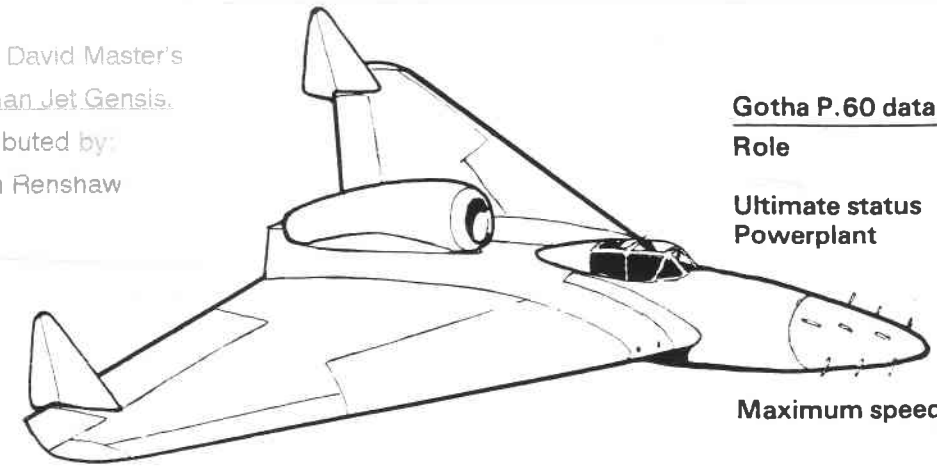
No. 83 MAY 1993

T.W.I.T.T. NEWSLETTER

From David Master's
German Jet Gensis.
Contibuted by:
Kevin Renshaw



Gotha P.60C

The third version in the series, the P.60C, had the same basic form as the A and B but was intended as a bad-weather and night fighter. A more conventional nose and cockpit canopy were envisaged, with the crew of two or three sitting in tandem. A fin and rudder assembly was to be mounted on the outer trailing edge of each wing. The extended nose housed a *Morgenstern* radar antenna for the *Neptun* AI radar, and a pair of oblique upward-firing 30mm cannon supplemented the four forward-firing cannon.

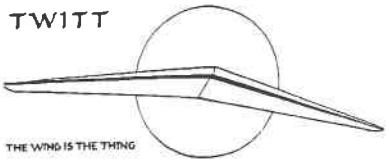
Gotha P.60 data

Role	Two/three-seat flying-wing jet fighter
Ultimate status	Design
Powerplant	Two BMW 003A (1,764lb, 800kg st each) (P.60A) or two HeS 011A turbojets (2,866lb, 1,300kg st each) (P.60B and C), and Walter rocket motor (4,410lb, 2,000kg thrust)
Maximum speed	596mph at 22,960ft (960km/hr at 7,000m) (P.60A), 607mph at 16,400ft (980km/hr at 5,000m) (P.60B)
Range	994 miles at 39,370ft (1,600km at 12,000m) (P.60A), 1,647 miles at 39,370ft (2,650km at 12,000m) (P.60B and C)
Weight	16,390lb (7,435kg) (P.60A), 22,000lb (9,980kg) (P.60B) loaded
Span	40ft 8½in (12.40m) (P.60A), 44ft 4in (13.50m) (P.60B and C)
Length	31ft 6in (9.60m) (P.60A), 35ft 1½in (10.70m) (P.60B), 37ft 4½in (11.40m) (P.60C)

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

The number to the right of your name indicates the last issue of your current subscription, e.g., **9305** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, May 15, 1993, beginning at 1330 hrs at hanger A-4, Gillespie Field, El Cajon, Calif. (First hanger row on Joe Crosson Drive - East 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
Vice Pres.,	Dave Pio	(619) 789-1650
Secretary,	Phillip Burgers	(619) 563-5465
Treasurer,	Bob Fronius	(619) 224-1497

Editor (Acting), Andy Kecskes

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) 224-1497

Subscription Rates:
$15 per year (US)
$22 per year (Foreign)

Information Packages: $2 (includes one newsletter)

Back Issues of Newsletter: $0.75 each (US)
Postage Paid

Foreign mailings: $0.50 each plus postage

Wt/#Issues	FRG	AUSTRALIA	AFRICA
1oz/1	1.00	1.00	1.00
12oz/12	5.00	6.75	5.00
24oz/24	9.00	12.25	9.00
36oz/36	14.00	19.50	14.00
48oz/48	16.75	23.00	16.75
60oz/60	21.75	30.25	21.75

Meetings are held on the third Saturday of each month, 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, east side of Gillespie).

TABLE OF CONTENTS

President's Corner	1
This Month's Program	2
Meeting Minutes	2
Letters to the Editor	3
Don Mitchell Obituary	4
Additions to TWITT Library	6
SB 13 Project Paper	6
Available Plans/Reference Material	10

PRESIDENT'S CORNER

In going through the roster this month I had to eliminate about a dozen people for non-renewal of their memberships. We are sorry they didn't renew, and hope that once they don't receive their next issue it will jog their memories.

When you become due, June puts a red circle around your due date as a reminder when she attaches the labels. We will send you at least one more issue beyond the expiration date, but after that your name will be removed from the roster if payment is not received.

For those of you who missed last month's meeting, you will have another chance at getting a glimpse of history this month. Bud Perl has made his presentation at several different functions, and we understand it is quite good. So, if you are a history buff, make sure and get to the meeting.

As I have mentioned before, we are always looking for program speakers. If you have an aviation specialty that would be of interest to the group, please let us know so we can work with you on putting a short meeting program together. If you know of someone who would be willing to talk to a small group on a Saturday, please pass along his/her name so we can contact them. Bob can use all the help he can get in putting together these monthly programs.

The number of letters coming in that have good information for publishing in the Editor's column has shrunk again this month. We appreciate all the input we get, and have no problem with publishing opposing views on the subject of flying wing theory. So, if you have a comment, whether long or short, please write us so the rest of the membership can be made more aware of all aspects of flying wings.

I would like to thank Bob Chase, Serge Krauss, and Al Backstrom for contributing material to the library and for publication in the newsletter. It sure makes it easier to fill out the remaining pages when you have too much material rather than not enough.

Andy

MAY 1993 PROGRAM

This month's meeting will be continuing the theme of aviation history. **Our guest speaker will be Bud Perl**, who has been involved in Southern California soaring for over half a century. His program will include a slide presentation entitled "Pioneer Gliding & Soaring with Charles Lindberg and Hawley Bowlus," circa 1929-31. You will get a look at the Bowlus Sailplane Co., and his glider school that operated out of what is now Lindberg Field (San Diego). There are shots of the manufacturing processes and some historical pictures of H. Bowlus conducting primary training off of sites like Point Loma.

Bud also has two videos for our viewing. One is footage of Charles and Ann Lindberg, with Bud and Hawley Bowlus in 1930. The other is of more recent vintage in that it covers some of the recent ceremonies at Torrey Pines Glider Port on March 21, 1993 during the declaration of the field as a historical site.

We are sure you will all enjoy this program, so be sure a be there.

MINUTES OF THE APRIL 17, 1993 MEETING

Andy opened the meeting with the usual housekeeping items, asked for visitors, and announced the raffle prize would be the Pioneers of Aviation history book and stamp collection (Bob indicated we would keep this up until everyone had a copy. Ha. Ha.!!).

Bob explained a little about the recent dedication of Torrey Pines as a historical site. There are still some problems with the Univ. of Calif. in getting them to release their portion of the land to make the site complete for all types of aircraft operations, full size gliders, hang gliders, and radio control.

Andy thanked Bob Chase for contributing some more information for the library. (See a complete listing of the articles later in this issue.)

Bruce Carmichael mentioned there would be a memorial service for Don Mitchell on May 1st, at Tehachapi. Unfortunately, we didn't have this information for last month's newsletter so more people would be aware of it. Bruce also announced the National Soaring Museum symposiums to be held at Elmira, NY at the end of May.

Andy then introduced Vic Saudek, our main speaker for the day. Vic's topic for the group was to be an outline of ancient glider history, starting as far back as there are records of any type of flight, or the thought of flight. The general underlying theme was that most of these early pioneers has asked the "right question" and then found an answer.

Stone age men sat around their fires and the children asked what made the smoke go up. The father would usually answer that the spirits made the smoke rise. Right question, wrong answer.

At about 2500 years ago, while Socrates was haranguing people in Athens he had an enemy named Aristophonese, a playwright by profession. Socrates had ideas that were contrary to the acceptable religion of the time, but he was able to deduce the correct answer to the question of what makes thunderbolts. Most people of the time thought it was Zeus throwing them, but Socrates wondered why so many innocent trees were being hit. He came to the conclusion that it was friction within the air that really caused this type of phenomena.

While on a trip to Australia, Vic noticed a very primitive kite in a museum. It came from stone age New Guinea and was made of leaves. The kite was used for fishing by hanging a special, sticky spider web ball at the end of a tail. Fish would jump at the ball and be caught by the sticky substance.

After finding an expert on these kites at the museum, Vic learned that a book was available at UCLA which would explain more about how the kites were used. It turns out that these early men asked the right questions. They designed some of the kites to look like birds so as to better attack the Gar fish they were interested in (the Gar fish knew that birds flew over schools of fish they fed on).

Vic then moved on to the 13th century where the Chinese used man-carrying kites in experiments, but they didn't ask the right questions at that point to follow through and come up with a glider.

There was a painting found, circa 1453, that showed a mother and child playing with a toy which was really the forerunner to the theory behind helicopters. But again, no one asked the right questions to follow through on the original idea.

In the late 1700s two French brothers discovered that rising smoke and gasses could be used to lift bags which later converted to hot-air balloons. About the same time, an Englishman also discovered that hydrogen could also be used to lift balloons. Both of these concepts were then developed into man-lifting devices.

Vic then moved into his slide presentation to accompany some of the concepts he was relating. His first slide was of an early drawing by Sir George Caley of Yorkshire, England, circa 1799. Although the idea was based more on the ships of the day, he did divert from the idea of having to use flapping wings to get the aircraft into the air.

Moving onto Lillienthal, the concepts of moving the pilots weight around to control the aircraft emerge. This was obviously

impractical as far as carrying any more than one person.

A French sea captain experimented with Albatross wings and thought he had discovered the theory of flight. He ended up building an aircraft that looked similar to the albatross, but it wasn't very successful.

Vic then moved onto how two brothers came up with the "Wright approach" to the theories of heavier than air flight. Their construction techniques and aspect ratios provided them the necessary strength and then they added the wing warping as a means of control. They even experimented with the gliders as kites before actually trying a manned flight. They were asking the right questions about flight and how to go about performing the proper tests.

They figured out how to solve the problem of adverse yaw, which led to the first three axis flight control system, and was the basis for their eventual patent.

By enlisting the help of Charlie Taylor as their chief mechanic, the Wright brothers went to work on a powered version of their glider, and 18 months later made the first successful flight at Kitty Hawk.

The Europeans weren't really making much progress in advancing controllability, until the Wright brothers introduced their 3-axis flight control system. Gliders were not being used as training tools to learn how to fly before getting into more advanced concepts, so Europeans just didn't ask the right questions until later in their aviation development.

Vic showed us a pamphlet on early American soaring events under the efforts of Ralph Barnaby and Dr. Klempner. It is available through the National Soaring Museum for $2. There is also another article that was published by the National Geographic Society called "On The Wings Of The Wind," by Howard Seapan covering gliding in Germany in 1929. He read a section from part of the article describing a cross-country flight by Wolfe Hirth that originated at the Wasserkuppe. It was this article that got Vic started in the soaring movement.

He then proceeded through the remaining slides, describing some of the history behind the various designs. One design was a German 4-place glider to be used for weather observation experiments. The Russians saw this design as a means of moving troops into battle areas, so designed and built some of the first troop carriers.

One of the stories relating to troop gliders had to do with a landing in Italy where the allied forces ended up shooting some of their own gliders out of the air. To solve this problem during D-Day, the now famous circular bands were put around all aircraft, and allied ground and sea forces instructed not to shoot at them. This time it was successful.

Vic talked a little about one of the glider snatch techniques he worked on for getting the craft out of the forward fields and return them for reuse.

The wrong question was asked and a solution provided when it was decided to make a upward swinging nose on gliders designed for carrying jeeps and other mobile items. If the glider nosed over or ended up against a hedgerow, the nose couldn't be opened and the equipment became useless. This was solved by making rear loading aircraft, which are now used by aircraft like the C-130, C-141 and C-5 of today's Air Force.

Vic was involved in an SSA project to investigate thunderstorms using a Pratt-Read side-by-side glider. This was done up to about 23,000', where a Blackwidow took over for higher tests.

He was also involved in numerous wave flights out of Bishop working with Bob Symons. In one instance, Symons ended up soaring (engines shut down to conserve fuel) a P-38 for over an hour in an Owens Valley wave between 13-33,000', at times experiencing 3,000 fpm rates of climb. However, the project also had its disastrous side too, in that one glider was completely torn apart by a pocket of turbulence, but the pilot Larry Edgar was able to bail out and survived. It was also during these wave projects that the altitude record of 44,255' was established.

One project that was never completed involved the design of a pressurized glider with a cabin section that could be removed and replaced another one. In this way, flights could be conducted continuously by putting on a new cabin with fresh instrumentation.

Bruce commented on Vic asking the right question several years ago and coming up with a better method of checking for laminar flow variations in wing surfaces. Now instead of running a wave gage chordwise over a wing, the gage can be run spanwise and find the same variations much quicker.

Vic took a few more questions from the floor and wrapped up his presentation.

The raffle was then held and the Pioneers of Aviation book was won by Bob Barbour. And with that Andy adjourned the meeting.

LETTERS TO THE EDITOR

4/14/93

TWITT

The attractive plank-type pusher "Mystery Airplane" in the photo from Alan Lewis in the April newsletter is called the Whitaker "Center Wing." I first saw it at Oshkosh around 1986, tied down south of the tower. Since then I have found it parked near the forum area twice, bearing this information in 1990:

Larry Whitaker
321 Brandt St.
Dayton, OH 45404

I have not followed up on this, but perhaps Mr. Whitaker could provide interesting information regarding design considerations, flight characteristics, and composite building experience. The plane seems well finished, but might benefit from less proximity of prop and trailing edge - what do you think? Since it apparently owes much to the Backstrom "Plank" series, member Al Backstrom may have been consulted during its creation. If so, I'm sure you'll hear from him too.

I have enclosed a couple dollars in the hope that you can provide me with a copy of the article "Fly the Wing" from the Feb. '93 Kitplanes (TWITT 3/93). I normally keep a close watch on the news stands each month, but that one got by me. Thanks!

Sincerely,

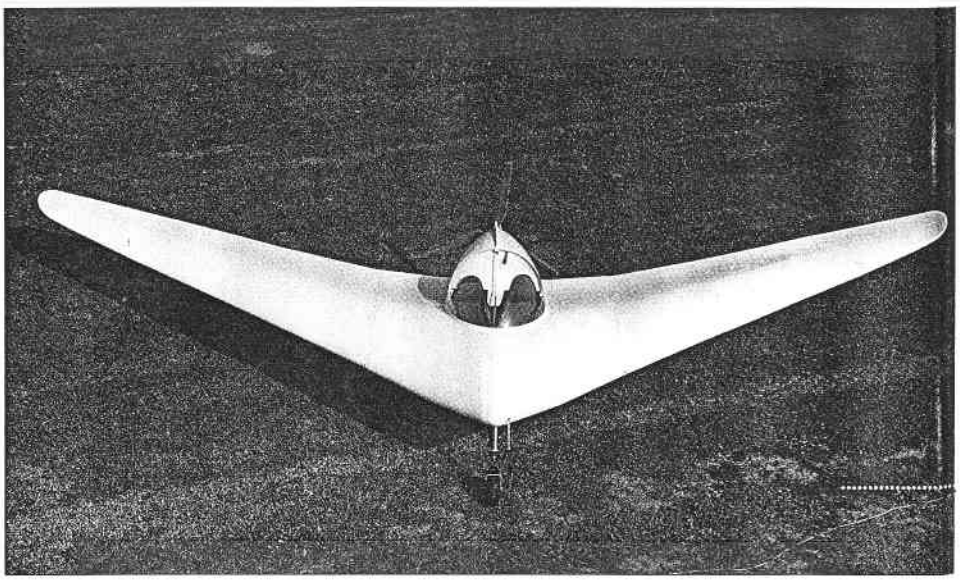
Serge Krauss

(Ed. Note: First of all, thanks for the information on the "Center Wing." Secondly, you were right in that Al Backstrom sent us some material which arrived at the same time. It is an article from Homebuilt Aircraft, July 1984, pp. 24-29, titled "Rally 'Round The Centerwing" by Larry Whitaker. Al did not include a letter with the article, and it did not mention that Al helped during the project, (the copy we received was missing page 26) so at this point we cannot be sure of Al's involvement.

We would like to thank both of you for the information, some of which will be published as space permits.

Hopefully, by the time you get this newsletter, you will have received a copy of the article on the French version of Horten's flying wing. Hope you enjoy it.)

BELOW: Overhead view of the PUL 10.



MITCHELL WING DESIGNER DIES OF HEART ATTACK

(Ed. Note: The following was given to us by Bob Chase at the March meeting. We regret this information was not available sooner so more of our Southern California members might have been able to attend. The article was published in one of the hang glider publications and contributed by Bob Chase.)

"On February 25, 1993, Don Mitchell, 78, died of a heart attack at Bakersfield Hospital, in Bakersfield, CA. On May 1st, a memorial service will be held at Tehachapi Glider Port in Tehachapi, CA. He is survived by this wife, Virginia, and three sons.

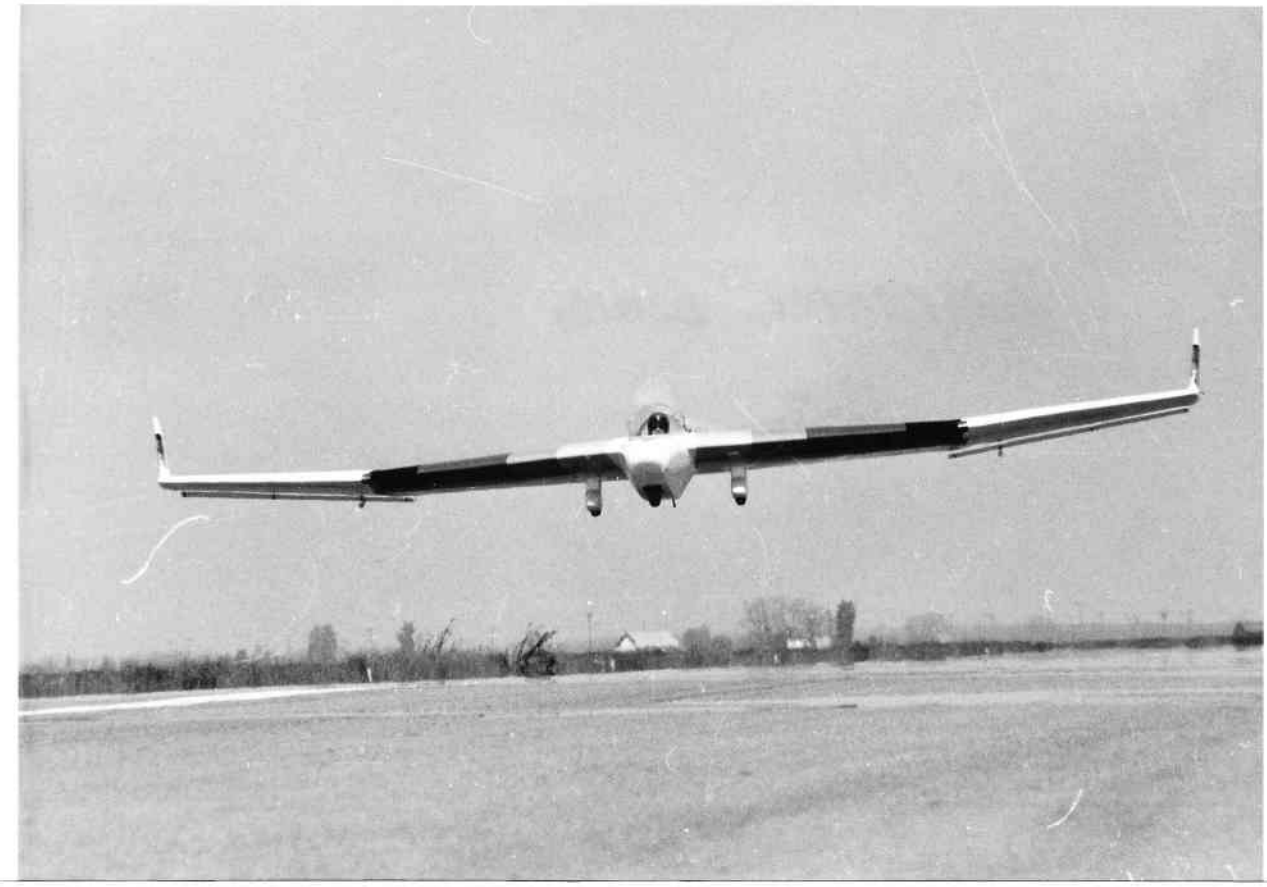
"Mitchell's name is well know among sailplane pilots as a prolific glider designer and fellow aeronaut. He is credited with helping build the original Baby Albatross with Hawley Bowlus in 1938; then started designing his own 50' 2-place side-by-side 3-wheel flying wing glider. Mitchell helped build the Cargo Glider XGC-16; co-designed and built with Hawley the Bumble Bee prototype (later changed to the Dragonfly); designed and built the Osprey flying wing; helped start the Northern California Soaring Association; then designed and built the first of the Nimbus sailplane series.

"In 1976-77, Mitchell designed and built the Mitchell Wing hang glider. This was the first rigid-wind hang glider with 3-axis controls and had outstanding performance. From 1978 to 1985, Mitchell experimented with various motorized versions of the Mitchell Wing and designed and built the Mitchell U-2. The U-2 holds the world's maximum altitude record for aircraft weighing less than 600 lbs, of over 26,000' and also holds the sustained altitude record of a little less than 26,000'.

"This designer then came up with the original A-10 - a foam and aluminum skin B-10. From 1986 to June 1989, he designed and built a foam and glass Victory Wing power glider.

"When Mitchell was admitted to the hospital a week before his death, he and current business partner Richard Avalon had completed the prototype of an ultralight motor glider. Called the AM01-Mitchell Wing, it is similar to the B-10 but is said to be stronger and lighter with conventional wood construction and Kevlar spar system."

FOLLOWING PAGE: Two of Don Mitchell's more popular designs. TOP: U-2 Mitchell Wing - note the placement of the outer control surfaces below the wing. BOTTOM: B-10 Mitchell Wing, with a 125cc, 10hp Mc101 engine. (Pictures courtesy of Richard Avalon.)



ADDITIONS TO TWITT LIBRARY

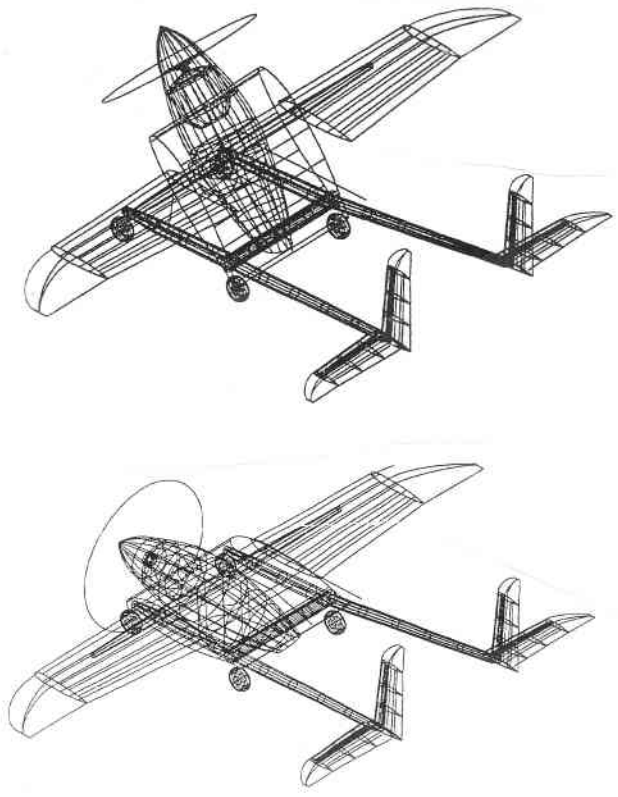
Bob Chase has found some more articles on flying wings in the following periodicals. We have photocopied them for the library in case someone cannot find the magazine at a local library. Thanks go to Bob for the contributions.

"Flying Wing," by E.T. Wooldridge, Aviation Heritage, November 1991, Vol. 2, No. 2, pp. 38-47. History of flying wings, primarily Northrop and Horten, leading up to the Northrop B-2.

"Is A Horizontal Tail Necessary - Tailless Part 5," by George B. Collinge, Sport Aviation, August 1984, Vol. 33, No. 8, pp. 38-41. General discussion of tailless concepts, including an extensive list of references.

"The WPB-1 Flying Plank," by Al Backstrom and Van White, Sport Aviation, February 1976, Vol. 25, No. 2, pp. 14-19. Designing, building and flying the powered flying plank.

Freewing Aircraft Flyer, Winter 1992-93, Vol. 3, No. 1, Freewing Aircraft Corp., Univ. of Maryland, Bldg. 340, College Park, MD 20742. "The freewing is an entirely different approach to the concept of flight. The wing is attached to the fuselage with a hinge system that allows the wing to yield to turbulent air." Included in this flyer is an article on Burt Rutan's Tilt-Body™ Unmanned Aerial Vehicle, an adaptation of the freewing concept shown below.



U.S. SOARING HALL OF FAME WEEKEND

The National Soaring Museum, Elmira, New York, will be sponsoring a series of symposiums and technical sessions beginning at 9:00 AM, Friday and Saturday, May 21-22, 1993 at the museum.

Bruce Carmichael will be the moderator for the Friday afternoon technical session and the schedule includes Oral History Recording Sessions on Saturday (assume these are for contributions by attendees recounting historical events in soaring).

By the time you receive this newsletter, it probably will be to late for west coast members to arrange attendance. However, those of you on the east coast might want to try and get up there for one or both days. Contact the NSM at (607) 734-3128 for further details and reservations (only costs appear to be for lunches and the Reception/Banquet/Induction Ceremonies portions).

THE AKAFLIEG BRAUNSSCHWEIG SB 13 PROJECT

(This material was contributed by Bud Mears, but does not contain a name of the original source.)

Preface: The following paper describes the flying wing project SB 13, which was developed, constructed and tested by the Akademische Fliegergruppe Braunschweig (Akaflieg) during the years 1982-1988. Because of the lot of facts the paper is divided into two chapters, one telling about concept and construction and the other one concerning flight tests and emergency system.

Chapter 1

Concept and Construction of the SB 13

1.1 Introduction

The Akaflieg is a group of about 25 students, almost all involved in engineering. The group's aim is to develop, construct and - of course - to fly sailplanes which are to point out new ways.

In the past, several extraordinary sailplanes have been built, for example the 29 meter ship SB 10 (H.W. Grosse and our team did four world records on it in 1979) and the 15 meter Wortmann flap SB 11 (on which H. Reichmann won the 1978 World Championship only a few weeks after first flight). Having constructed the SB 12 (the first glider with boundary layer control) in 1982, the Akaflieg reflected about a new project. After brief discussions we decided to start up with a so-called flying wing. There are several

arguments proposing an attempt to improve a glider's performance this way - a concept neglected for almost 40 years.
-- Pre-investigations showed that the reduced drag caused by the missing tail unit would increase performance by nearly 10% recording to modern standard class sailplanes.
-- It is possible to develop modern laminar airfoils with almost zero pitching moment. This is the most important point concerning flying wing mechanics.
-- To increase performance of sailplanes there is the possibility of doing many little steps - shown by the sailplane industry - or to do one big step with risks which can be beared only by a group without commercial interests.
-- A flying wing obviously needs less pieces to be built, causing low costs and little problems. (This last point turned out to be pure nonsense.)

The first question for the group of poor students is how to overcome the financial load of this project. It was answered by the German Ministry of Research and Technology, and the additional support by industries supplying us with materials and tools for free.

1.2 Concept of SB 13

The AB 13 is designed to fit the standard class requirements. Because of the fuselage and the vertical fins, it is not a regular "flying wing."

The first point to think about is the geometry of the wing. A nearly elliptical lift distribution (exactly: circulation distribution) versus wing span over a wide speed range is required to minimize induced drag. Every sailplane needs an elevator, but in contrast to conventional gliders, the elevator is integrated into the wing so that a change of deflection alters the lift distribution. This problem can be solved for a fixed position of the center of gravity if:
-- The pitching moment at zero lift coefficient of the glider with no deflected elevator flaps equal zero.
-- The wing chord is increased versus the span of those flaps compared to a normal trapezoidal wing (of course the wing still is tapered off).

The next question is about the sweeping angle of the wing. Sweeping forward seems to be unfavorable as the stalling behavior would be poor and the vertical fins would have to be very big (a swept forward wing is not stable around the vertical axis).

An unswept wing has the disadvantages that elevator and rudder have very little levers causing large changes of total lift at an elevator actuation. Other results of this are a vertical motion of the glider during rotation and high minimum speed because of the reduced total lift.

So the SB 13 is swept back with the advantage of good levers. As mentioned above, the wing chord is to be "enlarged" versus span and so the thickness of the airfoil. This enables the wingtip to bear the load of the winglets, which produce positive influence to induced drag at this position.

The sweeping angle determines where the wing hits the fuselage, because the aerodynamic centre of the wing has to be in a fixed distance to the c.g. of the fuselage at any sweeping angle. As there are only two possibilities to lead the spar through the fuselage (above or under the pilot's knees), a sweeping angle of 15 degrees with the spar under the pilot's knees was realized referring to better visibility at high angles or attack. To increase ground clearance (especially for the rotation during take-off and touch-down) a dihedral of 4 degrees was necessary. Fig. 3 shows the first design of SB 13.

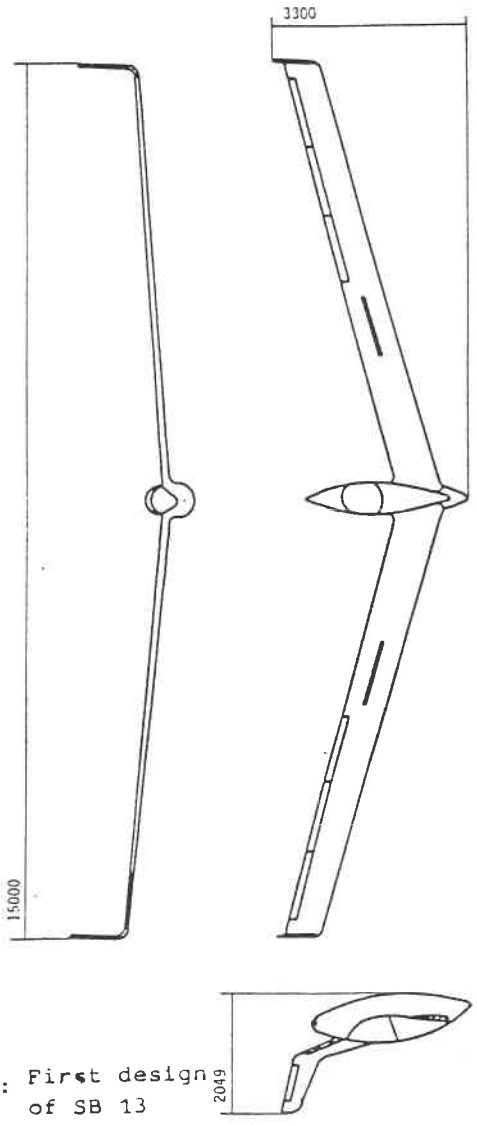


Fig.3 : First design of SB 13

Fig. 4 shows the meanwhile (or, to be more exactly: during the last two years) developed airfoils, using the free flying measurement equipment of the DFVLR. The HQ 34 N/14.83 was chosen for the inner wing section because of its good stalling behavior combined with little

sensitivity to bugs placed on the leading edge and high performance. The HQ 36 N/15.12 is the airfoil developed for the elevator and aileron section, having a high lift coefficient even with a negatively deflected flap. To achieve the right flap moment around its axis (a positive force on the stick) the trailing edge had to be changed a little bit and the airfoil is now called HQ 36 K/15.12.

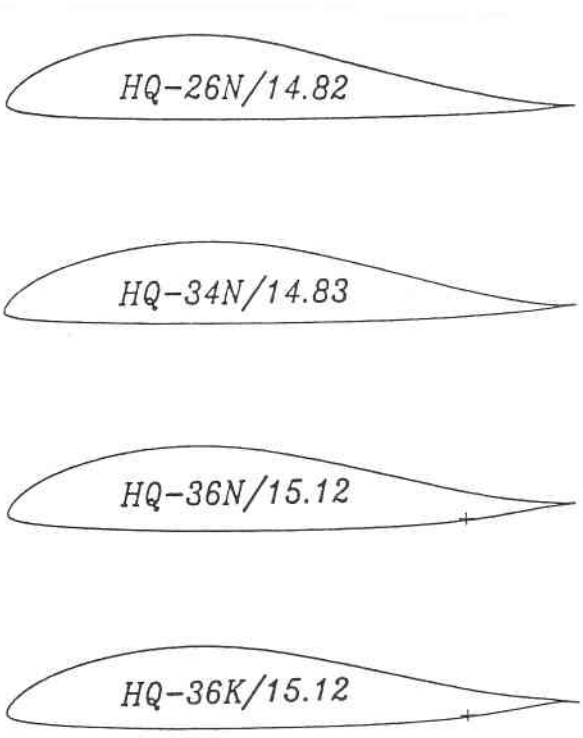


Fig.4 : High performance zero zero pitching moment airfoils

Flight testing a radio controlled model (1:3) turned out two problems: The first one was the stalling behavior followed by a spin and it was thought that the model's airfoil was responsible for this.

The other problem occurred by strange in-flight oscillations of the model from what obviously seemed to be severe flutter. Because we had no idea what kind of flutter this might be, a ground resonance test was carried out at the DFVLR Institute of Aeroelastics. The effect turned out to be a coupling between the first symmetric bending mode and the rigid body short period mode (Fig. 5). This flutter phenomenon is a characteristic of a swept back wing with high aspect ration because of the little damping of the short period mode due to the missing tail unit. Scaling up dimensions to the original SB 13 a flutter speed of 120 km/h was found.

As dealing with a flutter problem like this lies far beyond the capability of our university, we were assisted by the computer software and the know how of the MBB Company. After computing for several months we found out that a combination of two possible solutions would remove the flutter phenomenon to more than 280 km/h:

The first measure was to increase the frequency of the first bending mode by stiffening the spar. This led straight forward to the just available high modulus carbon fibres.

The second way was to do aeroelastic tailoring, i.e., utilizing the anisotropic properties of the fibres. So the spar is less swept than the wing for about 3 degrees (Fig. 6). To do this on a high aspect ratio wing, the inner wing sections had to be moved backwards to avoid a loss of strength and stiffness within this region. Therefore, the modified wing (Fig. 7) has two bends at the inner section and an enlarged root chord.

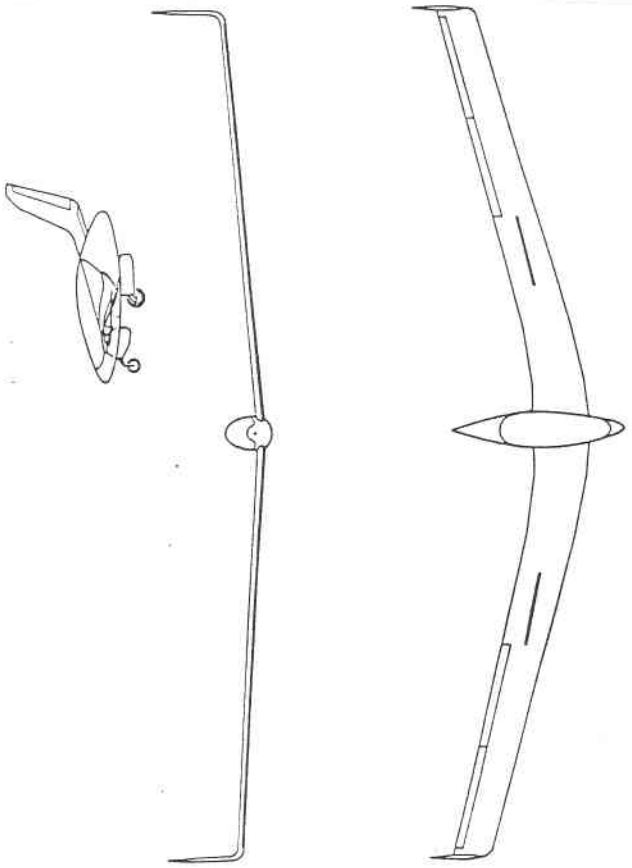


Fig.7 : Redesigned SB 13

(Ed. Note: The reminder of Chapter 1 will be concluded next month. The Figures included on the following page completes those associated with the design and construction portions of the paper.)

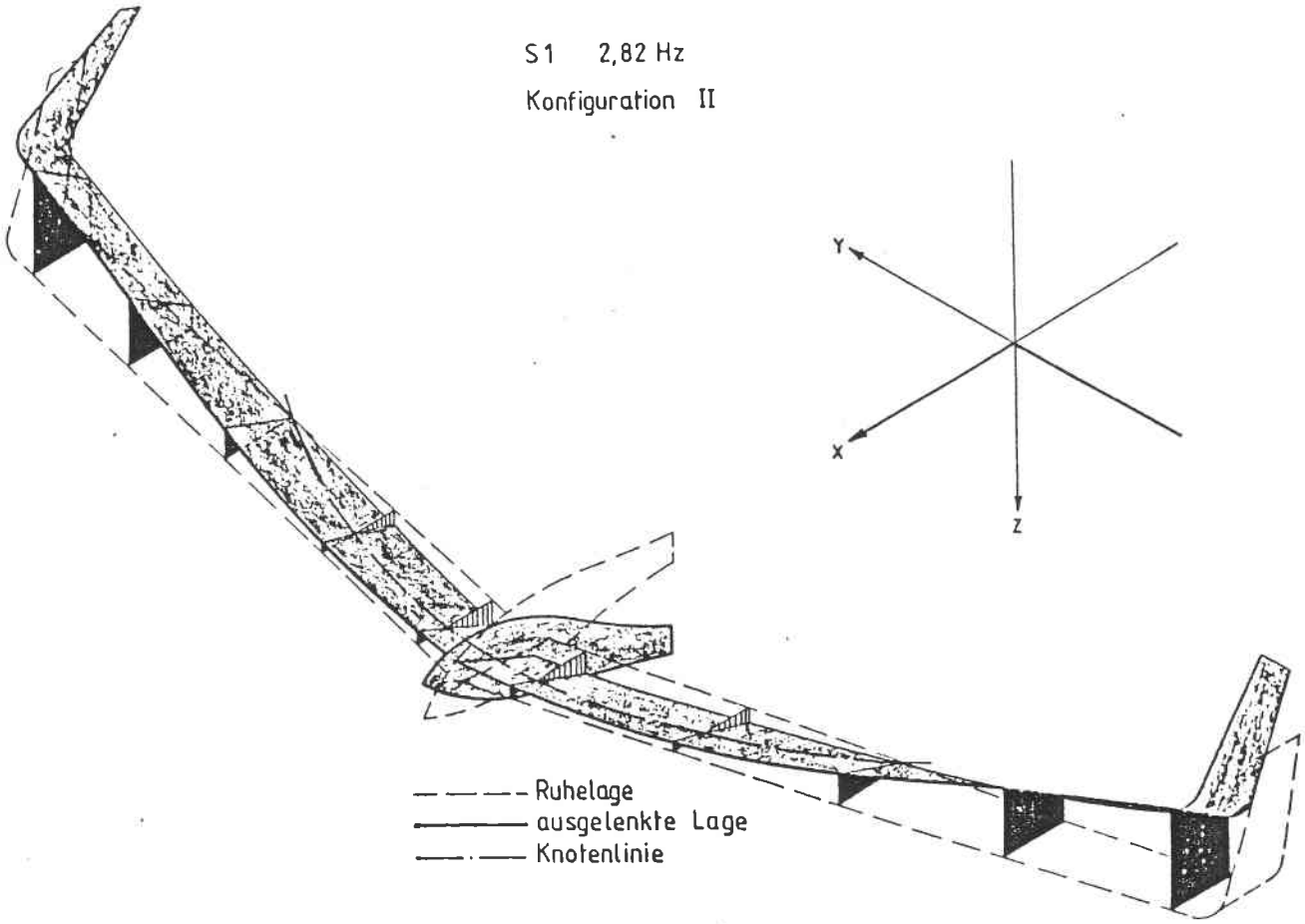


Fig.5 : Critical flutter phenomenon of SB 13

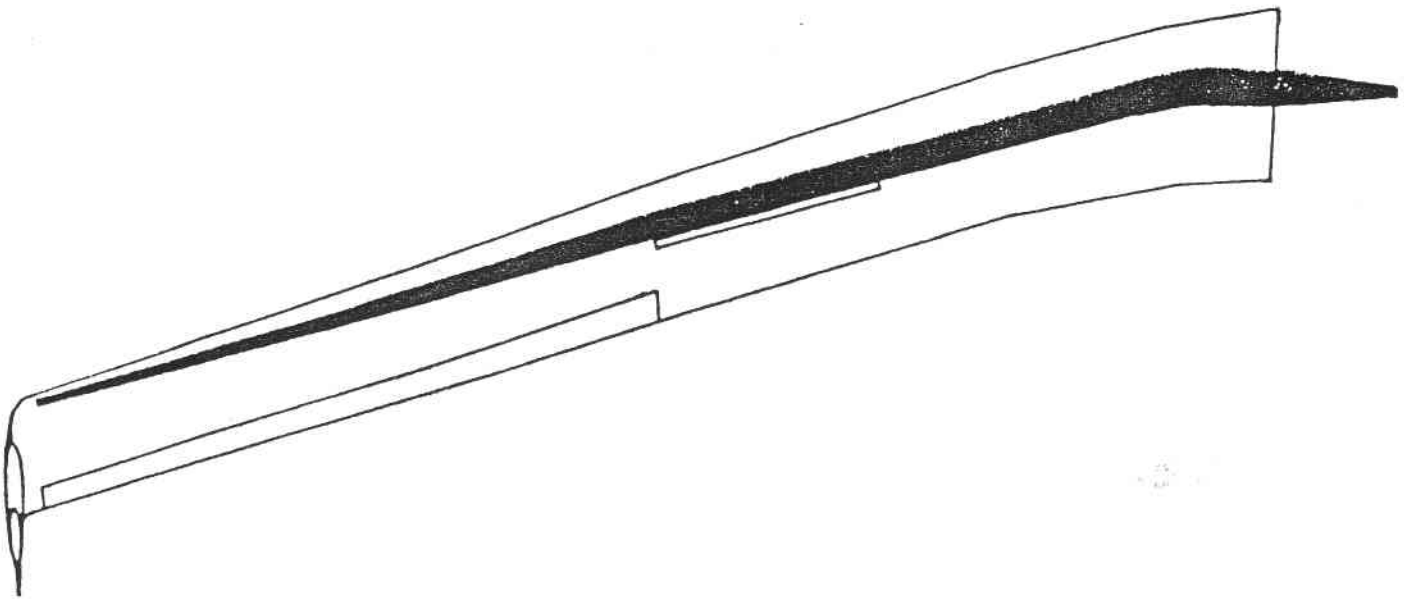
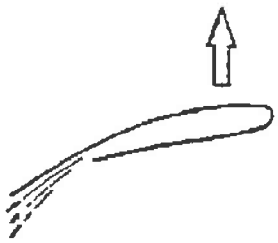


Fig.6 : Wing spar



THE HIAM AIRPLANE
NEEDS YOUR HELP

For those interested in assisting Budd Love with the future development of his High Internal Air Mass (HIAM) project, he would be glad to hear from you. This concept has changed in recent months to include both a conventional aircraft and design of a Horten type flying wing utilizing HIAM technology. (See Dec '92 newsletter, page 4.)

Contact: AIRLOVE, LTD.
6423 Campina Place
La Jolla CA 92037
(619) 459-1489