RUBBER SCALE TWINS, REDUX

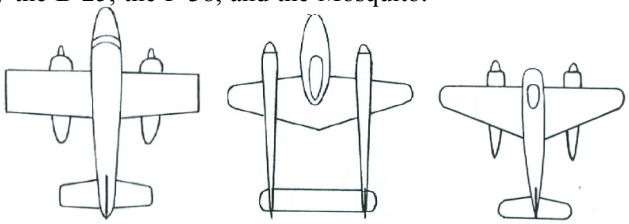
ByTom Arnold, March 2010

Over 25 years ago I got hooked on twin rubber scale models. I blame it all on Dick Howard of the Arizona Cactus Squadron as, besides being a great guy, he made it all look so easy. He attended the Flightmaster contests in Los Angeles and would literally fly his models right from the trunk of his car. I had never seen a twin rubber model fly before as I was struggling just to get a single motor subject to behave, let alone take on TWO of those cranky power plants. The eternal vision I have is seeing a pretty little 24" span Me 410 spiraling upwards to cruise, it seemed, forever back and forth over the cars. I well remember the yellow nacelle undersides and that speckled camouflage with the sun shining through. Ah, the days of youth.

Dick was a believer in minimalism in structure and he was able to do a great job of keeping wood volume down and distracting the eye with clever markings and camouflage. He also was one of those guys who just sort of knew what sort of motor would go with what prop and he got max performance with what he had. The result was he whipped everybody with a new airplane or two every time he came to the coast contests. I jumped into the twin fray with glee and fortunately had Dick to compete with regularly and just flying with a great modeler will teach you volumes. After a few years I wrote an article for FM on flying twins as I was so taken with them but since then a lot has been learned and unlearned and in case anybody stumbles across those old articles, let me offer this as an update as a lot has changed since then.

Planform

There are 3 general planforms of twins. They are exemplified by the B-25, the P-38, and the Mosquito.



All three have their little quirks due strictly to their unique shapes. First off let's look at the P-38 with its twin booms. At first glance it looks like a sure winner with those long booms and small fuselage leading you to think that a lot of rubber can be carried and the weight will be minimal because of the pod. In spite of being a piece of stunning industrial art, the P-38's shape will give you one of the heaviest models at the field IF you are not careful. There is double of everything behind the CG---twice as many bulkheads, twice as many fins, and twice as many stringers which translates into twice as much weight. A normal single fuselage has usually 12 stringers to fill out its oval shape and those stringers are usually of hard (heavier) A-grain balsa. The twin boom subject has 24 of those. Now double the wood in the fins and compare it all to the lessened lumber behind a B-25's CG.

There's more though. Most twin boom subjects have the boom tapering down to meld into the tail assembly and in actual practice give no room for all that rubber you were hoping to carry. The motor pegs on a P-38 wind up having to be placed almost at the end of the fuselage pod. So much for dreams of 2 minute flights. There is one nice aspect about this planform and that is the nose sticks out quite a ways for lots of ballast leverage. There are other twin boom types without the center pod like the F-82 which give much more internal volume but they are particularly prone to needing lots of stringers to fill out the aft shape. So all in all, they are doable---Dick had a great flying P-38---but you have to work around their weaknesses.

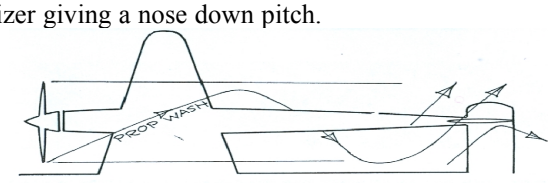
Next comes the Mosquito. Right away the careful builder sees his challenge---EVERYTHING seems to be behind the CG. It seems like almost a hopeless case and I think that is why you see so few Mossies at the field as they are not even attempted. Ah, but there is gold there and here is why. First, the planform is not as bad as the P-38 as you only have one of everything. Look at it this way---you only have HALF the weight of structure of the Lightening. The other hidden benefit is that the engines sticking out in front give a place to put the ballast and in comparing the distance from the CG to prop it is not as bad as some of the popular WWI aircraft's noses.

A second bennie that the snub nose twin has is that often you can swing a lot bigger prop than other types of twins. Clive Gamble' s high flying Welkin's secret weapon was the fact it could swing nice, big 8" props. As you may recall it came in second in WWII mass launch at Geneseo a few years back which is not chopped liver.

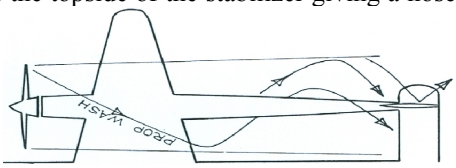
Last comes the most common twin motor configuration, the B-25. It is popular for good reason. There is no double lumber back of the CG, it has a forward nose for lots of leverage and minimal ballast placement, and many are high wing configurations to boot. Many have long nacelles extending back of the wing for a good motor length but its one flaw is mighty. There is precious little room between the prop shaft and the fuselage side yielding small, inefficient props. You can scoot the nacelles out a bit for a bigger prop, but if you are in FAC competition, the judges can spot that fudging very easily. For some reason the human eye can really pick up that change quickly but not something like a fuselage stretch---go figure.

Propwash

Propwash is the rotating blanket of air that flows back around the fuselage in the rotational direction of the prop. On a single motor aircraft it causes yaw by how it hits the fin and we all usually ignore it or cancel it with the usual trimming process. Twin boom aircraft are affected in pitch, of all things, by this strong swirl of air. If the props turn OUTWARDS at the top of their arcs, the swirl hits the underside of the horizontal stabilizer giving a nose down pitch.

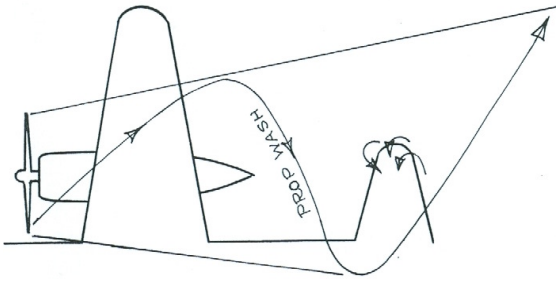


If the props turn INWARDS at the top of their arcs, the swirl hits the topside of the stabilizer giving a nose up pitch.



Of course the placement of the fins can block some of this swirl which means some aircraft will be greatly affected and others not.

Since we like downthrust anyway, I have my props rotate out-at-the-top to help in that mode. I have also had the resulting pitch so strong that it was like the aircraft kept trying for an outside loop. In a case like that, just switch the props and charge on. I don't think there is any one best prop rotation direction for a model twin, but I do keep the "try switching the props" as a possible trimming cure in my bag of tricks. On the B-25/Mosquito planform the affect is very weak.



It appears that the lack of a boom to channel the swirl to the tail allows it just to dissipate with little influence.

Props

Oh, man, this can be sheer voodoo. I admittedly struggle with the elusive prop and motor combination in all of my models, twins are no exception. The smart thing to do is to pick a prop and motor combo that has given you good results in a single engine configuration in the past. Now just design a nacelle around it and that will give you the size of the finished twin. There's just one problem----it is **BIG.** Maybe too big for your taste and you are like me and don't like to build jumbos. So that means going to a smaller prop and hopefully you have had good luck with some power package with a prop under 8" on your single engine subjects. The thing you want to avoid is to build the twin to some wingspan you like, and THEN have to deal with the motor package as the last thing. You will always come up with some oddball prop size and then it is a grind to test-test-test fly trying to find the best motor size for it. Invariably, it will require stripping some rubber for an equally oddball motor thickness. Constantly having to test fly and change TWO motors as you zero in on good motor size is a real pain in the wazoo. The moral of the story is to start with the prop size and work backwards to the model size.

So, let's say you have a prop size but it is really small and you want to get the maximum performance out of it. There are three routes to take: more and wider blades OR long motor run at high rpm OR higher pitch props. The bigger blade route seems to be the logical way to go as big paddle blades can shovel more air, however, they don't seem to be as effective as you would think and in the glide they are huge drag plates even when freewheeling. They work, but not well. The next route is long motor runs with lower pitched props which do work fantastically well as the air is getting shoveled back in smaller bites and very quickly. Sort of like driving in low gear. You know the problem, though----there is no long motor run in a short nacelle, however, with the current practice of using a "wobbly peg" combined with a big fat nacelle as in a Westland Whirlwind, this approach has potential. The last trick is to go to a higher pitched prop, combined with a fast launch to get up to speed. Sort of like driving in high gear with a push start. I had a lead sled with high pitched props like that which would wallow around through the air until it would finally fall exhausted after every flight. In desperation, I gave it the hardest javelin launch I could muster and was astounded at the resulting flight. The problem in that airplane was weight and hard launches eventually destroyed it but it did demonstrate the effectiveness of the higher pitched props. This area I am currently exploring so I cannot give any solid opinion on but combine a LIGHT aircraft with higher pitched props and I think there is hope. For definitions sake, I consider a P/D ratio of 1.0 to be low and 1.4 to be high for outdoor free flight scale subjects.

Winding and Launching

This is almost a non-issue but it seems to remain a big bug-a-boo to a builder contemplating a twin. While I have seen beautiful custom stooges for twins that hold both motor pegs at the same time, it really is not required. I have used my old beat-up, standard stooge for both singles and twins since I started. For some reason, guys fear that when they hook up a twin's nacelle to a stooge and the opposite side is hanging out there unsupported, it is going to bust. It won't, believe me. Look at it this way: you can pick up your model by one nacelle, can't you? Of course, and it doesn't break the wing off, does it? No, and neither will your stooge.

Now you DO have to wind the motor that is CAPTURED in your stooge. To wind the other one is a sure crowd pleaser as that WILL take a wing off. I don't want to talk about it, OK?

As far as pinning motors, the only one that is pinned is the first one wound, such that it can hold the winds as you wind the second. When the second is wound, the model is grasped at the nose such that your left hand fouls both the props in some way----it is a natural move. Unpin the nacelle from the stooge, unpin the first prop, grasp the aircraft with your right hand in the usual spot on the belly and walk out in the field. Lift it above your head, take the left hand away from the nose, and launch. It is all very natural moves and you will do it unconsciously. While I have seen guys with pins and lines attached to sticks to pull out prior to launch, I have also seen those things tangle, hang up, stick and cause the "launch hand" to crunch the model. Trimotors and more require those things but not twins.

Probably the simplest prop holder I have ever seen for a trimotor was Dave Rees when he held a big pad of sponge rubber under the nose of a trimotor with his left hand and just dropped it to his side at launch.

When it comes to winding, the only thing to keep in mind is to put the same number of winds in both motors or at least to within 5-10%. A myth is that a twin will roll over due to asymmetric thrust at the end of the motor run if there is a difference in torque or winds. If there IS any difference, it is at the end of the motor run when there is about 2 Butterfly power left in the motors and the model normally is trimmed to handle worse upsets. You won't even see it. Needless to say, a counter on your winder is a wonderful thing to have.

Trimming

There are two schools of thought regarding thrust adjustments. One says to make your props rotate the same way just for convenience sake. You never have to worry about winding a prop the wrong way (again, a real crowd pleaser) and you can use commercial props. The thought is that torque is something that a modeler has learned to deal with long ago with his single engine subjects so what's new? In fact, one common method of dealing with a left torque roll is to put a few degrees more downthrust in the right engine instead of the sidethrust thing. Cool.

The other school says to make them contra-rotating as there are enough fiddly things to deal with in a twin in the first place that you might as well get rid of an old headache from the git-go. You will probably experiment with props anyway so you might as well get used to making them. The biggest advantage, though, is that under the pressure of a contest, with the winds cranked in and the motors groaning and dripping lube, you can launch at the highest torque you have, and all it will do is rocket up as straight as an arrow. I almost cry at the memories of torque rolls into the ground of a model that flew fine at 80% winds but destroyed itself at 90%. This is obviously a contest thing.

Nacelle-Wing Intersections

Here is a whifferdill about twins most guys never anticipate until it comes time to stick all the parts together. Trying to join wings and nacelles symmetrically with dihedral and an angle of incidence in concert with the fuselage can get a bit maddening. In all cases, use SLOW drying glue as you will seldom hit it right the first time. I first join the nacelles to the wing, very carefully making sure their vertical centerlines are, indeed, vertical compared to the dihedral of the wings. Lots of shimming and pinning is done here as the sides of the nacelle each meet the wing differently. Then the angle of incidence is shimmed in---more fiddling, but no glue yet just pins. By sighting sideways to the wing, I can insure that both nacelles are parallel to each other and when all looks well, vital points are tack glued together. I check yet again for symmetry all around and then permanently glue things together and fill in at that 90 degree junction between nacelle and wing with tissue anchors. I realize that with some careful planning and measuring, you could cut some wing saddles and install them on the nacelles before even bringing the two together and it should all fall into place correctly. In fact, you could even make the saddles too big and then sand each down to make it all fit and that works too but double check everything before you hit it with glue. Misaligned nacelles are almost impossible to work around in the trimming stage.

Many nacelles centerlines go inconveniently right through the wing such that in order to load a rubber motor the major structural components have to get butchered like spars and trailing edges. Fortunately, a wonderful stuff will allow us to get away with murder----carbon fiber. This stuff in now pretty common and comes in all sorts of forms at your local RC emporium. I have used 1/16th diameter carbon rod as the very top edge of a spar and have cut away everything below it and the wing has held just fine. Just be sure that your carbon rod extends a good amount along the spar on either side of the cut out and is well anchored with glue. You can also use carbon fiber "Tow" which is a soft hair-like form of it and run it around the edge of a nacelle bulkhead and it creates a tremendously strong ring that can be incorporated into a spar or leading/trailing edge. I dampen the stuff before I work with it to keep it from getting all tangled and then hit it with CYA glue when in the right position. Carbon fiber is wonderful stuff and its only drawback is you have to be careful not to get so enamored with it that you over use it!

Before the wing is dropped into place in the fuselage, complete the noseblock assemblies and run a piece of long music wire shaft through both of them, sight between them and make any adjustments needed to bring them parallel. This is hard to do with a fuselage in place as you can imagine.

Noseblocks

A good noseblock in any rubber model is a must and in twins, it becomes even more critical if that is possible. A good noseblock can be defined as one that (1) holds a thrust adjustment time after time in spite of numerous hand removals and forced pop-outs on landings and (2) allows you to make changes in the thrust adjustments and continue to hold it. Unfortunately, most of those wind up being pretty ugly but hey, who said twins were easy? Let me suggest that whatever works well for you in a single engine set-up, use in your twins and go look there FIRST if you have trim problems. I have found about 90% of my trim problems come from noseblocks not doing what I thought they were doing. Usually it was because of a worn noseblock, the prop shaft would point in one direction with a fully wound motor and then would move to another direction as the motor ran down. You could live with that in a single but in a twin, it will drive you to strong drink.

Final thoughts

Since those first days of multi-motored rubber scale, some amazing airplanes have flown and I do mean "flown" not just sitting there looking pretty. Dennis Norman and his 4 engined bombers---I think he has had a Lancaster, a B-17, and a B-24---all wowed the crowds at Geneseo in past years (he's working on a Constellation now). Dave Rees has flown trimotors of all stripes and makes it look easy, and Chris Starleaf continues to knock the socks off skeptics with everything from B-24s to B-47s (rapier multiengine, no less). Clive Gamble came in second in the NATS WWII mass launch a few years ago with a Westland Welkin as mentioned which was a jaw dropper and Vance Gilbert brings out old multi-engine airliners just for fun. There just aren't the mental barriers about twins anymore. It is sort of like when Roger Bannister broke the 4 minute mile----it had never been done until his run and then after, it seemed like every other meet had a guy break it again. Somebody will do the Spuce Goose yet!