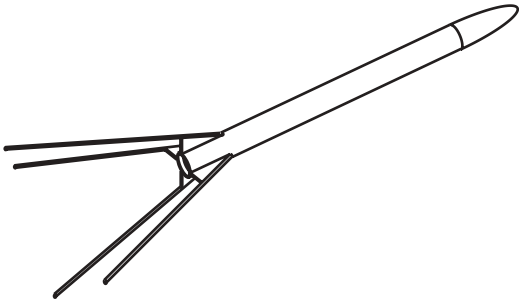
1. The CP will move rearward when you increase the thickness of the fin. RockSim will not predict this, but AeroCFD software will.

2. At some point, increasing the thickness will cause the airflow to transition from laminar flow to turbulent. This cannot be predicted by AeroCFD. But when it does, the lift force goes way down, and the CP will shift forward dramatically.

3. Increasing the thickness has the adverse effect that it also increases the overall drag on the model. The model will not fly as high.

4. In actuality, we want to reduce the fin thickness to decrease the drag. But the minimum thickness will depend on when the fin becomes too weak, or if it moves the CP too far forward.

As a side note: there are some rocket designs that don't have fins, and where the restoring force is provided exclusively by drag. I remember an old rocket design that resembled a witch's broom; where dowels were used in place of fins. These are neat and unusual designs, but they are far from very efficient. With all that extra drag, they don't fly very high. And from a stability standpoint, they can't really react quickly to disturbances. So they will wander about the sky a bit more.



I highly recommend that you have an interest in this subject that you purchase the AeroCFD software. It is well worth the investment. It can be ordered from Apogee Components at: www.ApogeeRockets.com/aerocfd.asp

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. 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.

Rocket Tip-Rocket Display Stands

Looking for a display stand to show off those cool plans you build from our e-zine newsletter? Try a CD-ROM spindle - you know those things that hold CD's until you use them up.

The CD-ROM spindles make nice display stands. They have a nice wide base, so the rocket doesn't easily tip over. And you and easily drop the rocket down right over the top of the middle post.

Recycle...standard operating procedure on Spaceship Earth.

Saturn 1B Update

Good news! We're really close to releasing the new Saturn 1B kit. I could probably finish it up in the next two weeks, but there are a couple of little glitches.

First, NARCON is coming up this weekend. That is going to set me back a little bit, because I've been busily preparing to meet with modelers down in Texas. I'm looking forward to attending NARCON, as it is the biggest indoor rocketry conference in the world, and I always learn a lot of great new things.

Second, my building lease expires at the end of this month. I've been looking for a larger facility for a few months, because these Saturn tubes take up a lot of room. There isn't enough room to start any new big projects; which I'd like to do in the future. And besides, Apogee has been slowly growing over the last couple of years, and it is time to spread our wings a little bit wider. The good news is that I'm really close to closing a deal on a new place, and if it goes through, we're moving! Unfortunately, will be a major upheaval for a few weeks. We'll have to box everything up, move it, and then unpack it again.

I'm going to keep working on the Saturn 1B to get it out quickly, but there may be a delay due to these little situations. I'll keep you informed on the progress of all these events.

Rocketry Essay Contest - $150 in prizes!

what do you dream about when you look at a rocket?

Shrox has been creating some awe inspiring rocketry artwork in the Apogee e-zine newsletter. You see examples of it with the free rocketry plans. I thought that the story behind the artwork is missing. For instance, what is the story of the rocket, and how did it get to the point where it is shown in the picture?

To find out, I'm holding an essay contest. Pick a rocket picture from the list below, and write a fictitional story about it. I know you daydream about these rockets, since I do it too. So just write down your story and send it in for your chance to win a cool prize!

SHX/TVM-01 - newsletter #73
Stonebreaker/AX - newsletter #75
Bolaero/Z - newsletter #76
Orion Luxury Shuttle - newsletter #78

There will be two age divisions: 17 and under, and 18 and older.
First Prize: $50 Apogee Gift Certificate
Second Prize: $25 Apogee Gift Certificate

Guidelines:
Maximum word count:1000 words. Deadline for Entries: May 17, 2000
Format: electronic *.txt files. Email the stories to: tvm@apogeerockets.com
Apogee Components reserves the right to re-print the essays in the free e-zine newsletter so that other readers can enjoy the stories too.