A Critique of two Recent Sailplane Design Contests

by

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ABSTRACT

Between September 1980 and September 1982, the Soaring Society of America sponsored two sailplane design contests. The author served as chairman for both. This paper describes the background and rationale for both of these contests, discusses the results, and offers some critical commentary on the lessons learned and prospects for the future.

INTRODUCTION

Despite steady growth over the past two decades, soaring has remained a limited branch of sport aviation in the United States. A number of reasons for this state of affairs have been recognized for a long time, and in addition a number of new problems have arisen, all of which taken together pose a potentially serious threat to the continued good health of the sport in this country. Among recent concerns are:

- Costs (both in equipment and in operations) have risen alarmingly.
- Threats of airspace limitations and constraints (e.g., noise and crowding) on existing facilities.
- Overall, the average age of SSA members is increasing. As one sage observer noted: "If we don't do something different to attract more youthful participants, soaring may become as obsolete Zeppelining."
- Soaring is a group activity. If one cannot get the minimum required group together (tow pilot, crew, etc.) one can't do it.
- To our embarrassment the U.S. relies too heavily, in the view of some, on foreign equipment and design expertise.

Thus, the question arises: How can an organization like the SSA take concrete steps to break the negative cycle of limited participation leading to a limited commercial market which drives equipment costs upward and stifles research and development, and thus limits participation - especially by the young and less affluent? Among the remedies which come up from time to time is the old chestnut: Why not hold a design contest?

The SSA is many things but among its virtues is that it provides a wonderful structure for drawing together a multifaceted crowd of visionary romantics and level headed realists. Beginning in 1980 a segment of the romantic wing of the SSA, with a mixture of anticipated sugar plums and brickbats dancing in fevered minds, began to dream of not one, but <u>two</u> sailplane design contests.

The first of these contests, sponsored by what has subsequently become the Sailplane Homebuilders affiliate of the SSA, was begun in September 1980. The philosophy of this Homebuilt Sailplane Design Contest has been discussed in Reference 1. A year later a related contest with quite different objectives was launched as the SSA/AIAA Student Sailplane Design Contest. This second design contest (with paticipation limited to university undergraduate students) was jointly sponsored by the SSA and the American Institute of Aeronautics and Astronautics. The purpose of this paper is to briefly describe the history of these parallel contests, discuss the results, and critically evaluate the lessons learned from them.

THE HOMEBUILT SAILPLANE DESIGN CONTEST

Despite the problems confronting soaring in the United States, there are a number of very positive recent developments. One of the most promising is the rise in interest in sailplane homebuilding - paralleling a dramatic growth during the 1970's of the Experimental Aircraft Association.

In 1979 the SSA began sponsoring a series of Sailplane Homebuilder's Workshops and the subsequent enthusiasm for them has been refreshing. As positive outcomes of these events, there has emerged a Sailplane Homebuilders affiliate to the SSA and the establishment in 1980 of the Homebuilt Sailplane Design Contest.

The design contest idea lead to a meeting at the home of Jim Maupin (designer of the "Woodstock," Ref. 2) over the Memorial Day weekend (May) 1980. Led by the efforts of Maupin, Irv Culver and Doug Lamont (past editor of Soaring), the framework of a design contest was developed. At that time, a time scale of one year for design, construction and flight testing was envisioned.

Following the meeting at Maupin's home, the author was asked to serve as chairman of the project in view of his position as chairman of the SSA Design and Configuration Technical Committee. As described in Reference 1, the final rules (Ref. 3) were drafted by a group including the author, Dick Schreder and Doug Lamont at the Homebuilder's Workshop in Elmira NY during the Labor Day weekend (September) 1980.

The main modification made to the final rules was a change in the time scale of the contest. The author felt strongly (and still does) that to do a proper job, three years would be required from inception to adequate flight testing of a significant enough number of designs to make the contest meaningful. Based on past design contest experience, however, there was serious concern that it would be difficult to sustain interest over the full three years and, since one year was absurd, a compromise two year time scale was established.

The basis for the contest finally established was a recognition that the resulting designs should meet three basic criteria:

- They must be "Buildable." Both construction time and cost should be minimized. The envisioned machines were thus to be as simple as possible within the constraints of adequate safety and performance.

- They must be "Acceptable." That requires that they be safe, easily flown, aesthetically appealing, and possess adequate performance.
- They must be "Operable." Central here was the observation that retrieves from out-landings and aerotows must become obsolete; both because they seriously detract from conventional soaring's broad appeal, and because of the energy they waste with consequent costs incurred. Thus a self-launching capability was specified.

The rules thus established on the basis of these guidelines (Ref. 3) are reproduced here in Appendix A. They represent a very substantial challenge, but appeared to be achievable with current technology and a great deal of hard work and imagination. Thus, with fingers crossed, the competition was launched with the speech (Ref. 1) delivered to the Homebuilder Workshop participants at Harris Hill, Labor Day, 1980.

THE RESULTS OF THE HOMEBUILT SAILPLANE DESIGN CONTEST

As will be noted, the contest rules (Appendix A) specify a number of check points which the contestants were expected to meet. These were established initially in the spirit of "what if we give a party and no one comes." Thus, if at any point the contest showed signs of becoming a fiasco for lack of interest, it could be abandoned with some semblence of face saving. Much to our surprise the first deadline came with receipt of over sixty letters of intent to enter the contest.

It is easy enough to send a letter of intent to do something, but when the second deadline (September 1981) for receipt of engineering packages describing the designs to be built arrived, we still had eighteen active entrants. The designs proposed at that time have been collected in a booklet (Ref. 4) published by the SSA, and represented machines ranging from powered hang gliders to high-performance motorgliders.

In preparation for receipt of the engineering packages, the judges for the contest had been selected. Under the chairmanship of Walt Mooney, the judges (Einar Enevoldson, Stan Hall, Oran Nicks and Jack Laister) with the advice of Bruce Carmichael, set up guidelines for both the contents of the engineering packages and the criteria to be used in the structural proof testing and flight evaluations which would conclude the contest.

As it turned out, the judges encouraged the construction of the majority of the designs proposed and awaited the final outcome. At this point the too-tight time scale for the contest became apparent. George Applebay, for example, ran into serious technical difficulties with his "Zia" and had to withdraw it (as configured at that time) from the contest. As the final deadline came around only Burt Rutan's "Solitare" (Figure 1) and Marty Holman's "Condor" (Fig. 2) were ready to be judged. In the end the "Solitare" (Ref. 5) was declared the winner.

While perhaps far short of the desired outcome, in the author's opinion the contest must be considered a success. It brought before the soaring community a valid (very difficult) requirement for a modern alternative to existing sport class sailplanes. It encouraged a great deal of work on the design of such machines. It produced two direct competitors and encouraged the construction of half a dozen more which for one reason or another did not quite meet the competitions deadline. And, the contest has spurred sufficient interest to encourage the sponsors to continue it on a yearly basis through 1984. Most remarkable, perhaps, was that all of this was achieved without benefit of any monetary prize offered to the winners. The value of the basic enterprise and potential commercial gain from sales of plans and kits seems to have been sufficient.

A CRITIQUE OF THE HOMEBUILT SAILPLANE DESIGN CONTEST.

Before discussing the second design contest, it is worthwhile to identify the things done both right and wrong in the Homebuilt contest. These comments are offered in the light of hind-sight for the benefit of those who might attempt to organize a similar effort.

On the positive side:

- o The rules for the contest defined an important class of sailplane. A lot of thought (spanning a decade of effort by many individuals) went into the specification, and the author believes the rules remain generally valid. [Note: Read reference 1].

- o The judges did a wonderful job of tying up the loose ends of the contest and seeing it through to completion.

- o A lot of good ideas came out of the contest - both in terms of ways to conduct a better design contest and in the range of new designs actually built or under construction directly inspired by the contest specification (e.g., the Maupin/Culver "Windrose" nee' "Extremely Easy," Ref. 6 and 7).

On the negative side, it must be recognized that:

- o A two year time scale was too short. Three years would have been more realistic - with appropriate prods and check points along the way.

- o Announcement of the contest in September 1980 was premature. The contest should not have begun until the sponsoring Homebuilder's Affiliate of the SSA formally existed. Formal recognition of the affiliate status of the homebuilders by the SSA came only near the end of the contest and left responsibility for sponsorship, prizes, etc. very uncertain. A serious liability question was thus inadequately addressed.

- o All the work subsequently done by the judges should have been done by the time the contest began. The author accepts responsibility for not fully foreseeing this potential problem. The judges - and Doug Lamont - can only be praised for the work they did. The finally successful outcome is due to them.

- o There was inadequate recognition of the inadequate data base on sailplane design available to the majority of contestants. This is a serious problem and will remain so for a long time to come. A step in providing a partial remedy is discussed in connection with the SSA/AIAA contest to be described next.

THE SSA/AIAA STUDENT SAILPLANE DESIGN CONTEST

With the Homebuilt Sailplane Design Contest underway, a parallel independent effort was instigated by A. J. Smith. A. J. observed that soaring and its technology was poorly understood by a very surprising number of aerospace engineers (both professional and students) and that these are the people (particularly the students) who can make major contributions to sailplane design. It also turns out that the American Institute of Aeronautics and Astronautics (AIAA, the aerospace professional society in this country) has administered for several years student airplane/missile design contests sponsored by Bendix and, more recently, by United Technology Corp.

In both the Bendix/AIAA and UTC/AIAA contests, a "request for proposal" (RFP) for a design project is drawn up by industry or university people and sent to most of the engineering colleges in this country. The contest is open to any individual or group (depending on the particular contest) of undergraduate students. The students who participate must prepare an engineering report of up to 100 pages detailing their design work about 9 months after that year's contest is announced. The reports are then evaluated by a panel of judges (usually professionals from industry) and three winners are announced. Cash prizes of $1,000, $500 and $250 are then awarded to the winning students. For over a decade these design contests have been a major cornerstone in many aerospace engineering students' education.

When one reckons that there are over one hundred AIAA student chapters at U.S. universities, there is a potential for reaching a very large number of just the right kind of individual with the story of sailplane technology and design. A. J. convinced the SSA Directors to go for it at their 1981 winter meeting. Thus was born the 1981-82 SSA/AIAA Student Sailplane Design contest - a one shot trial balloon.

In the style of all good managers, A. J., having sold his good idea, withdrew leaving instructions for John Dezzutti to design a design contest, i.e., make the will of the Directors happen. Dezzutti, also being a good manager looked about for someone suitable to do the work. The obvious answer was to go to the SSA Technical Board which in turn led to the author. The author agreed to do the job, despite some reservations (see Ref. 8).

Having found a someone to do the work, the next question was: What kind of sailplane should the students design? What should be the content of the RFP? Based on long experience with students, the author was admant that a "glass racer" was far beyond the capabilities of most students (not to mention the majority of their faculty advisers). After some head scratching and consultation with various people in the SSA and the AIAA it was decided that the ground rules for the Homebuilder's contest would be quite reasonable for the students as well. For one thing the Homebuilder's were being asked to design and build a sailplane not a hang glider, and it was to be simple. The rules were pretty open ended, thus encouraging the students (and homebuilders) to be innovative and creative. And finally, if the time scales could be meshed, the two contests would end simultaneously, allowing the students (who were not expected to produce hardware, but only a design study) the unique opportunity of seeing, but not being seriously influenced by, the actual machines their elders produced. The RFP thus prepared is reproduced here as Appendix B.

While this RFP was being drafted, the author also set about the task of rounding up a slate of judges to "grade" the students reports. Strong sentiment was expressed that A. J. Smith should not be so lightly let off the hook, since the whole things was his idea in the first place. A. J. readily agreed to be judge number one. A search for other qualified people led directly to stalwarts Stan Hall and Dick Schreder. To complete the set, and to provide some balance, David Lund, then Director of Student Programs at the AIAA and a fine young aeronautical engineering graduate of Texas A&M was chosen. The author remained chairman, judge and overall coordinator of the effort.

The RFP was sent out in August 1981 with an important addendum. The author's experience with undergraduate design courses had shown that, particularly when the technology is new to them, the students spend half of their design time trying to gather the basic information necessary merely to begin. Thus, as an innovative of sorts, the author put together a data book of technical papers and articles (see attached Bibliography List) which were reproduced by the AIAA and sent to each student group which returned a letter-of-intent to enter the SSA contest. Over 40 of these collections were sent out immediately fulfilling one of A. J.'s objectives for the contest, namely to bring modern soaring technology to the attention of engineering students.

All this done, the judges sat back and awaited the results, to be sent to each judge in June 1982. The AIAA had received over twenty letters of intent to enter by the February 1982 deadline and in June we did indeed receive reports. Large boxes full. All sizes and quality of reports from over 60 students at a dozen universities. Now began the fun of judging - which required the next two months to complete. For those interested the basis for judging the reports is also reproduced in Appendix B.

In the end, three winners were selected and two additional honorable mentions were given. At least two of the judges feel that while the amount of work that went into the reports was astounding and in many cases of high quality, none of the designs had reached a stage where construction of a prototype could be encouraged. They were, as they should have been, preliminary design studies. A sampling of what resulted is shown in Figures 3 and 4.

Was the exercise a success? I think a concensus of the judges' opinions was best expressed by A. J. him self:

"Participation in the Student Design Contest was most satisfying. Sixty-five students and thirty-one faculty advisors became involved with soaring through the contest. Their thousands of hours of thought, calculation, planning and testing, including tunnel testing, produced a foot high stack of reports. However, the involvement of these newcomers is more important than the mass or quality of this particular work. The newcomers sensed the challenge in soaring and tried the first step in the demanding task of producing the sailplanes we need. Likely, we'll see these important people often in the years to come. They'll have long productive careers in aviation professions and we expect they'll continue to participate with us in soaring. That's the promise for our future. Certainly, the SSA membership will see the value in planning for our future with such events. That's what we're organized to do."

CONCLUDING COMMENTS

Two design contests for a homebuildable, self-launching sailplane were conducted between September 1980 and September 1982. Both contests achieved their objectives, at least to a limited extent.

Based on the experience gained in these two (and other) design competitions, it appears that "success" depends on at least the following criteria being met:

- o There must be a clearly defined, specific, and realistic objective.
- o There must be a sufficiently large number of potential participants interested in the completion and its objective.
- o There must be a sufficient number of people with expertise and resources to participate.
- o The time scale should be long enough to allow the job to be done but short enough to maintain interest.
- o There should be some "prize" (money is only one possibility) to be won when the objective is met. The apparent mismatch in prizes offered the students (who were not expected to produce hardware) and the homebuilders does not particularly disturb the author.

On the whole the above criteria (with the major exceptions previously noted) were met in the two competitions described. In view of the lessons learned, future efforts of this sort should produce even better results - if these lessons are heeded.

As parting comments, a few last words need to be said about two aspects of the competition rules:

- o Originality. This criteria weighted heavily in the student contest and was implied in the Homebuilt contest. This requirement was badly understood by many participants and lead them to the superficial approach of selecting an "unusual" configuration. This is not originality unless the new configuration offers very distinct advantages over past "conventional" approaches. The real intent of this criterion was to encourage participants to think and approach the design problem with an open mind and imagination. A simple structure devised to build a perhaps very conventional aerodynamic configuration was the essence of the originality criterion in these contests.
- o Aesthetics and style. This criterion weighted little but was heavily critized during the contest. The author sees no conflict between good engineering and aesthetrics. This criterion was his and he makes no apology for it.

REFERENCES

1. McMasters, J. H., "Those Who Have Imagination Without Learning Have Wings But no Feet," Soaring, October 1980.

2. Hall, S., "A Design Critique - Woodstock I," Soaring, January 1980.

3. "Homebuilt Sailplane Design Competition Rules," Soaring, November 1980, p. 18.

4. "The Homebuilt Sailplane Design Contest," published by the Soaring Society of America, August 1982.

5. "Speaking of the Solitare," Soaring, December 1982, pp. 12-17.

6. "The Extremely Easy, A 'Preliminary' Design Study," Soaring, December 1980, p. 13.

7. "Windrose," Soaring, May 1983, pp. 16-17.

8. McMasters, J. H. and Sutton, R. C., "A Critique of Student Design Contests from the Judges' Point of View," AIAA Paper 81-1722, August 1981.

APPENDIX A

HOMEBUILT SAILPLANE DESIGN COMPETITION RULES

The Design Competition is aimed at providing a low cost, easy-to-build, safe sailplane which is easy to fly and fun to soar. A self-launching capability is considered to be highly desirable as a means of making soaring accessible and affordable to the majority of the participants. The purpose of the Design Contest is to promote and encourage individuals, groups of designers, kit builders, and would-be kit builders to focus on a design class sailplane.

Competition entries are expected to be flight-tested prototypes for evaluation by the panel of judges. Nominal cash prizes of a value to be named at a later date will be awarded to the winning entries. Judging will be accomplished by considering the following:

- o All designs should adhere to the applicable airworthiness standards for certification and should be stable and easily controlled throughout the flight envelope. Any design deemed unsafe for a low-time pilot will not be judged.

- o The prototype need not have the self-launching power unit installed, but the designer should indicate where the power unit would be located. The competition will, however, be heavily weighted toward entries which already have the self-launching capability integrated into the prototype.

- o Evidence of proof testing to structural limit loadings will be required, as well as results from thorough flight tests showing that no unsafe flight modes exist.

- o The judges will rate the design entries according to the following criteria:

Performance	20%
Quick to build	40%
Low Cost	20%
Suitability for construction in wood, metal, or plastic	10%
Aesthetics, style	10%

[Ed. Note: This requirement is no longer valid.]

In the summer of 1982 (at a date to be announced) an evaluation of the final entries is planned. It is expected this will include a fly-off of prototypes as well as documentation. Awards will be made at the 1982 SSA Homebuilt Workshop. All entries and correspondence should be sent to: SSA Homebuilt Sailplane Competition, SSA, P. O. Box 66071, Los Angles, California 90066.

The timeline for the contest is as follows:

September 1980:	Contest announced at Harris Hill.
January 1981:	Letters of intent to SSA from Design Contest entrants. How-goes-it appraisal at SSA Convention in Phoenix (Feb. 1981).
September 1981:	Preliminary engineering package due.
January 1982:	Letter of intent to participate in evaluation and fly-off. How-goes-it appraisal at SSA Convention in Houston (March 1981).
Summer 1982:	Fly-off and evaluation.
September 1982:	Winners announced at Homebuilders Workshop.

Summary of Basic Rules

Buildable
Low Cost
Safety
Soarable
Self-Launchable
Aesthetics, style
Conformance to airworthiness standards as an experimental homebuilt aircraft per Basic Glider Criteria Handbook or its updated equivalent (e.g., JAR 22).

APPENDIX B

1982 AIAA/SSA DESIGN COMPETITION

I. RULES

1. All groups of one to five undergraduate AIAA Branch or at-large Student Members are eligible, and encouraged to participate.

2. Five copies of the design will be submitted; each must bear the signatures, names, and student numbers of the project leader and the AIAA Student Members who are participating. Designs that are submitted must be the work of the students, but guidance may come from the Faculty Advisor and should be accurately referenced and acknowledged.

3. Design projects that are used as part of an organized classroom requirement are eligible and encouraged for competition.

4. The prizes shall be:

First place -- $1000; Second place -- $500; Third place -- $250;

with the awards going directly to the students submitting the winning designs. Certificates will be presented to the winning design teams for display at their university and a certificate will also be presented to each team member and the faculty project advisor.

5. More than one design may be submitted from student groups at any one school. Projects should be no more than 100 double spaced typewritten pages (including graphs, drawings, photographs, and appendix).

6. If a design group withdraws their project from the competition, the team chairman must notify the AIAA National Office immediately!

II. SCHEDULE AND ACTIVITY SEQUENCES

Significant activities, dates, and addresses for submission of proposal-related materials are as follows:

A. Request for Proposal (RFP) release date - 15 August 1981

B. Letter of Intent due date - 15 February 1982

C. Receipt of Proposals - 14 June 1982

D. Announcement of Award Winners - 6 September 1981

Groups intending to submit proposals must submit a Letter of Intent (Item B), with a maximum length of one page, to be received with the attached form on or before the date specified above, at the following address:

David Lund
Director of Student Programs
AIAA Headquarters
1290 Avenue of the Americas
New York, New York 10104

The finished proposal must be submitted to the same address, on or before the date specified for the Receipt of Proposal (Item C).

III. PROPOSAL REQUIREMENTS

The technical proposal is an important factor in the award of a contract. It should be specific and complete. While it is realized that all of the technical factors cannot be detailed in advance, the following should be included and keyed accordingly:

1. Demonstrate a thorough understanding of the Request for Proposal (RFP) requirements.

2. Describe the proposed technical approaches to comply with the requirements specified in the RFP. Legibility, clarity, and completeness of the technical approach are primary factors in evaluation of the proposals.

3. Particular emphasis should be directed at identification of critical, technical, problem areas. Descriptions, sketches, drawings, system analysis, method of attack, and discussions of new techniques should be presented in sufficient detail to permit engineering evaluation of the proposal. Exceptions to proposed technical requirements should be identified or explained.

4. Submit cost proposals, sufficient to extablish the reasonableness of the proposal.

5. Include tradeoff studies performed to arrive at the final design.

6. Provide an implementation plan (how the final product will be produced).

IV. BASIS FOR JUDGING

1. Technical Content (35 points)

This concerns the correctness of theory, validity of reasoning used, apparent understanding and grasp of the subject, etc. Are all major factors considered and a reasonably accurate evaluation of these factors presented?

2. Organization and Presentation (20 points)

The effectiveness of the report as an instrument of communication is a strong factor in judging. Organization of the written report, clarity, and inclusion of pertinent information are major factors.

3. Originality (20 points)

If possible, the design proposal should avoid standard textbook information, and should show independence of thinking or a fresh approach to the project. Does the method and treatment of the problem show imagination?

4. Practical Application and Feasibility (25 points)

The group should present conclusions or recommendations that are feasible and practical, and not merely lead the evaluators into further difficult or insolvable problems. Is the project realistic from a cost standpoint? Does the presentation include analysis of the function of the design in an overall system sense?

1982 AIAA/SSA DESIGN COMPETITION SELF-LAUNCHING SPORT SAILPLANE

I. OPPORTUNITY DESCRIPTION

General Aviation has developed in the past two decades into both a primary means of rapid transportation for business as well as personal use, and a major form of recreation. The term sport "aircraft" now encompasses the range of vehicles from personal jets to hang gliders and hot air balloons. Perhaps the most poorly understood (by the flying public) sport aircraft is the modern sailplane. This is regrettable since the modern high performance sailplane represents one of the highest pinacles in aerodynamic efficiency and beauty yet reached by any type of flying device -- either natural or man-made. In addition, current competition sailplanes are (and have been for a decade) the sole type of commercially available airplanes which rely almost entirely on advanced composite materials and structural technology in both primary and secondary load carrying members. The performance trends in sport and competition sailplane development and the niche these vehicles fill relative to other types of low-speed flying devices is shown in Figures 1 through 3. It should be noted that existing sailplanes can be differentiated from other "soarable" gliding devices such as hang gliders, by the range of performance (lift-to-drag ratio and sink rate) and weight and wing loading values representative of current types. In general, "motorless" flying machines which possess lift-to-drag ratios in excess of 15-20, sink rates less than 1.2 m/s (4 ft/sec) and wing loadings in excess of 15 kg/m^2 ($\approx$3 lb/ft^2) may be considered sailplanes as opposed to ultralight gliders, hang gliders, etc.

While the performance achieved by modern competition sailplanes is remarkable, there have been concomitant dramatic increases in cost of both equipment and operation. The high cost of both sport and competition soaring, as well as the operational liability of widespread dependence on aero-towing for launch has resulted in limited popularity of soaring in the United States. It has also been recognized that there have been dramatic increases in the popularity of aircraft homebuilding, and relatively inexpensive hang gliding. The current extension of this latter interest into the development of powered hang gliders and similar ultra-light powered aircraft indicates the desirability of combining the attributes of these alternatives with sailplane technology. In this way, it is possible to produce an inexpensive, homebuildable (from a kit or plans), self-launching sailplane, which on the one hand would provide soaring performance equal to or better than present sport sailplanes, but without several of the operational and cost penalties of existing equipment.

II. PROJECT OBJECTIVES

The objective is to devise a low-cost, easy to build (from plans and/or kit), safe sailplane which is easy to fly and fun to soar for the low-time pilot. A self-launching capability is considered highly desirable (although not manditory provided an alternative launch scheme of equal or greater simplicity/low-cost/safety is specified) as a means of making soaring accessible and affordable to the majority of participants. While "high performance" is not a fundamental objective of the aircraft proposed it is believed that soaring performance equal to or better than that of the bench-mark Schweizer 1-26 can be achieved within the present state-of-the-art and the constraints of the overall problem specification.

III. REQUIREMENTS AND CONSTRAINTS

Basic Requirements:

The basic requirements are to devise a sailplane which is (in order of importance):

1. Safe (structurally and inflight handling characteristics).

2. Easy and Quick to build.

3. Easy and Convenient to operate.

4. Low Cost (in Construction and Operation).

5. Soarable (Schweizer 1-26 or better capability).

6. Aesthetically appealing.

No restrictions are placed on aircraft size or weight, other than those intrinsically imposed by the above basic objectives.

The design shall conform to structural and other airworthiness standards as specified in either (at the choice of the design group):

1. Basic Glider Criteria Handbook, Flight Standards Service, Federal Aviation Administration, Washington, D.C. 1962.

2. Joint Airworthiness Requirements, JAR-22: Sailplanes and Powered Sailplanes, 1980.

IV. DATA REQUIREMENTS

Data submittal as part of the final proposal should reflect an amount of analysis/depth consistent with the preliminary design nature of the objectives and requirements. Based upon the objective and requirements, the final proposal should include:

a. An external three view drawing showing geometry and major dimentions.

b. An inboard profile drawing showing major system elements, structural integration and unique features for maintenance and access.

c. A structural drawing showing major structural load paths, materials selection and unique features.

d. Describe advanced structural concepts and materials and processes. If advanced composites are employed, identify the structural standards and data base which has been employed.

e. Provide group weight statement for the aircraft design and mass balance analysis.

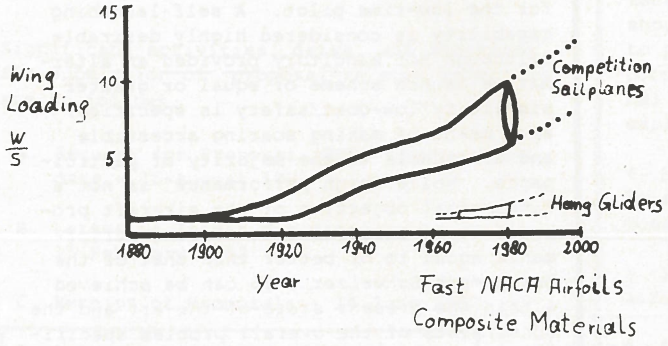
f. Describe launch system solution. Provide estimate of propulsion system development cost if applicable.

g. Describe performance capabilities.

h. Show design trade-offs leading to selection. Detailed working data should be shown in appendices.

i. Estimated cost and construction time, with supporting data upon which estimates are based.

j. As a complete section in the final report, your group will design in detail the engine mount structure; or launch release mechanism. Include drawings for shop production.



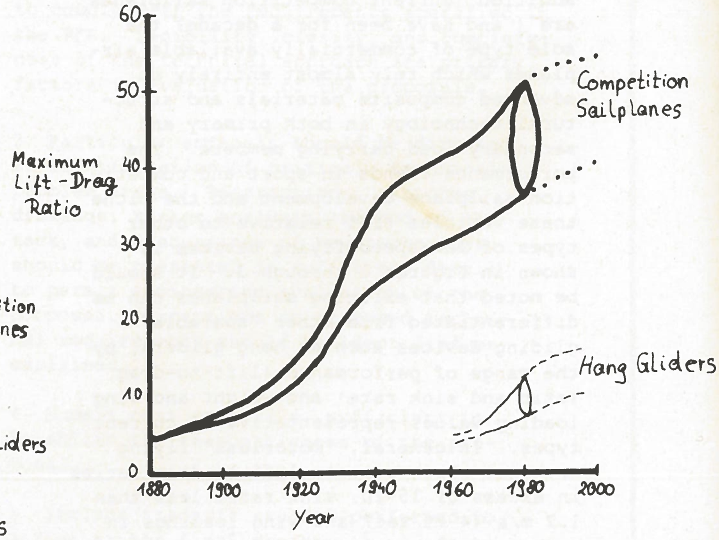


Figure 1. Historical Trends in Soaring

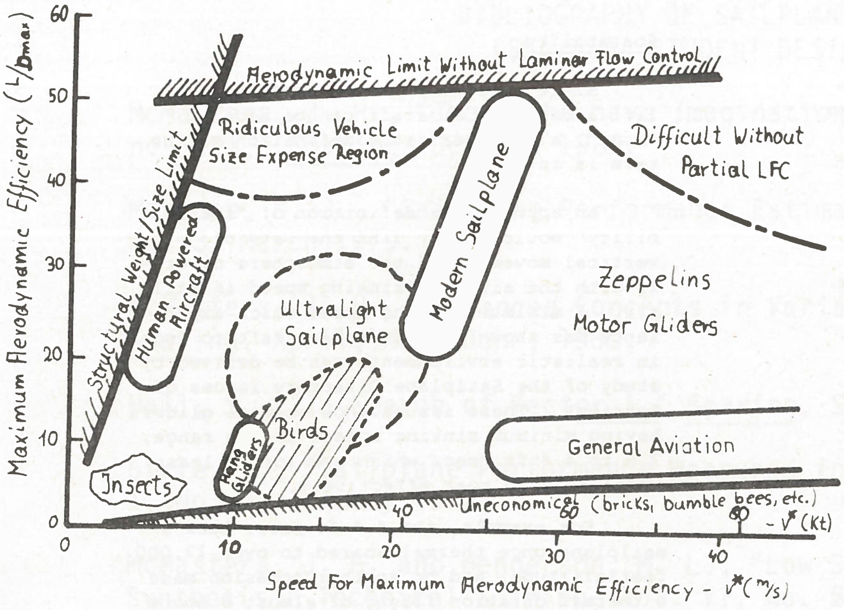


Figure 2. Approximate Boundaries of the Feasible/Economical Low-Speed Flight Spektrum

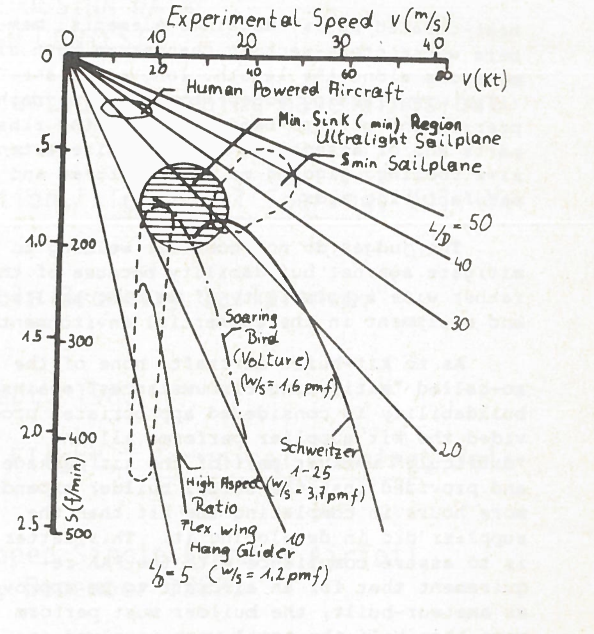


Figure 3. Sink Rate Preformance Comparison

ATTACHMENT 1 - Rule Interpretation

The following interpretations are offered as a guide to entrants in the AIAA/SSA homebuilt sailplane design competition.

The basic rules identify certain attributes considered desirable in a homebuilt sailplane. Entrants will be judged by how well and how completely their aircraft demonstrate these features.

1. "Buildability"
2. Low Cost
3. Safety
4. Soarability
5. Self-Launchable
6. Aesthetics, Style
7. Conformance with FAA/JAR airworthiness standards and criteria.

The purpose of these Interpretations is to discuss in further detail the attributes listed above.

Buildability

The term "buildability" is highly subjective in nature; what may be "buildable" to one person can be next to impossible to another. There is no readily apparent way to assign numerical values to how easily an aircraft can be built, or how difficult.

Definition of the term is also complicated by whether the aircraft is to be constructed from a kit (in the several degrees of completion which can be envisaged) or scratch-built from the plans.

In the latter case, however, several structural techniques and processes which mitigate against buildability can be perceived, e.g., the use of compound curves, heat-treated parts, machined elements, members whose cross-section changes in both dimensions along the length, long metal sheets (like wing leading edges) that require rather precise and uniform bending to fit the ribs, parts and/or assemblies which require extensive tooling, jigging or shop fixtures and manufacturing aids.

The judges do not consider welding to mitigate against buildability because of the rather wide availability of welding skills and equipment in the commercial environment.

As to kit-built aircraft, none of the so-called "mitigating circumstances" against buildability is considered appropriate, provided the kit supplier performs all the "difficult" work as part of the kit package and provided that the actual builder expends more hours in completing the kit than the supplier did in developing it. This latter is to assure compliance with the FAA requirement that for an aircraft to be approved as amateur-built, the builder must perform more than half the total work involved in construction.

Although as indicated earlier there is no readily apparent way to assign numbers to the buildability of a particular design it is possible to compare among designs on such a basis; a readily buildable aircraft would receive a higher score, say, than a less buildable one. This is the technique the judges will employ.

Low Cost

Any definition of the term, "cost", particularly in these economically inflationary times, is certain to be perishable. In addition, like "buildability, "the task of defining the term is complicated by whether the aircraft is kit or scratch built.

However, a certain amount of sense can be made of the effort by requiring the entrant to estimate the cost as best he can with as much documentary backup as he can provide.

Safety

The aircraft will be assumed to have met (or be capable of meeting) the requirements for safety if it has been designed to the requirements and/or criteria shown in the standard, referenced airworthiness requirements.

Since the requirements and/or criteria shown in the various documents vary somewhat, one to the other, those being most favorable to the entrant will be acceptable to the judges.

Soarability

Since under the proper conditions of lift almost any aircraft can be made to "soar", a more realistic definition of the term is in order.

An appropriate definition of "soarability" would likely link the rate of vertical movement of the atmosphere directly with the aircraft sinking speed in still air. A minimum sinking speed which experience has shown permits an aircraft to "soar" in realistic environments can be derived by study of the Sailplane Directory issues of Soaring*. These issues show several gliders having minimum sinking speeds in the range, 3.8 to 4.4 ft./sec/ which are (or at least were) able to soar effectively.

For example, the 4.4 ft./sec. Bock I sailplane once thermal-soared to over 17,000 feet altitude, and on another occasion made a thermal duration flight of almost 8 hours (Soaring, August, 1974; page 39).

Another example, the 4.0 ft./sec. Kennedy K-W (Soaring, August, 1974, page 44) had logged 390 hours of soaring at the time of publication of the journal.

Since no "soarable" aircraft having minimum sinking speeds greater than 4.4 ft./sec. have been reported in Soaring, for the purpose of the design competition this value is taken as the upper limit for aircraft which may be defined as "soarable."

Obviously, the lower the minimum sinking speed of the aircraft the more soarable it should be, thus to the advantage of scoring by the judges.

Aesthetics, Style

Interpretation of "aesthetics" and "style" is obviously highly judgmental in nature; beauty is still in the eye of the beholder. Nevertheless, the judges will do their utmost to come to a concensus of what constitutes a pleasing appearance.

Conformity with Established Airworthiness Standards

Flight safety is of overriding importance in the Competition. To insure that the designer has done all the technology presently permits to assure safety the judges will require that design be based on published requirements, standards and/or criteria developed over the years by private and governmental sailplane airworthiness experts.

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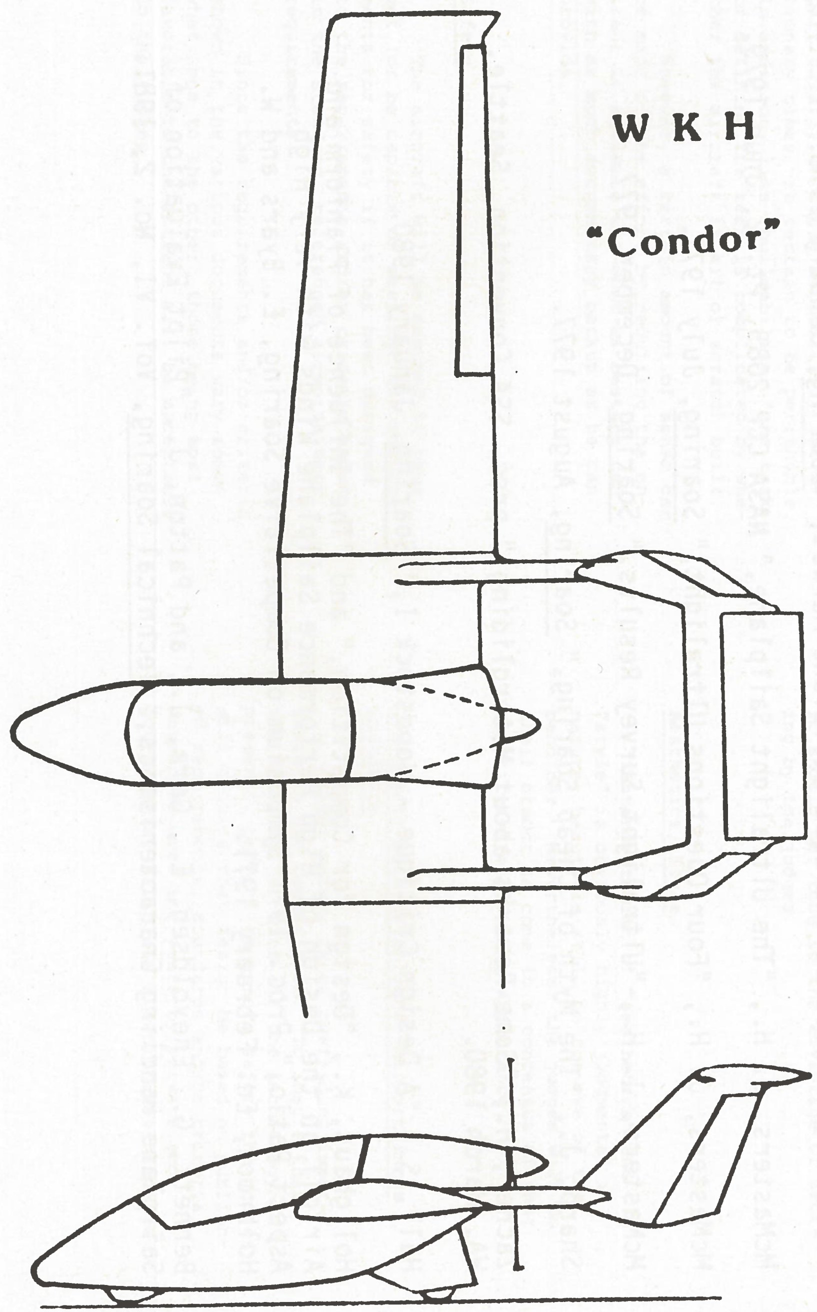


Figure 1. Holman "Condor"

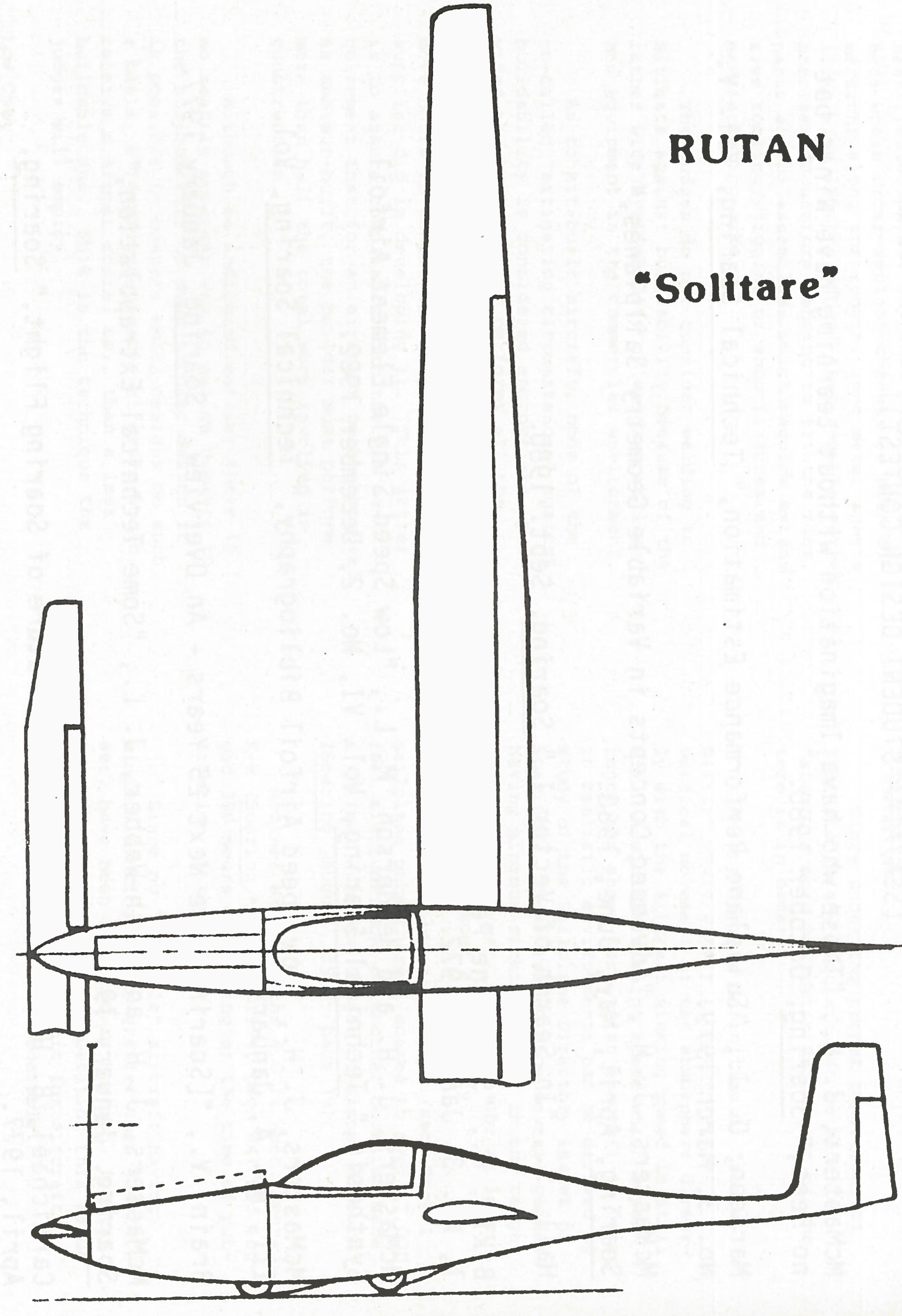


Figure 2. Winner of Homebuilt Sailplane Contest 1982

First Place Winner   Virginia Polytechnic Institute "Callisto"

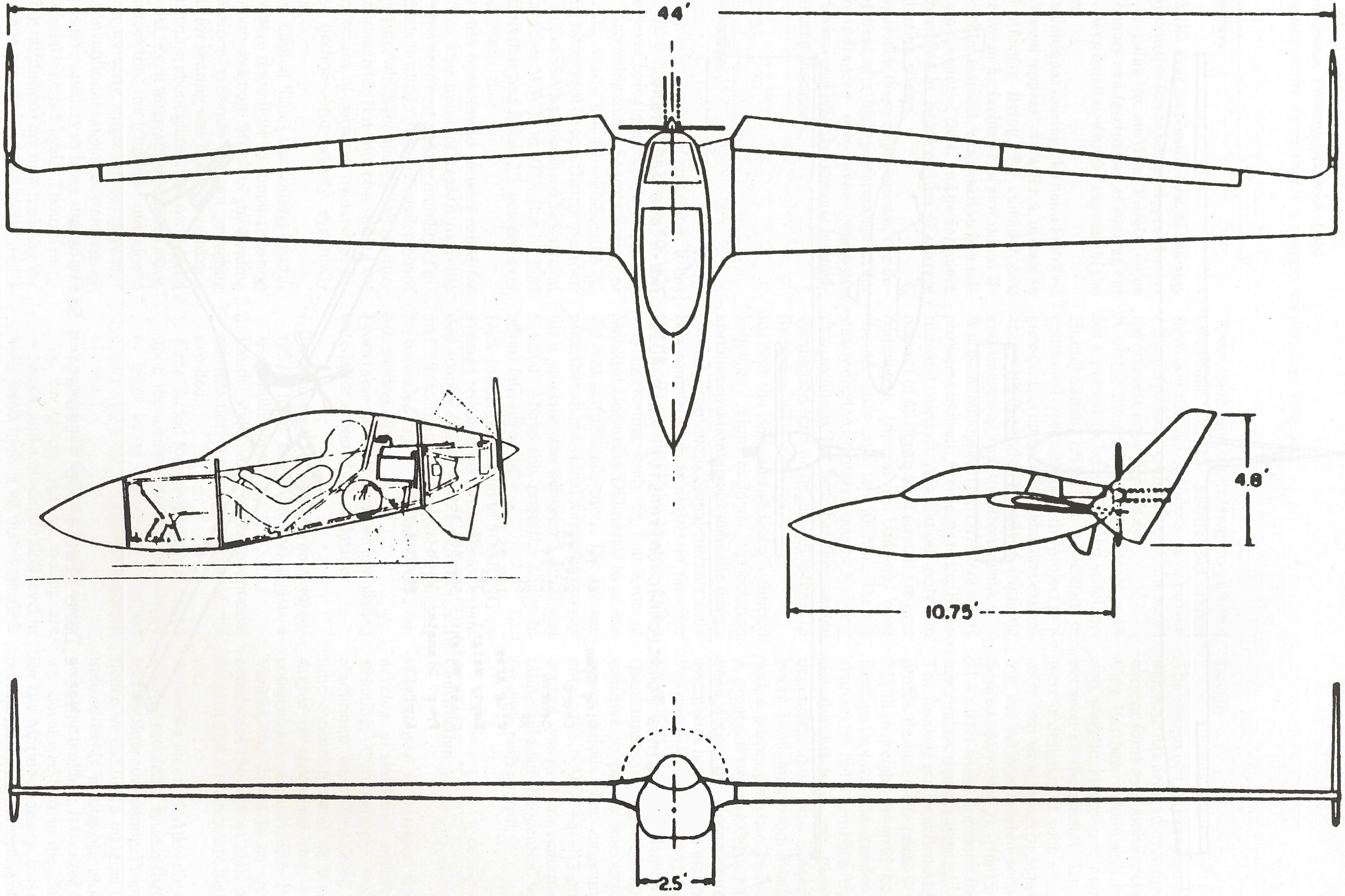
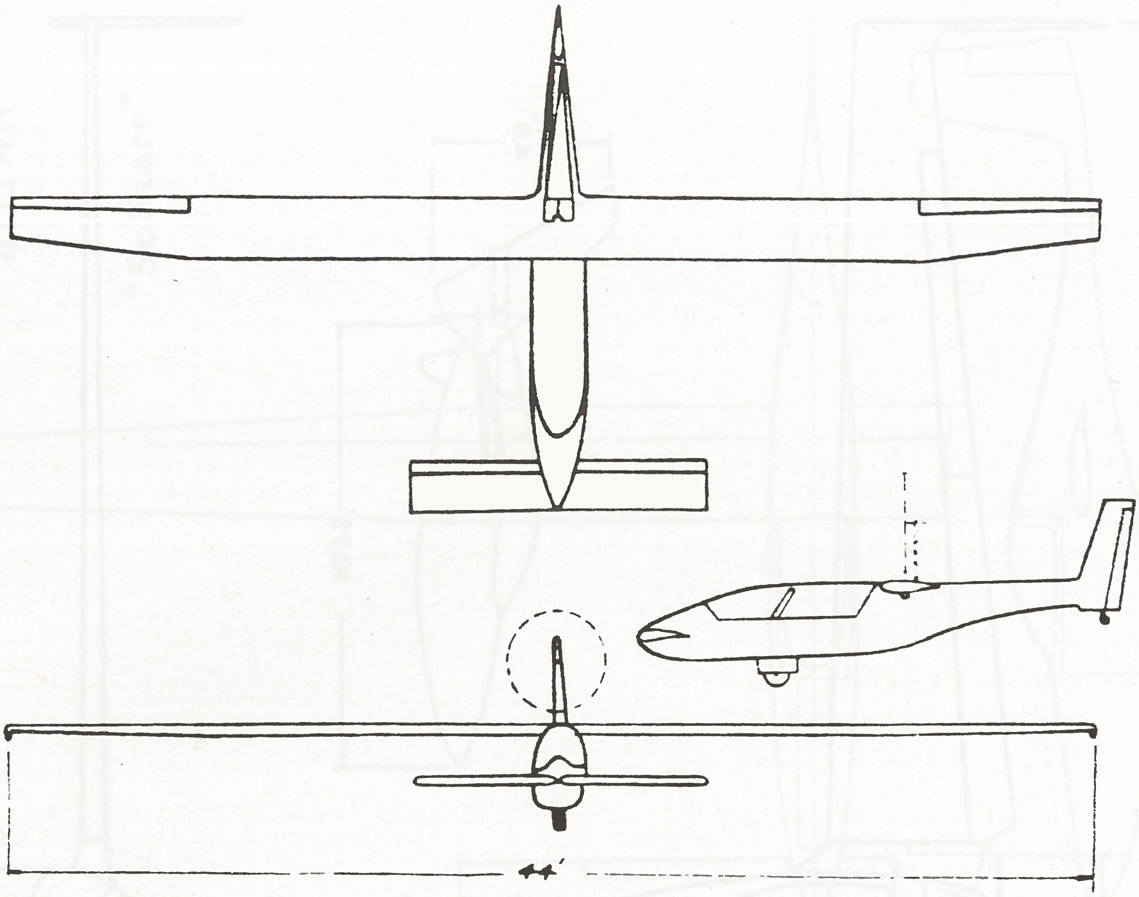
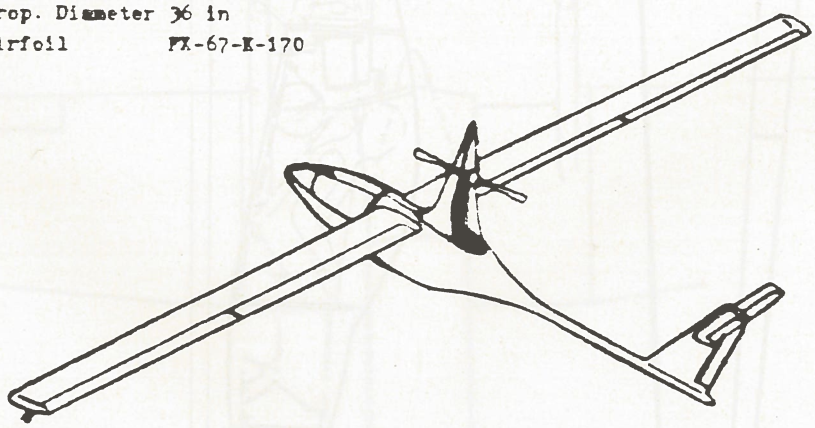


Figure 3: First Place Winner of the SSA/AIAA Student Sialplane Design Competition



Virginia Polytechnic University "Jake 4011" Two-Place Sailplane

Wing Span	49 ft
Chord	2.45 ft
Length	21 ft
AR	20
Wing Area	120.05 ft^2
Empty Weight	380 lbs
Gross Weight	560-605 lbs
Prop. Diameter	36 in
Airfoil	FX-67-K-170



Notre Dame "Eagle" Self-Launching Sailplane

Figure 4. Typical Entries In the SSA/AIAA Student Sailplane Design Contest.