No. 284 FEBRUARY 2010

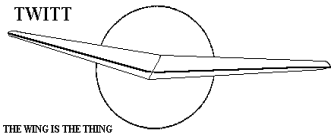
T.W.I.T.T. NEWSLETTER

A derivative of early Burgess and Dunne designs, the 1930 Arrowhead Safety Airplane was also inherently stable, weighed only 850 pounds and landed at a low 22 mph. Source: http://www.century-of-flight.net/Aviation%20history/flying%20wings/early%20US%20flying%20wings.htm

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., **1002** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, March 20, 2010, 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
Treasurer:
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) 447-0460 (Evenings – Pacific Time)
E-Mail: twitt@pobox.com
Internet: http://www.twitt.org
Members only section: ID – **09twitt09**
Password – **member2009**

Subscription Rates: $20 per year (US)
$30 per year (Foreign)
$23 per year US electronic
$33 per year foreign electronic

Information Packages: $3.00 ($4 foreign)
(includes one newsletter)

Single Issues of Newsletter: $1.50 each (US) PP
Multiple Back Issues of the newsletter:
$1.00 ea + bulk postage

Foreign mailings: $0.75 each plus postage

Wt/#Issues	FRG	AUSTRALIA	AFRICA
1oz/1	1.75	1.75	1.00
12oz/12	11.00	12.00	8.00
24oz/24	20.00	22.00	15.00
36oz/36	30.00	32.00	22.00
48oz/48	40.00	42.00	30.00
60oz/60	50.00	53.00	37.00

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).

TABLE OF CONTENTS

PRESIDENT'S CORNER

Time sure flies when you are having fun. It seems like just yesterday that I was preparing the last issue, but I guess that is because it was a week late so there was less time between them. Plus I am having fun working on my 1-26 restoration project at the hanger. I am able to work on it at least two days a week and it is going quickly in this initial stage of putting everything together and ensuring we have all the parts and the fit correctly. Kevin Renshaw's book has come in very handy already and will be a good reference when we get into the finer details of some modifications.

We have a lot of members whose memberships came up in January and more in February so I wanted to remind everyone to please get your renewals to me as soon as possible so you don't miss an issue. I am about ready to change the user ID and password on the members only section of the web site so without receiving the March issue you won't have access to future and past issues. We have a great core membership and I hope everyone continues to support TWITT. We just recently signed up new members from Germany and Sweden so there is still a lot of flying wing interest in Europe. Welcome to those members.

I hope everyone is progressing well on their projects as I am. Please don't forget to send us pictures and stories on what you are doing.

Andy

LETTERS TO THE EDITOR

January 13, 2010

Hi Andy. Here's an item for your next newsletter.

A couple of friends talked me into building an approximate model of the "Rattler", designed by Jerry Blumenthal, and mentioned in an old TWITT newsletter. I couldn't find any evidence that anyone had tried the design, even on a model. My model is a typical light-weight prototype, and I took a few shortcuts in order to see if the design would even fly. The original design had spoilers near the wing tip for yaw control, and a clamshell speed brake at the aft end of the fuselage. I chose to replace the speed brake with a rudder at the aft fuselage (to compensate for adverse yaw) rather than a more complex wing spoiler. I also extended the fuselage aft some to provide a little more vertical fin area.

The wing airfoil is a PW51, currently-popular in the "plank-wing" slope-racing model community. The fuselage fore body is flat on the bottom and is mounted at a 4 degree positive incidence relative to the wing. The wing has 6 degrees of dihedral, but no twist. The cg is at, or slightly ahead of, the wing leading edge.

I have made 6 flights on the airplane to date, launching from a powered R/C model. After some scary moments looking for the right cg location, it flies surprisingly well. It has a fast, flat glide, and is easily controlled in roll using a little rudder with the aileron. At low speed it tends to wander a bit in yaw with an aft cg. (One flat spin, which was recoverable).

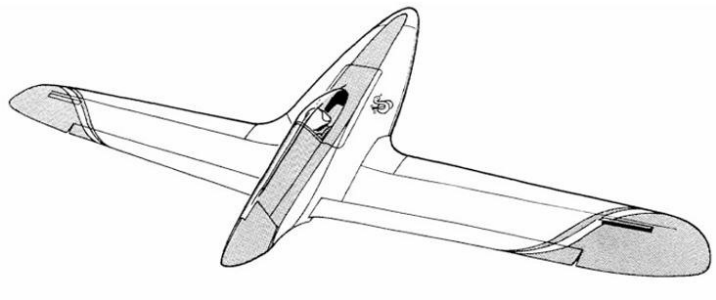
I am considering adding wingtip ailerons (like my bird models), which should allow me to handle the adverse yaw without the rudder, and then add a small electric motor (pusher) at the rear of the fuselage.

It is a very striking configuration in flight. I was pleasantly surprised at how easy it was to trim and fly. This is a pretty crude prototype model, but the design is worthy of some serious attention. I'll keep you posted on further tests.

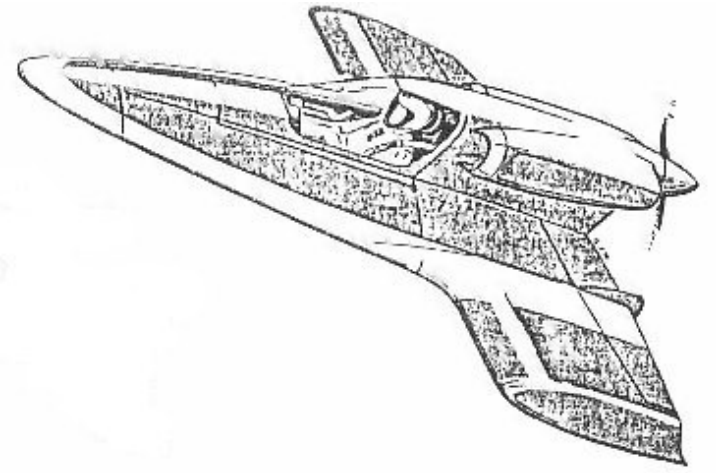
Bob Hoey
<bobh@antelecom.net>

(ed. - This is great. I am glad your friends talked you into it. Jerry would be pleased to see it in the air. While he did a lot of drawings and some static models (he was a wind tunnel model builder at Convair) he never finished any of this designs in an R/C form that I am aware of. I know he was working on one and had designed a clever mixer, but I am not sure which model and whether he got much further with it before his death.

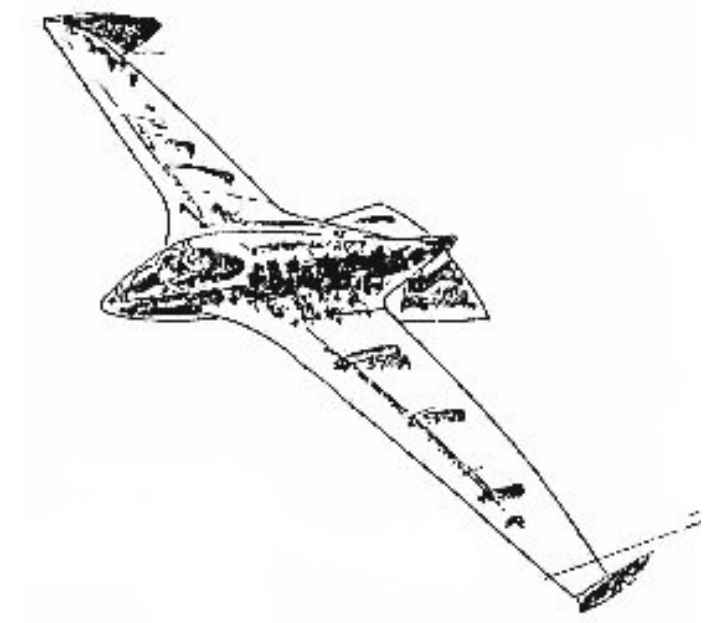
I will certainly add it to the February issue. I will also re-publish some of his other drawings to see if we can inspire others to give them a try.)



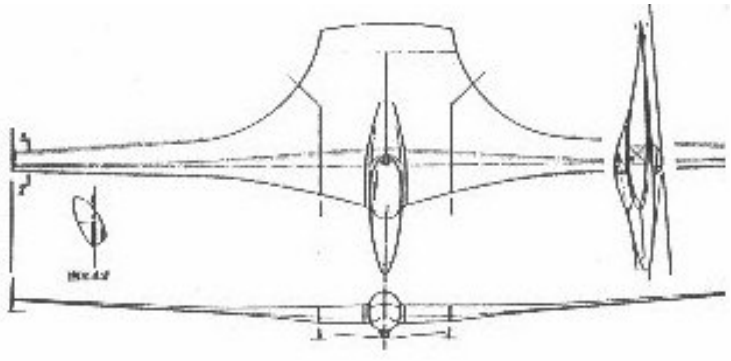
Original drawing of the Rattler



This is Raspberry – A Similar Design Idea



This is an unnamed design from Jerry



This is the Manta

January 25, 2010

I am in Slovenia visiting Eric Raymond. It is amazingly beautiful here and the river outside his house goes into a gorge of freezing water.

I stopped my mail delivery but something seems to have gone wrong. I will return Feb 1st. Perhaps you can send it again after that. Hopefully they didn't mess up more of my life. Perhaps my girlfriend can find out what's up with the Simi post office.

I am enjoying the newsletter (and brought some to my German friend who built & flew a plank Hang Glider in the '90's. Perhaps he can send a small report...)

Thanks for the fun of seeing the Dark Schnozolla in the newsletter! That inspired me to take it out for a few flights last month to amuse the young engineers at work.

The photo is Eric Raymond and Christof Kratzner of the DHV at the Deutches Museum Flight Annex in Munich.

Thanks for this notice, sorry to waste your time on this USPS problem. Address is good.
Ciao

RCDave Freund
<rc_dave@yahoo.com>

(ed. – For some reason the Post Office sent Dave's January issue back, which prompted this reply to my query about whether he had moved. And no, the Horten wing shown on the next page doesn't really have that type of curvature, its is just he camera lens making it look like we would all probably like it to be.)

January 28, 2010

My name is Jörg Schaden and I am one of the founders of the IG-Horten, so my connection to flying wings are the Horten Nurflügel.

I think there are many projects for the future like Horten and other interest Flying-Wings as R/C planes, but I am still dreaming of my own flying-wing like a Horten I or a Pioneer II in full size.

On Saturday we have an administration meeting I am going to ask if I can use the pictures of our first non-Horten Project the Schapel SSA 882 at 1:8 to write an article if you are interested?

Here is the URL to a short movie of the first flight http://www.rcmovie.de/video/baedeae873decb4cd01a/Erstflug-Schapel-Sa-882-Horten-Nurfluegel.

I am also searching for pictures for the first page of the Newsletter.

I will be in the USA in May and would like to know when the meeting at Gillespie Airport will be. I can show some short clips / pictures about Horten from R/C and real planes.

Some words about the newsletters. For me they are big collection of knowledge of all kind of flying wings. I am 27 years old and I have to catch up 24 years from the beginning of TWITT and many more in case of the Hortens. In case of the Hortens I started about two years ago and on TWITT today so lets go.

Regards,

Jörg Schaden
<joergschaden@googlemail.com>

(ed. - Thank you for the information and the offer for some pictures for the newsletter cover. I would welcome them as I am always searching for interesting ones each month.

I have forwarded your video link to Rod Schapel and hope that he gets it. His wife was the one really doing the e-mailing and she passed away late last year so I am not sure if he or one of his children and monitoring the e-mail account anymore.

I look forward to seeing and reading more about what your group is doing with the Horten type models.)

(ed. – I received an e-mail from Stephen Sawyer in Lincoln, CA who is a perspective member. He included a couple of pictures, one labeled and the other no so labeled. I thought they would make a nice addition as the last member contribution for this month.)

This was labeled as Lapidar on rotation.

Can't read the logos to tell which aircraft company BWB model this is – note shadow on ground.

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 and how they differ from the conventional. Those who chose 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.

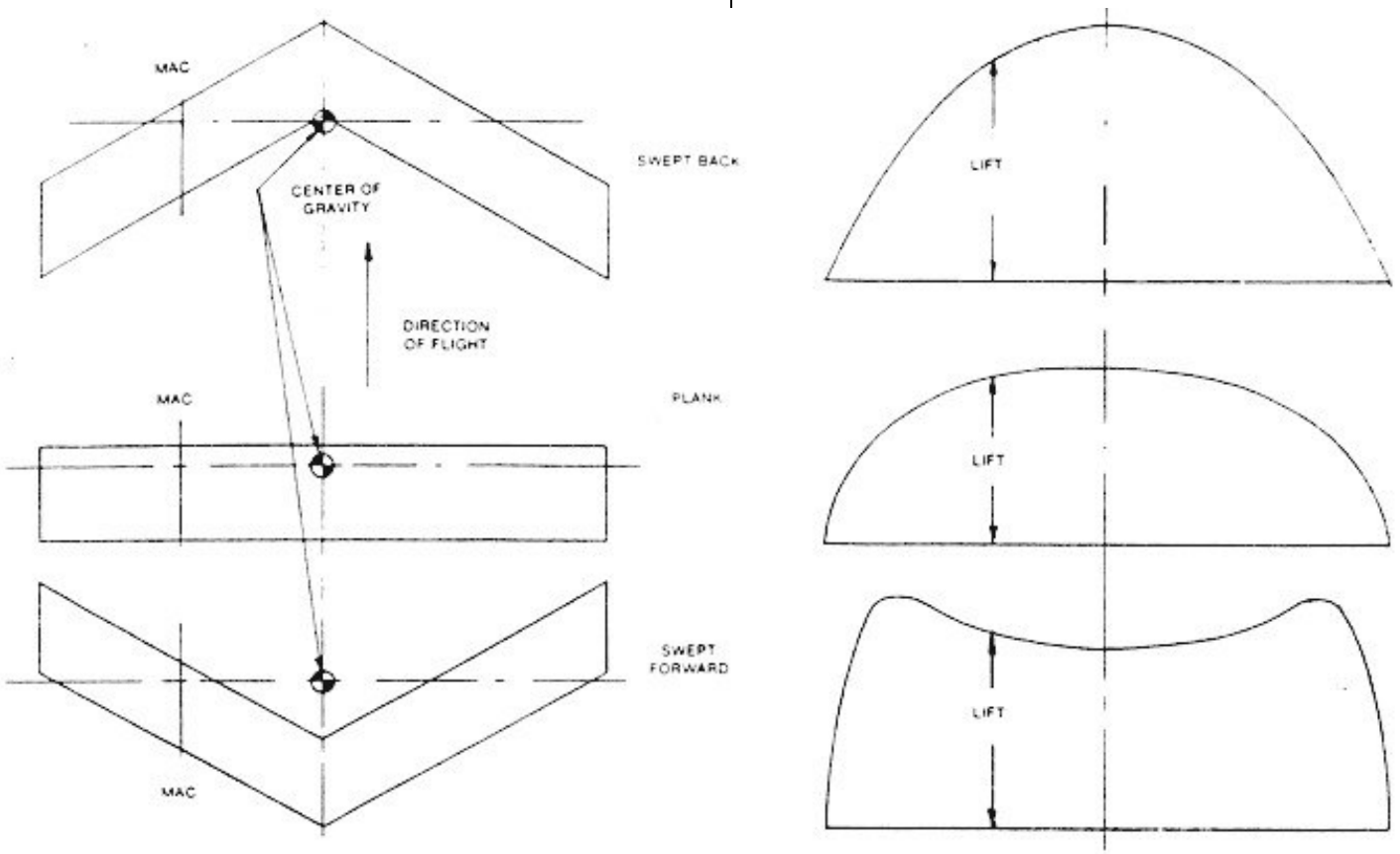


Figure 1 – Stable Wing Systems & Their Lift Distributions

All design problems must start with a desired result followed by a determination of the best way to achieve these results. In the case 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, let's look at the good things that may be gained from a tailless configuration:

1. 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 AV 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 the 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.

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.

(ed. – I apologize for some of the figures not being included with this article. I had it all planned for putting the article in this issue, since I didn't have any other viable material, when I discovered not all the pages from the Sailplane Builder issue were not included in the file I had and it was too late to pull together enough to fill the issue. I will try to find the missing figures and publish them next month. Enjoy the rest of the material.)

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 28 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.

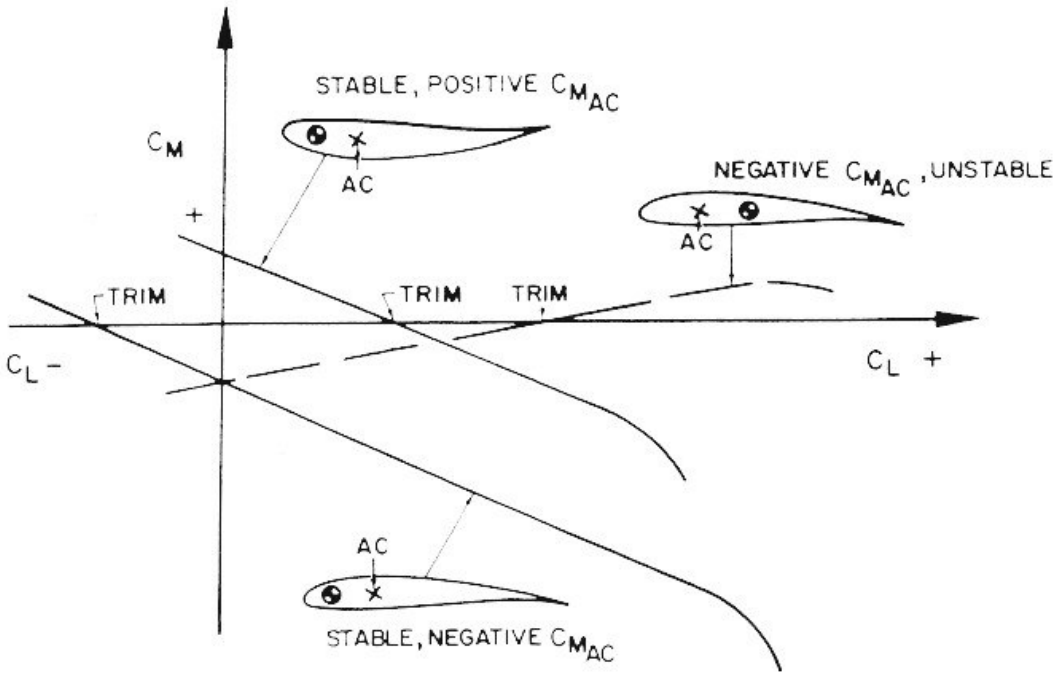


Figure 3. Effect of Cmac & C.G. position

Figures 3 and 4 show what a wing alone 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.

One factor that must be considered for tailless designs is the protection of the rear CG limit. A tailless sailplane 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 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.

AERODYNAMIIC 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 tip.

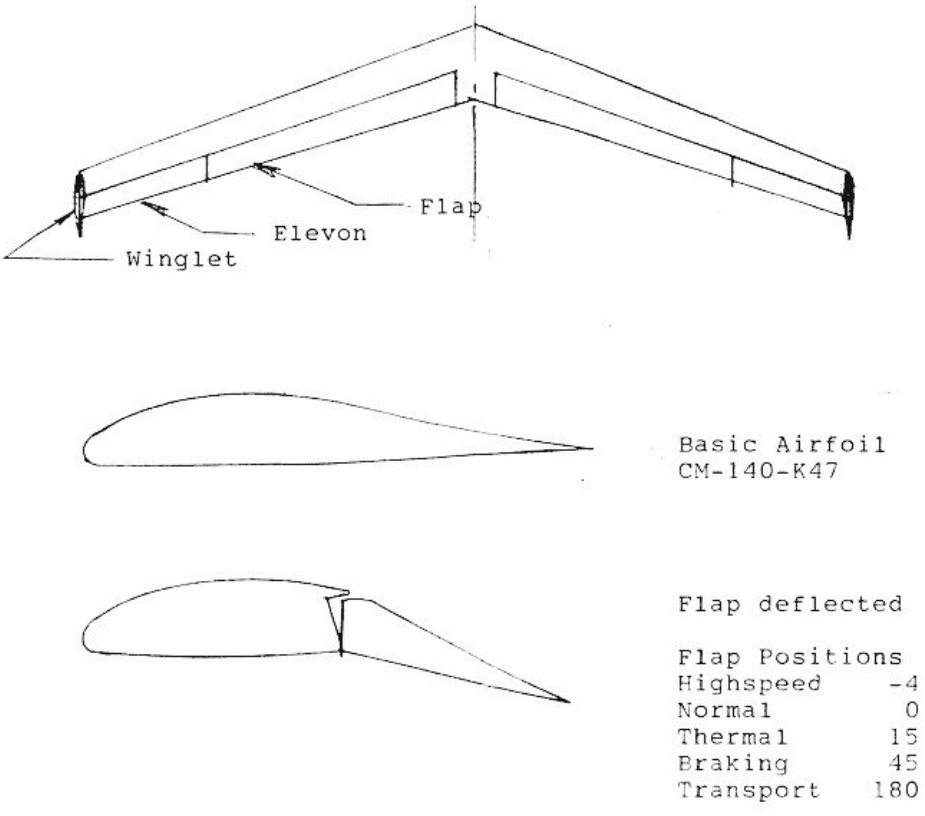


Figure 6. Flair 30 Planform and flap configuration

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 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.

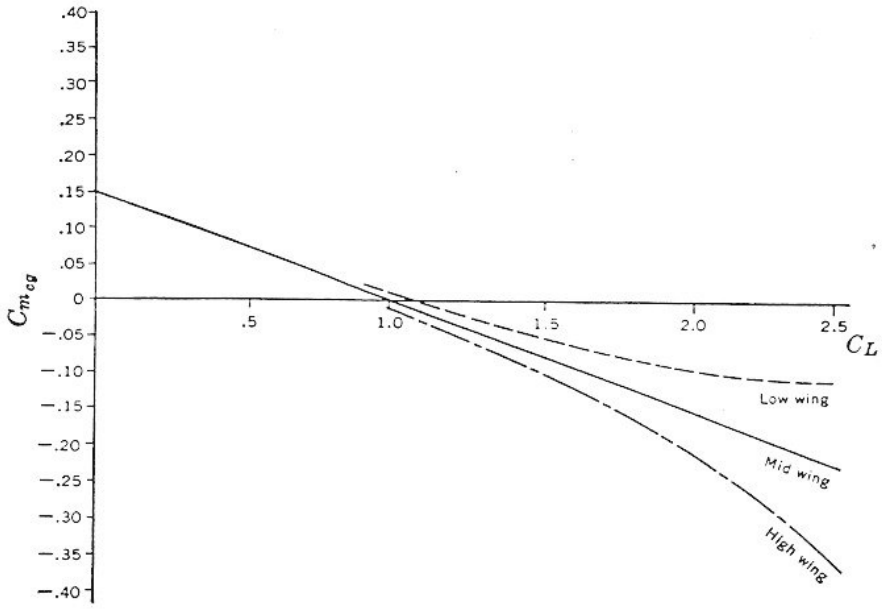


FIGURE 5–4. Effect of vertical location of c.g. on pitching moments.

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.

A Note From Al Backstrom

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 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 (5-4) copied from *Aircraft Performance, Stability and Control* by Perkins and Hage gives a good illustration of the effects.

The copyright date of the book is 1949, so there should be no problem with using the copy directly.

Mitchell U-2 Bulletin Board Threads

I have a set of unused U2 plans I would like to sell. I am asking $100.00 for them postage included.

Contact me @ hoffer54@comcast.net or pbrockhoff@yahoo.com

Thanks

P. Brockhoff

(ed. – This was posted on 12/3/09, but if you are interested it might be worth contacting him to see it the plans are still available. If not, then refer to the Flying Wing Sales item in our classifieds section and order a set directly from Carol Avalon who is carrying on Richard's business of at least producing plan sets.)

I noted the disclaimer on the groups front page. I very much like the cockpit (pod) in the photo. I'm guessing the aircraft displayed on US Pacific's front page is also heavily modified. Are there updated plans or prints that reflect these modifications?

I am Not an engineer and would not be comfortable making changes on my own accord.

I await your comments with great anticipation.

J.E. Caudle
Fenwick, WV
www.corbystarlet.org

My understanding is no. That fuse is a one-off created by the builder of that particular U-2. I have the latest plans from US Pacific and they are for the much different fuse that you see in most all of the photos in the photo section of this group.

Doug Hoffman

I had been in contact with Richard Avalon about the fuselage in question. He told me that he was looking into producing a similar pod. He told me that he was talking with someone about making a plug. That was all before he really started getting sick. Hopefully Carol will see this thread and tell us if Richard was able to get the plug completed. I know that Richard was wanting to offer this type pod at one time.

Ken Adams

It will be a long time before I get to this point, but I was debating using a wrecked Blanik, or something similar, as a plug/prototype for my pod.

Andy Gamache

Lots of BD-5 kits out there...If unfinished; they are pre formed and therefore easy to build.

Herb

I have the victory wing and it has a pod similar to the BD 5 except taller and roomier. I suspect if you keep the weight and balance within specs and you don't under build the pod, GO FOR IT!

Ray Landa

Ray, Where would I find plans for the Victory Wing? Thanks for the info,

JE Caudle

There are no plans for the Victory Wing. It is a one-off made by Don. If you want a composite U2 then you will have to buy the plans and re-engineer it. I will say this: the main wing has one main spar made out of wood and the rest of the wing is styro foam with what looks like an epoxy glass skin. And the outer section of the wing seems similar and is extremely light. The outer part of the wing is where the permanent slats are. Also, the rudders are part of the outer wing.

Ray

Hi Ray,

What can you tell us about the fuselage shape and construction on the
Victory Wing?

Doug Hoffman

The pod is mostly wood. It is covered in glass but i don't think there is much foam there. That is one place this ship can loose weight. On the TWITT web site (www.TWITT.ORG) look under "other flyingwing/ tailess design" and then go to the blue dot next to Mitchell Victory Wing. There are some pics there of the ship with Richard Avalon. BTW, the nose gear is retractable. I might make a mold of it one day so i can make some changes in construction which should make it lighter and stronger but that's no a high priority right now.

Ray

Nurflugel Bulletin Board Threads

Take a look at this idea.

http://www.scientificamerican.com/article.cfm?id=nasa-one-man-stealth-plane

Think about how much better it would be without a tail!

Doug Holverson

From the web site:

A super-quiet, hover-capable aircraft design, NASA's experimental one-man Puffin could show just how much electric propulsion can transform our ideas of flight. It looks like nothing less than a flying suit or a jet pack with a cockpit. In principle, the Puffin can cruise at 240 kilometers per hour and dash at more than 480 kph. It has no flight ceiling—it is not air-breathing like gas engines are, and thus is not limited by thin air—so it could go up to about 9,150 meters before its energy runs low enough to drive it to descend.

This is a perfect application for hybrid drive, which a friend of mine has worked out for a more-or-less conventional helicopter capable of scooping a soldier up from the enemy's rear and bringing him BACK - a more important and more demanding application. Hernan's design is a battery/electric using the best commercially available batteries, but with a tiny turbine/generator set for range extension. Peak power for takeoff and hover is provided by the battery pack and electric motors; the turbogenerator is rated around the cruise power requirement, and can run and recharge batteries during cruise and when idling on the ground. The numbers come out great, and the turbogenerator can be removed to increase payload for short hops using only the batteries.

As for prone flying, the Horten IV had it, obviously, and I don't remember reading any complaints. I think the VI had it too, but I don't have the book handy to check that. The best design I ever saw had a counterweight/pulley arrangement hooked to a modified crash helmet, completely compensating for the weight of the pilot's head without limiting mobility even slightly.

The machine can easily be made to fly itself, with the soldier just specifying where he wants to go. It can even be pre-programmed to carry a soldier to a preset location. We can now build aircraft that fly themselves to a specified spot, set down, allow a soldier to board, and then return on their own.

Marc de Piolenc

(ed. – Marc and Hernan are among the original founders of TWITT back in 1986. It is great to see that they are still very active in aviation and moving forward with new designs just like when they were working on a leading edge flying wing proposal.)

If our observation is accurate, the common position for a modern sailplane is not really supine or fully reclined. Similarly, the interesting historical examples of the headfirst pilot position (H-IV for example) are not fully prone. The exact dispositions of the body and the natural eye lines thereof are modified.

The exercise of lying flat on the bed shows problems for both feet first and head first. This is a bit of a loose and non useful experiment. However one could easily mock up with some cushions an approximation of say a H-IV vs an LS-6.

Having said that I think the ergonomics look easier to solve for the feet first pilot in the cushions mock up, as long as we ignore context, configuration, mission.

In the video of the NASA one-man stealth plane the pilot position looks undeveloped, even within the existing fuselage form.

Bill Daniels did some interesting mock ups for headfirst pilot position. I read about them somewhere.

Gregg

AVAILABLE PLANS & REFERENCE MATERIAL

Coming Soon: Tailless Aircraft Bibliography
Edition 1-g

Edition 1-f, which is sold out, contained over 5600 annotated tailless aircraft and related listings: reports, papers, books, articles, patents, etc. of 1867 - present, listed chronologically and supported by introductory

material, 3 Appendices, and other helpful information. Historical overview. Information on
sources, location and acquisition of material. Alphabetical listing of 370 creators of tailless and related aircraft, including dates and configurations. More. Only a limited number printed. Not cross referenced: 342 pages. It was spiral bound in plain black vinyl. By far the largest ever of its kind - a unique source of hardcore information.

But don't despair, Edition 1-g is in the works and will be bigger and better than ever. It will also include a very extensive listing of the relevant U.S. patents, which may be the most comprehensive one ever put together. A publication date has not been set yet, so check back here once in a while.

Prices: To Be Announced

Serge Krauss, Jr. skrauss@earthlink.net
3114 Edgehill Road
Cleveland Hts., OH 44118 (216) 321-5743

Books by Bruce Carmichael:
Personal Aircraft Drag Reduction: $30 pp + $17 postage outside USA: Low drag R&D history, laminar aircraft design, 300 mph on 100 hp.
Ultralight & Light Self Launching Sailplanes: $20 pp: 23 ultralights, 16 lights, 18 sustainer engines, 56 self launch engines, history, safety, prop drag reduction, performance.
Collected Sailplane Articles & Soaring Mishaps: $30 pp: 72 articles incl. 6 misadventures, future predictions, ULSP, dynamic soaring, 20 years SHA workshop.
Collected Aircraft Performance Improvements: $30 pp: 14 articles, 7 lectures, Oshkosh Appraisal, AR-5 and VMAX Probe Drag Analysis, fuselage drag & propeller location studies.

Bruce Carmichael brucehcarmichael@aol.com
34795 Camino Capistrano
Capistrano Beach, CA 92624 (949) 496-5191

VIDEOS AND AUDIO TAPES

(ed. – These videos are also now available on DVD, at the buyer's choice.)

VHS tape containing First Flights "Flying Wings," Discovery Channel's The Wing Will Fly, and ME-163, SWIFT flight footage, Paragliding, and other miscellaneous items (approximately 3½+ hours of material).
Cost: $8.00 postage paid
Add: $2.00 for foreign postage

VHS tape of Al Bowers' September 19, 1998 presentation on "The Horten H X Series: Ultra Light Flying Wing Sailplanes." The package includes Al's 20 pages of slides so you won't have to squint at the TV screen trying to read what he is explaining. This was an excellent presentation covering Horten history and an analysis of bell and elliptical lift distributions.
Cost: $10.00 postage paid
Add: $ 2.00 for foreign postage

VHS tape of July 15, 2000 presentation by Stefanie Brochocki on the design history of the BKB-1 (Brochocki,Kasper,Bodek) as related by her father Stefan. The second part of this program was conducted by Henry Jex on the design and flights of the radio controlled Quetzalcoatlus northropi (pterodactyl) used in the Smithsonian IMAX film. This was an Aerovironment project led by Dr. Paul MacCready.
Cost: $8.00 postage paid
Add: $2.00 for foreign postage

An Overview of Composite Design Properties, by Alex Kozloff, as presented at the TWITT Meeting 3/19/94. Includes pamphlet of charts and graphs on composite characteristics, and audio cassette tape of Alex's presentation explaining the material.
Cost: $5.00 postage paid
Add: $1.50 for foreign postage

VHS of Paul MacCready's presentation on March 21,1998, covering his experiences with flying wings and how flying wings occur in nature. Tape includes Aerovironment's "Doing More With Much Less", and the presentations by Rudy Opitz, Dez George-Falvy and Jim Marske at the 1997 Flying Wing Symposiums at Harris Hill, plus some other miscellaneous "stuff".
Cost: $8.00 postage paid in US
Add: $2.00 for foreign postage

VHS of Robert Hoey's presentation on November 20, 1999, covering his group's experimentation with radio controlled bird models being used to explore the control and performance parameters of birds. Tape comes with a complete set of the overhead slides used in the presentation.
Cost : $10.00 postage paid in US
$15.00 foreign orders

FLYING WING SALES

BLUEPRINTS – Available for the Mitchell Wing Model U-2 Superwing Experimental motor glider and the B-10 Ultralight motor glider. These two aircraft were designed by Don Mitchell and are considered by many to be the finest flying wing airplanes available. The complete drawings, which include instructions, constructions photos and a flight manual cost $140, postage paid. Add $15 for foreign shipping.

U.S. Pacific (559) 834-9107
8104 S. Cherry Avenue mitchellwing@earthlink.net
San Bruno, CA 93725 http://home.earthlink.net/~mitchellwing/

COMPANION AVIATION PUBLICATIONS

EXPERIMENTAL SOARING ASSOCIATION

The purpose of ESA is to foster progress in sailplane design and construction,which will produce the highest return in performance and safety for a given investment by the builder. They encourage innovation and builder cooperation as a means of achieving their goal. Membership Dues: (payable in U.S. currency)

United States	$24 /yr	Canada	$40 /yr
So/Cntrl Amer.	$40 /yr	Europe	$45 /yr
Pacific Rim	$50 /yr	U.S. Students	$18 /yr

(includes 4 issues of SAILPLANE BUILDER)

Make checks payable to: Sailplane Homebuilders Association, & mail to Murry Rozansky, Treasurer, 23165 Smith Road, Chatsworth, CA 91311.