THE

Hartill

SCATER

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President: Craig Cusick
Editor: Bill Hartill, 7513 Sausalito, Canoga Park, Calif.
Corresponding Secretary: John Wordin, 2915 W. Victory Blvd., Apt. F Burbank, Calif.
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TIRED OF "SPECIALIZING"?

One of the arguments often promoted in favor of sticking to one event is that you just can't be good in two or three. As a result many of us plug along in our specialty and quite often get discouraged when we hit a slump.

I for one believe that it pays to try a different event occasionally if for no other reason than to take advantage of a "change of pace." There seems to be considerable evidence that this helps. For example:

Jim Patterson (Scat) considered himself a gas flier, did quite well, too. Jim was on the FAI power team in 1958 having beaten out everybody else in the Western district. Then in 1960 he started fiddling with Wakefield and presto, he was on the 1961 Wakefield team. Now, of course, it didn't happen that easy. Jim really threw himself into the Wakefield "spirit" and worked very hard. He was Pirelli, skewed hinges, ball bearings, side thrust, and max turns from morning till night. The extra effort he generated that made the difference came from his newly found fascination with this "new" event.

Other examples of event switchers:

Ron Draper (England) won FAI power in 1956, was on the British 1958 Wakefield team and in 1962 became the first British flier to break 40 mins. while flying in the Indoor World Championships. Now he has to try Nordic.

Dave Kneeland (USA) won FAI power in 1953 and was 3rd in 1954. Now 10 years later Dave is on the Wakefield team.

Bond Baker (Australia) won Wakefield in 1958 and almost won FAI power, too, coming in 3rd!

Quite often we get in a rut, pounding along with the same old approach. After awhile we get the idea that this approach has to be the best one because we have been using it so long. But stop and think a minute. If you aren't the World Champion, then you don't have something right, like maybe your horseshoe slipped. Try a different event. Chances are you will bring an open mind and a keen desire to roll up your sleeves and work hard. You won't be weighted down with a lot of prejudice as to how it should be done. OK, everybody, switch and start new ruts.

JOHN WOODS (Winnipeg, Manitoba)

I found your letter again that you wrote to John Wordin describing Val Ure's "Failander" that we published in the Star Studded March issue. Now it all makes sense. John says:

> "Here is a new interpretation of an old standard. Val Ure's modifications to the "Dixielander" make his "Failander" at least as original as most of todays power planes. Val is honest enough to credit the parent design.
>
> The wing construction has proved itself an excellent layout for thin sections. There is no flutter or sign of warping and longitudinal strength is quite adequate. The climb is very fast even though Val trims for a couple of full twins in 10 seconds to ensure consistent recovery without auto-rudder. The glide is, of course, on the fast side but the rate of descent does not appear to be out of line, in spite of the thin sections."

NIGHTMARE DEPT.

Continually haunted by the fear that we will publish plans from another newsletter that got them from another newsletter, that got them from us.

BRILLANT IDEA DEPT.

After considerable thought and design analysis have come up with the ideal Nordic A-2 configuration--a parachute! No need for auto-rudder, it would tow perfectly. What's that Charlie, it would sink too fast? But Charlie, you don't release it till it's in a thermal anyway and then anything will go up. The gadget that will make all this possible will be a positive release mechanism whereby the launcher can cast off only when he wants to.

Now, how do you figure projected area of a parachute?

SOCIAL EVENTS:

Dick and Elsie Gildersleeve (Scat) took the big silver bird back to Middl town, New York, for a week's vacation. Report pleasant trip but were almost overcome by east coast type humidity. They made the scene down on the farm with Elsie driving the "Poppin Johnny" and Dick hustling the hay bales.

The Trego's finally figured out what to do with their green Chevy wagon, they barbecued it. The carburetor fire was a roaring success!

Jim Patterson has discovered a new event. Hi Fi Cabinets.

Did you ever try to dope with rubber-lube? One of the Scat members can tell you all about it. Who do you think it was?

IDEAS THAT FLOPPED

Starting with this issue we are inaugurating a new service. We will present detailed information on ideas, designs, techniques, etc., that didn't make the grade. We have the feeling that there is a vast back-log of material just waiting to be published. To start the ball rolling your Editor has graciously consented to provide the first item.

This gem is variously known as Hartill's screwed up airscrew or the case of the short sheeted shingle.

A while back there appeared an article in one of the English magazines on how to make a Rubber prop from laminated sheets. Well I figured this might be the answer. Rather than do it the way the article said I thought I would pioneer. Remembering Bob Wiehle's comments that Resorcinal type glue does not pull up I used it to glue up about 5 layers of 1/32 sheet wrapped onto a carved form. Waited about two days to make sure everything was dry and took it off the form. Then carved and sanded down to final shape. The blades looked real pretty with the glue laminations looking like contour maps of the Gobi desert. Then about four days later, what a mess! The blades went crazy and twisted all over the place. Haven't had the time since to check out why this great concept didn't work out, but we sure had a lot of belly laughs over those blades!

WHAT SIZE TAIL(by Bill Bogart, Westerville, Ohio)
(Part I of a two part article)

What size tail, indeed. Stabs traditionally have been between 30-40 percent of the wing area for gas and rubber powered models and 20-25 percent for towline gliders. Why this size in particular? Well, it looks right, they say. Why does it look right? Because most of the models have been designed this way for 30 years or more and the airplanes fly fine. Why not make the stabs bigger? They are too stable, or if the CG is moved aft it won't fly as well. Why not make the tails smaller? The airplanes will be unstable and negadive in. Why not move the CG forward? The nose is short and takes a lot of weight to do it right. Besides, my airplane flies fine. Just look at the trophies it has won for me. Why should I change my design?

By and large, most of us would put ourselves in the place of the modeler answering the questions above. And rightly so, if we did in fact have a string of trophies. You can't beat success as long as success is on your side. However, if modeling is ever to advance, changes must be explored and tried. Look what the engines have done to our design in the last ten years. The Zeek with a Torp 19 can be out-climbed and out-glided by many of today's warriors with a Torp or Cox 15, due mainly to the increased horsepower producing greater heights. The increased power permits (yea, demands) larger wings which improve the glide. Although that modeler with the Zeek was successful years ago, his model would not be today.

While the engine has caused changes in model design, there has been very little change in successful design. High thrust line has been seen more and more lately but still has not dominated nor placed well in the International FAI competition.

The writer has taken the part of the questioner and has pondered tail size for some time. The first results of the pondering were printed in MODEL AIRPLANE NEWS in January 1959 and in Zaic's 1959-61 Yearbook relating the CG to the tail size and tail length. More recently, reliable lift and drag data on three sections appeared in AEROMODELLER February 1962. These two pieces of data along with well established methods of calculating wing and tail lift permitted the writer to determine the effects of tail size, tail length, and degree of stability on the rate of sink in the glide. These three factors affect the design model directly. Different airfoils can also be compared.

Because of the large number of variables being considered, the author has made use of digital computing machinery to which he is most indebted.

The findings of this study have been extremely interesting. In some instances there is proof by calculation of some of the flight characteristics with which we are most familiar. In other cases, pure revelation.

The purpose of this paper and those to follow is to state the study findings to date and present data and methods in support thereof. If only the findings were stated, the reader would only agree or disagree.

However, support information for the findings will be outlined in broad enough detail to enable those so inclined to proceed on their own or to determine whether the author is right or not.

The paper to follow will discuss the following areas: derivation of equations and symbols and a review of the results considering rate of sink as affected by tail area, tail length, margin of stability, and several other factors. One section of interest will discuss the breakdown of lift and drag into their many sources to show relative magnitudes. From this information the reader will learn what he can work on to reduce drag most effectively.

A word now about the methods used in this study. Since the angle of glide is small, the airplane lift is assumed equal to the airplane weight. The airplane lift is composed of wing lift and tail lift. In some cases, the tail lift is negative or downward, causing the wing lift to be greater than the weight. Not only must the wing and tail lift equal the weight, but their moments about the CG must also be equal. The wing has two moments; one due to camber and one due to lift acting at the quarterchord along with its distance to the CG. The tail generally has camber, but its effect is neglected due to the relative size and generally less camber than the wing. In order to facilitate the equations, lift and drag coefficients are used.

Symbols:

C_L Lift coefficient = $L / \frac{1}{2} \rho V^2 S_W$

C_{Lw} Wing lift coefficient = $L_w / \frac{1}{2} \rho V^2 S_w$

C_{LH} Horizontal tail lift coefficient = $L_H / \frac{1}{2} \rho V^2 S_H$

$C_{L(H)}$ Horizontal tail lift coefficient = $L_H / \frac{1}{2} \rho V^2 S_W$

L Lift in ounces

L_W Wing lift

L_H	Horizontal tail lift
ρ	Air density in slugs/ft^3 = .002378
V	Airplane speed in ft/sec.
S_W	Reference (wing) area in sq. inches
S_H	Horizontal tail area in sq. inches
S_{TOT}	Sum of wing and horizontal tail area
C_D	Drag coefficient = $D/\frac{1}{2}\rho V^2 S_W$
D	Drag in ounces
C_{DW}	Wing drag coefficient
C_{DH}	Horizontal tail drag coefficient
$C_{D\epsilon}$	Drag coefficient due to downwash from the wing
ϵ	Downwash angle in radians
C_{Di}	Induced drag coefficient
C_{DiW}	Wing induced drag coefficient
C_{DiH}	Horizontal tail induced drag coefficient
C_{DPW}	Wing profile drag coefficient
C_{DPH}	Horizontal tail profile drag coefficient
ΔC_{DP}	Drag coefficient including engine, body and vertical tail
CG	Center of gravity position
ac	Aerodynamic center model minus tail - point on MAC where lift is assumed to act - assumed as 25% MAC for this study
$\bar{c}$	Mean aerodynamic chord (MAC)
$\frac{d\epsilon}{dC_{LW}}$	Rate of change of downwash angle with wing lift coefficient
W	Airplane weight in ounces
AR_W	Wing aspect ratio
AR_H	Horizontal tail aspect ratio
C_M	Pitching moment coefficient
C_{MOM-T}	Pitching moment coefficient at zero lift, model minus tail

l_{T_o} Tail length, measured from the leading edge of the wing MAC to the quarter-chord point on the horizontal tail MAC

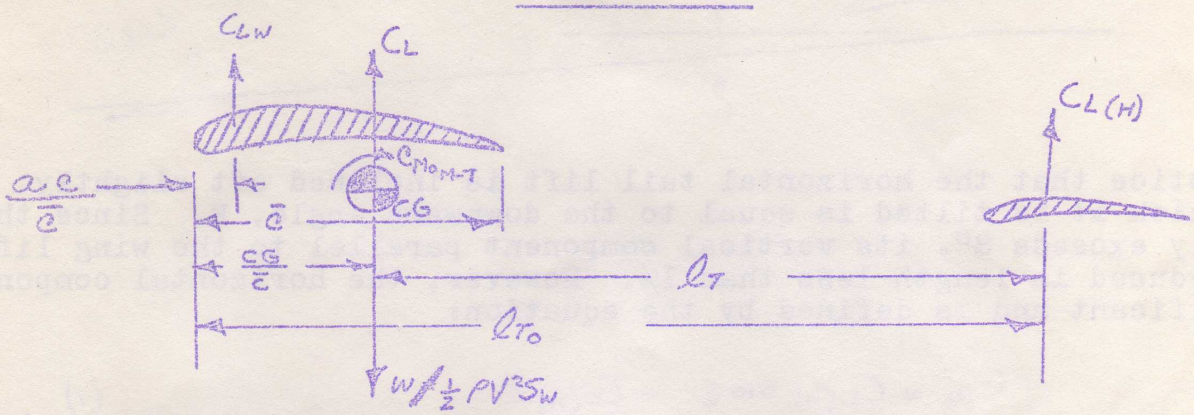
l_T Tail length, measured from the CG to the quarter-chord point on the horizontal tail MAC

TV_o Tail volume = $S_H l_{T_o} / S_W \bar{c}$

R/S Rate of sink in ft/sec.

Now for some equations, but first let us look at a picture of the forces and moments on the model:

FIGURE 1



Suming the vertical forces

$$C_L = W/\tfrac{1}{2}\rho V^2 S_W \qquad (1)$$

$$= C_{L_W} + C_{L_{(H)}} = C_{L_W} + C_{L_H}\frac{S_H}{S_W} \qquad (2)$$

Summing moments about the CG

$$C_{L_W}\left(\frac{CG}{\bar{c}} - \frac{ac}{\bar{c}}\right) + C_{M_{o_{M-T}}} = C_{L_{(H)}}\frac{l_T}{\bar{c}} \qquad (3)$$

Using equations (2) and (3) and solving for C_{L_W} we find

$$C_{L_W} = \frac{C_L\left(\frac{l_T}{\bar{c}}\right) - C_{M_{o_{M-T}}}}{\frac{l_T}{\bar{c}} + \left(\frac{CG}{\bar{c}} - \frac{ac}{\bar{c}}\right)} \qquad (4)$$

We now have defined wing and tail lift. What now is the drag associated with this lift? Induced drag is generally shown as;

$$C_{D_i} = \frac{C_L^2}{\pi AR} \qquad (5)$$

so that for our example:

$$C_{D_i} = \frac{C_{L_W}^2}{\pi AR_W} + \left(\frac{C_{L_H}^2}{\pi AR_H}\right)\frac{S_H}{S_W} \qquad (6)$$

The profile drag for the wing and tail sections used in this study was obtained from the February 1962 issue of AEROMODELLER, corrected to an infinite aspect ratio. The one given in this issue is 10. Thus, you can see that the wing drag is separated into two parts - profile and induced, and only the induced drag depends on aspect ratio.

There is another source of drag and that is due to downwash. Lift is defined as that portion of the resultant force which is perpendicular to the airflow approaching the wing or tail. Now, since the wing produces lift, it also produced downwash which acts over the tail. The amount of this downwash increases directly in proportion to the wing lift. Consider the drawing with one of the streamlines shown.



Notice that the horizontal tail lift is inclined aft slightly. The angle to which it is tilted is equal to the downwash angle, E. Since this angle rarely exceeds 8^0. its vertical component parallel to the wing lift vector is reduced in length less than 1%. However, the horizontal component is significant and is defined by the equation:

$$C_{D_\epsilon} = C_{L_{(H)}} \sin\epsilon = C_{L_{(H)}} \epsilon \qquad (7)$$

Since $\epsilon = \sin\epsilon$ at small angles.

Now, since ϵ varies with C_{L_W}, then

$$\epsilon = \frac{d\epsilon}{dC_{L_W}} \cdot C_{L_W} \qquad (8)$$

so that

$$C_{D\epsilon} = C_{L_H} \frac{S_H}{S_W} \frac{d\epsilon}{dC_{L_W}} \cdot C_{L_W} \qquad (9)$$

The source for determining $d\epsilon/dC_{L_W}$ came from an old Martin Aerodynamic Design Manual. While it is not as accurate as present day methods, it is consistent and sufficient for this study. The data used are shown in Figure 2.

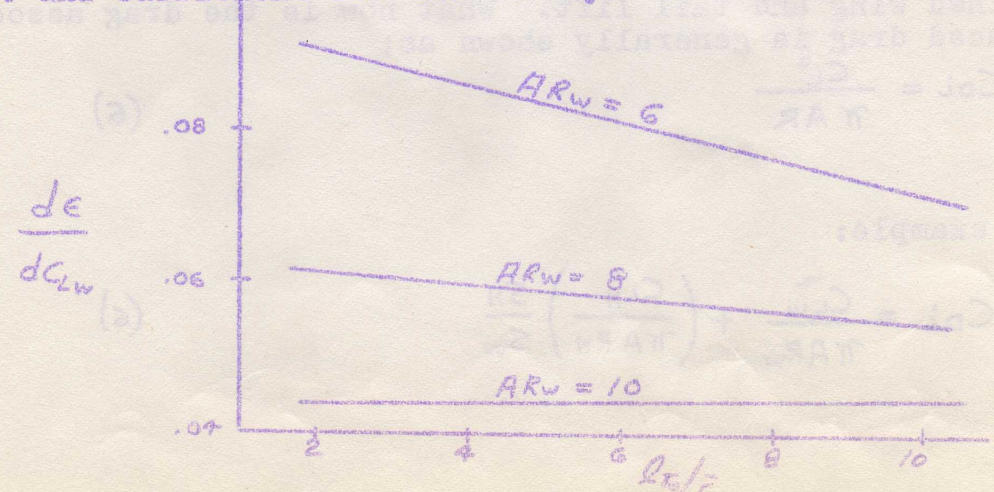
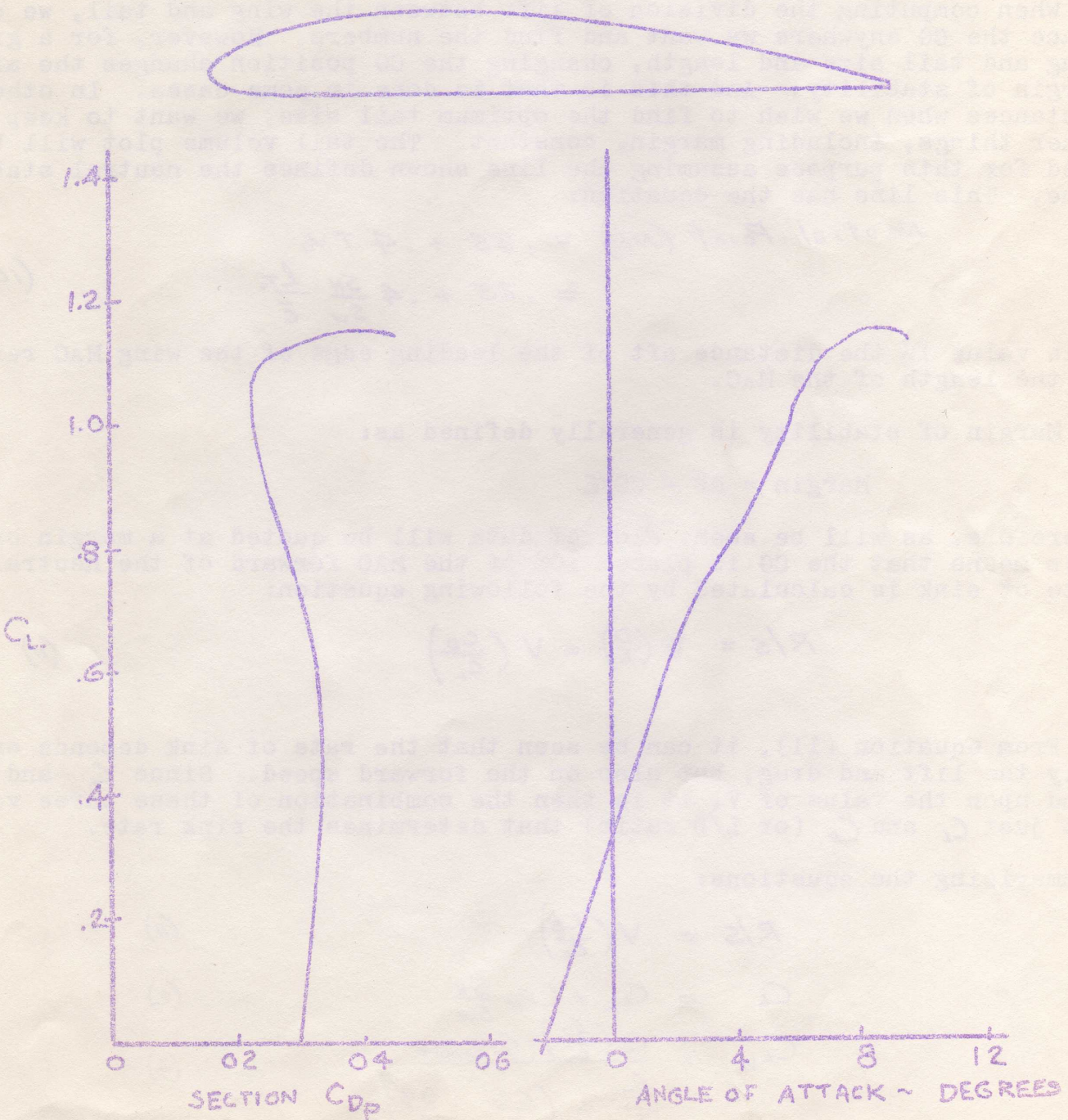


FIGURE 2

FIGURE 3

AIRFOIL SECTION CHARACTERISTICS

SECTION : GÖ 796
REYNOLDS NO: 75,000
REFERENCE : AEROMODELLER FEB 1962



Therefore, we now have defined all the lift and drag places, but three, that being the drag of the engine, body and vertical tail. These don't change with the changes being considered in this study and have been set at three values - ΔC_D = 0, .02, .04. The reader will observe later on how these values affect rate of sink.

A word about Reynolds number (RN). It has been observed in testing that certain aerodynamic parameters vary with RN. Those parameters are primarily maximum lift coefficient and profile drag. As RN increases, max lift increases and the profile drag decreases. The RN for the data in AEROMODELLER was listed as 75,000 and fortunately this is near the value of presently-configured FAI power models. Wakefield and Nordic models having lighter wing loadings and smaller chords will have much smaller RN and the wing profile data are or may not be valid. Werner Theiss has not yet provided us with additional data.

When computing the division of lift between the wing and tail, we can place the CG anywhere we want and find the numbers. However, for a given wing and tail size and length, changing the CG position changes the airplane margin of stability. And this is what is done in some cases. In other instances when we wish to find the optimum tail size, we want to keep all the other things, including margin, constant. The tail volume plot will be used for this purpose assuming the line shown defines the neutral stability line. This line has the equation:

$$\text{Neutral Point (NP)} = .25 + .4\,TV_0$$

$$= .25 + .4\,\frac{S_H}{S_W}\,\frac{l_T}{\bar{c}} \qquad (10)$$

This value is the distance aft of the leading edge of the wing MAC relative to the length of the MAC.

Margin of stability is generally defined as:

$$\text{Margin} = NP - CG/\bar{c}$$

Therefore, as will be seen, a lot of data will be quoted at a margin of .1. This means that the CG is placed 10% of the MAC forward of the neutral point. Rate of sink is calculated by the following equation:

$$R/S = V\left(\frac{D}{L}\right) = V\left(\frac{C_D}{C_L}\right) \qquad (11)$$

From equation (11), it can be seen that the rate of sink depends on not only the lift and drag, but also on the forward speed. Since C_L and C_D depend upon the value of V, it is then the combination of these three values and not just C_L and C_D (or L/D ratio) that determines the sink rate.

Summarizing the equations:

$$R/S = V\left(\frac{C_D}{C_L}\right) \qquad (11)$$

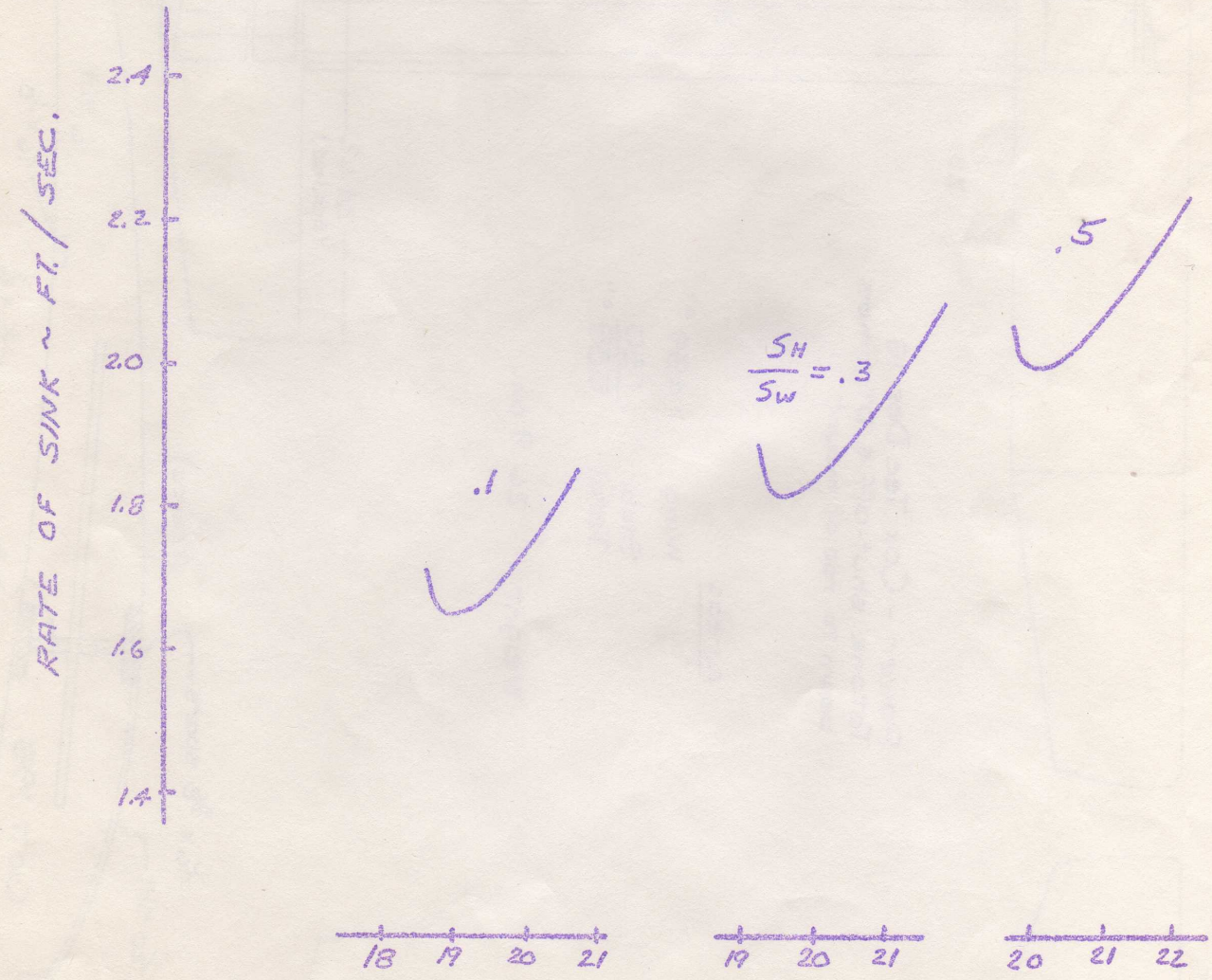
$$C_L = C_{L_W} + C_{L_H}\,\frac{S_H}{S_W} \qquad (2)$$

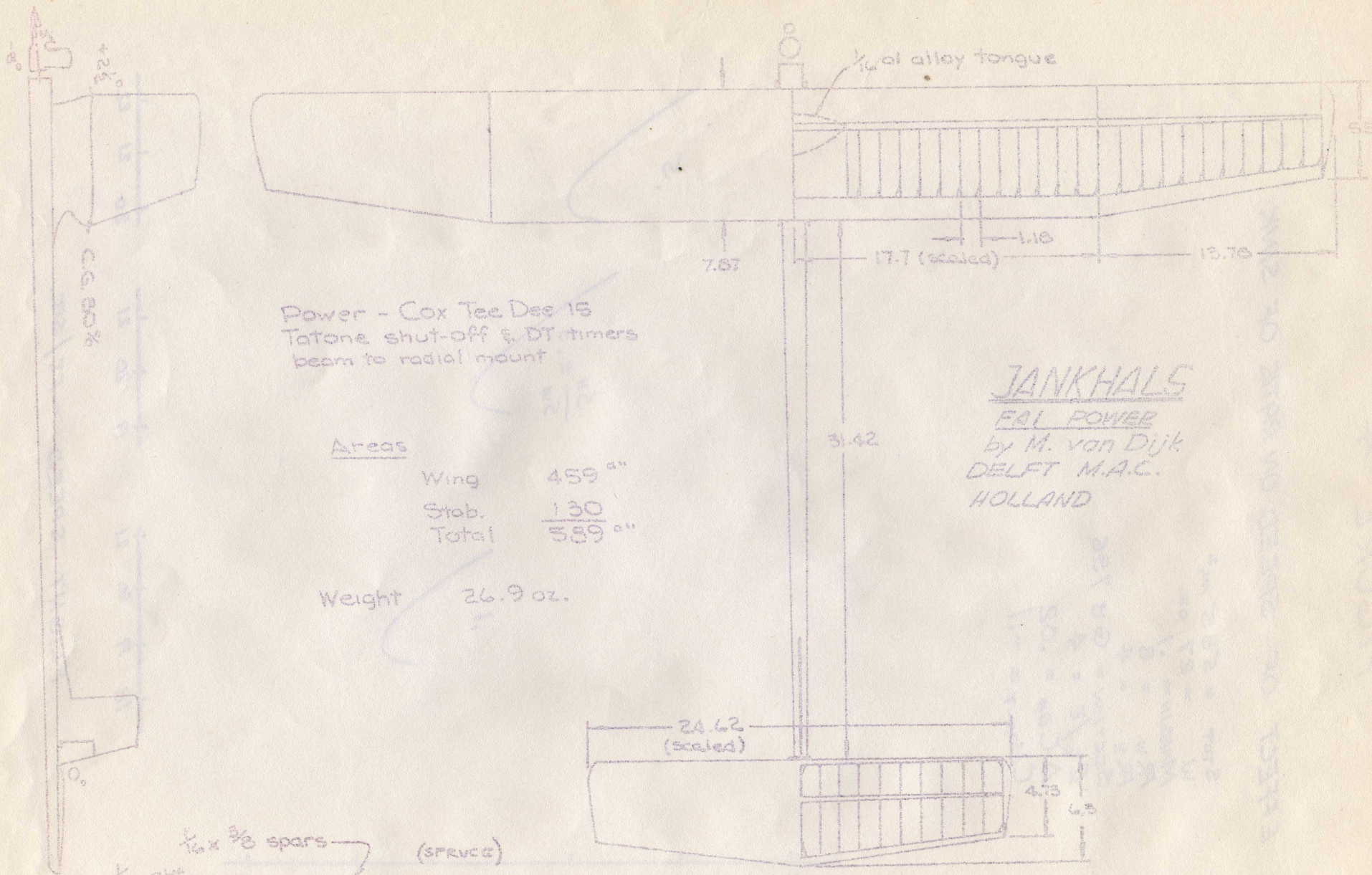
$$C_{L_W} = \frac{C_L\left(\frac{l_T}{\bar{c}}\right) - C_{M_{O_W}}}{\frac{l_T}{\bar{c}} + \left(\frac{CG}{\bar{c}} - \frac{a.c.}{\bar{c}}\right)} \qquad (4)$$

FIGURE 4

EFFECT OF SPEED ON RATE OF SINK

S_{TOT} = 585 IN.²
W = 27 OZ.
MARGIN = .1
AR_W = 8
AR_H = 4
SECTION = G8 796
$\ell_{T_0}/\bar{c}$ = 4
ΔC_{D_P} = .02
C_{MOM-T} = -.1





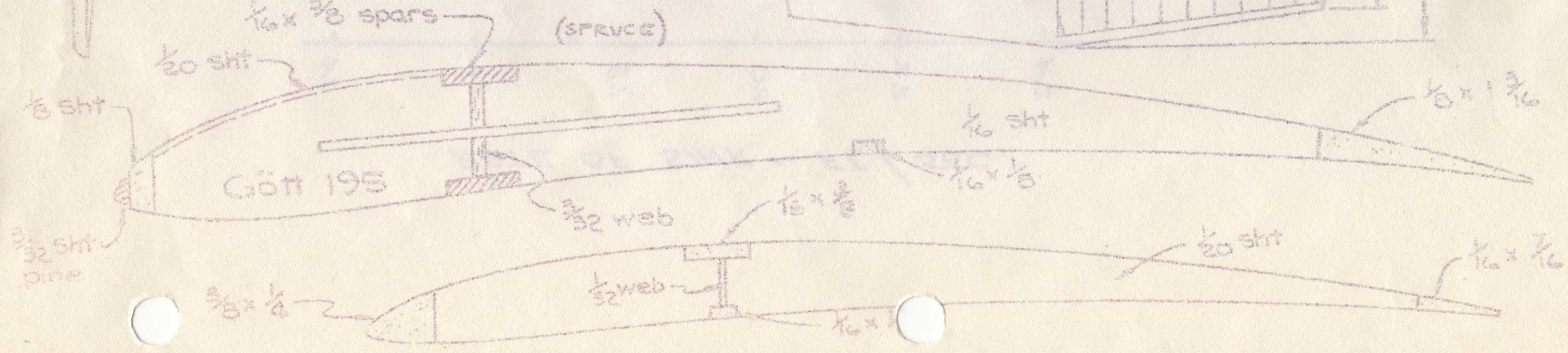
Power - Cox Tee Dee 15
Tatone shut-off & DT timers
beam to radial mount

Areas

Wing	459 sq"
Stab.	130
Total	589 sq"

Weight 26.9 oz.

JANKHALS
FAL POWER
by M. van Dijk
DELFT M.A.C.
HOLLAND



$$C_{D_i} = \frac{C_{L_W}^2}{\pi AR_W} + \frac{S_H}{S_W}\left(\frac{C_{L_H}^2}{\pi AR_H}\right) + C_{L_H}\frac{S_H}{S_W}\frac{d\epsilon}{dC_{L_W}} \cdot C_{L_W} \qquad (12)$$

$$C_{D_P} = C_{D_{P_W}} + C_{D_{PH}}\frac{S_H}{S_W} + \Delta C_{DP} \qquad (13)$$

$$C_D = C_{DP} + C_{D_i} \qquad (14)$$

$$MARGIN = NP - CG/\bar{c} \qquad (15)$$

$$NP = .25 + .4\frac{S_H}{S_W}\frac{l_{T_0}}{\bar{c}} \qquad (16)$$

Now that school is out on the equations, let us do some computing. Say, for example, we have an FAI power ship weighing 27 ounces. We know that the wing and tail area must add up to 585 sq. inches. Let us choose a 30% tail--135 sq. inc., leaving the wing area at 450 sq. in. Assume for tail length an $l_{T_0}/\bar{c} = 4$ and a $C_{M_{0_{WT}}} = -.1$. This latter value must be assumed since there is no reliable information on this factor at model Reynolds numbers. If we balance the airplane so as to have 10% margin, the CG is at $.63\bar{c}$ with the NP at $.73\bar{c}$. If we assume a flight speed of 20 ft/sec, $C_L = 1.137$ from Equation 1. From Figure 1 we can see that $l_T/\bar{c}$ is equal to $l_{T_0}/\bar{c} - CG/\bar{c}$. Thus we have all the parts for computing wing lift--$C_{L_W} = 1.020$ using Equation 4. Then C_{L_H} is computed from Equation 2--$C_{L_H} = .39$. In order to determine the induced drag, assume a wing aspect ratio of 8 and a tail aspect ratio of 4. From Figure 2 we find $d\epsilon/dC_{L_W} = .059$. Using Equation 12 the total induced drag is computed--$C_{D_i} = .0522$. To find the profile drag of the wing, we must refer to Figure 3. At a wing $C_{L_W} = 1.02$, $C_{D_{P_W}} = .0225$. At the tail $C_{L_H} = .39$, $C_{D_{PH}} = .0235$. Assuming $\Delta C_{DP} = .02$, we use Equation 13 to find total $C_{DP} = .0525$. Adding profile and induced drag together as in Equation 14, $C_D = .1047$. Now we can compute rate of sink from Equation 11--R/S = 1.84 ft/sec. At long last!

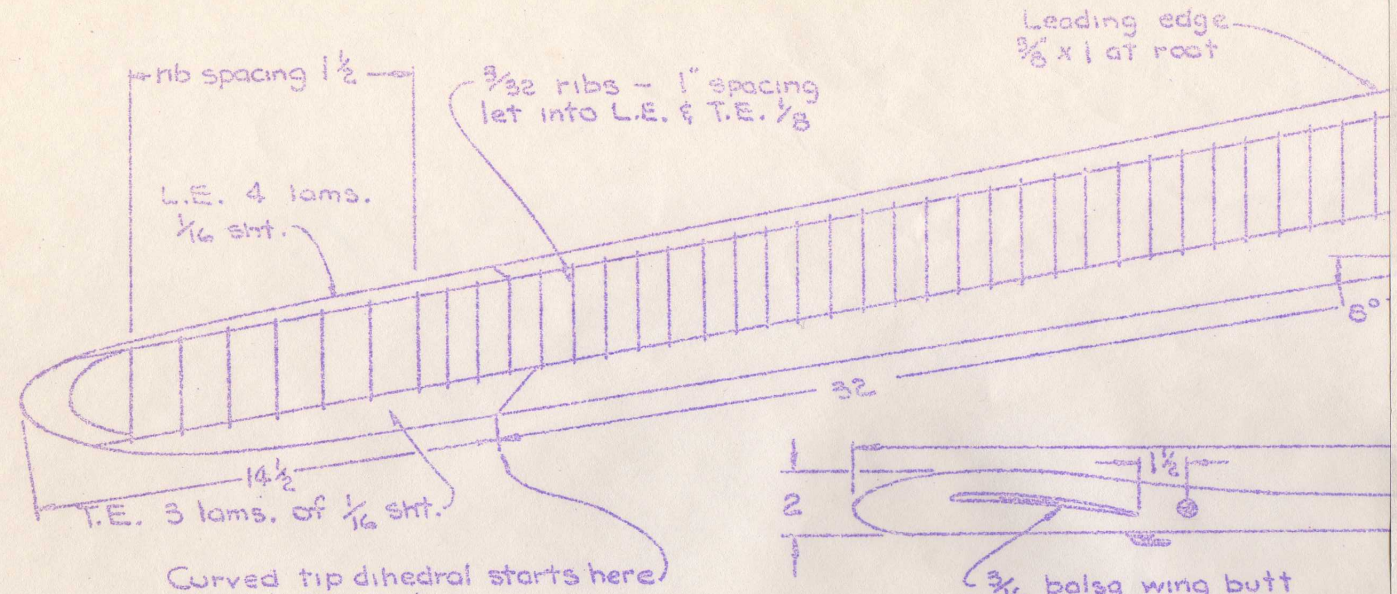
Several flight speeds must be selected and the computations run through again in order to determine the minimum sink speed. This has been done for this example and is presented on Figure 4. The reader must surely understand now why a digital computer was used to compute all the results of many variations that were considered. The variations that will be presented in this paper are as stated before, tail area, tail length, and margin of stability. Other airfoil data may also be considered when they become available. (Continued next month)

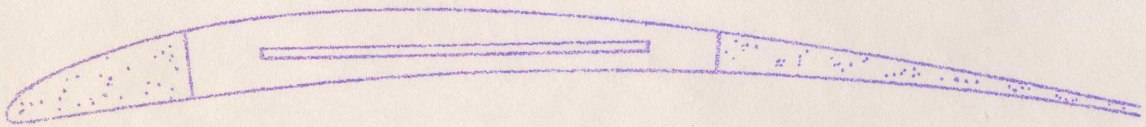
"JANKHALS" F.A.I. Power by H. van Dyk of the Delft. MAC, Holland

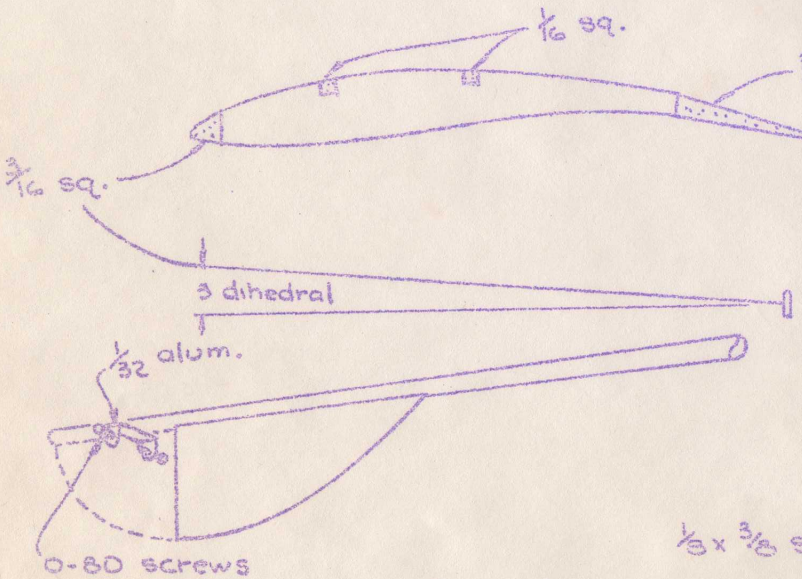
Here is another fine plan from Holland. This is certainly a *prolific* group. That tail moment looks pretty long, more tail volume fodder for Bill Bogart to plot. I don't recall any previous experience with the Gott 195 wing section. (Probably shows my ignorance) Perhaps our friends in Holland could send us some more information such as flight characteristics.

GOING TO THE NATS?

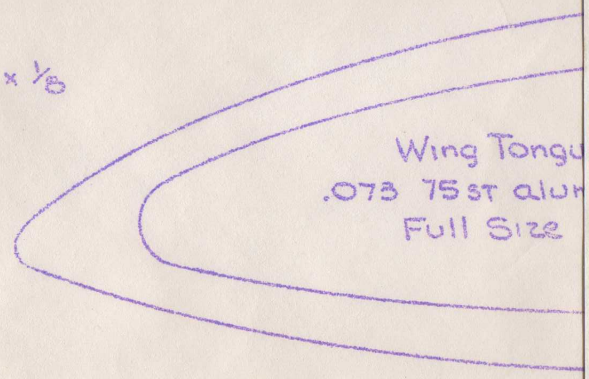
On Sunday, July 28, there will be held at the Orange County Airport a "World War I Air Show". Airplanes from the Frank Tallman, Paul Mantz collection will be flown and exhibted. These include Sopwith Camel, Fokker D-7, Nieuport 28, SE-5, DH-4, and Spad plus famous racing aircraft. Children under

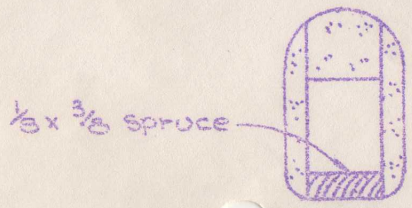




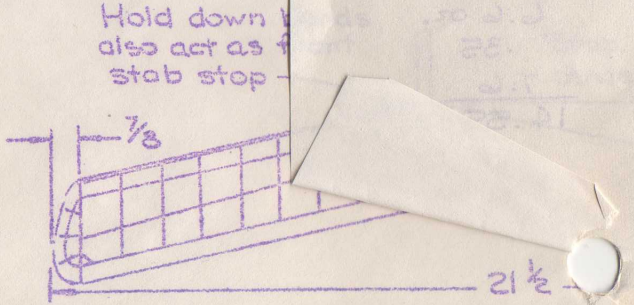


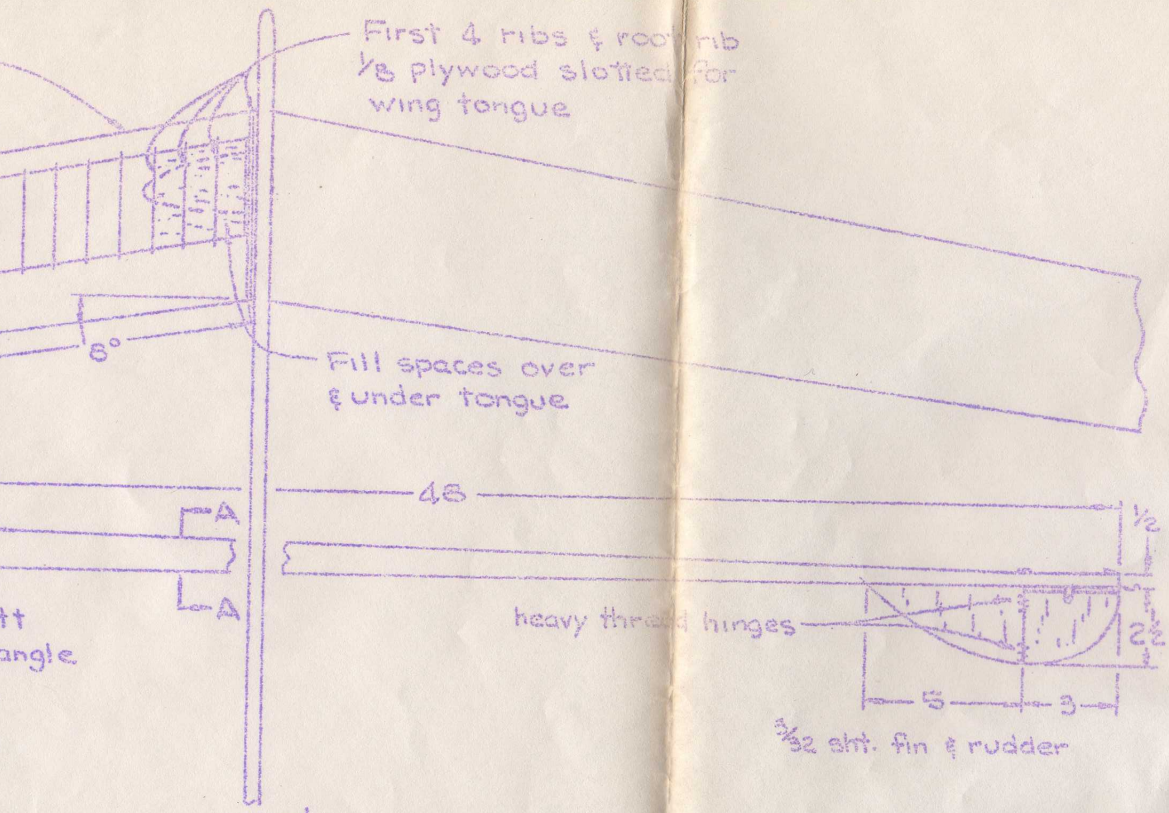
Auto rudder Detail

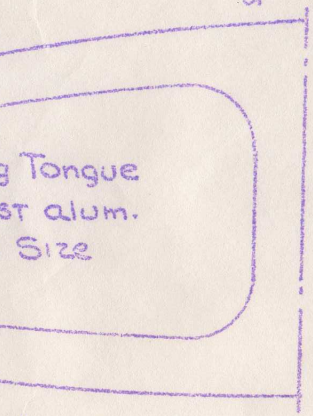




ction A-A







SORCERER

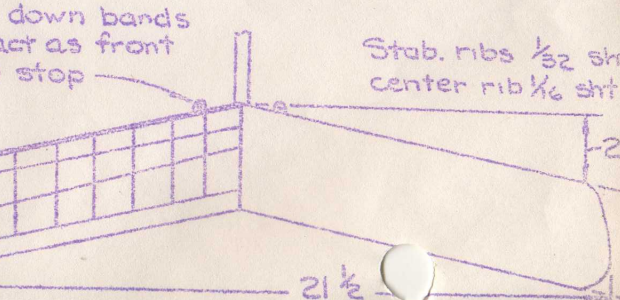
A/2 GLIDER by Don Thompson

Illinois Model Aero Club

SCALE 1/2" = 1"

Wash out all tips 1/8

Wash out left wing panel 1°



Wings	6.6 oz.
Stab.	.35
Fuselage	7.6
	14.55 oz.

six are free, 6 to 12 - $1.00, and over 12 - $2.00 per person.

We saw this air show last year and are positive you will get a thrill from this quite unique occasion. Orange County airport is only 14 miles south east of Los Alamitos Naval Air Station and is only 3 miles south of the Marine Corps Santa Ana Air Facility (the indoor site). July 28 is the day before the Nats indoor events. Include this in your plans.

DON THOMPSON'S NORDIC A-2 SOARCERER

Stolen from the November 1962 Illinois Model Aero Club Monthly Newsletters

"Four slightly different models have been flown over the period of a year with reasonable success. Drawings are of the best to date. The sweep-back has resulted in an almost uncanny stability--both on the line and off. The model is next to impossible to stall. Soarcerer also has two outstanding characteristics guaranteed to keep the competition in ulcers. It will do well over a minute from 60 feet--at a sufficiently slow crawl, and in normal flight it has a slight rocking motion which looks for all the world like the start of a thermal--three or four times each minute.

The wing tips were laminated from 1/16 sheet, soaked, glued, and placed in a two piece form overnight. Less flutter in this type construction.

What with sweepback, taper, and curved (Jack Daniels) tips, the wing will keep you concentrating at the building board, but each adds to the overall performance. I use a 250 ft. glide circle--tight turns are difficult with sweep back--but it will tighten up in lift. The ballast goes way back. The short nose is just for bashing things. No changes for windy weather.

Original inspiration was Bill Hartill's "Starched Vulture", in Zaic's '61 Yearbook. (Also Aug. 61 Scatter). More data on sweepback here--confirmed in my flight tests."

Thank you, Don.

Subscriptions:

Attention: See the March issue for renewal instructions. We need the money!

COMING NEXT MONTH

May will bring Carl Herme's Wakefield, the 2nd half of Bogart's fine article, reports from England, Canada, Austria, and Minnesota, and whatever else we can put over on the Postal service.