OPTIMUM RUDDER SIZING

An article published in the 2016-3 Issue of MaxFax as a part of a series of articles by a mysterious author—containing some worthwhile ideas

In a heroic quest to bring information to the masses, dedicated sleuths continually scan the airwaves for stray messages that shine light into the shadowy corners of the secret processes of the great powers! Yes modelers! It's time for another thrilling episode of ….

RADIO INTERCEPTS !!!

Today's episode: (R)udder Madness Continues!

(static) brought up the subject of steep climbs for our ML ships. I shared my observations on my two (static), both of which climbed very steeply and would maintain that high rate of climb right on through the end of the motor run. I believe the fin and rudder size of both of these ships is at the extreme low end of the spectrum, and are sized just a whisker above the point where Dutch roll in the glide disappears. The (static) flew right off the board with the size shown on the (static) plan. The (static) needed a bit of clear plastic added at the tail skid to enlarge the vertical area just past the point where Dutch roll was eliminated. Add to this the fact that (static) had a new (static) with a fin and rudder sized at 90% of scale, and it climbed and performed really well in WW II. Any others have data points on this topic?

I guess what [learned to-day is that half a Dutch roll is still a Dutch roll. A model that needs more rudder area can Dutch roll just half of one cycle . .1!" my model had a full right-to-left and left-to- right swing I would have said "Bingo. Add rudder." Half a Dutch roll was what I saw and failed to identify or rectify til today. Sorta like that lyric from the Beatles' "Day Tripper." It took me a while to find out ... but I found out. .. lt only took one flight with a Rube Goldberg style additional rudder area and suddenly my school school yard testing field is way too small!

I have really focused my efforts on prop/rubber combinations, and after several models realize that I still have a lot to learn. My own approach has been to get the model to leave my hand in a straight upward path ... it can turn to either direction after that, but I try to trim so that the first several seconds has it climbing straight and then go into a turn. I have gotten in to some trouble with this at times since most of my stuff really covers ground and uses up a lot of the field. I probably need to learn to trim for a circle better than I do now but I always shy away from using rudder since it is so powerful.

My (static) has been a troubling ship, capable of some good flights but with a strong tendency to fly tight in whatever direction it gets pointed, and with that long nose it is extremely sensitive to thrust line adjustments .. I think that using the "double gurney flap" on the rudder has fixed that, but more flying will be needed to finally confirm that. As pointed out to my by (static), almost all of Earl Stahl's ships have that same tendency to be too directionally stable. In hindsight, it certainly was true of my (static). I wonder if more experimentation with double **gurney flaps** would be beneficial..

I haven't yet had any brilliant successes with the double gurney flaps on the vertical tail. Only tried it a few times, and I'm planning to give it a go on a couple of reluctant models currently on the "to be sorted out" list. If nothing else, it's a quick and cheap trick to throw at the spiral dive problem, and if it doesn't work, it's easy to go back to square one.

The horizontal tail is pretty easy to measure, even if you want to go all mathematical and use that formula for tail volume. There's also very little downside to having too much of that good thing. The

vertical component seems to be a lot more slippery. For one thing, it's affected by several other components of the model's layout. The amount of dihedral has a huge impact on spiral stability, and the size of the prop comes into play too. I suspect that the position of the stab may play a roll, changing the vertical area that is somewhat blanked out of the propwash depending on where it's situated.

All that conjectural/theoretical blather aside, my recent escapades with the (static) have reinforced the idea that the vertical tail component is the key to solving a lot of those spiral problems. It flew like stink until the stooge incident that crushed the fuselage. (Self inflicted) As originally built, it could be touchy. I added vertical tail area with some packing tape, and it was pretty much locked in from that point on. With the same wing on a new fuselage and a new V tail that had the same area as the old one plus tape, I couldn't get it to stay in the sky. Maybe the tape was a figment, with enough flexibility to stay out of the way? I gave up on that set up and stuck an all-sheet V tail on it. I went to the field with a pair of scissors and chopped the heck out of that thing until the model behaved. It worked, but I was pretty astounded at how small it got before the model started behaving. With a new built up V tail, it's now as reliable as before the intervention by Dorkus. I don't dare wind it up all the way on our little field. **McCombs** sez that a larger prop is another way to reduce the effectiveness of the V tail. Hung only knows what other problems that opens up ...

I read an article on FIG Coupe' models about using PGI trimming (essentially a simpler locked down model rather than all auto surfaces) that referenced a bunch of work done by Jean Wantzenriether in the 70'S and 80'S. On fin size, it said in order to ensure a full climb throughout the power run the fin must be of the smallest size possible - just large enough to prevent dutch roll, otherwise the model would hook to the right and flatten out rather than continue a steady right spiral climb.

Good insight. I think that is one of the reasons the Fokker. DVII is such a competitive ship for so many. I know from experimenting with mine (built from the (static) plan) that the fin and rudder area is so very close to the lower Dutch roll limit.

I've never paid much attention to fin size other than making sure it is somewhere between large - spirally unstable and small - dutch roll ... think I may be looking a bit harder now.

And that is my take-away from this too. 1 will be 'watching that fin area relationship more closely. On a scale ship, it may be difficult to make the fin significantly smaller, while the stab gets a bit larger. (static)'s (static) had both surfaces going in different directions: larger stab, and smaller rudder.] think one needs to be careful not to let the aesthetics get too far out of whack on a judged scale ship.

I was reading Haufman's book on the gliders and it is amazing how far those guys get into this topic for their designs. Bottom line, they just want enough to have the effect of direction like for a dart. I've come to believe that there's some wisdom in that idea for FF rubber too.

I realize flight stability is a complicated subject. I'vc had some misadventures. I scratch built a lot of models of my own design when a teenager .. Many sported low amounts of dihedral. One of my early rudder only planes that flew well developed spiral instability when I moved the CC forward and increased the decalage. It suddenly developed the tendency to go from level flight into tightening spirals in eithcr direction. I didn't understand that until years later. Moving the CC forward increased the effectiveness of the vertical tail, keeping the nose pointed closer to the relative wind, reducing the dihedral effect.. Some years later, I had the privilege of hearing Carl Goldberg speak at my RC club a longtime ago. Carl showed us a simple balsa glider with no vertical tail. it new fine. With a bit of weight added on one wing. it crabbed. but still flew fine. Carl added a bit of vertical stabilizer. and it

spiraled in toward the heavier wing. What amazed me about the demonstration was that it new straight with the unbalanced wing. as long us there was very little vertical area behind the CG.

I'm not clever enough to think of a way to calculate the best size for a vertical tail. I have to resort to a "cut and try" method. Mostly I just leave well enough alone if a model will fly ok with whatever was on the original plan, even if it's not optimal. Reluctant fliers get the whole treatment, and end up with what is probably a better set up than the models that started out flying happy.

We do indeed have to be careful that we don't destroy the scale look of a model with mods to the tail. The vertical tail is a big part of the profile of a ship. A little fudging on the size can slide by ok, but if major reductions are required I think you have to go with one of the other work-a rounds. The old method was to put a soft hinge on the rudder and let it flop in the breeze, effectively taking it out of the equation. Double gurneys on the V tail look to offer some hope too. The flaps can be colored to match the airframe to make them less obtrusive.

I did some test flying over the weekend and had some success with the double gurneys. There were three models with me that had all exhibited good flight potential, but were plagued by right spiral-itis. Two of them responded to the flaps like they'd been touched by a magic wand. Forehead slapping moment as I thought of all the time I'd wasted trying to tweak away the spiral.

The third one didn't care one bit about those flaps. There was no change at all in the flight characteristics. Going in, I wasn't optimistic that they'd work on it because it has a V tail that (by eyeball engineering) looks to be on the smallish side. It was gliding without a hint of Dutch roll so I figured it wouldn't hurt anything to try. I ended up adding gurney flaps in various locations on the right wing. I got a crabbing flight, and still had a spiral at the end.

I've been over this ship six ways trying to find a warp or misalignment to explain the problem, and it looks ok to me. Flies pretty good too, except for that last part. So I gave up on the flaps and pulled all of them off. One more flight to confirm that it was still spiraling, and then I started messing with the stab. Ok, this ain't pretty and I'm not proud of it, but when I added a bit of "up" on the left elevator, the thing flew like it was supposed to. Please don't tell anyone ..

Prop size does count against it as well, someone told me that the effective side area of the prop (for a 2 blade prop) is effectively the side view of one blade. I know that changing from an 8" pecks to a 8" high pitch carved unit is quite a significant change in area. Going back to what (static) said about Earl Stahl and the rudders being too large, they were probably fine with the big hand carved wooden props they were using back then.

I was sticking some double gurneys on the V tail of one of the problematic models and a question came to mind. Does it matter where those little flaps go? I have put them near the rudder line in the past. Maybe they'd be more effective if they were at mid chord, or at the TE? Theoretically speaking, right about where the "center of lift" might be on an airfoiled wing. What better place to destroy lift/ effectiveness?

In preparing the (static) last night, I mounted small 1/32 sq balsa gurney flaps to either side of the rudder hinge line as discussed recently in this forum. The (static) has always frustrated me over the years spiraling readily to either the left or right. I attributed this to the highly tapered, pointy wing planform. That said, the model was light, and when it did fly it could uncork some nice nimbus-nudging flights. I do believe that the rudder gurney flaps worked for me today, because while the

model would still drop a wing and turn tightly to the left, it was damped some and I could use opposite rudder tweak to flatten the turn without driving the model into a right spiral as so often had been the case before. So thought I'd share this empirical evidence from the field on this spiral instability management technique ....