No. 174 DECEMBER 2000

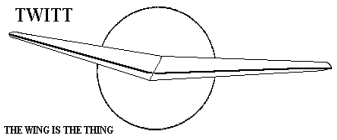
T.W.I.T.T. NEWSLETTER

The Genesis II nearing assembly completion at the November meeting. See inside for more information. Photo by Bob Fronius.

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., **0012** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, January 20, 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

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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

I think we all owe Jeff Byard a big thanks for bringing his Genesis 2 down from Tehachapi, CA for the November meeting. It finished up our year 2000 with a splendid program that I think everyone really enjoyed. It is not often that we get to have a hands-on experience with some of the most current hardware out there today, so it was kind of special.

I received an e-mail message from Michael Myal earlier in the month. He is the editor of Contact! magazine and had received a story on a ducted fan LongEZ. The author had also included some information about the Rohr 2-175 delta wing ducted fan as background material. Michael then wrote to us requesting any pictures we might have of the 2-175 and, more information on TWITT to add as part of that background. Bob dug up some pictures that I scanned and forwarded to Michael, along with a short piece on TWITT he could include which would give us some much needed publicity.

If you have Internet access you have noticed I changed the format of the home page. I hope you are finding it easier to use since all you have to do is click on the bar to get to the information. You should also have found I added two new pieces that I hope you enjoyed. The first was Stefanie Brochocki's presentation on the BKB-1 along with some of the historical material she left us. As soon as she gets through some patent hurdles, I hope to add more to this part of the page so come back later and take another look. The second was Al Bower's presentation on the Blended Wing Body and includes complete copies of his slides in full color, which was something we couldn't do in the newsletter.

Andy

JANUARY 2001 PROGRAM

As of our publication date we didn't have a lock on the January program, so you need to check this space next month to see what we have in store for you. We are working on a couple of good ones, so make sure to block your third Saturday for the meeting so you don't forget it after all the holiday celebrating.

MINUTES OF THE NOVEMBER 18, 2000 MEETING

Andy opened the meeting by thanking everyone for coming to the last meeting of 2000. He asked everyone to introduce themselves, since we had several visitors who were PSA pilots along with our speaker before it was bought out by US Air. We also had several other notables with us like Lyle Maxey, Jack Norris and Andy Bauer (about to release their book on propellers), and Gene Larrabee.

After the usual housekeeping items for the new people in the audience, Andy asked Floyd Fronius to tell us a little about his collaboration with Danny Howell on the Light Hawk, ultralight high performance sailplane. This is a Part 103, standard class sailplane weighing between 140 and 150 pounds with a 49'+ wing span. Danny is projecting a L/D of 36 with a sink rate of 60-80 feet per minute and a speed range of about 100 mph down to an ultralight stall speed. He has a complete set of molds and is working on the first three ships. Floyd is working on the side-stick controller, which has been designed to be ergonomically nice to the wrist. The only thing missing is some type of centering spring trim system to ease the control loads.

Andy mentioned that Danny had done a load test on the horizontal tail surface at the recent SHA Western Workshop. The surface weighed in at about 7 pounds, was loaded on a pre-programmed distribution and didn't fail until it had exceeded over 20 g's. This appeared to surprise even Danny, but it sounds like there are no plans to reduce the weight any further to allow for any manufacturer irregularities.

The question was asked about whether the pilot would be inside a canopy. Floyd noted that this is simply a light, high performance sailplane that will probably be built as a car/aero tow type aircraft. He did note they might make one that is foot launchable to try and break some of the current records. This is a commercial endeavor and he plans on selling the aircraft. Bruce Carmichael noted that Danny has been working with Professor Drela of MIT on the design which was done through computer CAD/CAM programs.

Andy then introduced Jeff Byard who brought his Marske Genesis II down from Tehachapi and was going to tell us about his involvement in the design and what he thinks of the sailplane.

Jeff started by telling us he's had the Genesis for about a year and flown it about 60 hours. His interest in flying wings started back in 1960 when he saw Jack Lambie's Fauvel at an airshow at Chino. The Horten and Northrop wings continued to impress during the intervening years until he heard a presentation by Vern Oldershaw at an SHA workshop. Vern had brought several models with forward sweep and wash-in at the tips. His theory was that the hawks and turkey buzzards weren't so much thinking about centering a thermal, but that it was happening automatically due to this configuration. Through a series of diagrams he showed how a thermal on the right wing would cause an increased angel of attack, increased drag and then turn the glider into the thermal.

ABOVE: From left to right, Ed LaBahn, Bruce Carmichael, Jeff Byard (our speaker), Bob Chase, Floyd Fronius and Pat Oliver.

At this point in time, Jeff had just recently graduated from college with his aeronautical engineering degree. He had built his own medium performance glider called the Jay Hawk and got to thinking what it would be like if converted to a flying wing. He began by reading some of Jim Marske's material and became interested in the Monarch since it had some of the same characteristics of his Jay Hawk. He started looking at reflexed airfoils, forward and aft sweep and, with various types of twist finding that all of this seemed contrary to a high performance sailplane. With sweep and twist you don't have much of a speed range and no one had yet come up with a good zero pitching airfoil that was low drag over any speed range. With that information at hand, he didn't go any further with the flying wing idea and continued to refine his original design.

He hadn't thought much more about flying wings until the SSA convention in 1990 in Indianapolis. Jeff was the western vice president of SHA and Jim Marske was the eastern vice president and was scheduled to talk at the convention. Marske brought with him the design of a sleek new flying wing sailplane that would be constructed of

composites versus the wood structures he had used with his Pioneer series.

Marske was working for an automotive components company at the time and they had given him a computer and some airfoil software to learn how to use it. Jim found he could try out many iterations of zero pitching airfoils each night instead of one or two a week using conventional manual means. He came up with some very good airfoils that had low drag over a wide speed range. With these new airfoils he went back to the drawing board and came up with completely new design that he decided to call Genesis.

After working on refining the design, Jim hooked up with Jerry Mercer who provided some of the initial financing to begin actual construction of the design. Jim also hired John Roncz for a couple of months to further refine the aircraft. Roncz did a lot more computer analysis on the airfoils, fuselage and various fairings. They built a prototype and did some more tweaking of the fairings, which significantly improved the performance to the point that the sailplane became the Genesis II.

At this point we all got up and went outside to actually put the sailplane together. Jeff picked a couple of helpers to reduce the confusion in doing the assembly. He commented on the excellent engineering of the German trailer, which was a work of art in its own right. Everything is well organized, moves easily on rollers and the fuselage cradle is a marvel in how it lifts it so the gear can be lowered as the last step in putting the glider on the ground. *(ed. – I won't go through all the details of the assembly, but will give you the highlights of the various unique items he wanted to cover as it progressed.)*

ABOVE: This gives you a good idea of how compact the glider is inside the trailer. There is ample room in front of the fuselage for things like wing stands, etc.

With the tail suitably elevated to sort of level out the fuselage, the wings could be removed from the trailer and installed. They have the typical root spar configuration with a single spar shaft on one wing fitting into a V-shaped shaft from the other wing. The spars are interlocked with two main wing pins and the load between the wing and fuselage is carried by leading and trailing edge pins going into a carry-through structure. The main pins are held in place by a spring-loaded locking device that can be activated with one hand.

ABOVE: This view shows you the right wing with the V-section of the main spar. You can see the spoiler and aileron bell-cranks in position to enter the automatic hookup system. (See picture below.)

The spoiler and aileron controls go into large capture buckets that narrow down so that the ball-bearing transfer points are held firmly in place without creating any unnecessary system drag. From what we could see this is a full-proof system for automatic control hookup since the wing won't go into the fuselage if the male portions aren't aligned properly with the female sections. This was graphically demonstrated when the spoiler lever wasn't in the right position for the assembly and they couldn't get the wing seated until the problem was corrected. The forward sweep took the tip handler a little getting used to, but other than that the wings went on as with any other sailplane.

With the wing installed, Jeff got the horizontal (trimmer) tail out of the trailer. While installing it he showed us what is thought to have happened in the one accident there has been with a Genesis. The locking pin is controlled with a special tool that lifts the pin for sliding the surface onto the

control horn. Once the surface is in the full forward position and aligned with the locator marks, the pin is released to lock it in place and the tool is unscrewed from the pin. Jeff says they think the surface wasn't pushed fully forward so the pin could be engaged. In this intermediate position it is far enough on the horn to pass a positive control check yet not be locked to the horn. So it turned out not to be a design flaw, but rather a case of inattention to detail or a distraction during assembly.

ABOVE: You can see Jeff's hand on top of the surface getting ready to pull up on the pin to slip it onto the horn. Note the leading edge is not yet all the way forward, which is also an indication the surface is not all the way on the control horn.

The last step in the process is to use the built-in screw jack system to raise the fuselage high enough to drop the wheels out of the retracted position and then lower it back down to the ground. There is a pneumatic nose and main gear and the glider rests in the nose up position when the cockpit is empty. The main wheel has a hydraulic brake. The whole process took about 12 minutes, which is a little longer than an experienced crew would need.

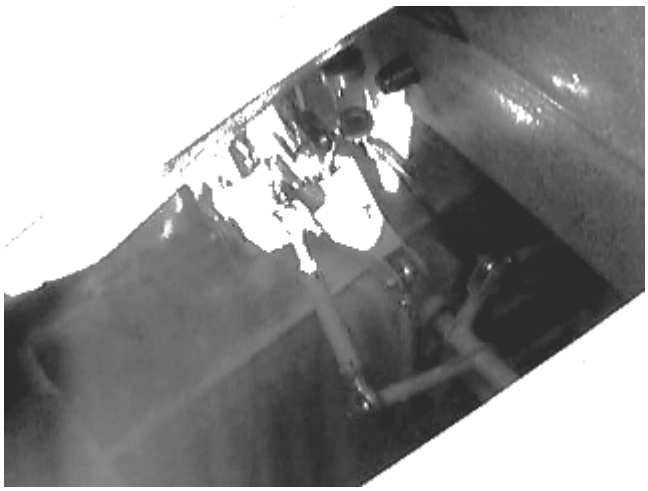
Once the ship was all-together everyone gathered around it and did a thorough inspection of the quality workmanship. The surfaces are absolutely smooth and have a very glossy appearance. Everything fits together perfectly and it is just an exceptionally good-looking sailplane sitting on the ramp.

The instrument panel is almost all electric with an air-data computer, GPS receiver, etc., which is all programmable through a laptop or PC. It basically eliminates the need for a manual map, except for the time when the batteries go dead or you loose lock on the GPS. Jeff has two batteries in parallel so that he has plenty of power for those long flights.

There were some questions about the "tip rudders". These are small trim surfaces at the tips of the ailerons that move at a two to one ratio in the up direction only. There is a range of adjustments the pilot can make between 1.5 to 2.5 to one, whichever suits his flying style. So as you roll into the turn, the tip rudders help the vertical fin rudder do its job to bring the aircraft around. At 45 degrees of bank it grooves around the turn very nicely with a little use of the normal rudder. It coordinates the turn a little better than other conventional gliders he has flown. The early models had the tip rudders inter-linked with the main rudder, but they have been found to work better when coupled with the ailerons. He can roll 45:45 in about 4 seconds with this configuration, compared over 5 seconds when linked through the rudder pedals.

The horizontal tail trims out the glider at about 65 kts. It uses a negative camber airfoil to give a little more feel in the stick as you move outside of the trimmed position. It has a lot of stick-fixed stability so it takes a lot of stick to get any pitch movement. There is also a small amount of spring feel and the trim system simply readjusts the center position of the spring. This is controlled by an adjustment level in the cockpit that only needs to be pushed so the springs can move to the current position of the stick. No trim wheel or sliding lever, just a simple push almost like hitting a reset button.

Andy went about rounding everyone back up and getting them back into the hanger so Jeff could continue with the rest of his presentation. After we got everybody seated, Jeff got out his notes to make sure he covered all the important points. Among them were that there are four distinct wing sections across the half-span. There is a wide variation in the Reynolds numbers due to the wide chord at the root and narrow chord at the tip. The wing loading can vary from 6 lbs. to 9.1 lbs per square foot and it has a higher L/D at the higher wing loading. The shifting in Reynolds numbers across these sections is lowering the drag.



ABOVE: The mixer section and an indication of the size of the access hatch area for working inside this area.

ABOVE:: About all that is left is installation of the trimmer. Everyone is intently watching the action.

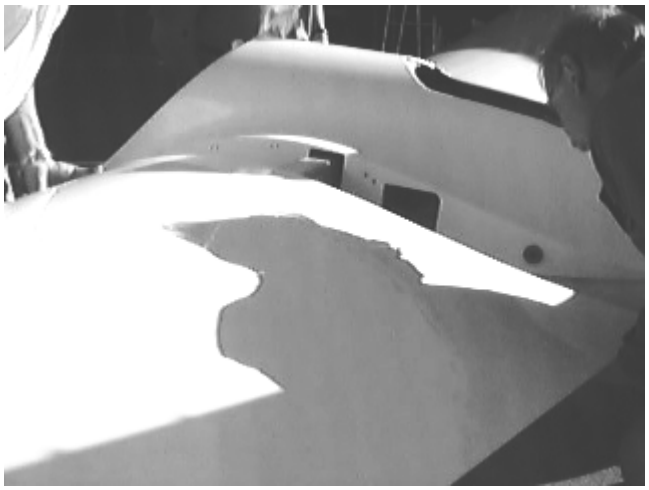
The wing section out about 1.5 meters from the root is actually a turbulent section rather than laminar flow. This was done since the fuselage was already turbulent so they decided to let the wing do it naturally. From that point out the section is laminar flow. Dick Johnson's testing yielded upper surface laminar flow beyond the 50% point of the chord and the lower surface past the 90% point. This is something no one has been able to do with a reflexed section before, which is one of the reason the Genesis performs so well. Bruce asked if the oil flow tests showed any separation bubbles on either surface. Jeff indicated the break was very clean with no bubble so there is no need for turbulator tape on the wings.

The aspect ratio is 20:1, while the Discus-B is 21.3:1 which was the target sailplane Marske was shooting towards performance wise. Genesis' L/D of 43 is also comparable to the Discus. Even though the aspect ratio is lower and the wing area is greater than the Discus, Genesis' reflexed airfoil has a higher "effective" aspect ratio since the lift production doesn't occur over the entire chord of the wing. So the lower overall wetted area drag and higher effective aspect ratio is allowing the Genesis to often exceed the performance of the Discus, thus accomplishing one of Marske's goals.

The spoilers are on the top surface only and very effective. Klaus Holinghaus had found the upper surface spoilers where about 90% as effective as upper and lower units. Upper surface only spoilers also allow the lower surface to remain perfectly clean and produce a smoother airflow over a wider chord range. This also eliminates the problem of air leaking up from the lower surface through the upper surface gap. They are double spoilers so there is a lot of area that is raised high into the airstream. There is no pitch change when the spoilers are deployed and the stall speed goes up about 2 kts. The only problem Jeff has experienced is the large cap area has a tendency to catch the air after a couple of inches of movement and jerk the spoiler lever back if you aren't prepared for it. He thinks they will be able to come up with a smaller cap and better seal and this will overcome the problem.

Jeff decided it was time to explain why this flying wing had a "tail". Apparently the original Marske design was a pure flying wing with elevators on the trailing edge of the wing and the vertical fin and rudder. When John Roncz began running the numbers through his computer he found a couple of things that needed improvement. One was not having the control surface break on the wing and disturbing the airflow along the surface, especially when trying to maintain laminar flow as far aft as possible. The other was that by moving the trailing edge elevator it was changing the C_l of the wing and thus the C_d, so he reasoned the wing needed to remain clean. The overall drag with the smaller horizontal is much less than if it had the corresponding elevator system. The handbook calls the horizontal a "trimmer" and Marske was against it and is continuing to pursue the "trimmerless" flying wing with his Pioneer III sailplane currently under development. He has also modified the Roncz airfoils (the basis of which were his) to try and overcome the original problem. *(See Serge Krauss' update on this project later in this newsletter.)*

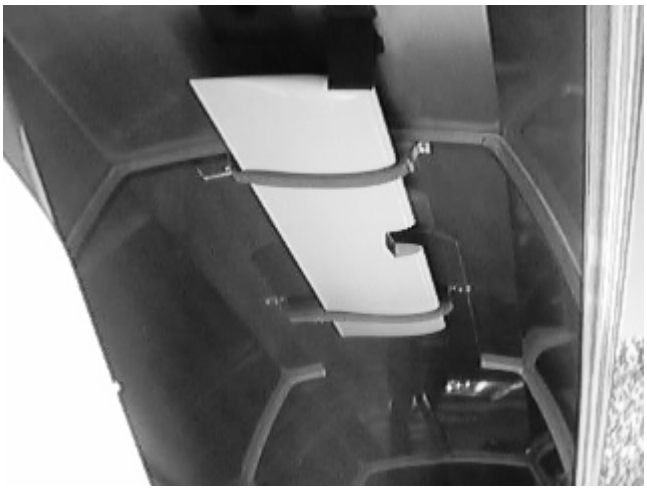
Jeff noted that the Pioneer won't be comparable to Genesis due to it's lighter wing loading of around 4 lbs. per square foot. It will be all composite compared to his past wood, tube and fabric methods of construction. The Monarch is also now being done in composites.



ABOVE: The left wing going into the fuselage. It helps to have a person on the trailing edge for guidance. You can also see how substantial the load carrying pins are by the hole at the aft end of the root section of the fuselage.

The Genesis wing is all fiberglass with foam core except for the spar caps that are carbon rod pultrusions. They are eighth inch carbon rods, are all machine made and the filaments are precisely tensioned the same so you can get by with much less of the rod. The wing was tested to 17 g's with a tip deflection of 19' before it finally broke. The failure point was at one of the main wing pins. There was some discussion after the test as to whether the wing failed first or the test rig failed causing the wing to then fail. There was no definitive answer to this question, but it was obvious the wing had the required strength.

One of Jeff's few criticisms comes from this strength in that it provides a very stiff ride when flying the turbulence of the Sierras. Since there is no give it really pounds you to death which can be very tiring over a long flight.



ABOVE: The trimmer surface is kept in a very neat overhead bracket in the roof of the trailer.

One of the things the Genesis did differently was to pivot the horizontal tail at the 15% point rather than the usual 25% for chord. What it does during gusty conditions is flop the elevator up and pull the stick forward. It's not that bad, but noticeable, and you don't want to pull against it since it is giving you good feeling of a possible thermal. It is 100% mass balanced around the 15%, which makes it quite heavy. The new generation of elevators are much lighter since the balancing is being done by placing the lead in the control rod coming up through the vertical fin. This does a couple of things like a lighter surface, which lowers the moment of inertia around the elastic axis of the aft fuselage, which is quite small. The aft fuselage and fin are all carbon fiber to give it the necessary rigidity to prevent flutter. Although this change has been made, the construction of the aft fuselage still remains the same. There is a conversion kit to the new balancing system and Jeff hopes to take advantage of it in the future.

Gene Larrabee asked about the location of the tow hook in the nose pitot tube hole. Jeff indicated that it makes the sailplane very stable on aero tow. The hole needs to be there anyway for cockpit air and the temperature probe for the airdata computer. He also noted that pilot comfort (well ventilated) makes a big difference on long contest or record flights. Bruce asked whether it was tripping the fuselage's laminar flow, but Jeff said Roncz's calculations found it was not a factor.

The canopy frame was probably more of a factor in tripping the flow than the nose hole. He wasn't sure what the frame was made of, but its coefficient of expansion is different than that of the glass. On a cold day (or at altitude) a gap of about a quarter inch develops on the leading edge of the canopy. Jeff is going to have it flushed in by one of the glass experts at Tehachapi on a cold day to correct the problem.

The wing is swept forward only for moving the CG to the correct location and has nothing to do with stability. The forward sweep is also like adding anhedral so they had to put more dihedral into the wing and make the fin a little taller. To prevent tip stalling they added 3 degrees of "washout". Marske doesn't think you need this and will not include it in the Pioneer III which he thinks will provide for a better higher speed range. Lyle Maxey asked if the trimmer could ever get into the wake of the wing and Jeff said he didn't think you could ever get to that high of an angle of attack.

Jeff added that one of the neat things about the flying wing was the way it handled the changes in pitch when experiencing a gust. Contrary to a more conventional design, the Genesis doesn't have a large pitch change or airspeed fluctuation since the wing naturally seeks the best angle of attack when hit by a gust. The noise level in the cockpit doesn't change much either. So this is one of the reasons he thinks that the tail would never get into the wing's wash.

Jeff has tried spinning it through about three-quarters of a turn, but it doesn't really like to spin. It recovers normally. He had to stand it on it's tail and drop it to do something other than try to spiral out of a normal stall entry position. He has also looped it with no unusual problems encountered.

ABOVE: Shot of the instrument panel with programmable airdata computer resting on the top. You can also see that the cockpit is relatively roomy. The large cylinder on the right side of the canopy support is the jettison spring.

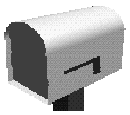
Jeff went on to discuss the addition of boundary layer control at the wing root area. Due to the fuselage taper and the wing getting smaller it creates a bad place for turbulence to form. One of the early owners put a turbulator strip on the fuselage around the ballistic chute hole down to the wing root. He was able to get a noticeable improvement in climb performance, but a decrease of about a point and an half was found in top end at speeds over 80 kts. The two polars (with and without turbulators) cross at about the 52 kt. point. Since then blowholes (about forty thousandths) have been added instead of the

turbulator and the pilot turns them on and off depending on speed. This has been found to achieve the best of both worlds. Jeff is waiting for this owner to discover the right locations for the holes before doing it to his sailplane. His brother-in-law is working on an automated valve that will work off the airdata computer and pitot pressure to open and close at the correct speed so he doesn't have to worry about doing it manually.

One of the things Jeff covered while outside included how the canopy could be jettisoned for bailout, heavens forbid that should ever become necessary. The nose of the canopy sits on a compressed spring that is release when the jettison handle is pulled. This pushes the nose up into the airflow, which then pulls the canopy up and back away from the pilot. However, they found that during this pivoting the rear edge could come down into the nape of the pilot's neck and do a lot of harm. There was a quick solution in the addition of a strong protrusion from the back of the fuselage canopy framework that provides a pivot point for the canopy, keeping it away from the pilot's neck.

In closing, Jeff noted our little piece in last month's newsletter on geese. He related that while a student at Cal Poly one his professors gave them a one question final examine. It said to use the Prantdl lifting line theory to calculate the effect on the eighth goose back on the side of a vee. He in turn asked the group it they knew why one side of the vee was almost always longer than the other. No one had the highly technical answer of "there are more geese on that side".

For more information on the Genesis II, contact Group Genesis USA, 130 Yellow Rose, Alta, WY 83422, (307) 353-8403, www.groupgenesis.com



LETTERS TO THE EDITOR

11/15/00

TWITT:

Thanks for the second half of Al Bowers presentation of the R & D on the BWB. It really looks as if it was designed to fly.

Re editor Joe Faust, I think that he has a degree in aeronautical engineering and was a mover and shaker in the past Rogallo hang glider community in the 1970's. He published his last newsletter as I recall sometime in the 1980's and the last current address of his, that I have, is a needle in a haystack, lost in the archives since I moved in 1992. Maybe you could locate a current Joe Faust address from someone in the Los Angeles hang glider community.

Another possible interesting guest speaker for a TWITT meeting program might be Bill Bennett. He's the pilot who flew a Rogallo around the Statue of Liberty in the 1960's and later manufactured his own line of hang gliders.

Best regards,

Edwin Sward

(ed. – We have managed to get a hold of Bill Bennett and he has agreed to make a presentation. Unfortunately, he has a potential scheduling conflict for January, so we are not sure right now if it will be next month or perhaps March or May. Thanks for the suggestion, since it worked into a program.)

11/22/00

TWITT:

Sorry about the delay. I was in Marion, Ohio building my Marske Monarch flying wing. If you want to see progress, check www.continuo.com/marske website. Mine is the second of the "G" model. It flies beautifully.

Jerry Nolan

(ed. - Thanks for the note on what you have been doing. The Marske website has a lot of information on all his designs, but there is a nice section on the construction of a Monarch so I recommend those of you with access take a good look.

Jerry, could you provide us with a first-hand pilot report of the Monarch and perhaps some of the more interesting things you learned during the building process? It would make a nice piece for next month since Serge's material also covers the Monarch from his visit with Jim in October.)

MARSKE UPDATE

(ed. – The following was provided by Serge Krauss after several visits to Jim Marske's facility in Marion, Ohio. I would like to thank him for this timely material that supplements the coverage of Jeff Byard's Genesis II. Due to its length, it will be presented in two parts, so come back for the rest next month. If anyone else has information on Marske's designs and would like to contribute them for next month, please send them in to go along with the current theme.)

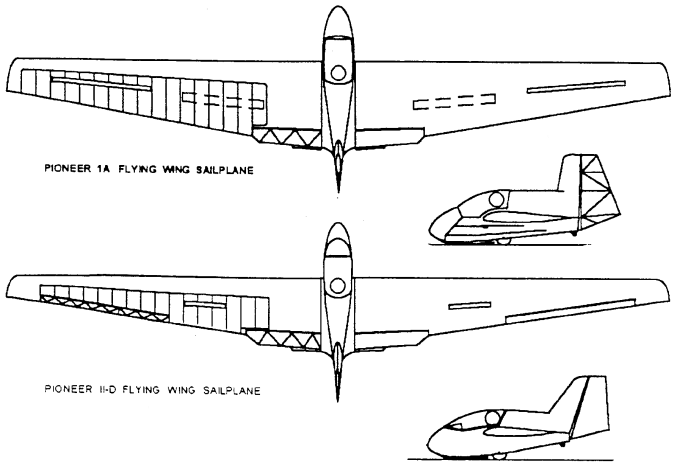
VISITS TO MARSKE SHOP

My two **visits to Jim Marske's shop** in Marion, Ohio this month were, as always, fascinating, due to the constant activity, progress being made in the flying-wing field, and openness in sharing news and technical information. I will relate what I can without violating proprietary information.

My first visit was to present a short history of tailless aircraft at the fall workshop – sort of like delivering a history of the world in a few short sentences! Obviously, it cannot be done thoroughly, but I was pleased to highlight

some of the important people, planes, and ideas. I was able to make some reasonable transparencies for the overhead projector, and the participants seemed to enjoy the presentation. I enjoyed THEM too.

A second visit, to help fabricate parts, afforded me experience in laying up fuselage halves and a D-tube, attaching the D-tube ribs to a spar, and bonding the D-tube/ribs/spar combination. I look forward to doing this again. These parts were all for the third production **Monarch G**. Marske Flying Wings has an apprenticeship/help program for those who would like to learn fabrication techniques and be part of progress in flying wings. This is a great opportunity for enthusiasts and can lead to paid work for those who can work unsupervised. The operation is scheduled to move on November 4 to a larger shop nearby but off the airport.



ABOVE: Top view is the Pioneer 1A and bottom view is the Pioneer II-D.

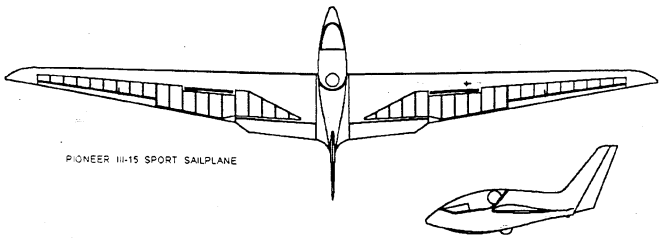
I feel privileged to have viewed some of Jim's computer archives and engineering images of the **Genesis II** and **Pioneer 3 and 4 projects**; his technical ideas, backed by practical experience and computer analysis, are always enjoyable and thought provoking. He again expressed definite preferences on practical performance improvement and preparation for the Genesis II, citing how the optimized Genesis I had once matched the performance of a stock Genesis 2. In particular, he was a little disappointed that the Genesis II used for Dick Johnson's recent Soaring Magazine flight test evaluation had not been fully optimized. He also demonstrated why the superficially similar next-generation Pioneer fuselage might not have the aft flow-separation problem that has prompted the use of turbulators on the Genesis. A wealth of subtle practical and theoretical knowledge is at work here.

Jim has further refined the airfoils for both his D-tube/fabric and glass Pioneer wings and has drawn around them some of the most striking designs for sport, 15-m, and 18-m sailplanes that you will ever see – short but substantive steps beyond the P-3 currently under construction. While the P-3 should surprise many with its D-tube/fabric-wing performance, the numbers for his new glass wing sections and corresponding P-4 designs are remarkable. Cockpits are typically roomy, and I wonder what performance improvements could be achieved with a 17% reduction in fuselage cross-sectional area. He is not advertising anything, but I hope he has the time and resources to put a couple of these drawing-board Pioneers into the air. What modest aerodynamics background I have says that they will perform.

I also enjoyed seeing the original hand-drawn plans for the Australian "Twin Plank" of 1956 by German builder Steve Marton.

REFLECTIONS ON THE MARSKE PIONEER SERIES

I have long been a fan of the Marske Pioneer II, which has been unjustly underrated for years. Originally designed simply as a sport sailplane comparable to the 1-26 (the Pioneer I's wing area equaled the sum of the wing and tail areas of the 1-26, and wing sections were comparable), its performance has nonetheless been consistently superior to sailplanes of similar span and construction.



ABOVE: The Pioneer III-A as a comparison to the earlier models and the Genesis series.

The pioneer series wings, through the IID, are tapered with straight leading edges, giving a slight forward sweep to the quarter-chord line. The P-3 and P-4 leading edges are swept very slightly forward - less so than the Genesis. The Pioneer configuration inhibits tip stall, places the centrally located elevators a maximum distance behind the aerodynamic center of the wing, sacrifices no lift to wash-out, and minimizes pitch effects from roll control. When you think of it, sweeping the wing back to move the elevators back moves the a.c. back too, while forward sweep moves the a.c. forward and away from the elevators. Root Reynolds numbers benefit in the Marske configuration too, although aspect ratio may be compromised. The Pioneer II series uses wing sections derived from the NACA 5-digit series, while the new Pioneers have been designed around Marske derivatives of a Marske/Roncz/Lednicer laminar design with low positive pitching moment. The P-3 section designed for a fabric-covered wing is said to be 24% higher in L/D, and the current P-4 section for glass wings is considerably better than all previous sections. Specifically, the infinite-A/R maximum L/D's for the Pioneer II (NACA 33012), P-3, and P-4 are 100, 124, and 155 (so far), respectively. The Pioneer series employs no wing twist.

Performance validates the Pioneer configuration. The Pioneer II resists stalling and spinning (only one example, with modified tips, is known to have been made to spin), and is highly maneuverable. Its seemingly optimistic advertised L/D max of 35 has apparently been exceeded by well-built examples and matched by some with important flaws. One builder in the northwest reports that direct in-flight comparison to planes of known performance puts his L/D between 37 and 39. The builder/pilot of a more highly publicized example that I have examined reports performance in the advertised range, despite a very rough and wavy upper wing surface and mis-aligned control surfaces. He has said that he wanted to smooth things out, but was having "too much fun" to take the plane down. An otherwise attractive craft, this particular Pioneer has had its sink rate *reduced from* 107 fpm by sealing the spoilers and has been praised for its performance by other pilots. I note also that TWITT member Kevin Renshaw, in his Soaring article "Wetted Area and L/D", rated the Pioneers highest among flying wings in performance for a given index of span divided by square root of wetted area: "The only standouts among the flying-wing homebuilts are the Pioneer series by Jim Marske, which both show up in the competitive band. With some better airfoils and a tighter cockpit, there might still be something there." This is pretty impressive for a relatively low-A/R design dating back nearly 30 years and employing wing sections with roots in the 1930's.
(ed. – The rest comes next month.)

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