No. 243 SEPTEMBER 2006

T.W.I.T.T. NEWSLETTER

This is the 1940's LAPIDAR flying wing that belongs to Robin Andrew, Birmingham, UK. It has over 700 sq. in. of active wing area and is an electric powered pusher. Norm Masters provided the link through Nurflugel. http://www.rcgroups.com/forums/showthread.php?t=538935 to see more of this interesting old design.

T.W.I.T.T.
The Wing Is The Thing
P.O. Box 20430
El Cajon, CA 92021

The number after your name indicates the ending year and month of your current subscription, i.e., **0609** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, September 16, 2006, beginning at 1:30 pm at hanger A-4, Gillespie Field, El Cajon, CA (first hanger row on Joe Crosson Drive – Southeast side of Gillespie).

THE WING IS THE THING (T.W.I.T.T.)

T.W.I.T.T. is a non-profit organization whose membership seeks to promote the research and development of flying wings and other tailless aircraft by providing a forum for the exchange of ideas and experiences on an international basis. T.W.I.T.T. is affiliated with The Hunsaker Foundation, which is dedicated to furthering education and research in a variety of disciplines.

T.W.I.T.T. Officers:

President: Andy Kecskes (619) 589-1898
Secretary:
Treasurer: Bob Fronius (619) 447-0460
Editor: Andy Kecskes
Archivist: Gavin Slater

The **T.W.I.T.T.** office is located at:
Hanger A-4, Gillespie Field, El Cajon, California.
Mailing address: P.O. Box 20430
El Cajon, CA 92021

(619) 596-2518 (Hanger-No answer call evening number)
(619) 447-0460 (Evenings – Pacific Time)
E-Mail: twitt@pobox.com
Internet: http://www.twitt.org
Members only section: ID – **twittmbr**
Password – **member02**

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Meetings are held on the third Saturday of every other month (beginning with January), at 1:30 PM, at Hanger A-4, Gillespie Field, El Cajon, California (first row of hangers on the south end of Joe Crosson Drive (#1720), east side of Gillespie or Skid Row for those flying in).

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PRESIDENT'S CORNER

I am not going to say much this month in order to allow more space for some important letters and a comment on renewal notices.

In order to help the members with recognizing when their renewal is due I have been bolding, highlighting and circling in red the due date that is included in the mailing label. I am not trying to be pushy, but just jogging your memory on the due date. It is important to renew on time so you don't miss an issue. It also makes roster administration easier.

LETTERS TO THE EDITOR

July 13, 2006

Here is my renewal for another year. Sure miss going to the meetings.

By the way, where is the CG on the Ehling glider model in the June 2006 issue on page 5?

Paul Stahlhuth
El Dorado Hills, CA
<phsjes@sbcglobal.net>

(ed. – Thanks for the renewal. It is always good to hear from you and I hope all is going well.

You are right about the drawing not showing the CG location, but I have no idea on where it is. Perhaps Larry can fill in the blank based on his experience with the models. I'll be happy to publish the solution.)

July 18, 2006

Here it is, time to renew my subscription already. I truly look forward each month to seeing what the rest of the fling wing experimenters around the world are doing. So thank you for all the effort that goes into the TWITT Newsletter. (continued on next page)

SEPTEMBER 16, 2006
PROGRAM

Well, we almost had a program for this month, thanks to a suggestion from Walt Scott. However, a conflict with his teaching schedule meant the speaker couldn't come down and discuss composite construction techniques with us. But he did indicate he would keep our information and see where he could fit in a program for us in the future.

I want to thank Walt for keeping his eyes open for a possible program and providing the necessary contact information. The more contacts we can develop, the better chance we have of coordinating a program for each meeting date.

LETTERS (continued)

My latest project, shown below, has a 50" span, a 7% thick airfoil and, weighs 10 ounces. With a wing loading of 4 oz. per sq. ft. it flies in very light lift. However, I have flown it in a 20 mph wing with no problems. It will be interesting to see how it flies when ballasted to about 12 oz. per sq. ft.

I first flew it with elevon controls but it had a pitch-up stall in low speed turns. Changing to elevator-aileron controls cured that problem and made the handling feel much more solid.

The interaction between the winglets, the CG and the reflex is challenging and still getting adjusted. Now it doesn't tuck under in a dive. Anhedral was added to compensate for the dihedral effect of the winglets and sweep back. It still has a slight fast alpha-oscillation at low speed. Anyone know how to fix that?

In general, it is a good flying plane that looks like it could be a real performer.

Thanks again for the good newsletter.

Allan Morse
San Bruno, CA

(ed. – Thanks for the renewal and the information on your latest design. It looks really nice and based on the planform looks like it might be easy to build.

What you didn't mention was the type of airfoil you used and the chord. This information might help others give you a better answer to your oscillation question.)

July 22, 2006

Time to renew my annual membership. Enclosed please find $30 to extend my membership one more year.

It has been great to read the newsletter every month. Excellent new material is printed that capture a lot of attention and study.

Congratulations for TWITT's 20th Anniversary.

I look forward to a lot of coming years of great flying wing information, discussion and, new projects.

Artur Moreira Goncalves
Ermesinde, PORTUGAL

(ed. – Thank you for the renewal and the gracious comments on the newsletter. Now I just have to live up to the expectations of all these great newsletters to come. It will certainly be a challenge.)

August 14, 2006

The TWITT newsletter arrived just before leaving on holiday and at a short look I found some questions about the H IV. Let me give some comments that may help: the H IV was restored by the Deutsches Museum in Munich, the Deutsches Technikmuseum restored the Horten VI and some others. So anybody interested in the H IV should focus on the Deutsches Museum in Munich. The restored H IV is located north of Munich, in the Schleissheim-departure.

The Deutsches Museum rebuilt the center section and has redrawn the center section (a great job done by Peter Hanickel). This set, in my understanding, comes very close to what the original airplane was. However, the drawings were never done for a flyable version! That makes some difference!!

There are about 30 original drawings still available, which are depicting some components of the H IV prototype (W.Nr. 22). The cutaway, which you have included in the newsletter, was done by me some years ago, mainly based on photos of the original airplanes and an analysis of the wings of the Deutsches Museum, long before these were restored. What is also available are the calculation sets both for the prototype as well as the serial version. Both calculations used the Lippisch-method. Calculated L/D was 39 for the prototype (just a comment, I do not want to start any discussion). The H IV built new by Bernd Ewald will incorporate some new materials, as far as I know. So we will see...

Andy, thanks for your effort to keep the flying wing idea alive. Even if I am not able to continue any research at present, I enjoy and read the TWITT information that keeps me in touch.

Best regards,

Reinhold Stadler
<mw40200@mucweb.de>

(ed. – Thank you for the update on how the restorations were conducted and what might be available for information. We need to see about getting copies of the 30 drawings to add to the archives and I will work on that in the future.)

August 15, 2006

I just saw your letter in the TWITT newsletter. My bookmark also failed but Google found the new URL.

http://www.ae.uiuc.edu/m-selig/ads.html

I case of future problems you can also find a lot of the same data in the NASG database:
http://www.nasg.com/afdb/index-e.phtml

I have sent in my renewal and a donation to help with the expenses. Thank you for highlighting the due date on my August newsletter.

Norm Masters
Grand Junction, CO

(ed. – Our thanks to Norm for the donation that we can use to cover the expenses of publishing the newsletter and keeping the subscription rates stable for a while longer. I would like to thank the other members that have sent in small donations over the past year, since they all go to help the cause.)

August 17, 2006

I include US $30 in cash to join your group and have access to the monthly newsletters. Please find my address, phone, fax and e-mail included.

Best Regards,

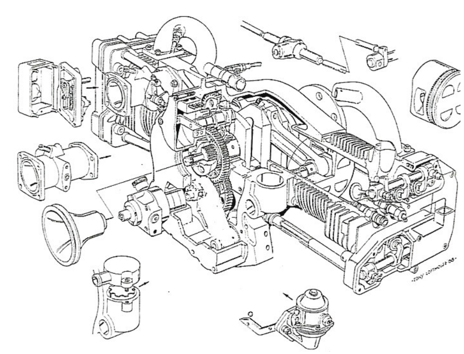
Claus Leisler Kiep
Sao Paulo, BRASIL
<clakiep@terra.com.br>

(ed. – It has been a long time since we have had a member from South America and I believe the first from Brazil. I passed along the user ID and password for the Internet archived newsletters after receiving Claus' payment. Since I haven't heard back from him I want to assume he is so engrossed in reading through four years of issues is keeping him otherwise occupied. I hope he is enjoying them.)

September 1, 2006

I have an EMDAIR 80 hp engine for sale. It is ready to run, has a fuel injection system, electronic ignition, etc. Bed style mounts need to be made for the application. Need to get it in a going project at no cost to project owner. Would like it to be close (northern California) so I could help, but might not be possible.

Howard Allmon
<howardallmon@netzero.net>



The following article by Al Backstrom was published in the June 2000 issue of Sailplane Builder and Al has given us permission to re-print it here.

The Elements of Tailless Sailplane Design

By Al Backstrom

INTRODUCTION

In the years I have studied and worked with tailless aircraft design, the attitude of the aviation public has changed from belief that tailless machines could not possibly be stable or practical to an acceptance of them as another way to lay out an aircraft configuration. The successful designs of many people have contributed to this change in attitude. This discussion is not intended to be about history but to cover the generalities of tailless design as they differ from the conventional. Those who choose to proceed with the study of tailless aircraft should obtain Tailless Aircraft in Theory and Practice by Karl Nickel and Michael Wohlfahrt. There is no more complete work on the subject

All design problems must start with a desired result followed by a determination of the best way to achieve these results, in the ease of sailplane design, the tailless configurations offer advantages and disadvantages. What is the best design relies heavily on the compromises made by the designers. It is best to first consider the major advantages and disadvantages of the tailless configurations.

First, lets look at the good things that may be gained from a tailless configuration:

I. Reduced aerodynamic drag
2. Reduced structural weight
3. Simpler structure, i.e. fewer parts to build.

We cannot get these advantages without paying a price in other areas and these are:

1. Reduced CG range
2. Limited use of high lift devices.

The reduced CG range is a problem that cannot be avoided and this alone will rule out tailless configurations for many applications. Sailplanes generally do not need a large CG range so this is not a big problem. The CG range can be increased by having a low aspect ratio, but this is not practical for sailplanes due to the large induced drag at thermalling speeds.

There has been a lot of work done on the use of high lift devices on swept wing configurations in the last few years. This is discussed later.

WING PLANFORMS

The primary wing planforms that have been used for tailless aircraft and their required lift distributions are shown in Figure 1. Other configurations such as cranked or planforms with varying swept areas are possible, but the structural complexities induced make their use questionable in most cases.

In the low speed range, sweep angles are measured at the one quarter chord line of the planform.

Of the primary wing planforms, both the plank and sweptback types have been used extensively. The swept forward planform has seen little use as it has special problems with tip stall prevention. In the discussion that follows reference to swept wings refers to sweep back unless noted. Small angles of forward sweep such as used by Jim Marske or the Fauvel A.V. 22 have shown no problems with tip stall. A tapered wing with a straight leading edge normally has very good stall characteristics.

The swept wing configuration offers possible increased CG travel and use of high lift devices. The greater the required CG travel, the larger the sweep angle will be. The plank types offer the simplest structure but at the penalty of small CG range and very limited use of high lift devices.

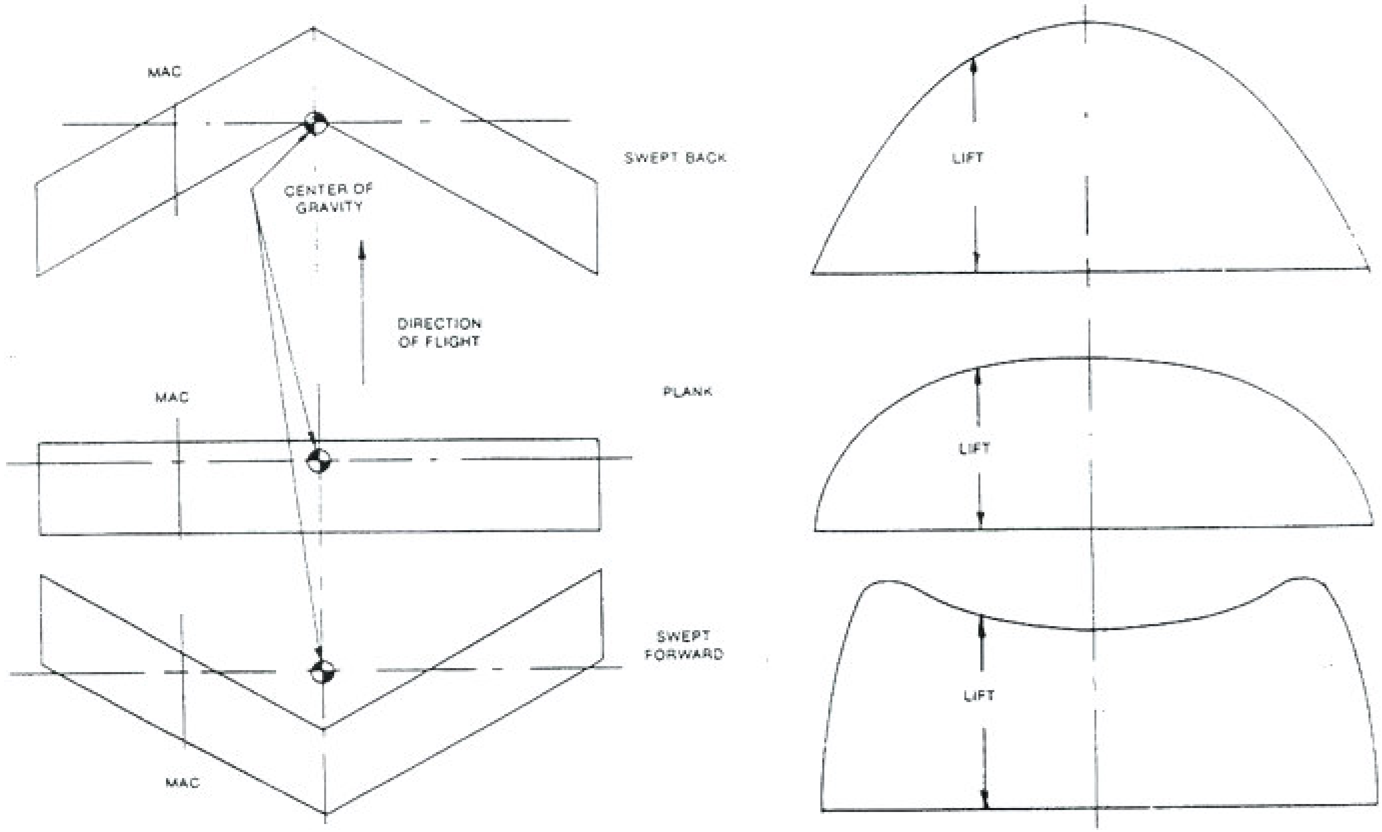


FIGURE 1
STABLE WING SYSTEMS & THEIR LIFT DISTRIBUTIONS

LONGITUDINAL STABILITY AND CG LOCATIONS

Static longitudinal stability in aircraft is not an extremely complex problem. This is true for tailless aircraft just as well as conventional configurations. To provide an understanding of longitudinal stability, let's take a quick course using the figures from Harry Hurt's excellent book Aerodynamics for Naval Aviators. In these figures, Cm is pitching moment coefficient of the entire aircraft, Cmac is the pitching moment of the wing about the aerodynamic center, approximately 25% chord for subsonic speeds. The sign convention is + for nose [or leading edge] up. Cl is the lift coefficient and an increased Cl at fixed weight means lower speed or higher load factors.

Figure 2A shows characteristics of a Cm versus Cl curve for a typical stable aircraft. Stick fixed, it will trim at the point marked Cm = 0 and when displaced from this Cl it will tend to return to the Cm = 0 point. Figure 2B shows other possible conditions and that the stability is directly proportional to the slope of the Cm versus Cl curve. Ordinarily the static longitudinal does not change with Cl except in the range where Cl versus angle of attack is no longer linear, i.e. near the stall angle. Figure 2C shows the possible conditions with changes due to power effect, high lift devices, wing location, etc.

Figures 3 and 4 show what a wing atone can contribute to longitudinal stability. You will note that wing alone can be stable or unstable and that the trim point will depend on whether the airfoil [or wing system for swept types] has a nose up [+] or nose down [-] negative pitching moment. Also, these figures illustrate that the amount of longitudinal stability is directly tied to the CG location. Figure 5 shows the build up of the components of a conventional aircraft and the effect of CG location. You can see that once an aircraft configuration is established, that the CG location relative to the neutral point determines the static longitudinal stability.

The numbers in Figure 5 are approximations but serve to show that tailless configurations will have a neutral point well ahead of a tailed type. On a wing alone the neutral point will be at approximately 25% of the mean aerodynamic chord (MAC). The addition of pods or other protuberances will shift this position slightly.

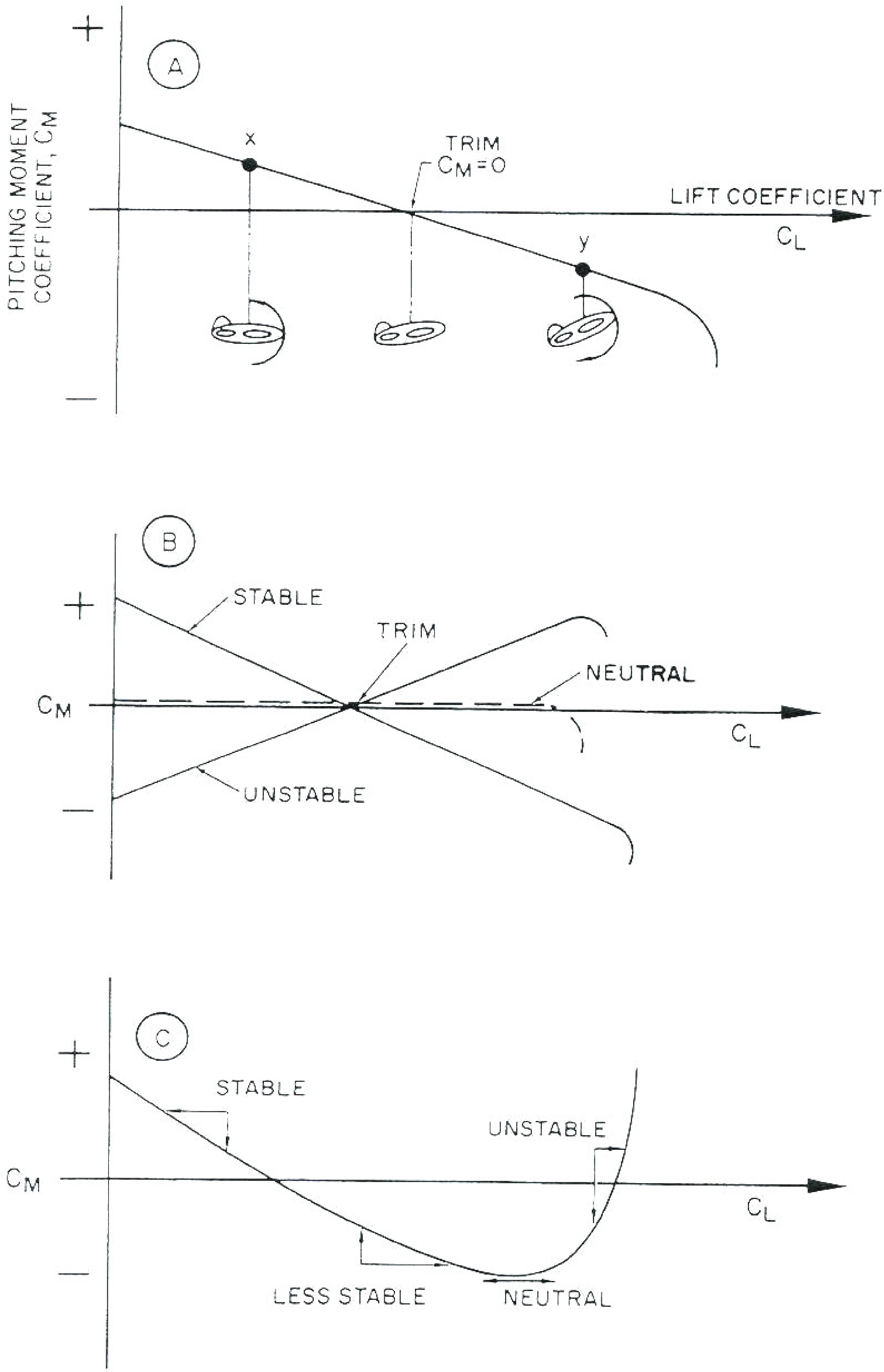


Figure 2 Airplane Static Longitudinal Stability

A Note From Al Backstrom 6/23/2000: After discussions with Dave Magerstadt on our trip to Penrose, Colorado, I realized that it was possible that the figures I copied on static longitudinal stability could lead to a misunderstanding of what happens near minimum speed. These figures all show an increase in stability in the range where Cl versus Angle of Attack is not linear, i.e. near maximum Cl. In actuality, the static longitudinal stability can increase, decrease, or remain constant depending on the relationship of the vertical CG to the aerodynamic center of the wing. The changes are not normally large, but do have an effect. The figure copied from Aircraft Performance, Stability and Control by Perkins and Hage gives a good illustration of the effects.

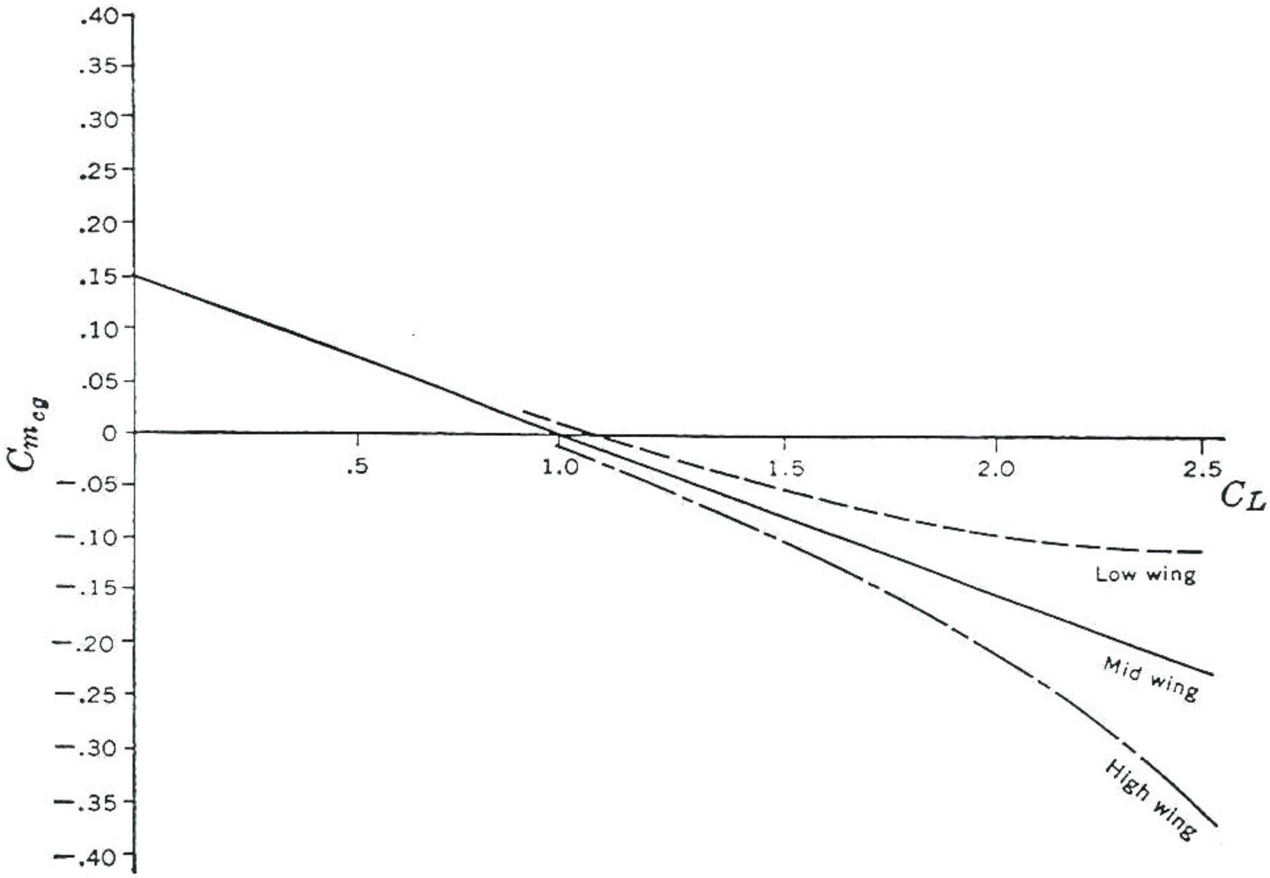


FIGURE 5–4. Effect of vertical location of c.g. on pitching moments.

One factor that must be considered for tailless designs is the protection of the rear CG limit. Tailless sailplanes should be designed so that it will be very difficult to load the aircraft to where the CG is aft of the established rear limit. This is because the range between unstable and un-flyable is smaller than a tailed type.

As noted above, the CG for a tailless aircraft will be forward of what is normally accepted as correct for tailed types. A good generality is to use a 20% MAC as a starting point for initial flights and work forward and aft of this point during the flight test program.

DIRECTIONAL STABILITY

Most of the reports of poor flight characteristics in tailless aircraft are the result of low directional stability. The solution for obtaining directional stability is to have adequate surface area with a decent aspect ratio far enough aft to get the aircraft to fly in a straight line. I know that many tailless designs have flown without vertical surfaces, but trying to get by without them is not advisable in my opinion. The proper design of tip fins (winglets) can provide both directional stability and can increase the effective aspect ratio.

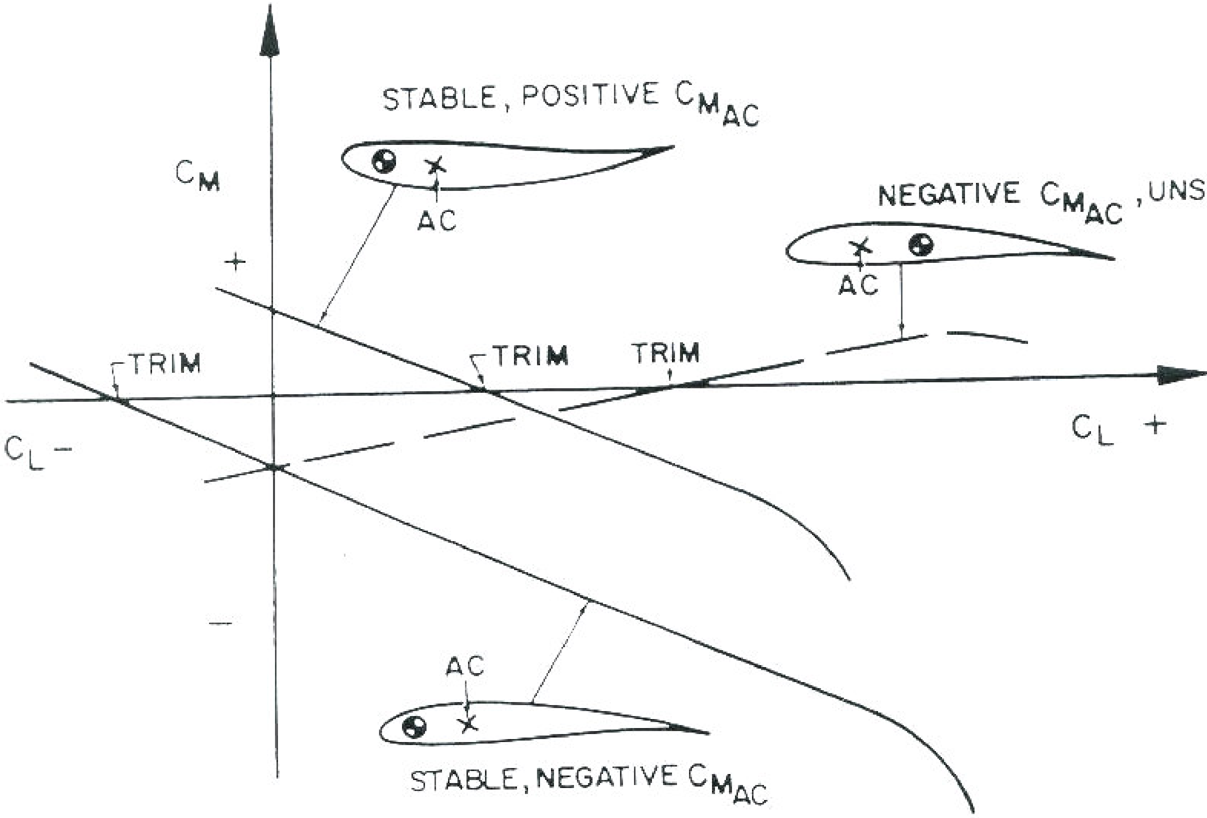


Figure 3. Effect of Cmac & C.G. position

AERODYNAMIC CONTROLS

In the selection of aerodynamic controls, you should select types that have a minimum of adverse secondary effects. I personally favor the use of elevons near the wing tips for pitch and roll control. These increase the effective washout near the wing tips, which helps prevent tip stalling and increases spin resistance. On either swept or straight wing designs, the use of drag rudders at the wing tips provides the best moment arm for yaw control. A normal fin and rudder can be used in some cases but a large area or long arm is required. On the EPB-1C, the short arm produced a condition where the side force was large and yawing moment small such that on takeoff the aircraft was noted to move sideways rather than taking on the desired heading. With altitude where it was comfortable to roll this was not noticeable. A better solution would be using a fixed fin with drag rudders at the wing

SPINS

At one time it was believed that tailless aircraft would not spin. This has been proven to be untrue. Several designs have been tested for spins and found to both spin and recover. It is best to design any aircraft where it will not spin or at least be very difficult to force into a spin.

To prevent spinning, the CG cannot be too far aft and the wing should have a large amount of damping in roll at minimum flying speed. This has been provided by slots and/or elevons [which provide large effective washout when deflected up for low speed flight] or a combination of these.

HIGH LIFT DEVICES

The use of high lift devices is very limited on tailless configurations with little or no sweep. The only type of devices that I know will work are leading edge slots and drag surfaces located above the CG. One French experimental design used an adjustable drag flap on a pylon above the basic aircraft for elevator control. Leading edge

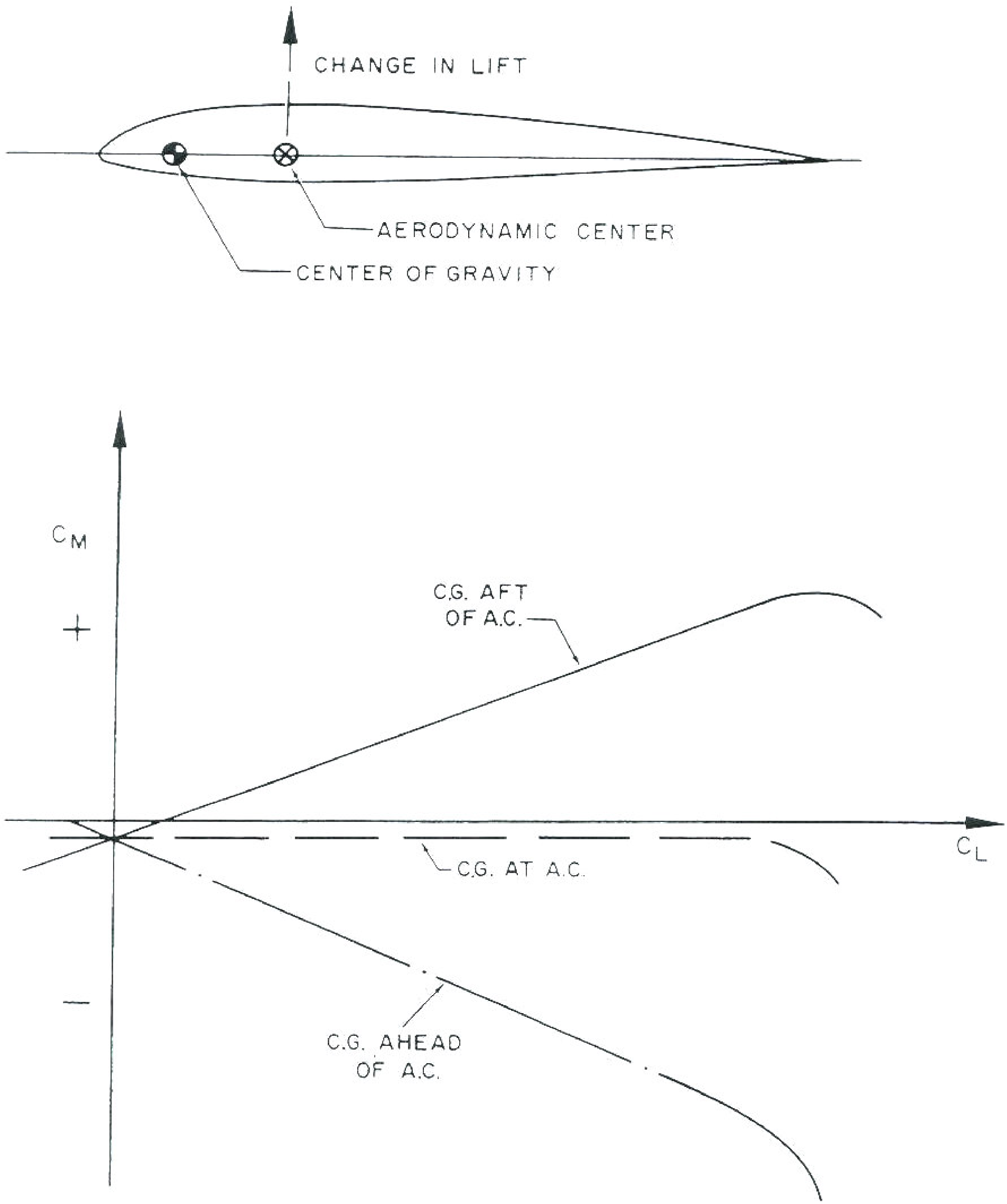


Figure 4. Wing Contribution

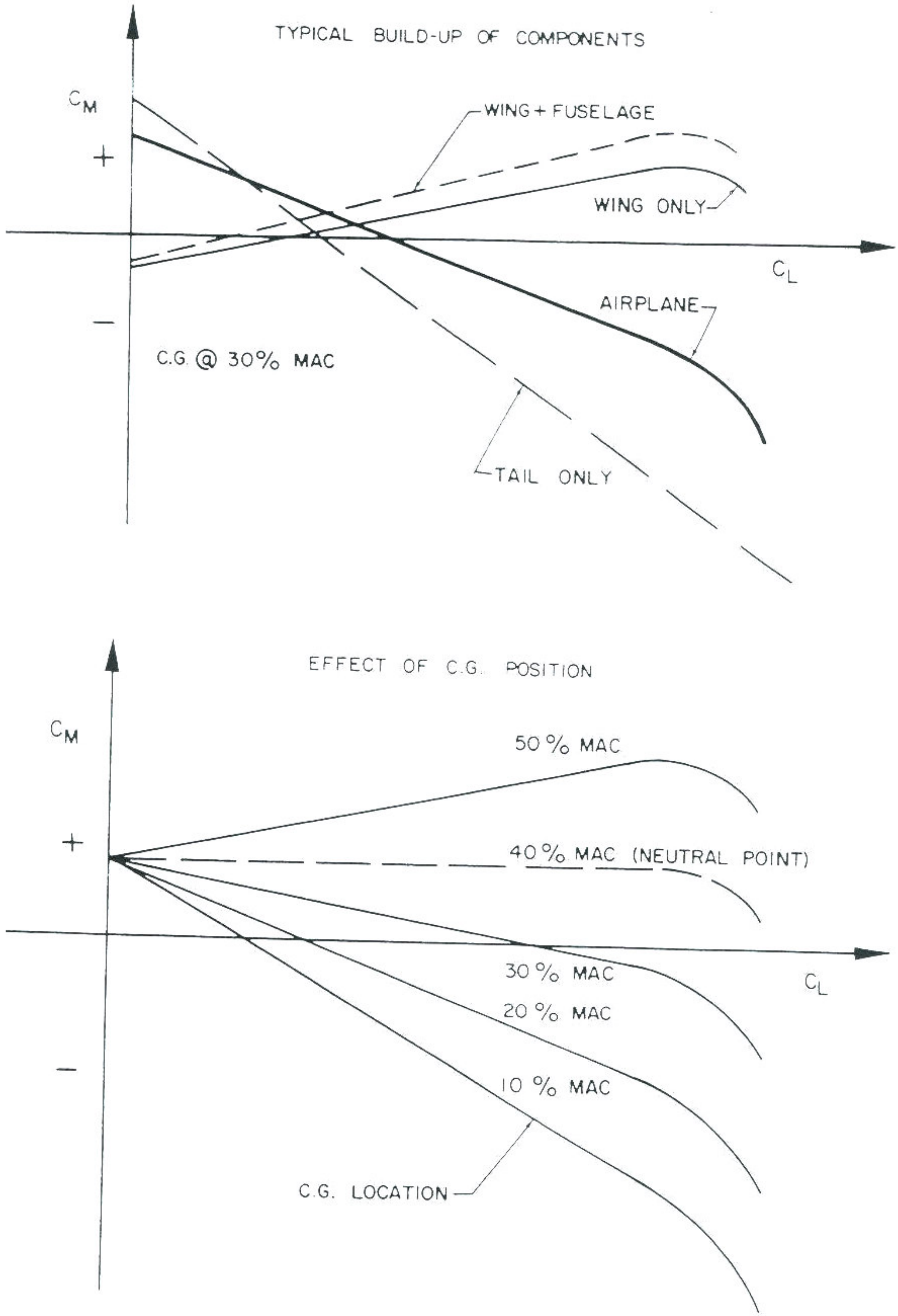


Figure 5 . Stability Build-up and Effect of C.G. Position

slots increase the maximum lift coefficient by increasing the stall angle. This higher angle leads to complex landing gear geometry. The split drag flap above the CG offers possibilities as a drag brake but has the disadvantage that sudden closing of the brake could leave the aircraft below flying speed. This is of course possible with conventional aircraft with flaps.

Some recent swept wing tailless designs have used very effective trailing edge flap systems. Notable of these are the SWIFT (Swept Wing Inboard Flap Trim) and the “Flair 30” which has a very large pitch neutral flap. Sketches of the Flair 30 configuration and flap are shown in figure 6.

SUMMARY

The tailless configurations should be considered as viable alternatives to conventional tailed designs. The gains that can be made depend on the skill and ingenuity of the designers. If you want detailed information of tailless aircraft aerodynamics there is no better place to start than with the book by Nickel and Wohlfahrt mentioned in the introduction. There is also a good deal of information available on the Internet. The TWITT (The Wing Is The Thing) and Nurflugel sites are a good place to start.

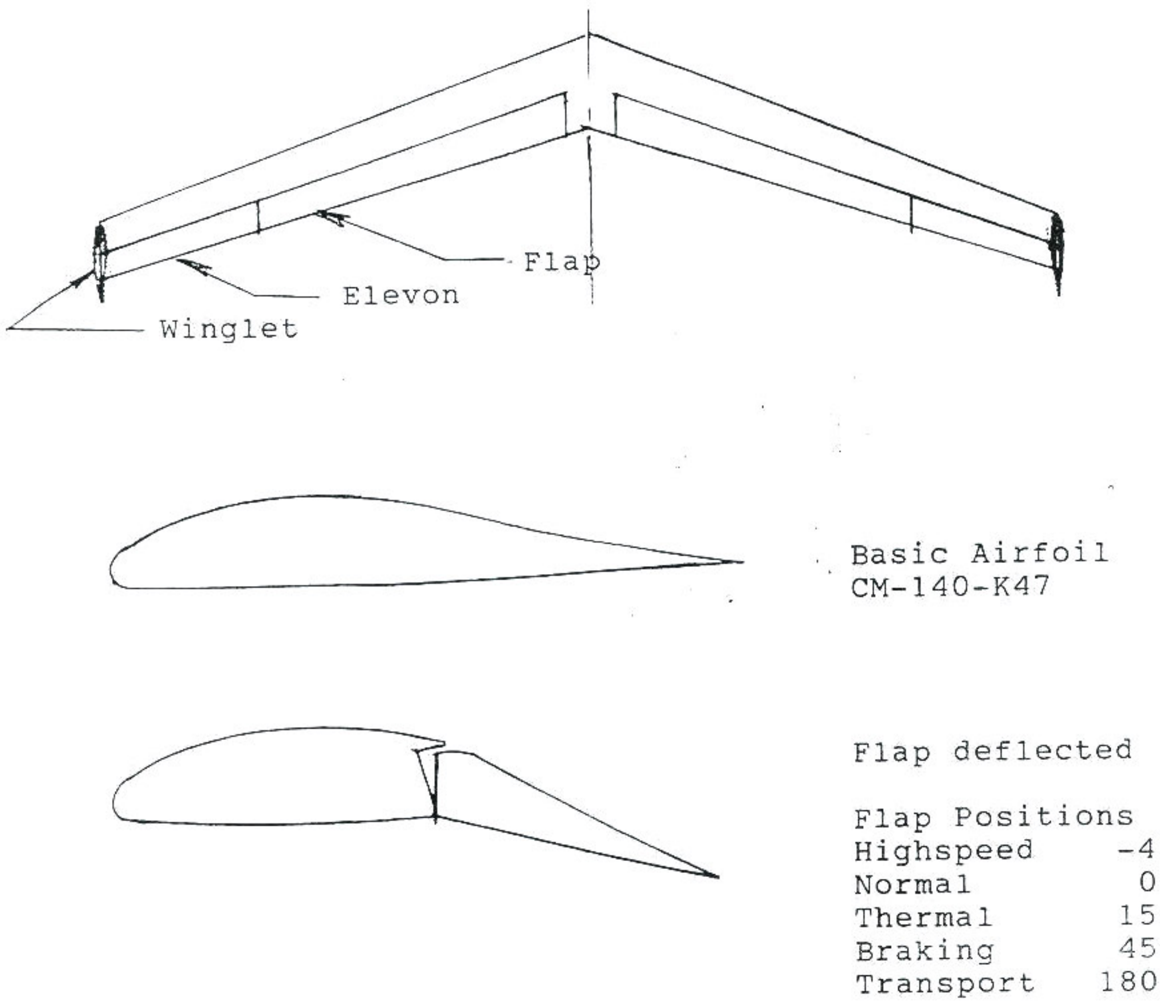


Figure 6. Flair 30 Planform and flap configuration