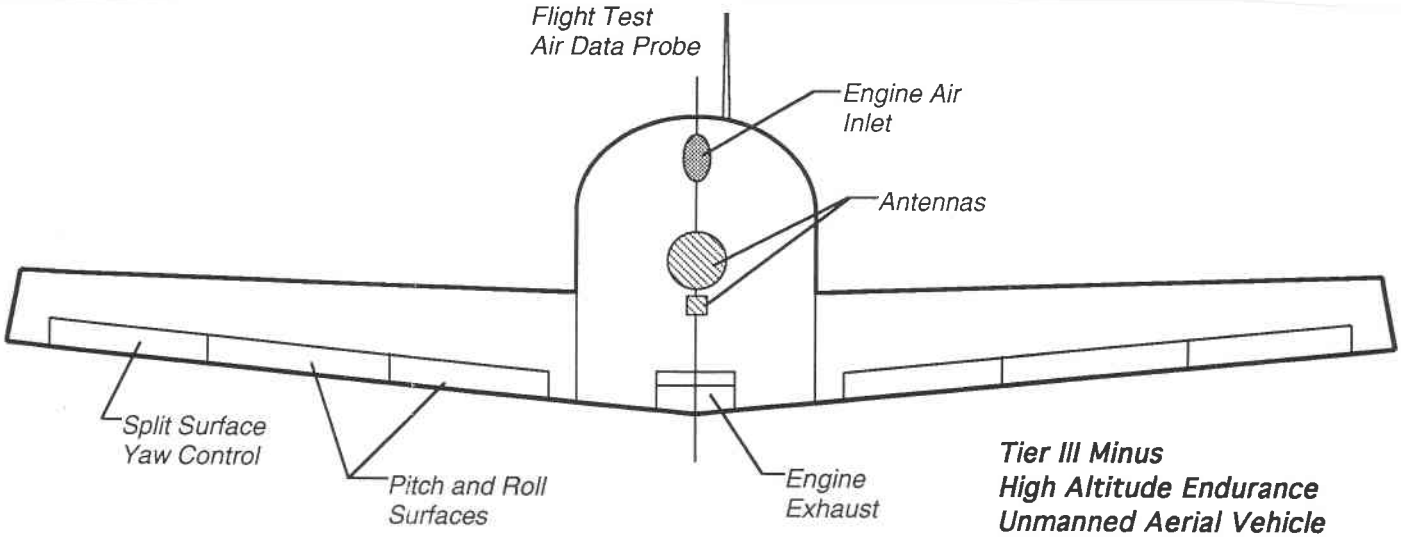
No. 109 JULY 1995

T.W.I.T.T. NEWSLETTER



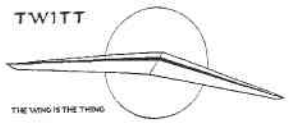
Tier III Minus
High Altitude Endurance
Unmanned Aerial Vehicle
"Darkstar"

SOURCE: Artist's rendition by Kevin Renshaw of the top view showing what has been described in the recent articles covering the rollout of this unique project. The data probe will be for testing only. For more information on this aircraft, see the accompanying material on pages 6-7.

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., **9507** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, July 15, 1995, beginning at 1330 hrs at hanger A-4, Gillespie Field, El Cajon, CA (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.

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Subscription Rates:
$18 per year (US)
$22 per year (Foreign)

Information Packages: $2.50 ($3 foreign)
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Postage Paid
Multiple Back Issues: $0.75 ea + bulk postage

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

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PRESIDENT'S CORNER

It's time for my periodic plea for your cards and letters to start rolling in. The material for the newsletter is getting a little sparse and I could sure use your help in filling the pages. Tell us about your latest flying experience, or how your flying wing project is going, or ask some questions about a design concept. We can't exchange information if you don't send it to us to share.

I have been surprised that there aren't more members who are connected to the Internet. Since publishing our address I have only received the initial welcome to the net messages from a few people, but no new ones. I still haven't had the time to learn more about home pages, etc., but the day will come when I will get this done.

An early reminder that the Labor Day weekend should be reserved for at least one day to attend the SHA Western Workshop at Tehachapi. Last year there were a number of SWIFTs at the field along with Mitchell wings. This is a good opportunity to see some hardware and exchange ideas with other enthusiasts.

As you can see we are gradually putting more things in the classified section of the newsletter. Although this takes some space, we feel it is in keeping with the overall purpose of TWITT, and that's to keep you informed of what's happening in the world of flying wing development both past and present. If you know of some particular article or book that would be good for members to know about, send us the information on contents, cost and how to order, and we will let others in on it.

This issue contains some material on Charles L. Freel's flying wing, using the woodworking shop at San Diego High School in the late 1930's. The material we have came from the San Diego Aerospace Museum's archives, and it is believed the wing crashed after several test flights. However, no one seems to have anymore information on Freel. If any of our old-timers out there have anything in their "archives" that might shed some light on this project and C. Freel, please let us know.

Andy

JULY 15, 1995 PROGRAM

As we announced last month, the July speaker will be **Jack Norris** who will give us a first hand exposure on how to perform zero thrust glide tests. With the summer fast upon us and hopefully many of you ready to do some flying, and the proverbial testing to tweak your machine, this should be a good program.

Working with his lifelong friend, Andy Bauer of Orange County, they have solved the longest, most basic "unsolved problem" in the Aeronautical Engineering Profession, how to test for "real drag" on the basic propeller airplane using "Zero Thrust Glide Testing". Sponsored by the EAA, and now the FAA, the CAFE Group of Santa Rosa, CA is underway on what will become the broadest, most comprehensive test program in history, defining the entire private aviation fleet.

Jack is currently writing what can become the definitive book on easily understanding efficient flight, The Logic of Flight, for publication later in 1995. He feels the public needs to be helped to better understand how technology, engineers and engineering have completely changed our lives, and our potential for a better life, since the early 1900's.

Among his accomplishments was being Technical Director, Mission Control of the World Flight of the Voyager Aircraft. He wrote the book Voyager, The World Flight for the Smithsonian and World's Archives, and all those interested in how the world flight was accomplished.

With over 100 of his Spacecraft Controls in the "Milestones of Flight Gallery", the central hall of the Smithsonian National Air and Space Museum, he is the individual with more critical products on more projects than anyone else there.

LETTERS TO THE EDITOR

4/1/95

Report on a trip to the restoration facilities of the Berlin Museum for Technology and Commerce, by Jan Scott, Vintage Sailplane Association.

The Museum für Verbhehr und Technik was one of Germany's largest museums before it was destroyed by Allied bombing raids in 1944. Among its many rare aircraft was the famous 12 engine flying boat Dornier X, which toured the U.S. in 1931. It's remains can still be seen in the museum ruins. Only a third of the building has been rebuilt. The smaller aircraft that could be moved, were crated an evacuated to German controlled Krakow, Poland before the bombing raids started. These aircraft survived the war, and some of them are now offered for sale or trade by the Polish government.

The aviation department of the Berlin museum, under the direction of Dr. Holger Steinle, has embarked upon an aggressive program to have significant aircraft returned to the museum collection from countries like Poland and the U.S., which confiscated large numbers of German aircraft after WW II. As part of this effort, an agreement was entered into with the National Air & Space Museum in Washington DC to return four flying wing gliders to Berlin for restoration. The initial arrangement was that Berlin would keep one, and the other three would be returned to Washington after they were restored.

The four gliders were among 10 models designed by Dr. Reimar Horten between 1935 and 1943. The design concept was a pure flying wing without any vertical surfaces, based on the 1910 "Junkers Patent".

The appearance of the Horten sailplanes is that of the swept back wing of modern jetliner flying all by itself. A month after a photo of the Horten II glider appeared on the front page of the New York Times in 1937, Northrop received a U.S. Government contract to develop a similar flying wing. Northrop built several models, from small single seaters to large multi engine bombers. While their appearance was very similar to the Horten designs, they lacked Horten's aerodynamic qualities. These, which included the "bell shaped lift distribution curve" made the gliders stall and spin proof, and eliminated adverse yaw. The technology remained a secret until Dr. Horten published a book on his work and theories in 1983. (Horten/Selinger "Nurflügel")

The four gliders were shipped to Germany about a year ago. They had been stored outside and exposed to all kinds of weather for about 20 years, after Northrop engineers finished studying them in 1946. The one that was least damaged, a Ho II L and the second of four built, went into restoration first. As the wings had been stored on their leading edges, all the rib noses and the entire outer wing section with the drag rudders had to be rebuilt along with sections of the spar and trailing edges. During the repair, the wings were supported upside down on specially built jigs, with proper airfoil contour support for every rib. The steel tube center section was stripped, repaired, rust proofed and attached to one wing.

The woodwork was adequate for display purposes but far below the quality standards produced by the experts at the Paul Garber facility at Silver Hill, MD. The repair work is being carried out by a team of Polish craftsmen under the direction of a Mr. Hundertmark. Since limited resources are available, there is an understandable reluctance to use 30DM/hour labor to do extensive and time consuming fitting and sanding where it is not necessary. A lot of

splicing and patching was done to preserve as much of the original material as possible. An interesting discovery was the hinges for "clamshell" drag rudders that had once been installed on this aircraft.

Money for the repair work had been obtained from the State Lottery, which is obliged to make 20% of its income available for "cultural projects" like this.

The restoration work is not carried out at the museum but in a workshop across town in the Reinickendorf section of Berlin. The shop is part of the former Argus aircraft engine factory, which somehow survived the war. I was invited to attend the first public showing of the gliders since the restoration began, and before the work was covered up by the plywood and fabric skin. The covering will be completed in May.

ABOVE: TWITT founding father Bob Fronius (the old guy under the hat) attending a farewell party for a long-time Skid Row resident. Craig and Nancy Roberts can be seen at the left also enjoying the evening.

The gathering was hosted by Mr. Edward Uden who has obtained the rights and possession of the works and artifacts of the late Reimar Horten. Mr. Uden has produced high quality blueprints and precise calculations from available material, using advanced computer technologies. Calculations that took Reimar Horten days and weeks to complete are now verified in minutes. Mr. Uden did extensive research on the controversial advantages of the "bell shaped lift distribution" that presumably reversed the direction of the "normal" wing tip vortices and produced beneficial thrust instead of induced drag. Mr. Unden's research showed that the wing tip effect was indeed as stated, but that the added load on the inboard portions of the wing more than canceled out the benefits. In fact, the Horten wings were found to have 33% more induced drag than a similar wing with a normal elliptical lift distribution.

Mr. Unden's drawings will be of great help in restoring the two Ho III's and the VI, and also enable VSA member Uwe Schmidt to build a real Ho IV. We erroneously reported in a previous issue that Uwe was going to build a model of the Ho IV. Not so! He's building the real thing!

During the gathering, lectures on the Horten theories and videos showing some early footage of the first motorized Ho II called "Habicht" in flight, the PUL 10, two place power wing, the last of Horten's designs and films of radio controlled flying wing models were presented.

The event attracted several model builders who brought their flying wing models with them. Mr. Uden is himself an active model builder and uses flying models to test the Horten concepts. One of his models, a nearly finished flying scale model of the Ho IX twin jet, complete with working ducted fan electric engines, is the most impressive example of modeling workmanship I have ever seen! Mr. Uden has a miniature machine shop connected to his computer, and builds models the way Boeing builds commercial jetliners! The two electric fan engines, built entirely of wood except for the motor, looked much like the original Jumo 004 engine!

The Ho II restoration is expected to be completed early this summer. Next wing jigs for the two Ho III's will be built. It appears that the four wings needed will have to be built from scratch, as only the metal parts have survived, and two wings are missing.

The Ho VI is complete and in relatively good shape. Its center section with the cockpit has already been put on display a the museum. Since the VI was the last type produced, it will also be restored last.

There were other significant soaring events taking place during my four days in Germany. On Friday, the 18 meter span Ventus 2c, was flown for the first time at Hahnweide. On Saturday, the Horten presentation. On Sunday, Mr. Klaus Heyn allowed several of us to see and photograph the Musterle replica that has been "secretly" built in his home near Stuttgart. This is the type that Wolf Hirth flew from a park next to River Drive in New York City in March 1931. The wings have yet to be built. There are some problems finding the proper material for the spar caps of the

three piece wing, and also problems convincing the German Air Ministry that it should be allowed to fly in its original configuration. And finally on Monday, the successful first flight of the new ASW-27, -the news conveyed by telephone from an excited Gerhard Waibel.

On Monday, I got a guided tour of the Schempp-Hirth factory escorted by Sales Manager Berger and Jocki Selinger. The factory is going full speed with a two year backlog of orders. I was allowed to try the new Duo Discus on for size. It fit me very well! I asked if I could trade in an old Schempp-Hirth glider that I had for a Duo. Berger said that they did not accept trade-ins, but asked with obvious lack of interest what I proposed to trade. When I said "a Minimoa" he sort of snapped to attention, but offered no deal.

(ed. - Jan is not a member of TWITT, but knows what kind of information we like to see in the newsletter. We thank him for this update on information relayed to us a year or so ago by Phillip Burgers after he visited Silver Hill.)

2/21/95

TWITT:

I wish to thank you for sending Tailless Aircraft in Theory and Practice. It is a very good book and well worth the price, and very well translated from its German. Unfortunately, there is very little Fauvel data or airfoils, however, it has almost all Horten data.

I enclose some information about Dr. Horten's bell shaped lift curve as I found it.

The VHS tape you sent me is very good and well worth getting.

I appreciate TWITT and wish you all the best.

Alan Lewis

The Bell Shaped Lift Position

Reimar Horten wrote me a letter and described his bell shaped lift curve. I have a two seat, 100 hp, Stits Playboy SA-3 with about a 23' span and 5' chord.

I read his notes and from what I could make out, Horten seemed to want max twist in the wing. When I built the plane I had flown it with max WRONG twist in the wing, resulting in the wing dropping slightly but definitely in a stall. Bluntly, wing twist would have little effect, but wrong twist (different on either side) made rough riding in turbulence.

The Playboy has adjustable wing twist struts. I applied maximum twist to the wings (normal is max 3%). I had to make chrome molly fittings for the aileron cables. I obtained 5 kts more at the same R.P.M. so left the twist in. Aircraft Surveyors commented that the ailerons were badly twisted. Stall solo fell to 40 kts from over 50. Landing was the same.

I wondered if the reduced incidence of the tip ribs or Horten's theory was working. Reduced incidence of the tip ribs would mean less drag.

(ed. - Thanks for the information Alan, and it fit in well with the prior article by Jan Scott who also mentioned the bell shaped curve.

It also provides a lead-in for the following information provided by Raul Blacksten on where others can get the Nickel/Wohlfahrt book.)

Tailless Aircraft in Theory and Practice (ISBN 0 340 61402 I) is available from:

M.R. Plans
Springfield Bungalow, Butlers Cross
Aylesbury, Bucks, HP17 OTS
ENGLAND
TEL: 0296 - 624375
Cost: £34.95
Postage: USA Surface £4.00
USA Airmail £9.00

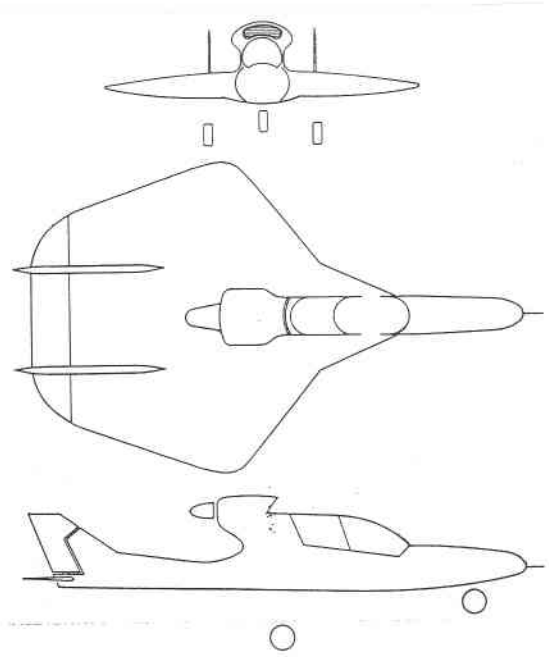
Enclose a cheque/Eurocheque drawn on a UK bank in £ payable to M.R. PLANS.

ABOVE: Alain Mirouze on take-off in his own design ultralight hangglider. This is another example of a low aspect ratio wing and is similar in design to one Alain designed that was inflatable. (This last part is an assumption based on my limited translation of some French on the material he sent.)

Also from Raul Blacksten is a copy of the following article to add to the library:

"Tailless Tales From Coventry", by Barry Jones, Aeroplane Monthly, May 1995, pp. 38-46. Describes the evolution and testing of the Armstrong Whitworth A.W.52 flying wings and their powerless forebear, the A.W.52G.

Contains numerous pictures of the various models and one schematic of a cockpit.



ABOVE: We think this is the A.M.1 "PULSAR" designed by Alain Mirouze. Span is 4.9 meters, length 7.5 meters, height 2.4 meters, empty weight 400 kgs, and all up weight of 800 kgs. One article he included shows a picture of the actual aircraft, so this is not just a concept.

5/19/95

TWITT:

Even though it is not the HPA design, you might be interested in the article and cover from the June 1948 issue of Air Trails on the Custer Channel Wing. This is in reference to the letter in your May newsletter from Mr. Sward.

I would suspect that the possible loss of power/lift/control at slow airspeeds was the main reason that the concept was not more successful. And, it would not be helped by simple multi-engine designs.

An interesting thing from observing another low lift off and touchdown speed design, the Peterson Wren full Cessna 182 conversion, is that the crab angle from crosswinds increases dramatically at very low speeds.

Keep up the good work. The newsletter is looked forward to each month. It was a real privilege to attend your meetings when I lived in the San Diego area.

Best regards,
Larry Nicholson

(ed. - Thanks for the information. Since it doesn't have anything that will reproduce very well, I will send the material on the Ed Sward just in case he hasn't run across it and have it his library. If he doesn't, we hope he enjoys the article.)

6/1/95

TWITT:

About your page 6, May issue, Edwin Sward comments and propositions on Custer Channel wing, and having extensively tested this formula in the past (RC models) I can help him with some comments.

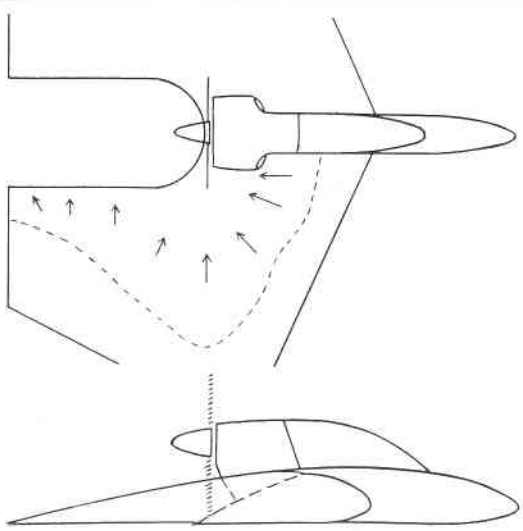
Custer Channel wing needs a good feeding; all obstructions ahead of the channel drops the efficiency of the propeller (of the whole system).

A drawback of the formula is that there is a large travel of the lift center following the power setting. Unhappily, the vertical lift given by the formula is, in some way, proportional to the chord length. At a zero take-off speed, a very well and efficiently blown surface has to be installed behind the propeller (no flying wing apparently possible with this formula).

Without an engine, and additional flying surfaces, we have a good down-going bullet.

His proposition is, also, aerodynamically sound, but structurally a nightmare.

However, this idea may be the only alternative to helicopter expensive option. Ultra-light world can answer to all the problems listed above; escape with rocket-ejected chute, very small, highly reducted engine (which can be installed in the cockpit), and (oh, sacrilege!) maybe a tail strengthening the U-shaped wing. Integrated and very short landing device seems a must.



ABOVE: Diagram from one of Alain's articles apparently showing the airflow pattern created by the wing shape, which includes an open channel behind the engine. A tufted model shows a lot of disturbance all along the channel versus a smooth flow progressing rearward.

I add some elements of studies done here and already published on the subject and close ideas.

Best regards,
Alain Mirouze

(ed. - I am sure Edwin will appreciate the comments on the channel wing. It looks like a very complex project structurally, therefore would probably be difficult for the average builder, and more so if tried in a flying wing format.

The material Alain included with this letter covers a number of different configurations, some of which I have included in other parts of the newsletter. The articles that accompany them are all in French, or course, but if something interests you give us a call and we will send you a copy along with Alain's address so you can obtain a better explanation.

Alain has responded to our request for a loose translation of the Fauvel material we had in the library. It has been sent to him, and we are looking forward to some interesting material for future newsletters. Thanks Alain, for this contribution.)

ABOVE: Craig and Nancy Roberts showing off Craig's concept model of his joint project with Floyd Fronius. The full scale version will be 15 meters with elevons and drag rudders.

6/10/95

TWITT:

During the first week of June, the Lockheed Skunk Works in Palmdale, CA unveiled a new High Altitude Endurance Unmanned Aerial Vehicle (HAE UAV) that has a very interesting layout. Enclosed is a press release that was distributed at the rollout. I have also put together a rough planform drawing, although I don't have exact dimensions.

The aircraft is a very large (70+ ft span) all wing design with no vertical surfaces. The large round forebody planform is designed to house a Synthetic Aperture Radar (SAR) as part of the sensor package.

With this large forebody out in front of the wing, my guess is that the design is longitudinally unstable at moderate to high angles of attack. For a UAV that is designed to cruise at a relatively low angle, and has an on-board computer controlled flight control system, this should not be a problem.

The program is called Tier III Minus, because originally there was to be a Tier III Reconnaissance UAV that included some very ambition capabilities. When the government saw the price tag for meeting all of their wish list, they decided to scale back the program goals (hence Tier III Minus). The rest of the available details are in the release (a copy of which he included).

Regards,
Kevin Renshaw

(ed. - As you have already seen, Kevin's art work made the newsletter cover - came at just the right time since I hadn't found anything suitable yet. Somewhere in the library there is an short article or photo caption that shows this in conceptual form.

DarkStar is being jointly developed by Lockheed Martin (design and development of the body, its subsystems and final assembly, integration and test) and Boeing (responsible for the wing and wing subsystem development and testing). It is powered by a single turbofan engine supplied by Williams International (same engine as in the Cessna Citation).

Mission duration is 8 hours on station with an operating radius of 500 nautical miles at 45,000' and 250 kts. It will be capable of fully autonomous take-off, flight and recovery; will be able to be dynamically retasked while in flight; and is designed to operate in the existing force structure.)

From the June 19, 1995 issue of Aviation Week & Space Technology ("Mission of Tier 3- Reflected in Design" pp. 52-55, and "Tier 3 Minus to Test Value of Stealh" pp. 41-42, both by Michael A. Dornheim) comes the following information about this aircraft.

Tier 3- is made mainly from graphite composites, with an aluminum fuselage carry-through spar for the wing. It was noted the composite was more expensive but if offered a 25% weight savings compared to aluminum.

Tier 3- appears to be nose heavy, and it would be without lift from the sharp-edged forward fuselage. The aircraft balances within 2" forward and 4" aft of the MAC leading edge,

and the average position is 2.7% MAC. The wing is swept forward to get closer to the CG. The wing has noticeable reflex for nose-up moment, particularly in the center section, and the elevons may also deflect 1-2 degrees up for some cruise conditions. Engine thrust contributes little pitching moment. The fuselage has two tank on either side that can be used for trimming the CG.

Wing span is 69', area 321 sq. ft., A/R of 14.8, MAC of 56.5', root chord of 69", tip of 41.7", taper ratio of .60, leading edge sweep of -0.5 deg., trailing edge sweep of -4.5 deg, dihedral of 2 deg., length of 15', with a maximum take-off weight of 8,600 lbs.

Outer control surfaces are split-flap ruddervons like the B-2 bomber, and the inner surfaces are elevons. The chined saucer fuselage acts as a lifting body to help overcome the drone's forward CG. Spreader vanes in the exhaust duct help broaden flow into a thin rectangle for low infrared signature similar to the F-117. The trailing edge behind the exhaust duct is made of tile to withstand the heat, yet have a low radar signature.

It has a limited speed range of 110 kt takeoff, 100 kt landing and a cruise speed of about 130 kt equivalent airspeed, or about 300 kt TAS at 45,000'. Cruise lift coefficient is about 0.38 at a 7,000 lb. mid-mission weight.

The airfoil should have laminar flow for 40-55% chord on top and 70-75% on bottom, based on tests in a modified Caproni jet-powered sailplane at Mississippi State University. The aircraft's L/D ratio is estimated at about 30. The nose gear has a two-position strut that is extended for an unrotated takeoff because the short-coupled elevons do not have enough authority for takeoff rotation.

(ed. - Some of the design statements made in the above articles are very similar to those that have been made over the years by various members of TWITT. One person who has seen this design likens it to Jerry Blumenthal's Rattler with its forward straked fuselage and straight wings. Is this an example of technology and design moving in simultaneous directions because it is the most logical course, or did Jerry have some secret knowledge of what was coming out of the Skunk Works?? Jerry's hand-launched test models flew very well, and he was in the process of producing an RC version before his untimely death. We can only hope that he is able to see this latest development in flying wings and say to himself "I knew it would work".)

THE FREEL FLYING WING

(The following came from the material provided by the San Diego Aerospace Museum, and was a synopsis of two articles, one from The Consolidator newsletter of Consolidated Aircraft Company (CONVAIR), and the other from a newspaper article of unknown origin.)

Designed by San Diego High School student Charles L. Freel, the Freel Flying Wing was a development of a successful 36" wingspan experimental model built under the supervision of Letain T. Kitterege, aircraft rigging class instructor. Begun in 1933, construction of the full-scale wing was completed in 1935. Flight tests were conducted by Mr. Kitterege and Charles Freel.

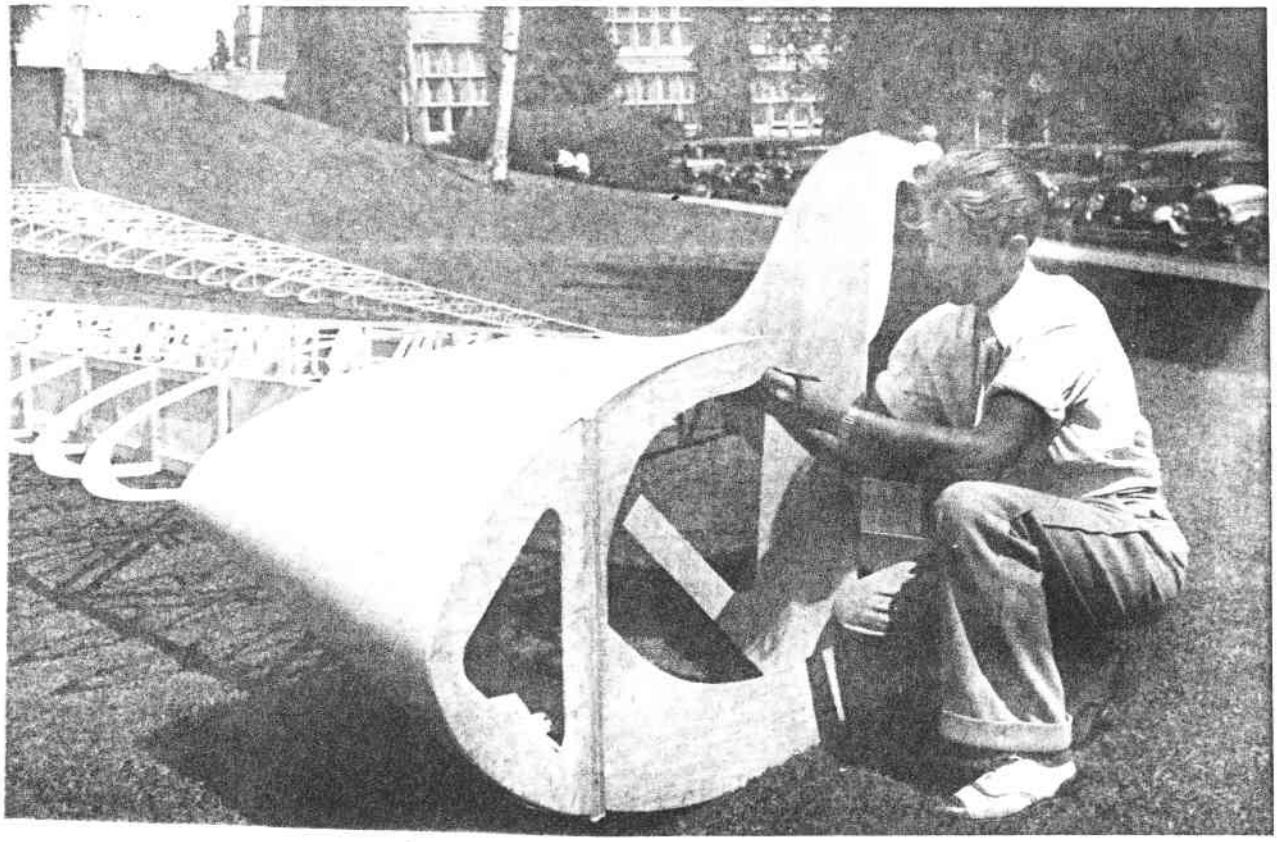
The wing was a full cantilever wooden structure made in two 26' sections bolted together at the center. Tapered in planform and thickness, the wing offered both structural and aerodynamic advantages. Main spars running the full length were "I" beams with plywood webs and spruce cap strips. The NACA airfoil section was chosen on the basis of moment coefficient. Tapered ribs were made of 1/4" spruce with 1/8" diagonals. The wing and all control surfaces were covered with fabric.

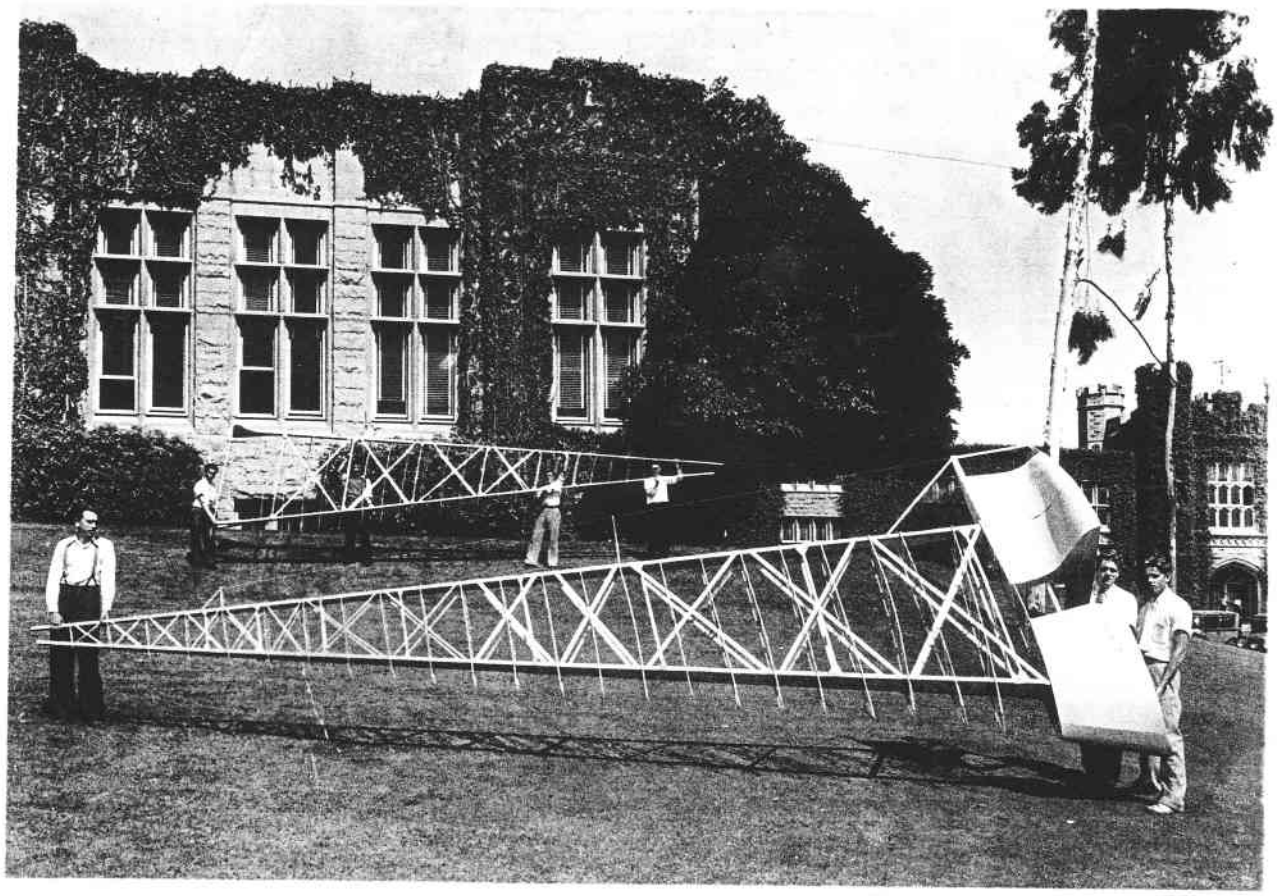
Lateral and longitudinal control was accomplished by means of a combination aileron and elevator control device which functioned in the same manner as the control wheel in a conventional aircraft. The unit was linked by bellcrank and push rods to two 14' movable surfaces in the trailing edge of the wing on each side of the ship. When the control wheel was turned left or right, the simultaneous control device produced a movement up on one side and down on the other 14' aileron. When the wheel was moved backward or forward, the ailerons moved up or down together and functioned as an elevator.

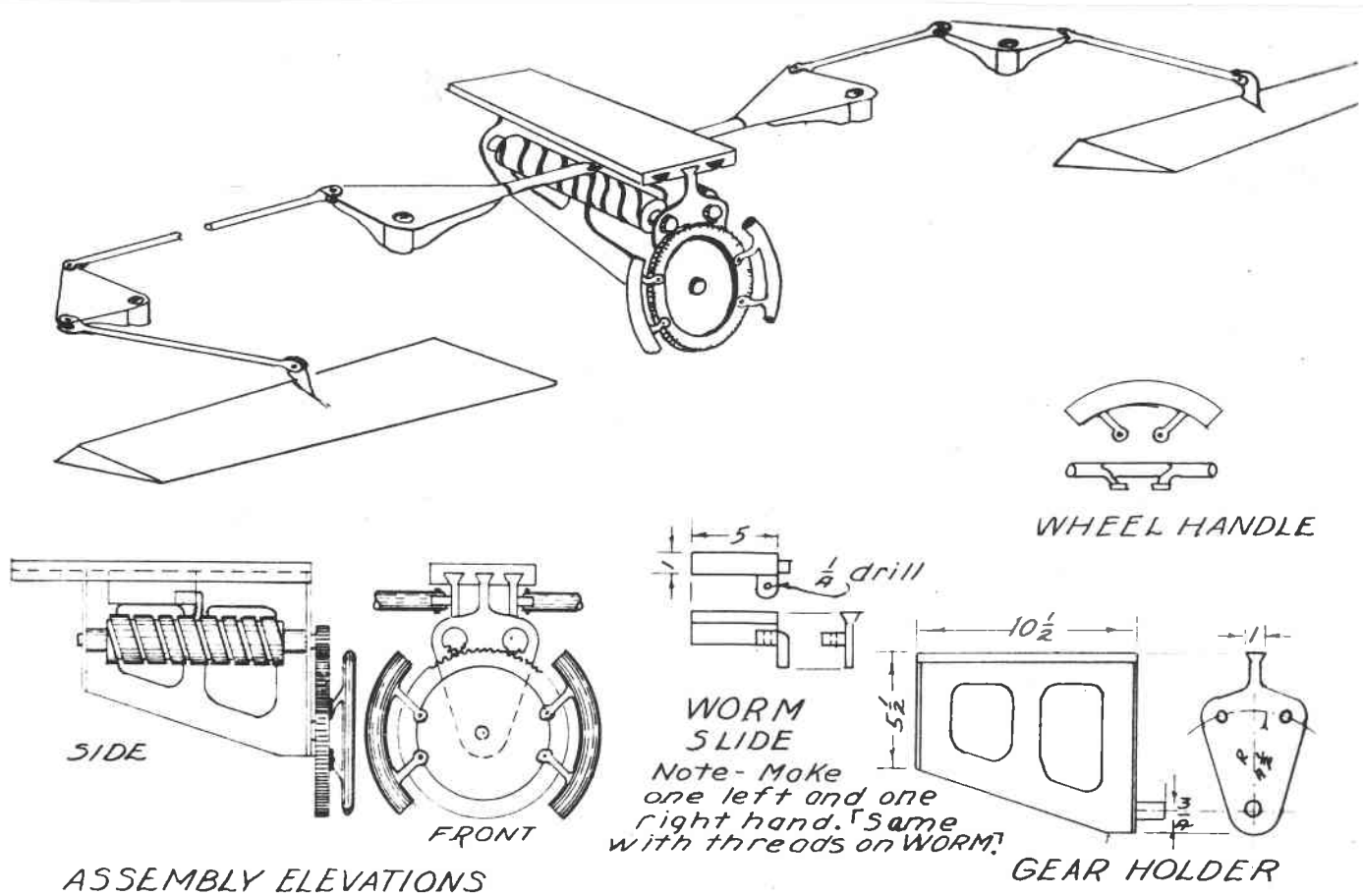
Directional control was provided for by 7' movable surfaces at the outboard trailing edge of the wing. Operating on a drag principle, and working independently of each other, they were actuated by cable and foot control, and took the place of a rudder. The sweep back and dihedral of the wing added further stability to the ship.

Wing Span	52'
Root Chord	8'
Aspect Ratio	3.2
Wing Area	270 sq. ft.
Wing Loading	1.7 lb/sq. ft.
Airfoil Section	NACA m-6
Dihedral	3 degrees
L.E. Sweep	18 degrees
Empty Weight	280 lbs.

Pages 8 & 9 contain a coupl of the photos of this aircraft taking at the school, along with a control system diagram.







BELOW: This unusual flying wing was designed by John D. Akerman of the Univerity of Minnesota, and built by University students in 1934.

It had slots, flaps, unusual controls (which probably means outward moving drag rudders at the tips), and was powered by a 55 hp engine.