No. 172 OCTOBER 2000

T.W.I.T.T. NEWSLETTER

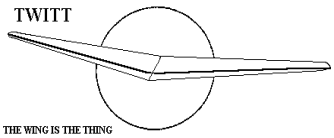
Al Bowers flying a custom hanglider at Playa del Rey, circa 1974, while he worked for a hangglider

Al flying his Seagull (Ser. #4465) at Playa del Rey. He put more than 150 flights on this hangglider. See inside for more.

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

The number after your name indicates the ending year and month of your current subscription, i.e., **0010** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, November 18, 2000, beginning at 1:30 pm at hanger A-4, Gillespie Field, El Cajon, CA (first hanger row on Joe Crosson Drive - Southeast side of Gillespie).



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

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

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

President: Andy Kecskes	**(619) 589-1898**
Vice Pres:	
Secretary: Phillip Burgers	**(619) 279-7901**
Treasurer: Bob Fronius	**(619) 224-1497**
Editor: 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) 596-2518 (10am-5:30pm, PST)
(619) 224-1497 (after 7pm, PST)
E-Mail: twitt@home.com
Internet: http://www.members.home.net/twitt

Subscription Rates: $20 per year (US)
$25 per year (Foreign)

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

Single Issues of Newsletter: $1 each (US) PP
Multiple Back Issues of the newsletter:
$0.75 ea + bulk postage

Foreign mailings: $0.75 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 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).

TABLE OF CONTENTS

PRESIDENT'S CORNER

I would like to personally thank Al Bowers for coming all the way down from Lancaster to put on an excellent presentation on the Blended Wing Body. Although the group was small, it was a lively one and kept Al on his toes answering questions. He made the point about the flying public accepting something like the BWB as a mode of transportation, whereas, we as TWITTers wouldn't hesitate to climb aboard.

I would also like to thank him for allowing us to use his synopsis of the September 9, 2000 hang glider reunion at Dockweiler Beach (Playa Del Rey) on the coastline outside Los Angeles. Al also sent along some pictures of his early days in hang gliding that I think some of you will enjoy. Bob Fronius and June Wiberg also attended and had nothing but good things to say about the event. There were a lot of old-timers there, along with vintage gliders. It is my understanding that this stretch of beach is now open for hang glider activity.

We all need to thank Wayne Donaldson for allowing us to use his company's high quality video recording camera and associated equipment. Without it we wouldn't have been able to adequately tape Al's program or the many others we have done over the past several years. Wayne has also donated copies of the building instructions and drawings for Taras Kiceniuk, Jr.'s "Icarus II" and "Icarus V" hanggliders and, the "Batso" first introduced by Richard Miller at Dockweiler. We will add these items to the TWITT library for others to look at as they pass through the hanger from time to time.

Not many letters are coming in with questions or tales to relate. I hope everyone's still there and keeping busy!!!!!!!

Andy

NOVEMBER 18, 2000 PROGRAM

As of the publishing date we didn't have a confirmed program for November. We are working on a couple of good ones, so make sure to check this spot next month for the program announcement.

MINUTES OF THE SEPTEMBER 16, 2000 MEETING

Andy opened the meeting thanking the small group for coming out in the very high heat of the day. The outside temperature was predicted to be 102º and we still had to close the hanger doors to be able to view our speakers overheads. We had put some fans around the edges hoping that keeping the air moving would help a little.

After covering the usual housekeeping items, Andy announced we would be having a free door prize drawing consisting of three Tim Huff ZingWings and one four pack of Quaker State oil and filter. *(ed. – See what happens when you don't show up each month.)* Due to the heat he also decided we would split the program into two sessions to allow everyone to cool off while having a donut or two and a cold soft drink.

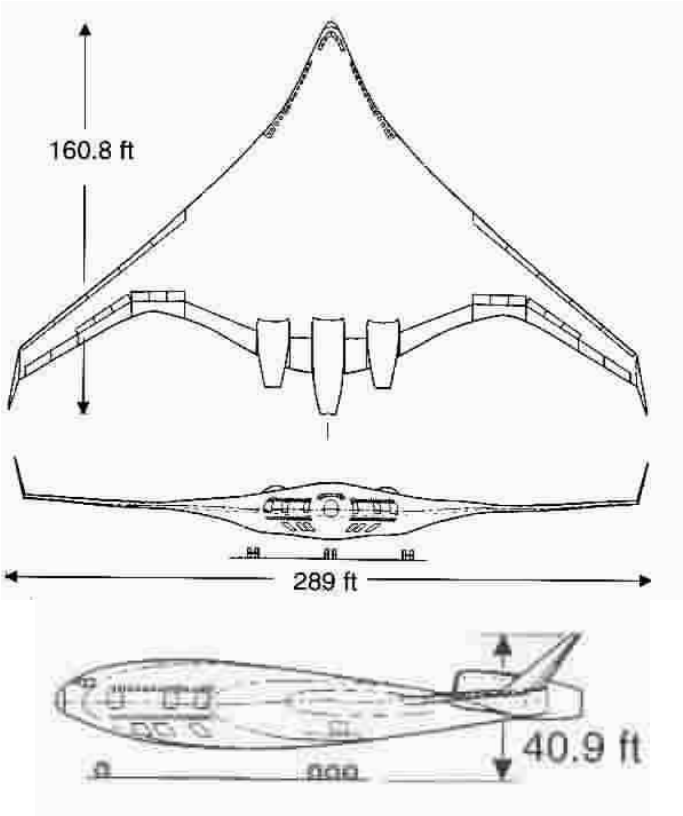
Andy then introduced Al Bowers, from NASA Dryden, who was going to tell us all about the joint project between NASA and Boeing on the Blended Wing Body. Al opened with a picture of him flying a customer's hangglider at Dockweiler Beach in 1974 where he started his hangglider career the year before. See left cover photo. He worked in a hang glider shop, and they would receive gliders from manufacturers. They'd assemble them, test fly them once or twice, and then deliver them to customers. This was one of those. His logbook says it belonged to "Doug" (no last name) and that they had to re-trim the glider because it was a little tail heavy. (See the cover photo.)

(ed. – The following historical information was provided by Al after the meeting and I thought it gave us an insight into why Al's interest are what they are.)

The right cover photo is his own personal glider, a Seagull III (serial number 4465) at Playa Del Rey. "I loved this glider, it flew really well. I have more flights (about 150), and more time, in this one hang glider than in all the other hang gliders I flew all put together. In a strong breeze, I could soar this hang glider at Playa Del Rey (a sand dune only about 20 ft high). I remember when it was marginal, we'd take-off by running sideways, and we could barely maintain flight. I'd have to hold my feet up, I was that close to the ground. But there was a clump of ice plant part way down the ridge. I can remember hitting the ice plant, bits of it flying from the collision, and coming out the far side still flying. On a good day, we could get to the far end of the ridge, and land back on top. We'd turn around and soar back down to the starting point on the ridge, landing on top again. My personal record was doing this for four lengths of the ridge before a lull would force me to turn out and land on the beach below.

The new training gliders (mostly Falcons, and Condors) have far more performance than my old Seagull III. And they can soar the ridge in much more mild conditions than I ever could. All the same, that Seagull was a hot ship in it's day, and I wish I had held onto it." *(ed. – Now on with the other real stuff.)*

The Blended Wing Body (BWB) is being considered as the next generation commercial airliner. The trend is towards larger aircraft that can carry more people, economically while reducing the number of operations from airports. He noted that recent surveys have identified about 60% of the delays are due to the number of aircraft saturating the airspace, as anyone who has been delayed can attest, the ramps and runways of airports. This movement of more people on fewer aircraft has been defined by NASA as "The Lure of Large Aircraft". There are a lot of other infrastructure problems that also need resolving like terminal congestion, parking facilities and, adequate loading gates.



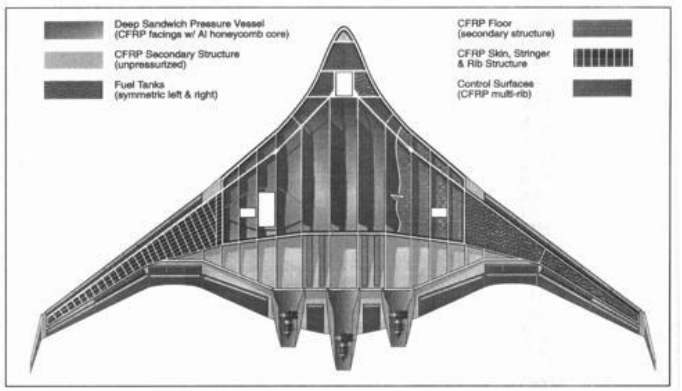
ABOVE: Three-view of the initial concept vehicle.

There is a very competitive large aircraft market as illustrated by the AirBus decision to produce the A3XX that could carry about 650 people on two decks. The intra-Asian market is another area that can utilize high density loading. They are already doing it with Boeing Super 747s rigged for full economy seating to haul 550 people over the

short distances between cities. The trade off is less fuel, but it isn't needed for the short runs. This is going to be a problem for the Chinese in about 10 years as they become more affluent and want to travel throughout their country.

Another aspect of large aircraft design is the ability to adapt it to the all cargo market. Al didn't hasn't really seen the full logic behind the idea yet, but NASA is pursuing it. With used Boeing 747s available at relatively low prices, along with other smaller aircraft that are readily available, the market for a new large cargo hauler may not be as great as expected by NASA. However, the military gets interested it design and helps defray some of the startup costs, then the picture for the commercial markets could change.

Gavin asked the question about whether or not the design would allow for doing quick conversions between people and cargo moving to get better airframe utilization. Al noted that due to internal structure and layout of this particular design, it would be very difficult to do the conversion on a daily basis. The interior design includes a lot of chordwise bulkheads to form several different passenger compartments across the span of the center section. There would be more passageways to negotiate with seat pallets getting them to the doors and removing the overhead compartments.



ABOVE: BWB general interior arrangement. Center for passengers, then general cargo and then fuel in the outer panels.

Al went on to say that you really have to start thinking differently when it comes to unconventional configurations, but there are potentials for breakthroughs. Eventually, someone will take the bold step to do the development work on these designs and then sell them to the air traveling public. This is one of the biggest questions that there isn't a good answer for right now. People have been used to the "tube with wings" concept for almost 90 years and it will take some doing to get them into an unconventional one.

(ed. – Some years ago there was a proposal for multi-blade, external fans for aircraft like the MD-80, but surveys found the public wouldn't fly on them because they had "propellers". But maybe the introduction of aircraft like the B-2 and some of the next generation fighters currently starting qualification testing will turn the tide toward flying wing acceptance by the public.)

So where are these potentials. The biggest kicker is to take the body of the airplane and morf it with the wing, then you get a body that produces lift merging with the spanloader idea. You can't take it to the point of a true flying wing due to the added wing area at the outboard ends creating too much drag. So you end up with a blended wing body that looks like the one below. The lift to drag ratio can be increased from something like the 747's 17 to the a range in the mid 20's for the BWB. This savings in drag translates into substantial economic and environmental benefits. This particular model would be expected to use 20-25% less fuel, require 10-15% less weight (or conversely allow for more paying payload) and result in 10-15% lower direct operating costs.

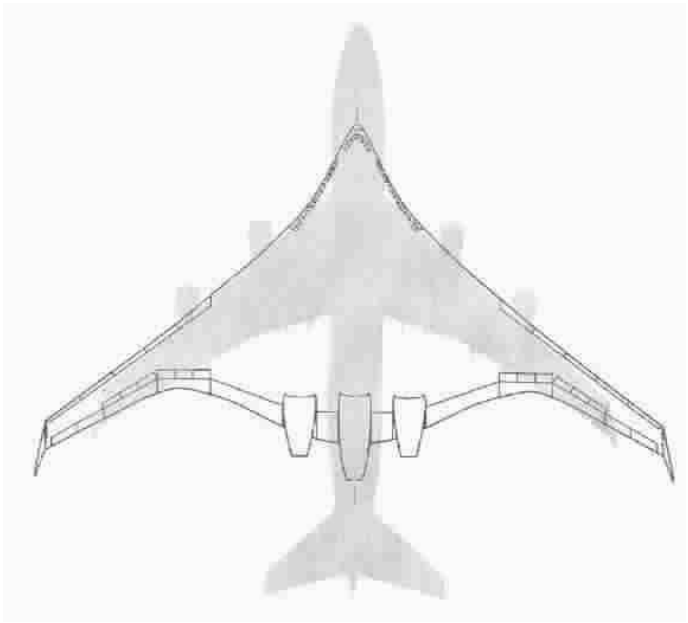
This was all started by a design study in 1989 by Dr. Dennis Bushnell, Chief Scientist at NASA Langley. He foresaw the need for a commercial aircraft that could carry 800 passengers over 7000nm and a speed of .85 Mach. This was the result of that design study which was originally McDonnell Douglas'.

One of the more interesting facets of this design was the position of the engine inlets. Since they are right down on the wing surface, they are ingesting the boundary layer so any airflow sucked into the engines can be ignored as drag. This gives a huge increase in the L/D due to the decrease in drag. There are also a lot of control surfaces on this version, however, the larger inner surface has been eliminated in follow-on designs. As part of what Al was talking about earlier, notice the 290' span that won't fit into the current passenger terminal infrastructure. This makes this configuration non-viable as a solution to the high density passenger carrying BWB.

Al then moved from the outside features to the inside layout of the airframe. The diagram shows how this applies the spanloader concept by having the weight out where the lift was being produced. The passenger compartment goes out into the wing structure area which is obviously different that a conventional fuselage. Outside of the passenger area are the main fuel tanks which also run out into the wings, further moving weight out to the lifting areas. This is entirely different than the point loads of the fuselage arrangement.

In an overlay comparison of the BWB to the 747, you can graphically see why there is a problem with this particular BWB design. You can park 747s side-by-side at current passenger terminal gates, but the BWB's 290' span makes this impossible. Both Boeing and McDonnell Douglas looked into folding the wings like aircraft carrier jets, but determined that the public would not like to fly on an airplane that looked broke. Another idea was to caster the wheels so the aircraft could come into the gate area slightly sideways, but this means higher weight in the landing gears.

Staying on the inside, Al put up a slide of a full scale mockup of a section of the passenger compartment. One of the first questions everyone asks is where are the windows. In this design there are no real passenger windows, but each seat will have a multi-functional LCD screen on the seat in front of them. A selector will allow the passenger to select from a number of views, including looking to the rear and straight down.



ABOVE: Size comparison of the Boeing 747 vs. the BWB. Graphic illustration of why BWB won't fit into current infrastructure of airports.

The other obvious thing in the pictures are the really heavy structural walls between the compartments. Al now went on to answer Ralph Wilcox's question about how hard is it to pressurize a square box versus a cylinder. The heavy walls are one of the ways and due this extra weight they also cut into the ultimate potential gains Al talked about in the first part of his presentation. However, he also commented that it is expected enough gains will be made on the aerodynamic side to offset the extra structural weight. Gavin asked about putting a series of round section within the wing to carry the pressurization loads. Al commented that this was looked at, but in the final analysis it was determined that weight wise it is better with the current design parameters. He did note there are some fatigue questions that still need to be worked out before there is any commitment to building something like the BWB.

Al moved along to the direct operating cost analysis between a 747, a new conventional design like the Airbus 3XX, and the BWB at the year 2015. The numbers all show the BWB makes gains in the areas of operating costs, fuel efficiency, gross weight and nitrous oxide emissions. This last item is of great concern to NASA since they have been linked to the green house gases. Here there was a 17% expected gain for the BWB predicated on the fact there are no major breakthroughs in engine design during this period. Some of the gains will come from a combination of many little improvements over the entire airframe versus one or two major improvements.

Gavin ask Al whether or not the airlines would be behind these types of changes in aircraft design. Al commented that in his opinion changes in the environmental laws will probably create the need for such aircraft to meet things like emission standards. If airport and airspace congestion rules are changed, the aircraft will have to change and the airlines will go along because they will have too.

The next slide was a comparison of the benefits and challenges. The benefits include: lower operating costs; lower production costs; reduced airport/airspace congestion; lower fares; reduced environmental impact and; improved safety. Operating costs he had already covered. Lower production costs come from not have as many tight bends so the manufacturing costs go down. Although the number of aircraft at terminals won't go down, they will be moving more passengers with each departure which will impact congestion by preventing its escalation. It is felt this design concept is at least as safe, and possibly saver, than a convention design.

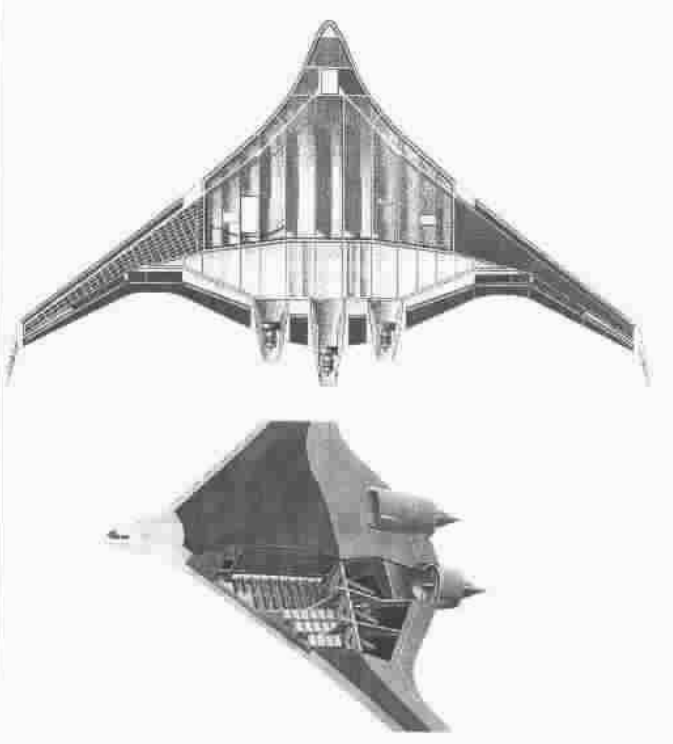
The challenges included: structures and materials; aero-structural integration; aerodynamics; controls; propulsion-airframe integration; systems integration and; infrastructure. Structures is back to the pressurization issues and the integration issue revolves around making the structure clean enough to work aerodynamically and achieve the savings potential.

ABOVE: Typical passenger section looking toward the leading edge. Note the heavy vertical bulkheads needed to support pressurization loads.

Aerodynamics is a separate issue from the aerostructures. Imagine that this design has an elliptical span load associated with it, so that is the minimum induced drag for this vehicle. Then think about the lift coefficient that needs to be produced for this type of wing. Since the span load is chord dependent the center body section with its wide chord had no problem meeting the requirements. But as you move out towards the tips you reach a pinch point where the chord narrows sharply. The problem is going to tip stalling due to the high taper ratio and the loading out there. This is a problem for the aerodynamicist since the aircraft must takeoff and land. This means you need to generate high lift coefficients, which puts you close to the stall, which is also close to the departure. Of course the last thing you want is a passenger aircraft with bad departure characteristics, so

how do you get the lift coefficients at the pinch point to avoid these problems or at least degrade elegantly so you don't lose control of the airplane.

Ralph asked the question about boundary layer control at that point on the wing. Al commented that it had been looked at and there was still a problem even using vortex generators. Boeing went to slats on the outboard section since this would generate a lot of lift on this portion of the wing. The disadvantage of this system is that slots and slats have really bad hysterisous effects, so once stalled it might be hard to get back. NASA is still looking into this area.



ABOVE: Examples of the structures and aero structural integration. Imbedded engine nacelles are more clearly visible in this view.

On systems integration, Al noted that this area is becoming more and more complicated. This is the digital fly-by-wire systems so you can control the way in which the aircraft reacts to the control inputs. This particular design has a nose slice just before reaching the stall, so some method is needed prevent in inadvertent departure. The digital controls with its accelerometers and other sensors feeding back information, the control surfaces in the affected area can be deployed upward to decrease the span loading and move it inboard. This will prevent the airplane from departing, but it is so sensitive that any external changes can have major effects on the departure characteristics.

Gavin asked a question about what types of construction techniques would be used for this aircraft. Al said it was planned to be built by bending tin and used the 747 as an example. If you look at the outer wing panels on the 747 and compare them to the same panels on the BWB you find they are very similar. Since the BWB was originally a McDonnell Douglas design, the outer wing sections were based on the DC-12 which was never produced because of the buyout by Boeing. This then became a good starting point so the center body construction problems became the focal point of further development.

Al moved on to the really big issues of structure and aero-structural integration; non-cylindrical pressure vessel. How do you pressurize something that doesn't look like a tube or a sphere. Initial thoughts were to use conventional metallic structures, but more recently thoughts have been turning towards composites like graphite stitched epoxy resins. They are questioning whether this would help with the pressure structure problems and perhaps also save some weight.

There is another issue with joints between the various panels. One of the things NASA does with their test aircraft is go through a ground vibration test. Hopefully this predicts what the structural modes are in the wing. The is a mass suspended by a fairly rigid beam structure which will vibrate at a particular frequency and a guess is made as to what it will be based on the existing structure.

With metal airframes there is an I-beam with a plate on the top, the skin, that is riveted in. It turns out that due to the factors of give, flex and friction the actual frequency actually, when tested, comes out lower than the prediction. This goes back to the fly-by-wire system where the pilot can make a jerk input to the stick which would give an almost perfect square wave input to the system. The system looks at it as a change to the angle of attack. In most airplanes the change would occur gracefully with some overshoot and then stabilize out, which is the short period frequency. If this frequency is the same frequency as the structural wing bending the aircraft will catastrophically fail. The pilot can't be told not to make these types of control inputs, especially if they are fighting an aircraft in turbulence while landing.

Now we bring in the composite structure. Some composites joints are glued together and other are not, so in some cases there are butt joints where the load transfers are harder to calculate. In tension and compression there is pretty good data, but not in the bending. Apparently the joints don't handle the stresses that same way in each direction so this makes the calculation much more difficult. At this point in time there just isn't a lot of experience on how to handle these types of joints on airplanes. This is due to the load having to transfer from one skin, through the flange or other connecting structure, to the other skin. Since the cloth fibers are not running continuously along the known stress line, the calculations become much more complex.

Another major issue that will need to be worked in the future, but is not a top priority at this point, is the outer surface "bulging" that will occur as the aircraft is pressurized. These bulges will form in-between each of the main structural bulkheads forming the passenger compartments. Obviously this will deform the elegant cruise airfoil shape that is being planned, so it has to be taken into consideration in the design. When doing this

with composites it becomes even more difficult due to the lack of experience in this area.

(ed. – At this point we took a fifteen minute break for sodas and fresh air. The sodas were provided courtesy of Jim Anderson and we thanked him very much on this hot, muggy day. A lot of hanger flying went on including Pat Oliver getting out his hybrid flying wing model that he brought to hang from the hanger ceiling as part of the growing collection of R/C gliders.

When we got back together Al finished up his program which will be covered in next month's newsletter. This will allow room this month for some pictures and line drawings that he worked from for the first half.

We also have a VHS video tape of this presentation available for those of you who would like to see the real thing. The will be accompanied by a complete, printed set of the 18 slides he used so you can clearly see them or make notes as he talks about each one. Also included on the tape is some television coverage of the BWB that shows Ilan Kroo's Stanford team and their flying BWB model. It is priced at $10.00 US for stateside delivery and $12.00 for foreign delivery*.)*

DOCKWEILER BEACH REUNION (Playa Del Rey, CA)

This past weekend, Saturday, Sep 9, was a hang glider reunion at Playa Del Rey. We always called the site, Playa Del Rey, but it's really Dockweiler State Beach. The hill is just south of and off the departure end of LAX. Heavies from Boeing and Airbus thunder overhead all the time.

I showed up, and the first person that ran into me was Russ Velderrain. Russ was the founder of Velderrain Kites, and after he sold the company he ran the Soaring Emporium hang glider shop.

The shop was about 2 miles from my house. I stopped in and asked questions, and told Russ of my own hang glider (which I had been flying for about 3 months at that time). Russ hired me to sweep up after school. Russ also sold me my first dacron sail for my second glider. And Russ took me out testing customer gliders before we'd deliver them.

Russ looked good. I hadn't seen him in over 20 years. I also ran into Mike Riggs. Mike was the founder of Seagull Aircraft, a hang glider manufacturer. In fact, I owned two of Mike's gliders. Just for reference, Russ was PHGA/SCHGA/USHGA #326, Mike Riggs was PHGA/SCHGA/USHGA #77. I was SCHGA/USHGA #4572. I think the USHGA is up over 50,000 for membership numbers now.

Also there was Richard Miller. Richard was the first person to try and fly a hang glider at Playa Del Rey, way back in 1966. Truly, Richard Miller is the person responsible for hang gliding today. I also ran into a number of other folks, Steve Morris, Bill Bennett, Tom Vayda, Dan Armstrong, Joe Faust, Roy Haggard, and others too numerous to name.

ABOVE: BATSO being launched at Playa del Rey, pilot unknown. Photo courtesy Wayne Donaldson.

I enjoyed watching the antics. Playa Del Rey is a 20 foot sand dune, right on the beach. The local shop, Wind Sports, uses it as a training hill, and runs the concession. Wind Sports was allowing folks to fly the Wills Wing Condor trainers. The Condor is a new trainer with about 330 sq ft sail area (this is HUGE by hang glider standards; most hang gliders try to achieve wing loadings of 1.2 to 1.5 psf, the Condor is right around 0.5 psf). The Condors literally float along. With a little breeze, you can walk faster than these ships fly. But the real comedy was the impromptu L/D match going on amongst the rigid wing hang glider folks. Brian Porter tried to get the Millennium

ABOVE: Taras Kiceniuk, Jr. getting ready to launch in an Icarus II. Photo courtesy of Wayne Donalson.

launched, but the lack of breeze and poor launch area conditions caused him to stumble on his first try. The second launch was a little more successful in that he got airborne, but only with just enough airspeed and altitude

to flare for landing. The ATOS was able to get a few decent flights in. But the Condors were the most interesting to watch.

ABOVE: Wayne Donaldson getting ready to launch his Icarus II. Photo courtesy of Wayne Donaldson.

Several times, I think the pilots were at the edge of incipient dynamic soaring conditions. They would start to flare for landing, the glider would balloon/zoom a little into the higher speed breeze, and the process would start over again. Several pilots were getting flights that were longer trying to land than the portion where they were away from the ground. Several folks were able to soar this little "bump" in Condors too. In the old days, we couldn't get enough altitude at the end of the ridge to make a 180 and fly back. So we'd either land on the beach or if conditions were optimum we could land on top. You would turn around and fly back down the ridge (this was really cool, you wouldn't have to haul the glider back up the sand dune after the flight). My best was stringing about four of these in a row together. The Condor makes it possible to do 180s and soar back and forth along the ridge.

ABOVE; Nice view of the beach and slope at Playa del Rey. Doesn't look like you could really get hurt much here due to the low altitudes and "soft" sand. Photo courtesy of Wayne Donaldson.

In all, it was a lot of fun. Russ gave me an old photo of me test flying a customer glider. Pretty funny to think of now. I was age 14 and a "test pilot." :-)

I made my first hang glider flight on June 19, 1973. My first flight at Playa Del Rey was Jun 16, 74. My last flight at Playa Del Rey was Mar 26, 1975.

I hope others who were there can post some of their impressions, and maybe we can swap some lies about how good we all used to be...

Al Bowers
bowers@orville.dfrc.nasa.gov

NORTHROP ON FLYING WINGS

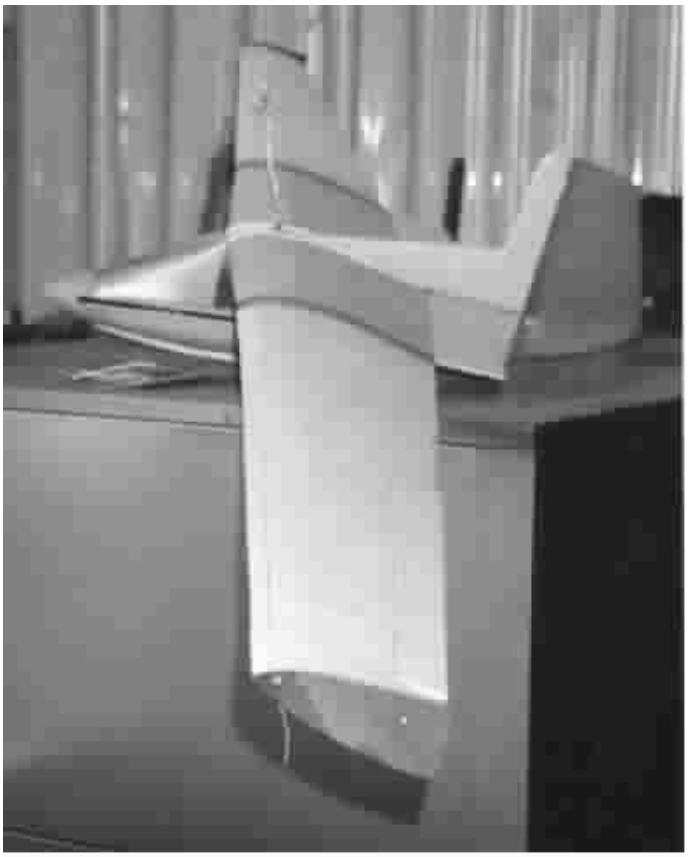
We had a request for a copy of Jack Northrop's 1947 presentation to The Royal Aeronautical Society's 35th Wilbur Wright Memorial Lecture on "The Development of All-Wing Aircraft". It just so happened we had a copy and Bob has had it reproduced and bound in a very nice package. This is a 29 page document that includes photos, charts and graphs as presented by Northrop. For you dyed in the wool purists, this would make a nice addition to your libraries (Christmas is not that far away). They are priced at $8.00, including shipping in the US and $10.00 for foreign deliveries. Send your check, money order or cash to: TWITT, P.O. Box 20430, El Cajon, CA 92021.

WEBSITE LISTING

(ed. – Below is a listing of Internet sites related to soaring, many of which are vintage in nature. They were compiled by the Vintage Sailplane Association and printed in the Fall 2000 issue of Bungee Cord. I thought some of you might like them since there are a few flying wings among the many pictures, and most of the sites also have additional link pages.)

1. British Gliding Association
   www.gliding.co.uk
2. Charles Fauvel and His Flying Wings
   www.nurflugel.com/Nurflugel/Fauvel/e_index.htm
3. Danish Vintage Glider Club
   www.dsvu.dk/dask/index_uk.html
4. Deutsches Museum
   www.deutsches-museum.de/zweig/werft/fws.htm
5. Flying Wing Homepage
   www.nurflugel.com
6. French Vintage Gliding Association
   Dedale.decollage.org
7. Glider.com
   www.glider.com/
8. Glider History Site
   www.gliderhistory.com/
9. Hellenic Soaring Archive
   www.paragliding.gr/gliding
10. National Soaring Museum
    www.soaringmuseum.org
11. Sailplane Homebuilders Association
    www.sailplanehomebuilders.com

12. Soaring Society of America
    www.ssa.org
13. Swedish Vintage Glider Club
    www.segelflyget.se/svs/
14. Swiss Vintage Glider Association
    www.osv-ch.org/osv/
15. Vintage Glider Club
    www.vintagegliderclub.org.uk/
16. Vintage Glider Club in Poland
    www.vgc.pirxnet.pl
17. Vintage Sailplane Association
    www.iac.net/~feguy/VSA/
18. Wasserkuppe Museum
    www.segelflugmuseum.de/
19. Wings and Wheels
    www.wingsandwheels.com



ABOVE: Pat Oliver's hybrid flying wing, R/C Glider. Pat has hung it up in the overhead of the meeting area for others to see in the month's to come. Photo courtesy of Bernie Gross.

ABOVE: Pat Oliver holding his hybrid flying wing. It may have started with a set of discarded Schweizer 1-36 wings, but that's another story. Photo courtesy of Bernie Gross.