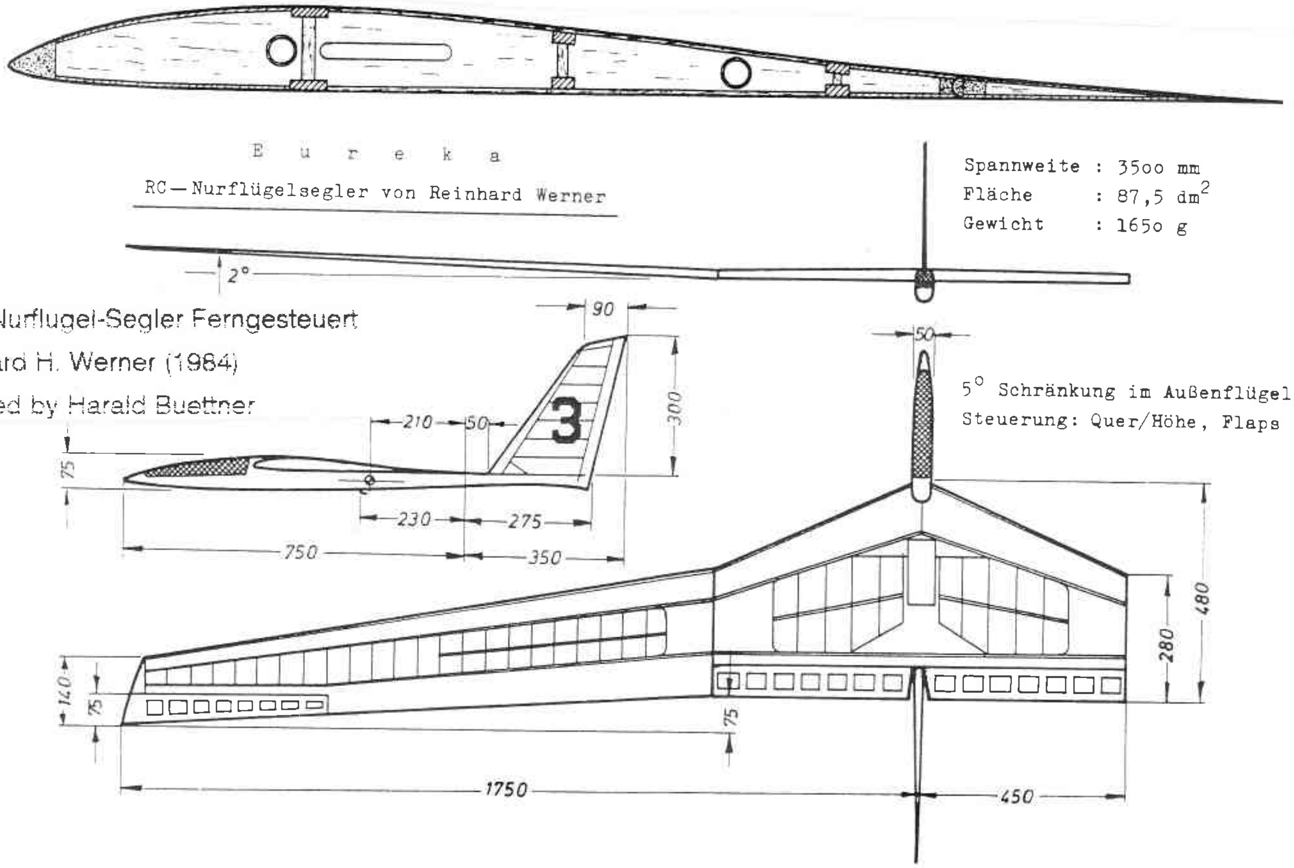
No. 84 JUNE 1993

T.W.I.T.T. NEWSLETTER



Source: Nurflugel-Segler Ferngesteuert
by Reinhard H. Werner (1984)
Contributed by Harald Buettner

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., **9306** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, June 19, 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

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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).

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PRESIDENT'S CORNER

I must apologize to Bud Perl for a most unusually small turnout for our May meeting. We still have not found out why this happened, and we hope it will not become a trend in the future.

The last couple of programs have been very much geared towards the history of gliders during the early years. Perhaps this is the problem. If so, we are more than open to suggestions for future programs, to include who and how to contact the desired speaker(s).

As you can see from the program announcement, we are entering our eighth year of helping aviation enthusiasts keep abreast of current events in the area of flying wings. We continue to grow in membership, and hope that the new members who joined us during the 1992-93 period are enjoying what they get and encourage everyone to be a participant in the organization.

You can see that designing and building a state-of-the-art flying wing can be a most difficult and time consuming venture. We congatulate those of you who have elected to undertake such a project and wish you good luck in seeing them to completion.

We are looking forward to another exciting year of learning more about what each of you is doing to get that favorite project in the air. There are several of you who have promised us some material to fill these pages in the near future, and we hope they are stories of success in any phase of the construction or flight process.

For those of you in Southern California, make sure a come to this month's meeting for our anniversary celebration and enjoy the traditional ice cream and cake.

Andy

JUNE 1993 PROGRAM

IT'S THE SEVENTH ANNUAL TWITT BIRTHDAY BASH

Come and enjoy an excellent program (see below) and join in on the cake and ice cream celebration of our 7th Anniversary. This meeting is always a good opportunity to hanger fly with your friends and learn what's happening in the local area.

The program this month will feature **Larry Edgar**, one of the pioneer aviators in wave and jet stream flying. He will be talking about his experiences while performing research in these two phenomenon. He has slides and a time lapse video of wave clouds and the instrument panel of his Pratt-Read during a altitude record setting flight.

Larry started flying in 1939 in a Franklin glider with the XYZ Soaring Club of Michigan, outside of Detroit. During 1950-52 he worked as a tow pilot, A&E, and glider pilot for the Sierra Wave Project, accumulating over 200 hours flying in waves. Many of these flights were between 30-40,000'. The record flight occurred on March 19, 1952, when he and Harold Klieforth, a U.C.L.A. meteorology student, reached 44,225'.

In 1955, he was involved with the Jet Stream Project in which he experienced a mid-air breakup at 14,000' caused by severe turbulence.

MINUTES OF THE MAY 15, 1993 MEETING

Andy opened the meeting to an unusually small turn-out. After some house keeping items, the floor was turned over to our guest speaker for the day Bud Perl.

Bud began by explain-ing how the recent his-torical dedication of Torrey Pines Gliderport came about over the past several years. Larry Fogel, of the San Diego Gulls R/C model club, was the main force behind the effort, along with the Torrey Pines Soaring Council.

Early in the program, both Larry and Bud attended a San Diego City Council Historic Site Board meeting and made a presentation to con-vince them Torrey Pines was a historical site. This program was also presented to the full City Council, which was also attended by the UCSD Chancellor, whose arguments were enough to get the council to put the nomination on hold.

A subsequent meeting was attended in Riverside with the State Historical Resources Commission, who has jurisdiction over all the state historical sites. Their decision could also lead to inclusion on the National Register which would add greater prestige to the site.

The Commission in fact decided to designate the entire 65 acre block of land as a historical site. UCSD owns about 30 acres of the property, which includes the main runways, and could at some time in the future attempt to build more educational facilities in that location. However, since the area is now a historical site it will be more difficult for them to proceed, which may deter them from taking any action in the foreseeable future.

Bud then showed the group a series of viewgraphs, some of which were presented during the various meetings. The Commission kept cutting into Larry and Bud's presentation time due to a full calendar of other considerations. Bud's part included showing that he was a direct participant in the historical events at Torrey Pines. Among his credentials were two gilder pilots licenses, both signed by Orville Wright.

He also had several viewgraphs of the various types of gliders that flew at Torrey Pines during the early thirties. The pilots included Charles and Anne Lindbergh, Hawley Bowlus, Johnny Robinson, Woody Brown, Paul MacCready, Bill Ivans, and many other well known pilots, some of who are still active today.

Bud went on to cover some of the other historical events that have occurred within the San Diego area. These included the building of the Spirit of St. Louis, with Hawley Bowlus as a construction superintendent, and then the forming of the Bowlus Glider School. Both Lindberghs took instruction from the glider school and spent a great deal of time in San Diego establishing soaring records. Much of the flying was done along the slopes of Point Loma.

The Commission had only one criteria for deciding on declaring a site historical: the criteria was "is it historical." Bud summed up this aspect by showing that Torrey Pines was a center of aviation activity during the very formative years of the industry.

The next part of Bud's presentation included a series of slides covering a wide variety of aviation history in the San Diego area during the 1929 to 1931 time frame. He also showed several short videos of the Torrey Pines historical dedication, slope soaring along the cliffs by some of the early pioneers, and a brief clip of the Lindberghs flying at Point Loma.

Bud was involved with the Bowlus school for a number of years, and spent time with the Lindberghs during their glider training at all the sites around San Diego. The slides included shots of Charles Lindbergh doing shockcord launches, which were an exciting means of getting into the air. Bud commented that these activities created a lot of curiosity on the part of the spectators who didn't understand how an aircraft could stay up without a motor. He also noted that those flying the machines didn't always understand what was going on during the flights.

On one of Charles Lindbergh's soaring flights he hit a gust of wind that broke off one of the ailerons. At first glance this would seem like the end of his sterling career, however, due to the push/pull tube control rods used by Bowlus he was able to maintain control and land safely. This was a type of redundant control system, since it didn't use a common cable between the control surfaces which would have been fatal in this case.

In the early thirties, Hawley Bowlus sold the glider school to Frank VanBeesal, and Bud stayed on as an instructor and test pilot. However, the depression took its toll on the school and it folded about a year and half later.

The shots of Hawley Bowlus flying one of his Baby Bowlus' at Torrey Pines were quite spectacular for the state of the art in photography equipment at the time. The cameras were mounted on different parts of the glider and provided simultaneous views of the glider and ground soaring over the near vertical cliffs.

After viewing the historic videos, Bud concluded his presentation by asking for questions from the small, but interested, audience. Bob Chase asked about where the landing sites were on Point Loma. A road along the point provided one landing spot, although it involved making a crosswind landing after launching into the wind. The parking lot by the old Spanish lighthouse provided another of the launching and landing sites for the Bowlus gliders.

(After the meeting Bob was able to arrange for Bud and his son to make a video tape of the above mentioned sites as they exist today. It is hoped this will aid in getting these sites declared as historic with appropriate markers placed at them for future generations.)

Due to the small turnout, there was no raffle conducted, so Andy closed the meeting after the question and answer period.

LETTERS TO THE EDITOR

4/15/93

Dear TWITTers:

Please find enclosed $22 for my renewal. Each of you newsletters provides me great pleasure.

In fact, the article "Fly the Wing," in the February (1993) issue of Kitplanes is not the same I sent you, but the further development of Reimar Horten's PUL 10.

I'd be glad to hear more about the announcement of Graham Fleming about the ultra-light version of the Arup flying wing style aircraft (flying pancake).

I'm eager to learn about the successful model ornithopter video provided by Don Woodward.

Concerning Don Mitchell's passing, I'd like to know why there was never any note for available plans or reference material of his? And where Don Mitchell published his material?

Thank for any response.

Faithfully yours,

Gunther Rudat

(Ed. Note: We will work on getting some more information about the things you asked about over the next several months. Bob will have to contact both Graham and Don to see what we can come up with.

As for Don Mitchell's work, you will probably have to correspond with Richard Avalon who was working with Don just before his death. It is our understanding that Richard now holds all the Mitchell design material, and any future releases of it. His address is in the roster.)

By the time you get this newsletter you *should have received the tape and material from Bud Mear's talk. We hope you enjoy it.*

Thanks for the compliment on the newsletter, and please keep us informed on what is happening in your area of the world.)

(The following was received by Bob Chase from Gunther Rudat. Bob has provided the letter and his response for the information of other TWITT members.)

Dear Bobby:

After reading your letter to Jim Loyd as published in TWITT's February '93 issue, I'd like to ask you some questions about wingtips and others. What do you think about Rutan's Varieze wingtips with rudders? I'm sure in this region of the wing important things happen. I agree Rutan's formula isn't a flying wing but a canard and this canard-surface works only in and for better pitch control but the vortex problem remains the same concerning the main wing, you don't think so? I heard talk about little stall problems by rainy weather on the canard surfaces, but never about vortex problems on Rutan planes.

Could you give me some details on your spin and crash, if you were injured and your plane, what condition you saved your life. If you can send me a photo of your wing and if you could repair it or in construction with another one.

Actually, I'm flying with an ultra-light classic bi-plane two seater in the center of France nearby the city of Bourges about 30 miles NW from Moulins where each year is held the European Oshkosh.

Please accept a little money for postage, I'm looking forward to hearing from you and your activities.

Sincerely yours,

Gunther Rudat

Dear Gunther:

Thank you for your inquiry. Your questions are of interest to many TWITT members so I am taking the liberty of asking them to publish your letter and this reply.

My disapproval of wingtip rudders and fin was aimed at the type depicted on Jim Loyd's drawings. Many wingtip treatments will improve efficiency and stability such as diffuser tip, diffuser feathers, vortex turbines, and the swept back canted fins as used by Rutan's Varieze and Voyager.

One wingtip fin of the Voyager was destroyed on take-off and the trip around the earth was completed without it, so I assume the efficiency lost was not a critical factor.

All lifting surfaces must deal with vortex drag, but diffuser tips and fins are seldom used on canards. The reason is these devices give additional lift at high angles of attack and may delay the stall. On a canard aircraft the canard must stall or lose lift before the main wing does.

An excellent article on a wingtip called the Finch Tip was in Sport Aviation magazine a few years ago. I will send you a copy under separate cover when I locate it and if permission can be obtained I will ask TWITT to put it in the newsletter.

The details of my ultralight and its crash would take more time and space than I have available here and I lost all photos of it. A short article on it will be in the newsletter in the near future. It is repairable but a new project is taking my time now. My only injury was a cracked ankle which put my foot in a cast for a few weeks.

Your letter was appreciated. Please write again if I can be of assistance.

Best wishes,

Bob Chase

(Ed. Note: This is the type of thing TWITT is all about. We appreciate the time taken by both you gentlemen to ask and answer questions that might be on the minds of many other members. It is our hope that more of you will come forward and ask those nagging questions. The level of expertise available through the membership is simply phenomenal and we would like nothing more than to start several dialogues on the subjects you value the most.)

4/7/93

Dear TWITT:

Enclosed is my membership check. As you can see below we have moved from sunny Colorado to cloudy Connecticut.

My project has been on the back burner these last several months while we found an adequate workshop with attached house.

We are getting the shop organized - shelves built, cupboards installed, lights, electricity, etc. So I hope to start work on the fuselage mockup again. I had to retrieve the RC model parts and have found a modeler here that is finishing it.

So with a bunch of patience and fortitude I hope to have more information for you in a short time.

My membership in TWITT has been most enjoyable and rewarding. Keep up the good work.

Cordially,

Jim Loyd
222 Daly Road
Coventry, CT 06238
(203) 742-9017

(Ed. Note: We wonder how many members would like to be able to look for a workshop "with attached house." We are glad that your membership has been of benefit to you in developing your project, and hope that you will ask again when the time comes for any more assistance.)

A NEW NEWSLETTER HITS THE STREETS

Chuck McGill, a long time TWITT member, has taken over the reigns of The New Rigid-Wing Reader with the publication of the Spring 1993 issue. The newsletter seems to be dedicated to providing a united voice in further developing the rigid-wing industry. The following is quoted from Volume 1, Issue 1.

"HOW TO SUBSCRIBE TO THE RIGID-WING READER: There will be no cost to you for the next issue or two as I am absorbing the costs myself. At some point I will announce a price I feel is appropriate, along with fees for classified and other advertising should any interest in that materialize. Everyone will by then have had a newsletter or two and will have an idea what he or she is getting into. I, too, will have had a chance to see if I am cut out for this endeavor and if I will be getting enough help from the readership, if designers and manufacturers are going to respond to the idea that they are a rigid-wing industry, and if we will be able to develop a rigid-wing certification program with which to establish credibility in the minds of pilots, satisfy our self-regulation imperative, and give designers and manufacturers a leg to stand on in court when the matter of having adhered to 'industry standards and specifications' comes up."

Chuck included a very nice advertisement for the TWITT Newsletter in this issue, along with providing the names and addresses of other publications that would be of value to a rigid-wing hang glider enthusiast.

Chuck has done a fine job with his first endeavor at putting together a newsletter directed at a particular segment of the aviation community. We wish him lots of luck and hope the rigid-wing flyers out there support his effort to provide them with a voice.

If you are interested, contact Chuck at P.O. Box 304, Mercer Island, WA 98040.

THE AKAFLIEG BRAUNSCHWEIG SB 13 PROJECT

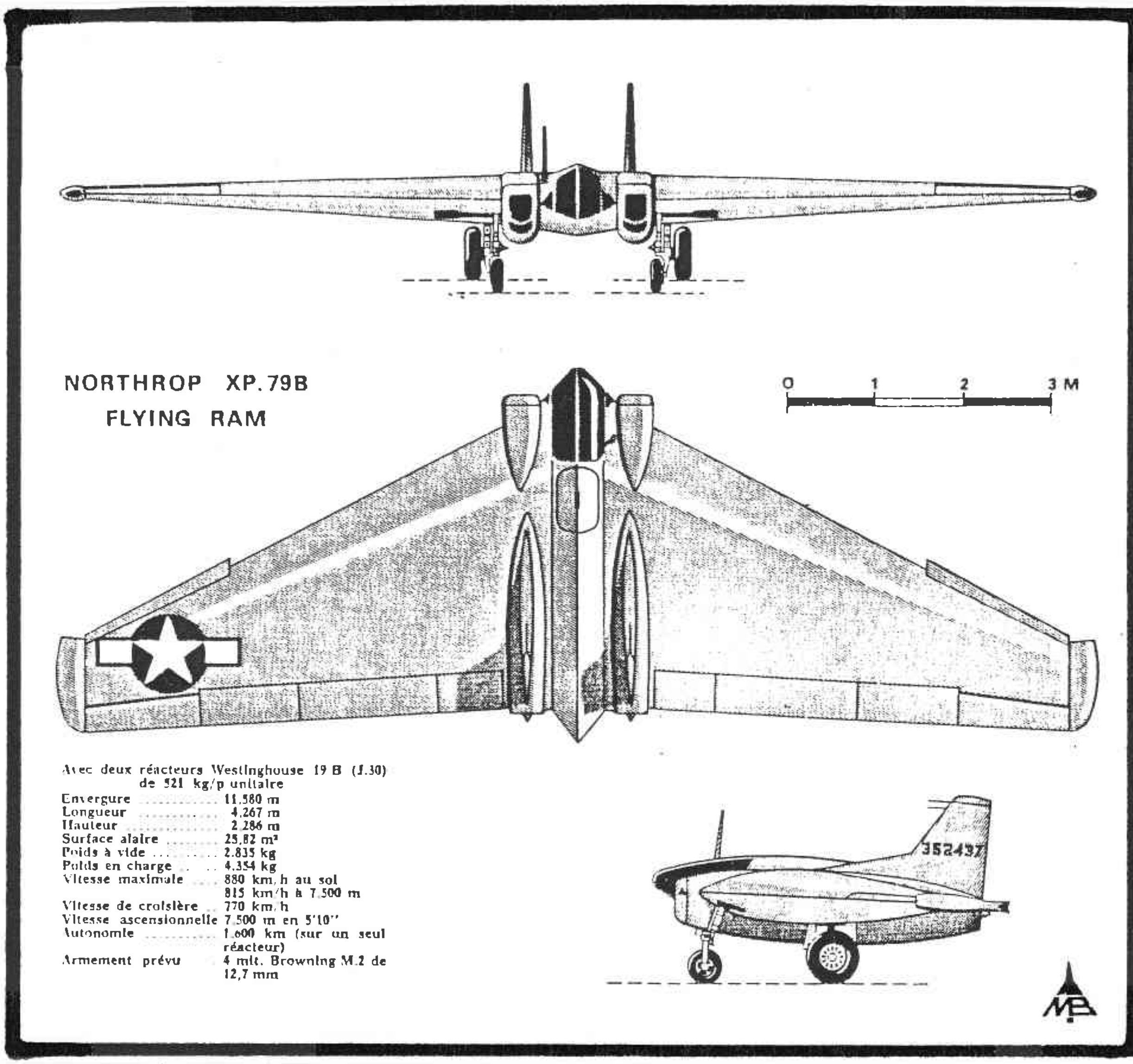
(The following is a continuation of the article started in the May 1993 issue of the TWITT Newsletter. The material was contributed by Bud Mears, but the source is unknown. From the text it appears to be written by the students who participated in the project. The only remaining figure accompanying the text is the one of the parachute recovery system.)

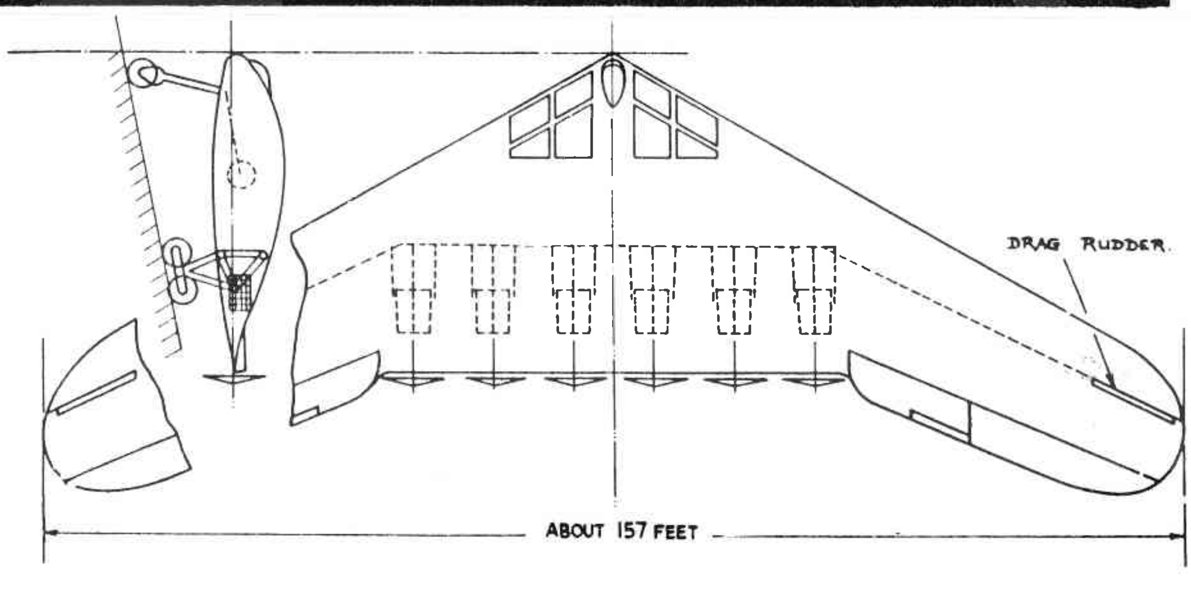
1.3 Construction

Having solved this critical problem, the whole group got involved into the project. A complete set of positive cores and negative molds were built (approx. 1 year), while the working and construction of the controls had to be thought through. It was decided to reduce the number of flaps per wing from three to two, because this solution would fulfill the requirements sufficiently and it would be far easier to build. The outer flap primarily works as an elevator and the inner one as an aileron, although functions are mixed. Mixing

BELOW: The XP-79B turbo-jet powered derivative of the XP-79 rocket interceptor. Jason Wentworth is looking for member interested in helping him with a project to build a ducted fan powered R/C model of the SP-79B.

BOTTOM: The Horten VIII Transport, as depicted in AVIATION, August 1946, p. 68. Extracted from Bruce Carmichael's extensive notebook on historical flying wing activity.





takes place within the small space in the fuselage left of the spar junction, nosewheel box and the pilot's legs. Because space is limited and mechanical functions are very complex, it took about three months just to justify the controls.

The problem of the wing controls is the diagonally running spar, so all controls (except the speed brakes) had to be transmitted through the spar. The rudder motion shows a deflection of 20° at the outer rudder and 70° at the inner rudder causing additional turning moment by enlarged drag. To reduce weight all poles and levers were made of carbon fibres.

But we are getting ahead of ourselves. Before building the inner pieces of a wing, the primary structure has to be constructed. The first step was to carry out standardized material tests on the high modulus carbon fibres to obtain official aviation permission. After this, a rupture test on a 2 meter model spar had to be done to prove the fibres properties within a macroscopic construction.

The main problem was to construct the original spar. Because of the straight in-line junction (male and female) of the spar, combined with the sweep back, the bending load on the spar is partly converted into torsion stress which the fibres cannot stand. To deal with this, nine thin carbon layers had to be interlaced within the curved section of the spar. This construction leads to time stress during building, because a single roving (based on 6,000 filaments) has a section area of 0.2 mm^2 and there are 18,000 rovings to be soaked and placed into the mold (without any twist) within five hours (the vacuum pressure technique has to be started up before the resin starts hardening).

The slide *(not included in article)* shows the developed soaking machine which is capable of soaking 30 rovings simultaneously. Eighteen of the resulting ropes had to be layed down beside each other on marked positions on a silicon coated paper. After a closed layer was produced it was given to a second group of people who positioned it into the mold and laminated the interlaced (fabric) layer. Thirteen to fifteen people were busy to do 10 of these cycles to produce one flange.

Because computing the properties of a construction like this is not easy, an inner wing section of about 4 meters span was built to test the production technique which turned out to work very well. To test the elastic and strength properties of the chosen construction, this inner wing section underwent a rupture test at a temperature of 54°C. The original wing load was simulated by steel constructions and the results (interval of path detectors, wire strain gauges) were registered by a computer, which also controlled the applied load. But it was just a test - up to a load equal to 16g at a speed of 190 km/h no crack or noise appeared.

The stiffness distribution (the second main result) followed the estimated data which means that at normal speed the wing tip bends up 30 mm, and 300 mm at maximum permissible load.

During the following 14 months, the SB 13 was built. A two wheel, retractable, 80 cm high gear was to be constructed - a remark which sounds quite normal, but there was little space left for a shock absorbed main gear, the front gear and last but not least an easily working driving mechanism.

After the wing and the fuselage were brought in line and getting the bolts fitted in, a ground resonance test had to be carried out and the resulting natural modes had to be computed to air-forces by a computer program. It turned out that the first symmetric bending mode occurs at a frequency of 5 Hz which is twice as much as the frequency of a conventional glider. The critical flutter phenomenon mentioned above now happens at a speed of almost 300 km/h, with a satisfying distance to the aspired red line speed of 210 km/h.

Another flutter phenomenon, caused by winglets and rudder, was computed for a speed of approximately 230 km/h. Because the masses of the rudders are to high to solve this problem, maximum speed is limited to 180 km/h until new lighter rudders will be built.

Weighing of the completed SB 13 showed that the total mass (303 kg varying during flight test) was higher than expected due to the enlarged mass of the flange and the 25 kg of the emergency package which gives rise to another additional trim mass of 22 kg in the nose.

Finally, the first flying wing built with modern technology took off on March 18, 1988.

Chapter 2

Flight Testing and Emergency System

2.1 Flight Testing the SB 13

The main question was how to carry out the first flight of this unconventional sailplane.

Winch launching - the most common take off method in Germany - seemed to be difficult due to the pitching moment of the tow during the first moment of the launch and to the possibility of the front gear to touch the tow line.

So we decided to do an aero-tow launch, although there might be problems concerning the downwash of the tow plane. The inner wing section of the glider might fly within the downward component of the plane's vortexes while the outer wing remained at the upward section thus producing a negative pitching moment.

Normally a first flight is carried out with a large static longitudinal stability (a large distance between neutral point and c.g.) to achieve harmless stalling behavior. So we did with the SB 13 as the elevator deflects more upwards and thus the angle of attack is reduced at the outer wing. A stall would take place at the inner wing section first producing a nose dropping effect.

We decided to approach the first flight in three steps, accelerating the glider just to take off and releasing the tow. This way controls were tested and they work quite fine. Because of the no shock absorbing front wheel and the short ground wave which the glider passed through, the SB 13 took off dynamically during the third test not having reached its stalling speed. After the remains of the following inelegant touch down (a spoiled gear) had been repaired, take offs took place on a concrete runway until the new shock absorbing front gear was finished.

On March 18th the regular first flight was done towing the SB 13 up to 3,000'. Neglecting a somewhat low rollrate, flight characteristics were good. The stall behavior turned out to be absolutely harmless. But soon some disadvantages of the large stability were shown. When the flaps are deflected in the direction of pulling and the tow plane rotates as soon as possible, the strong downwash makes it very difficult for the SB 13 to climb to a higher position. Furthermore, the pitch attitude is very large so that the pilot might not see the tow plane as it is hidden by the glider's nose. And last, but not least, the minimum speed is increased due to the reduced maximum lift.

A more serious problem is the rigid body short period mode. For conventional planes the damping of this mode is very high (90-100%) so it does not occur. Because of the missing tail unit of the SB 13 this mode is not damped much, and in a configuration of high static stability the glider will perform a whole oscillation (i.e., speed varies ±20 km/h) at a frequency of 1-2 Hz after every disturbance either by turbulence or elevator motion. At a frequency like this the pilot has no chance to avoid this effect by moving the stick, because PIOs (pilot induced oscillations) would be produced. This behavior obviously concerns the take off method of the tow plane, because a steep rotation produces a large vortex remaining at the runway. Reaching this vortex, the glider would easily hit the ground.

Decreasing stability increases the damping of this mode and decreases its frequency. After several steps it was found that the dynamic behavior was improved so that the pilot was able to control the remaining oscillations now by the stick.

Both the more the stability was decreased the more the stall behavior became bad. Referring to Murphy's Law, this was first shown during a public demonstration, when the SB 13 went into a steep spin without warning. The pilot immediately stopped the spin by the common technique, but as he came out in a light slip the glider started to spin the other way. Within a second try the pilot succeeded in leaving the spin at very high speed, low level and one hand touching the rescue system's actuator. The speed of rotation was high and the height loss per rotation was about 100 meters.

To watch these effects more objectively, a video camera was mounted on the top of the canopy and videos were taken showing the pilot's view of the horizon and other ones showing the woolen tufts fixed onto the wing. It was clearly seen that this effect is based on a crossflow in the leading edge's pressure peak and is caused by the sweeping angle of the wing (although we had thought that 15^0 wouldn't matter).

The only countermeasure known for this is the employment of boundary layer fences, even if their optical impression is very unkind. We tried several shapes of fences all located between the two control flaps. But only those fences beginning at 40% of the bottomside, running around the leading edge and ending at the flaps showed the desired effect (they have a height of about 50-100 mm). Stability was now decreased again watching the stall and the stick force gradient. With one of these fences on each wing it is still possible to get into a spin, but the pre-stall warnings are very distinct. To overcome the remaining indifferent forces on the stick, small trim tabs were applied to the outer flaps. Because now the pitching motion is very sensitive to stick movements, the transmission between stick and elevator will be changed by about 20%.

These were the main points of flight testing which had - or have - to be overcome. But we are still working to optimize the glider's properties and so a whole lot of small modifications are required. The project shows that a flying wing is not as easy as it first looked like - in fact it is only one problem. But as the Akaflieg showed, it was the very obstinate behavior of the group holding on to the flying wing project that we were able to succeed at all.

2.2 The Parachute Rescue System

The parachute rescue system was started up during flight testing of the 1:3 model. Because all flights took place in headwind, every spin spoiled the model by hitting the ground. Peter Hoenen, who was a member of the disbanded DFVLR parachute department, developed a model rescue system based on a cluster of three parachutes. These parachutes show a cross outline thus avoiding the tendency to rock.

Having dropped the system off a helicopter several times, the good results led the Akaflieg to a system for the original SB 13 to increase the test pilot's safety. Of a special importance was the fact that for spin testing normally a spin recovery parachute is mounted at the tail - no chance for us.

Another fuselage was built in the SB 13's molds and was equipped with a telemetry borrowed from the DFVLR. Thus we were able to get data about vertical speed during free fall, loaded forces during the opening process and the sinkrate with the parachutes opened.

The rescue system consists of three parachutes, each with an area of 100 m^2. As the required area is fixed by a given mass and sinkrate, one can affect the opening process by the number of parachutes. One big chute leads to low forces during the opening (the opening force is inverse proportionally to the chute's area) but also causes a long opening time (high minimum actuation altitude). A cluster of parachutes gives rise to high opening forces but short opening time. Because of redundance this version was chosen.

A vacuum packing technique is required to bring 300 m^2 of parachute area down to a volume of 35 litres which is left at the rear of the SB 13. Canopies are made of nylon ripstop material and suspension lines are kevlar ones, thus leading to a weight per parachute of 5 kg which is half the weight of a conventional parachute.

Being actuated via the handle at the pilot's shoulder, a little pilotchute with an integrated spring opens the compartment door and tears a 1.3 meter diameter extraction chute out the door (Fig. 8). Both these chutes are designed as ribless guide surface chutes (developed by Prof. Heinrich) and thus they are able to work within the vortexes of the fuselage. While the main package is pulled out, its locking pins are removed and the vacuum pressed contents of the package relaxes but still keeps in place. Finally, the ropes are brought out and the package breaking cords are released. The canopies straighten parallelely and while opening they drift apart before they join the typical cluster formation.

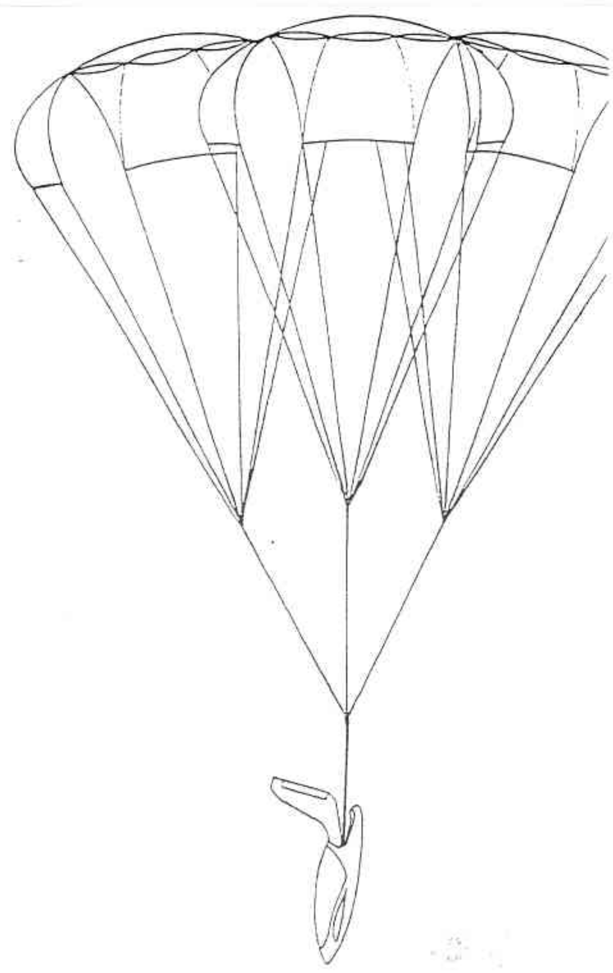


Fig. 8 : Emergency rescue system

We first tested a single parachute with a reduced mass of the fuselage dropping the system off a helicopter at 2,000'. As it was seen that it worked quite fine, we launched about a dozen tests on the whole system at different actuation speeds. The project was delayed for several months when a weak bolt on the dynamometer broke during a high speed test at about 300 km/h causing the fuselage to hit the ground at a speed of approximately 500 km/h. This led us to a small emergency parachute for the emergency parachute testing system.

The results show that this system produces sinkrates of 5-6 m/s at a mass of 420 kg which is comparable to normal personal rescue parachutes. For a speed range above 250 km/h the minimum actuation altitude is about 700' (referred to this case a pilot needs about 2-3,000' to do an emergency exit) and is reduced to less than 300' for zero speed actuation. Acceleration during the opening process is high (approximately 15 g at a speed of 320 km/h) due to the fact that one parachute may open first. At a speed range above 250 km/h the first opening of one chute will destroy it partly, thus resulting in a sinkrate still less than 8 m/s.

Three tests carried out with a dummy within the fuselage showed that the high acceleration forces during opening cause no harm to the pilot due to the short time. The only moment the pilot may be injured is the touch down and to avoid this it is necessary to protect the pilot by a fifth safety belt and shock absorbing foam placed around the pilot (especially around his head and back).

Although the system is tailored for a flying wing (referring to the simple spring actuation), the results show that the only point to be altered for conventional sailplanes is the actuation technique, because the package has to be prevented from twisting around the plane's tail unit. But if people are interested in a system like this (weight about 25 kg, costs about $6,000) there would be just a little step left.

ADDITION TO TWITT LIBRARY

"The Wing's the Thing - The Marske Pioneer," by Bill Daniels, Soaring, May 1969, pp. 24-27. Contributor is unknown. An article on flight testing the Pioneer 1A both before and after some modifications.

Among Daniels closing comments was a prediction that he would not be surprised to see highly competitive flying wings in the early seventies. His final comment: "The question I find difficult to answer is: Why hasn't it been done before?"

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