

BUILDING LIGHT AND STRONG

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(Ed. Note: Although much of this talks about scale models, Henn is a long-time SAM flyer and many of his techniques here are equally valid endurance models.)

Occasionally other modelers ask me why my models are lighter than those they have built from the same plans. A few examples are my 22" wingspan Chambermaid, 13" Chambermaid, 23" Fiat G-55 and 23" Reggiane Re-2005. The big Chambermaid, built from my own plan weighs 42 grams; the Peanut from the Ruppert plan, 10 grams; the Fiat and Reggiane, both Dave Smith designs, 20 and 19 grams respectively. Dave Smith told me personally that he had built five G-55s and four Re-2005s and all of them were heavier than the two of mine by as much as 4 to 5 grams.

Although these models may not weigh as much as those built by some competitors, they are robust enough as to be capable of resisting the rigors of mass launch competition in all kinds of weather year after year.

The surfaces are firm enough to maintain proper alignment. The wings have the strength to resist folding and the fuselages more than enough torsional rigidity to withstand the torque of large motors.

The two Smith designs were built exactly as shown on the plans with the exception of the wing and stabilizer. I believe considerable weight was saved by using conventional multi spar/sheet rib wing construction instead of the cracked rib design shown on the plan. I tried the latter procedure once on a 30" wingspan Focke-Wulf Ta-152 in order to save myself the tedious job of cutting a multitude of different sized ribs. I used very light and soft 1/16" square balsa for the cross pieces which resulted in a disaster. The strip wood warped, distorting the shape of the airfoil and ruining the appearance of the wing. Even some of the strongest proponents of cracked ribs admit that the 1/16" square strips that form the rib outline must be made from rather dense wood to resist warping. Furthermore, the main spar extends from the bottom of the wing to the top which adds more unnecessary weight. The multispar wings on my Smith models use 1/20" sheet inner ribs with the ribs nearer the tip made from 1/32" sheet. Ribs this thin are also prone to warping but this can be prevented by applying adhesive to the bottom of the ribs when attaching tissue as is done with undercambered wings. Two 1/16" square spars stripped from 12-pound balsa were used on the top of the wing with none on the bottom. Experience indicates that these two spars give the wing adequate strength providing they are hardened with Cy A at the point between the three innermost ribs. Since the trailing edge adds little to the strength of a wing, it can be made from thin, soft wood. However, such a flimsy T.E. is prone to bowing when the covering material shrinks. This can be prevented with hardly any measurable weight gain by doping

a thin boron filament to the bottom of the trailing edge. An alternative to the boron would be 5-pound test Power Pro Fishing line which has the advantage of being available in white and other colors so as to be less conspicuous. Modern filament fishing lines are incredibly thin, light and stretch free. Another good use for these lines is for spiral wrapping light balsa tubular fuselages used on duration models in a direction so as to counter twisting due to the torque of the motor.

The stabilizers on both models were not built as shown on the plans but with flat-bottom cambered sections of about 6% thickness. The stabilizer ribs were cut from 5-pound balsa. Although many argue about whether stabs built in this manner improve performance, they certainly are much more warp resistant and can be made at least as light as a flat stabilizer. The entire keel and stringers on the fuselage were made from 4- to 5-pound 1/20" square balsa strips. The side stringers in the area where the model is held during launching are hardened with Cy A. The formers from the trailing edge forward were cut from 1/20" sheet and those behind the T.E. from 1/32". Since both subjects have long nose moment arms and structure behind the e.G. was of light construction, the models did not require nose ballast even though they used balsa propellers carved from light wood. Thin CyA glue was used on all tight fitting joints, applied in miniscule amounts. Unfortunately this adhesive has been given a bad name. If used in such small amounts it can provide secure joints with no significant weight gain. If pressure is held on the joints with fingertips as the glue is being applied, the strength of the joint can be assured. Duco cement was used for gap filling. Tissue was applied using a mixture of about 40% original Titebond and 60% water. Some modelers have complained that the application of such a mix causes light structures to warp as the glue is being applied. This can be prevented by applying a light coat of plain water to the opposite surface. The warps will be removed instantly and the surface will usually remain warp free after it dries. The tissue used on these models was ordinary green Esaki, tinted darker to a scale color with green chalk. Only two or three very fine dust coats of clear Krylon Krystal Klear #1301 was applied over the tissue. This was enough to bring out the color of the chalk but not enough to make the surface look glossy.

The propellers on my Fiat and Reggiane were both carved from light balsa. After sanding, several coats of CyA were applied then the propeller was finished with 400-grit sandpaper. This hardens the blades and results in a glass like finish. I believe a propeller finished in this manner can be made lighter and stronger than one covered with silkspan or Japanese tissue and then heavily doped.

It should be realized that these two Smith designs have little in common with the slab sided BF-I09s, Tonys, P-51s, Barracudas, Judys, etc. that have been winning major FAC contests in the past. Dave Smith should be complimented for designing models that have true to scale fuselage cross sections. However they require a multitude of stringers to replicate which add weight.

The two Chambermaids were built in a similar manner, but

directly from the plans with no revisions except a wing dethermalizer installed on the big model. The entire Peanut Chambermaid was built from 5- to 6-pound balsa-even the spars and fuselage longerons. The main spar between the first and second ribs was reinforced with Cy A as described in the foregoing and a few extra cross pieces were installed between the bottom longerons at the point where the model is held during launching. The ribs and formers were made from the lightest 1/32" sheet that I could find, the spars and longerons from 1/16" square and the stringers from 4-5 lb. 1/20" square. White tissue was applied using the Titebond/water mix after it had been pre-shrunk and dusted lightly with pale yellow chalk. The finished model was sprayed very lightly with two thin coats of nitrate dope.

On the big Chambermaid, some of the 1/16" sheetwood shown on the plan was replaced with 1/32" and 1/20" in areas where strength would not be compromised. As with the Peanut, the 22" version was constructed almost entirely with 5- to 6-pound balsa, the only exceptions being the fuselage longerons and the two wing spars. Even though the span of the wing was about the same as those on the two Italian fighters, it had a wider chord and had to carry more weight. Therefore the wings spars were made from 1/16x1/8" 12-pound strip wood. The spars near the base of the wing were also reinforced with a thin coat of Cy A. No spars are needed on the bottom of the wing. I have been using the same wing design for more than three decades on my Chambermaids and have never had one fold or warp to any significant extent. The propellers on both Chambermaids were also carved from light balsa and coated with Cy A.

It should be noted that all the balsa used on the above mentioned models was "A" grain. In fact I have used nothing but "A" grain on even my Jumbo and Giant scale models. I see no reason to use "B" or "C" grain. Besides, good quality, light "A" grain is much easier and more inexpensive to acquire. I always like to use wood with straight, uniform grain patterns that has no blotches or discoloration. To check for uniform density through an entire 3x36" sheet of 1/16" or thinner balsa, just hold it up in front of a bright light.

I noticed years ago that the dihedral on some of my early models with only two top spars seemed to have increased. Close examination revealed that there was a slight bow in the spars. Over time the tissue must have continued to shrink, causing this problem. This did not cause any trim problems because the wing did not twist. This bowing was eliminated on later models by running a single strand of 10 lb test monofilament directly behind each of the spars on the bottom of the wing. A slit about 1/8" deep was made in each rib and the mono inserted from the root rib to the tip. After the monofilament was installed, the slack was pulled out (no tension) and the joints glued with Cy A. The monofilament ran just under the tissue but did not touch it. Since the monofilament could stretch, it allowed the wing to remain flexible. This worked fine and added considerable strength with no measurable weight gain. Of course this would be of little use on thin airfoils but my models used 10% thick Neelmeyer sections. (See Airfoil article elsewhere in this rag)

I have heard many scale modelers claim that a few grams of weight is of no consequence. The same is said about variations in wing airfoils. I differ with the opinions of these people. Anyone who has been watching mass launch events for a while must have observed that frequently the winning model only land within seconds of other models. Occasionally I have witnessed the first, second and third winning models landing at almost the same time. With such close competition it should be obvious that many factors determine the outcome of these events with wing loading probably being the most important.

The four models covered in this article have outstanding contest records. The G-55 was flown at local contests with 15% rubber for six seasons without a loss. Although the Reggiane's record is not as impressive, it flies just as well as the Fiat. I've lost a few times because I dorked the launch. Otherwise the Re-2005 won every contest in which it was entered. I flew the G-55 in WWII at Geneseo 2007 with a heavy motor. It flew fine on the early heats, and was among the last down. It was flying equally as well as the G-55 that eventually won the event, but it got eliminated due to a broken motor.

The record of the Peanut Chambermaid was essentially the same. A few were lost to thermals but their replacements went on to win local events. The four that I built all weighed between 10 and 10.5 grams. The last one built won the Greve Race at the 2006 FAC Nats flying against much larger models. During one of the early heats it even survived a mid-air with Frank Rowsome's big Chambermaid. Frank's model went right in but the little Peanut prevailed with little damage.

My big Chambermaid easily won the Shell Speed Dash at Geneseo 2007 with three maximum flights. Actually these flights were three minutes or more with the model very high when the DT went off at about 2:30. The same model went on to win the Greve at the same contest. Despite the fact that it stalled on the last heat and almost hit the ground before climbing higher than the rest of the models.

I learned long ago that the secret of winning FAC mass launch and non-judged events was to have a model that is light enough to max time after time but durable enough to withstand constant contest flying without going out of trim or breaking.