FACN #317 JAN-FEB 2021

Flying Free Flight Scale Models

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Over 25 years ago I happened to go to an open "build and take" PROGRAM IN Glastonbury, CT with my eldest son and his best friend. The boys made some AMA darts and finished that part of the program and several people began flying their indoor scale ships. I was amazed. The planes flew beautifully. Everyone was so friendly and having fun. They said they could teach me to do it. That's how this adventure started for me.

The code of the Flying Aces Club has always been to help each other, even your competitors. I have been the recipient of a lot of good advice over the years, from so many people, literally from all over the country. Perhaps the ideas shared here will help you out a little.

1. *Plane selection: Clearly the most important consideration is to build something you like. There are thousands of free flight rubber plans available on several websites including Outerzone, Hippockets Aeronautics, The Plan Page and many more. Check out the Flying Aces Club website for links (Ref. 1) I have always enjoyed competing and there are a few things I look for in a scale ship. They are wing area, nose moment, tail moment and clean design.*
2. *Whatever plane you decide to build it is important to make sure the interior is built in such a way that there are no places for the rubber to snag on. Put in some triangular fillets between upper formers and side upright if necessary; you don't want any projections the motor could get hung up on. I now sheet the upper part of the nose of the fuselage on most of my Golden Age and Modern Civilian planes. I have had too many instances where the long motors I run get snagged on upper deck stringers and it either ruins the flight or the cowl. Don't shy away from planes with big radial engines. They can fly quite well (wateh the CR-2 or the CR-3 in the Thompson Trophy Race).*
3. *Construction thoughts: You can't really save much weight once the plane is framed up. Tissue and paint can be used judiciously but real weight savings are done on the airframe by careful selection of balsa and reinforcing the frame in the critical areas. A plane made out of 6-7 lb. balsa will weigh a lot less than one made out of 12 lb. I usually save the stiffer, heavier (8-9 lb.) for the top spar and leading edge. Most of my 24" span ships (my current favorite size) are built with 6-7 lb. wood. It is important to select balsa not just by weight but also by stiffness. Not all 6 lb. balsa is created equal. I will add diagonals at times particularly if l have enlarged a plan a little. Tissue should provide some torsional strength but I try to have the fuselage frame pretty rigid.*

   The wing needs a lot of careful attention. I always use some "Phillips entry". Airfoils in the 9-10% range seem to work really well for me. If I were to build from an old plan with a thick airfoil, I might be tempted to substitute a thinner one. I have friends who swear you need a turbulator spar on the wing but the Rees Wing has worked very well. The Rees wing has two spars, with diagonals between them, and sliced ribs, resulting in a smooth covering from LE to TE. An example is the structure in the wing of my Dave Rees designed Hornet Moth. [FIGURE 1]

   Adding dihedral to the wing is a critical step. Sand in the dihedral angle carefully and then line up well with the plan. Having a crooked leading edge that tapers back only on one side will induce a turn and may lead to a bit of aggravation during trimming. Use gussets at the TE, LE and at least the main spar. Be careful that you don't use pressure to hold the wing in place. You don't want to see a wing tip sag down or pop up when you move the dihedral supports- that is cause for a "do-over".

   The location of the motor peg is very important. Often designers put the peg at the ack of the fuselage in an effort to run long motors. I usually place a peg point at 50-50 of the CG, it is much easier to switch to lighter or heavier motors without rebalancing.

   Stab rudder: I almost always build up the stab and rudder. After building them flat in the usual manner, I add cap strips of punky 1/32X1/16 or 1/20X1/16, front to back and sand in a symmetrical airfoil. Look at nearly any Earl Stahl plan if this is unclear [REF. 2]. This really stiffens them and will pay off during trimming.

4. *Calculating the CG: This is a critical step. Don Deloach has written about calculating the CG and Tail Volume Coefficient in the FAC newsletter Sept/Oct 2012 [REF. 3], TVo, and many other topics related to flying scale models, are also explained in McCombs book "Making Scale Model Airplanes Fly," which is self-published (there are ads for this book at the back of the NFFS Digest. Sometimes the CG is on the plan, which can be a real timesaver. I use a couple of upright dowels with pencil erasers on the ends to get the static balance. Be careful here, a 1/8" difference can really have a noticeable effect.*
5. *Stab stuff: It is possible to compute a desired area of the stab using the Tail Volume calculation. A simpler rule of thumb that I have often used is the stab area be 25% of the wing area. I have recently adopted the habit of making sure I have a nice slot for the stab adjustment and start with less incidence than what is shown on the plan. I add a nylon screw at the back post for adjusting the stab at the field (again thanks to Don Srull for this advice). I use a nylon screw, a 2-56, 0-80 or 0-90. The stab has to have a hard piece of balsa to take the pressure from the screw. A piece of balsa is added to the tail post and then is drilled and tapped. I then add the very thin CA to harden the screw threads in the tapped balsa and usually have to tap it again after that. I put paraffin on the screw. Here's a top view on a ship that has a stab-up DT. Sometimes the screw will come up from the bottom instead and is adjusted through small access hole as shown on my Tom Hallman designed Mitsubishi 1MF1 [FIGURE 2]*
6. *Props: I have carved props but don't feel this is my strong suit. Rather, I have had some success with modifying plastic props. I have written an article about this for the NFFS digest [Ref.4]. I usually modify the props by trimming, cutting back on the diameter and usually adding some pitch. Currently my favorite prop/rubber combinations for scale ships are 7" with 2 loops of 3/32; 8" with 2 loops of 1/8" or a loop of 3/16 and 3/32; 9.5" with 2 loops of 3/16; 10" with a loop 3/16 and ¼ or 2loops of ¼. I usually run props that are 30 to 40% if wing span.*

Switching a prop on a new ship might be necessary and can have a big effect on both the climb and the glide. Smaller diameter props will spin faster and run the motor out but may give you a better climb. Increasing the pitch may need more rubber but will improve the glide phase. As my friend Rich Weber says, "change the prop and you have a new airplane."

7. *Motor selection, etc.: One of the most effective ways for improving the duration is by using a lot of rubber. Don Srull has a formula for estimating the amount of cross section you need. Here's how to compute it. Once the plane is finished, weight it and add 50% of that weight. That will give you a motor weight that is 33% of the all up weight. Then divide that by 90 to get a recommended motor cross section. So for example, if your plane weighs 30 grams (ballasted to balance at CG), you need a 15 gram motor. Forty-five divided by 90 is .50 so you will need a half-inch in cross section or two loops of 1/8 (or 4 strands of 1/8). For more details on estimating rubber requirements see [Ref. 5] .*

   I try to run as long a motor as I can get away with, which is usually 3-4 times the prop hook to peg length. There are a few things you need to employ in order to adopt this approach. You need to have clean interior, a Stott peg (also called a wobble peg) at the back motor peg, and a reverse "S" hook. The Stott peg is simply a spool. I use ¼" aluminum tubing with some fuel tubing at either end. Some people think you only need a spool that slides over the motor peg, but the point here is that it needs to be very loose, so the motor can move away from the sides of the fuselage as the motor unwinds. I attach the motor to the Stott peg with dental bands. I use ¼" aluminum tubing over 3/32" or 1/8" diameter motor pegs. [FIGURE 3]

There are some YouTube videos and information archived on the FAC website on how to bend an "S" hook. I have not had good success trying to use Crockett hooks with really long motors. You will also need a very tight nose block. Don't think the motor is pulling your nose block into the plane. It isn't. It is chaos in there. I use a round nose plug, with a spline to prevent rotation. You should have to push the noseblock gently into place. Glue some tissue or thin balsa until you get a good fit. My nose blocks are usually ½" deep. If you want or need to go shallower than that, small magnets are a great backup plan.

In order to run really long motors you will also need a good freewheeler. Part of my "system" is to have the motor tightly braided. I use a "tube in a tube" on the prop so that the pressure of the braided motor is taken by a piece of brass, usually .047-diameter tubing, rather than the plastic prop hub.

8. *Trimming: Getting your plane through the trimming process without wrecking it is a critical step. I have used John Koptonak's 10 step guide for trimming with good success (enter this in Google search for several web locations; Hippockets has it). I start with the plane empty, no prop and ballasted at the CG. I glide new planes a lot. I want it to go as straight as possible in the glide without the prop on it. If the plane dives or stalls, you need to adjust the incidence. If it drops a wing, you need to look for warps in the wing, stab or rudder (or rudder offset). Under guidance from Don Srull, I am trying to go to the trim field with "not-to-much" incidence in the stab and the plane balanced at the CG as calculated. Start with a conservative amount of incidence should help prevent the situation where you plane goes up into a stall.*

   Adding thrust adjustments during trimming is critical. You can use shims or sanding of the noseblock but these are not very precise. I have been a strong proponent of the Gizmo Geezer nose button [Ref. 6]. I always dial in down and right thrust before I put any turns in the motor. Thrust adjustments at the field are muche easier with the GG nosebutton. If you decide to use shims, do so carefully. Don't allow the noseblock to become loose ar be able to "rock" on the nose.

OK, so now you are balanced at the CG, and have some down/right thrust in the plane. Begin with a couple of hundred finger turns. What you want to see is a nice powered glide, no dropping of a wing or other bad habits. I try to resist the urge to start fooling with the CG and instead rely on stab adjustment and thrust adjustment, but sometimes once you get the plane high enough you start to see the flight pattern a little better. The plane will tell you what it needs. Needless to say, stab adjustment, CG and thrust adjustments are intertwined. If you increase the stab incidence there is a good chance you will need more down thrust.

When managing the power phase, be very careful of the second half as you work, up the torque ladder. There is a lot more power in the last 25% or the turns than in the last 25%. Rushing to increase the power at the end might lead to disaster.

I try to get my power adjusted so that the plane goes generally straight out of my hand and then flies right. Remember that under power the prop will pull the plane to the left, and when it starts to freewheel it will go to the right. If possible, a right-right pattern is desirable. The trick is using thrust adjustments to fly right under power, and then to keep its right wing up in the glide phase. This can usually be done through the use of Gurney flaps or a "Srull" flap as drawn by Don [FIGURE 4].

This flap will effect some turn without much rolling. As pictured here, the flap will keep the right wing "back" depending on the size and location on the wing, it can make the plane turn right or open up a left hand turn.

I almost never use real rudder adjustment to affect turn in my ships. Rudder is very effective under power. I will occasionally use a Gurney flap on the rudder if needed to keep the inside wing up in the turn, i.e. put a Gurney flap on the left side of the rudder, 1/16" X 1/2" while still allowing the plane to glide right. Whether you use the Gurney flaps or Srull flap you may need to experiment with the size and position of them on the wing to get the trim you want.

I have some ships that want to go left but it is not my preference, it's theirs. Left-right patterns will cover a lot more ground, and in my opinion the chance that you will stay centered in a thermal.

What we are aiming for in the efforts to trim, is a plane that "flies on the wing" and is not just hauled up by power and then promptly coming down. I don't have any scale plane with a reliable 2 minute motor run. I need to rely on a good glide and some good air to get to the two minutes. If your plane tends to speed up in the glide it is almost certainly due to a to forward CG or too little decalage or both. Stalling in the glide may be due to reward a CG and/or too much decalage.

Very often, damage is done due to stalls. If you start to trim and decide you need to move the CG back, there is a very good chance you will need to add downthrust. If you decrease the stab incidence you may need less downthrust and vice versa. If you are making changes to incidence or CG, you will need to be careful with the power pattern. For example, let's say you are at 50% power and decide you want to tweak he stab up to improve the glide. It would be prudent once you make that change to not go back to that 50% power level without checking the effect of the new setting on lower power.

9. *Torque meters: I remember well when Don DeLoach encouraged me to start relying on torque meters. I always thought they were too much trouble. However, it has led to a much more consistent performance in my planes. The use of a torque meter and a blast tube will be a big asset to flying scale rubber ships.*
10. *Fly with a friend: Dave Mitchell commented to me "it takes 4 eyes to trim an airplane." It really helps to have someone who is standing back from the launch to help see what the plane is doing. Plus, it's just more fun.*

I hope this information will be useful. My sincere and heartfelt thanks to all the members of the FAC and Free Flight community that have offered me such great guidance and support over the years.

References:

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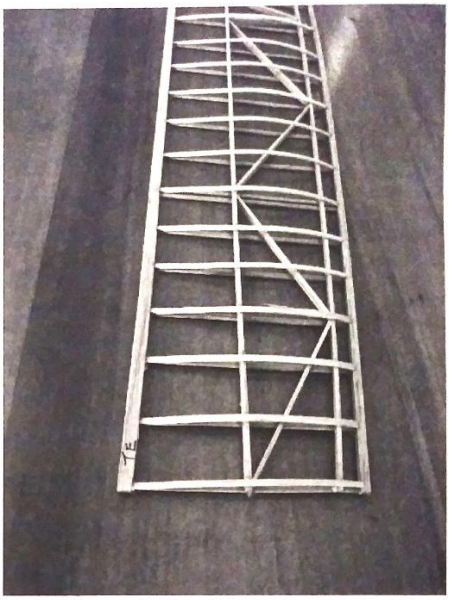

FIG. 1

FIG 2

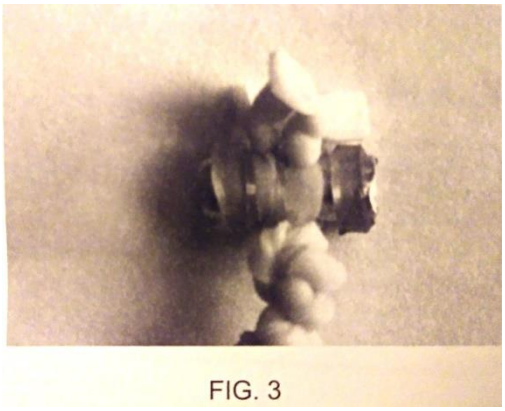

FIG. 3

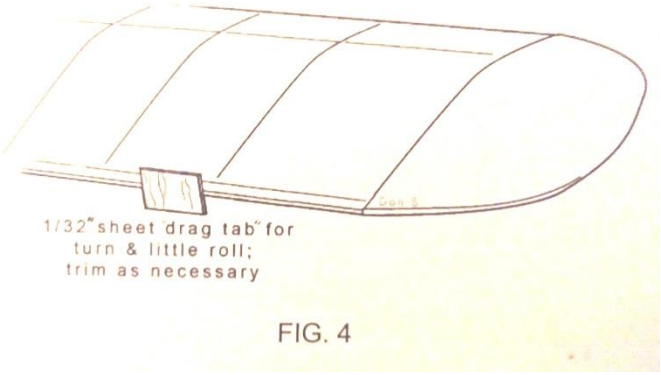

FIG. 4