

This is the keynote lecture which was presented as an historical document at the opening ceremony of the XXVII OSTIV Congress at Leszno, Poland, 2003. Dr. Sandauer is a long time OSTIV member who has contributed many times to the Sailplane Development Panel and Congresses.

The History of Polish Sailplane Technology

Justyn Sandauer D.Sc.Eng.

Mr. Chairman,

Ladies and Gentlemen,

It is a great honour and a real pleasure for me to make a speech during the opening ceremony of 27th OSTIV Congress. Following the title of my lecture, I will try to present you a compact survey of the milestones in the history of the Polish glider design technology. In my opinion, in contrast to the achievements of Polish glider pilots that are widely known to the international soaring community, the efforts of Polish engineers, who have built a sound technical foundation for our gliding, are much less recognised. I would also like to mention that both the lecture subject as well as its rather retrospective nature has been affected by the following two facts:

- firstly, for the third time we have the opportunity to host the OSTIV Congress in Poland;
- secondly, the congress is held in the year of the 100th anniversary of world aviation.

However, having in mind the first flight made by the Wright brothers a hundred years ago, it is worthwhile to note that the gliding history dates back by 12 years since Otto Lilienthal made his first flight in 1891.

In order to keep within the time limits I would like to give you only a brief outline of the beginnings of Polish science and technology in the field of gliding. It should be noted, however, that in the period between World Wars I and II, an exceptionally rapid progress was observed both in gliding sports and its technical background.

In the year 1939 there were 100 glider airfields in Poland; we had 1200 gliders and 14 000 glider pilots, 225 of them bore the FAI Silver Gliding Badge.

During those 20 years a few teams of glider designers created about 40 prototypes of gliders, a dozen or so of which entered a series production. Especially, the work done at the Institute of Gliding and Motor Gliding Technology founded in Lvov in 1933 should be appreciated here. The Institute's staff conducted research in the fields of aerodynamics, flight mechanics and meteorology as well as designed the prototypes of new gliders and motor gliders.

Those years "Orlik" (Fig. 1) was the best-known Polish glider all over the world. It took the second place (after Olympia-Meise) in the competition for the Olympic Glider in 1938. In 1939 the glider was sent to the USA and after the war it was owned by a well-known glider pilot – Paul Mac Cready who mounted on that very glider the best flight speed indicator he had invented, known as the Mac Cready ring.

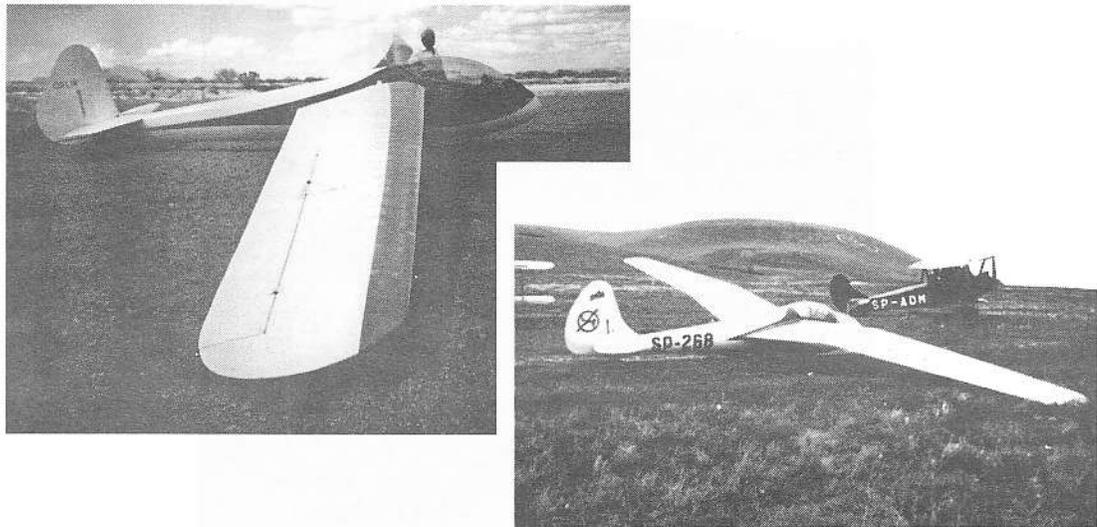


Figure 1. Olympic sailplane „Orlik”

Summing up the early stage of Polish gliding development one should say that in the world ranking, both in sports and technical aspects, Poland held the second position after Germany.

Unfortunately, the Second World War brought about massive material devastation and dramatic losses in intellectual potential of the nation; a high number of engineers were killed. Practically almost all the achievements of Polish gliding technology acknowledged before the war were erased. Under those circumstances one should consider the year 1945 as the year of Polish gliding rebirth. The fans of gliding who survived could eventually engage their enormous potential of energy and devotion into the rebuilding process. The extensive process of searching and securing of the aircraft equipment had started all over the country; also the service workshops were launched and gliding schools and aero clubs were brought back to life.

In 1946 the Institute of Gliding (Polish acronym is IS) was founded in Bielsko renamed then as the Sailplane Experimental Enterprise (Fig. 2) (the well known Polish acronym is "SZD"). Its main aim was to continue the work done at the Institute of Gliding and Motor Gliding Technology before the war. At the initial stage of its activity the Institute's staff consisted of those designers who worked for the Institute of Gliding and Motor Gliding Technology before the war and managed to survive. After a few years the Department of Aviation of Cracow University of Technology, at which a majority of lecturers were the designers from Bielsko, became a main source of the educated staff.

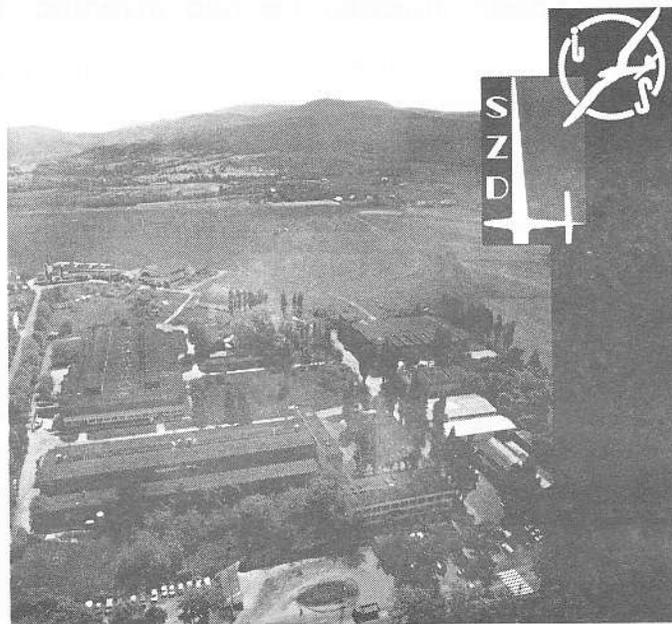


Figure 2. Top view of the Sailplane Experimental Enterprise and aero club on the airfield Bielsko - Aleksandrowice

In the years 1947-1949 at the IS and SZD the glider prototypes were constructed that were fully comparable with most outstanding ones produced all over the world. After starting their series production the gliding schools and aero clubs were supplied with a modern equipment that satisfied the needs of the whole training cycle, including the demands of gliding acrobatics. Those were the gliders:

- basic training IS - 3 ABC (Fig. 3)
- high performance IS-2 Mucha
- high performance IS-1 Sęp (Fig. 4)
- aerobatic IS-4 Jastrząb (Fig. 5),

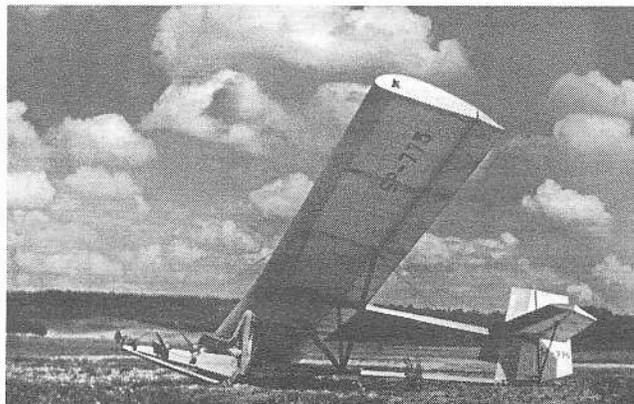


Figure 3. Training sailplane IS-3 „ABC”

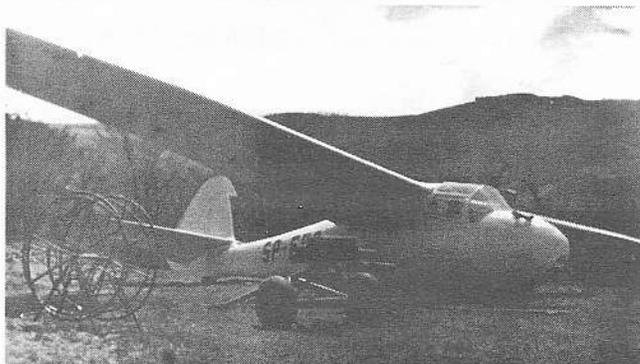


Figure 4. High performance sailplane IS-1 „Sęp”

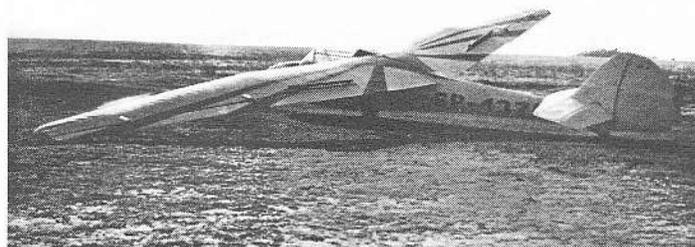


Figure 5. Acrobatic sailplane IS-4 „Jastrząb”

Then (in the years 1949-1951) the following three experimental prototypes were designed and constructed in the SZD:

- IS-5 Kaczka – canard glider with the horizontal control plane situated at its front (Fig. 6)
- SZD -6X Nietoperz - a flying wing (Fig. 7)
- SZD – 7 Osa – with a laminar airfoil wing.

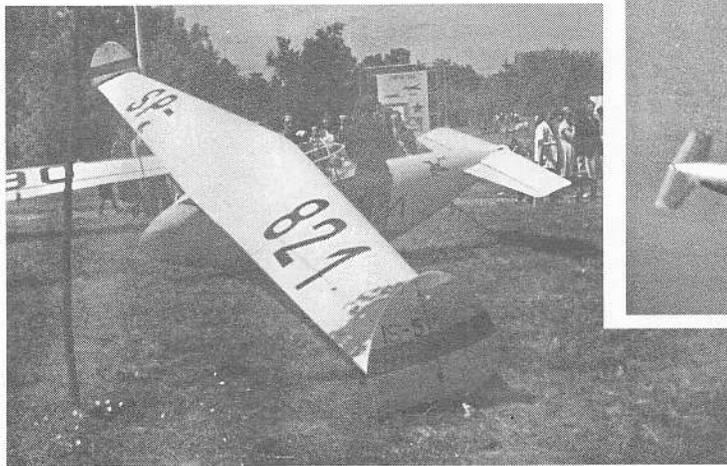


Figure 6. Canard sailplane IS-5 „Kaczka”

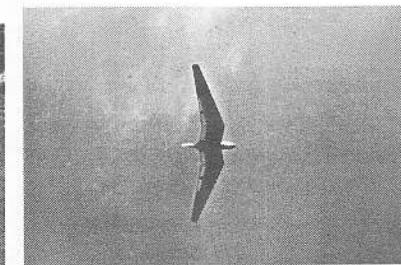


Figure 7. Flying wing sailplane SZD-6X „Nietoperz”

The results obtained in flight tests of all the aforementioned gliders proved that we had a highly qualified design staff, attracting at the same time much attention of the international soaring community.

The following prototypes were born in the years 1951-1953:

- high performance SZD-8 Jaskółka (Fig. 8)
- training two-seater SZD-10 Czapla
- high performance two-seater SZD-9 Bocian (Fig. 9)
- high performance SZD-12 Mucha 100 (Fig. 10).

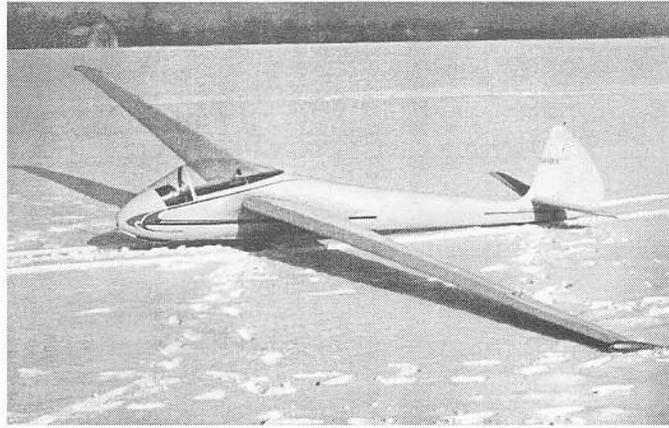


Figure 8. High performance sailplane SZD-8 „Jaskółka”

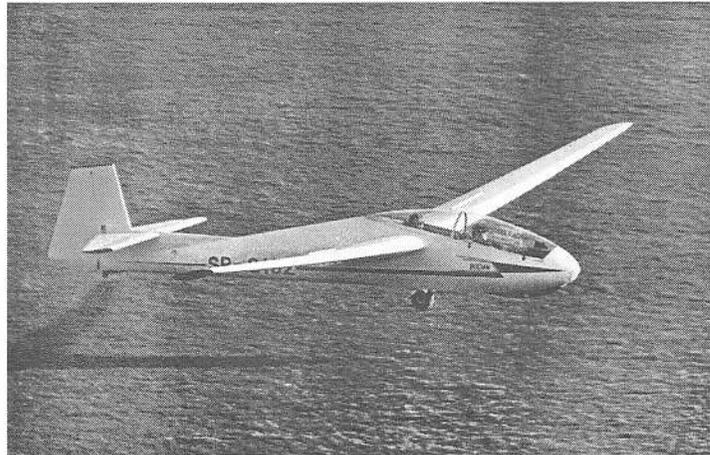


Figure 9. High performance 2-seater glider SZD-9 „Bocian”



Figure 10. High performance sailplane SZD-22 „Mucha 100”

All these gliders entered a series production, were sold to Polish aero clubs and exported. 573 pieces of the aforementioned types of training, and high performance gliders were exported in the years 1958-1978 together with 90 complete assembly sets exported to the People's Republic of China.

sheet. The prototype of Jantar had launched the whole family of composite gliders; i.e., SZD-38 Jantar 1, SZD-42 Jantar 2 (Fig.14), SZD-41 Jantar Standard, SZD-48-1 Jantar Standard 2 (Fig. 15), SZD-48-2 Jantar Standard 3, and SZD-52 Jantar 15.



Figure 14. High performance sailplane SZD-42 „Jantar 2B”

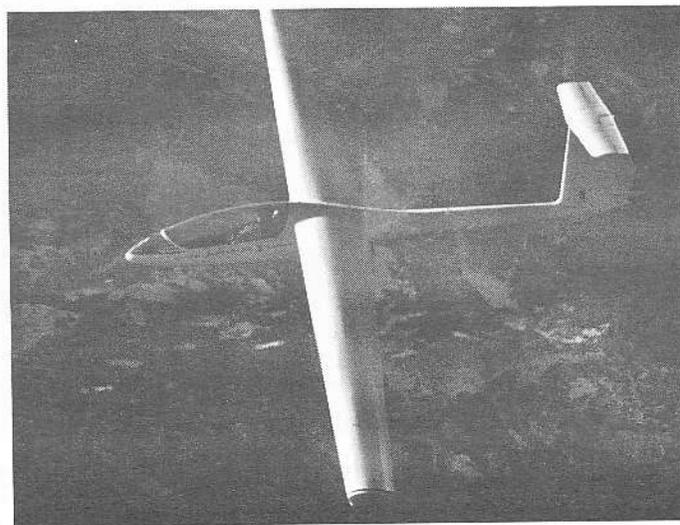


Figure 15. High performance sailplane SZD-48 „Jantar Standard”

They had different wingspans, and mechanisms changing aerodynamic characteristics of the wing; different technologies were employed for constructing fuselages [and] they had also many other different structural elements. In the years 1972-1986 the total number of 1041 gliders of the Jantar family was manufactured, of which 846 pieces were exported. The knowledge gathered in the field of composite design and technology resulted in a number of glider designs produced those days; namely, two-seater training SZD-50 Puchacz training (Fig. 16), SZD-51 Junior, high-performance SZD-55 (Fig. 17) and SZD-56 Diana (Fig. 18) as well as acrobatic SZD-59 Acro. It should be noted that in the design of SZD-56 Diana the epoxy-aramid-carbon laminate of highest quality was

applied. The gliders SZD-50 Puchacz, SZD-51 Junior and the nameless SZD-55 enjoyed a spectacular commercial success; in the 1990s, the total number of 684 was manufactured, 497 of which were exported.



Figure 16. Training 2-seater SZD-50 „Puchacz”

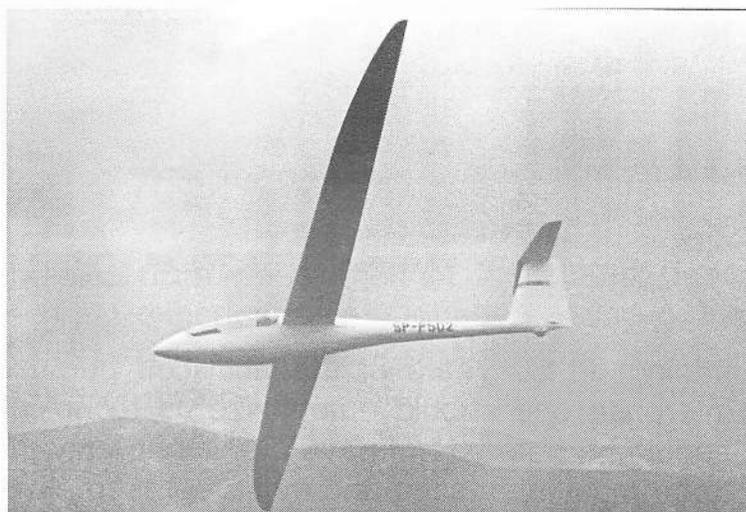


Figure 17. High performance sailplane SZD-55

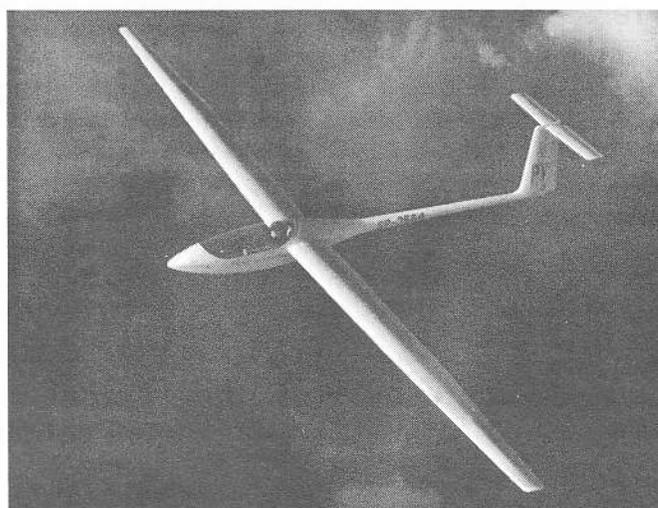


Figure 18. High performance glider sailplane SZD-56 „Diana”

A survey of the scientific, engineering and manufacturing achievements of the Sailplane Experimental Enterprise would not be complete without any remarks on motor gliders. The field of motor gliding has attracted a growing interest over the last 30 years, creating a growing market as well. A prototype of the two-seater motor glider SZD-45 Ogar (Fig. 19) with a pusher propeller was constructed in Bielsko in 1973. The motor glider was allowed to execute basic aerobatic figures, 64 pieces were produced, and 41 of them were exported in the years 1976-1994.



Figure 19. Motor-glider SZD-45 „Ogar”

When summing up 50 years of the activities pursued by the Sailplane Experimental Enterprise one should emphasize its technical integrity and self-sufficiency. It should be noted that I have mentioned only those types of gliders that I consider to be most interesting and most representative of the consecutive phases of glider design and technology development. It is worthwhile to note, however, that the process of designing those prototypes and starting their series production was a result of long studies and aerodynamic investigations, strength tests (both static and dynamic) and finally the flight tests. To achieve that, a highly qualified staff of engineers and pilots and specialised research and measuring equipment were necessary. In the cases of shortages in the experimental base, the help of Warsaw University of Technology and Aviation Institute in Warsaw was efficiently used.

Also the co-operation established within the scope of OSTIV activity has been fruitful. It is my pleasure to present you as an example of such activity the co-operation maintained over several years between aerodynamic engineers from SZD and Prof. Loek Boermans with his team conducting investigations in the low turbulence wind tunnel in Delft.

Due to a limited scope of the survey, I have not presented you names of the persons whose abilities and efforts allowed for the SZD achievements. One name, however, should be mentioned here. Mr. Władysław Nowakowski had been the managing director of SZD since 1948 till 1977 when he retired. His work in Bielsko had started as the designer of IS-1 Sęp and SZD-6X Nietoperz. He was appointed as the managing director of the Institute of Gliding in 1948 and then he became the managing director of the Sailplane Experimental Enterprise, which he had founded and built. For 30 years he had constantly put into practice his idea of [a] modern centre of aviation technology development. Unfortunately, in the very difficult 1990s, when the process of economic system transformation and free market economy had posed completely different problems to research centres and factories, there was no man in Bielsko like Mr. Nowakowski. His successors could not respond adequately to huge challenges and failed in implementing a new concept of exploiting the technical and human potential in a more economic way. The SZD declared bankruptcy in 1999.

The fact that the SZD had disappeared from the map of Polish gliding centres did not cause the collapse of our gliding technology. Two new teams of glider designers started their work, [and] have developed and pursued intense activity. One of them is working in Bielsko and the other in Warsaw.

The Aeronautical Enterprise owned by Edward Margański, an aircraft designer, with a great experience was founded at the gliding airfield Żar near Bielsko in 1986. However, the enterprise started its activity with repairing and maintaining services of gliders and motor gliders, [but] the owner realised soon that there arose on the world market a strong need for a modern acrobatic glider. In a few years time he designed and manufactured 30 aerobatic gliders Swift (Fig. 20) and then also 30 acrobatic two-seaters Fox (Fig. 21).



Figure 20. Aerobatic glider "Swift"

The single-seater Swift may serve as an example of a successful attempt at constructing a modern high-performance acrobatic glider benefiting from flight characteristics of the glider SZD-21 Kobuz designed in Bielsko many years ago. Its wing and tail plane are the same but made of composite structures, while the fuselage and vertical tail unit are completely new designs. In the 1990s Swift became practically a monotype glider on international, continental and world championships of gliding aerobatics. Polish pilot Jerzy Makula won the World Championship in 1991 on this glider.

The two-seater Fox with its elongated wingspan exploits all the advantages revealed by the Swift (aerodynamics, design and technology); on the other hand, through the allowance of full aerobatics with a two-person-crew, the range of its applicability expands greatly. A very important advantage revealed by the Fox consists in the fact that when piloted by one person only it can compete successfully with the Swift. That was proved by Jerzy Makula, who won the World Championship on this aerobatic glider three times.

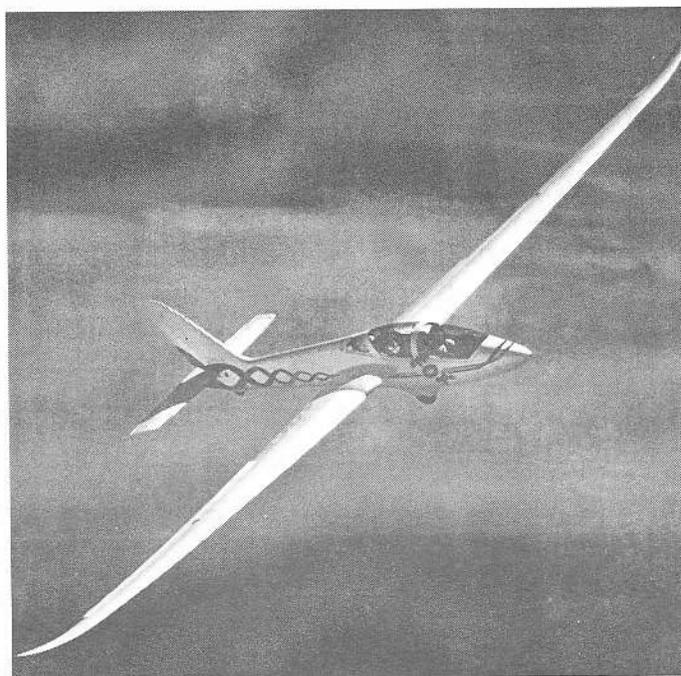


Figure 21. Aerobatic 2-seater "Fox"

The second team continuing our tradition of glider design has been working for Warsaw University of Technology [WUT] and is headed by Mr. Roman Świtkiewicz, PhD. The Team of Composite Structures in Aviation was established to realise the ULS (Ultra Light Sailplane) Project consisting in education of young aircraft engineers. A new concept of student education has been developed via engaging them in the whole process of creation of a new glider; i.e., from the preliminary design, through technical and technological documentation, designing, construction of the technological equipment,

manufacturing of prototypes and ending with their ground and flight tests, certification and finally starting its series production. Over the last 20 years the team has designed six types of gliders and one motor glider. It is obvious that this program is similar to those realised by German Akafliiegruppen.

A crucial breakthrough the WUT team made was the design of PW-5 Smyk (Fig. 22) that won the international FAI competition for the World Class Glider in 1993. The FAI had announced in 1989 the international competition, the final stage of which took place at the German gliding centre Oerlinghausen. There were six designs taking part in the competition and the International Jury chose the aforementioned Polish design PW-5 Smyk. According to the decision of FAI the glider was appointed as a monotype called the World Class Glider for the period of 15 years. The PW-5 entered a series production in the PZL-Świdnik factory, where, parallel to the main production stream, i.e. helicopters, the gliders SZD-30 Pirat had already been manufactured. The factory had also contributed to the Smyk prototype manufacturing. About 250 pieces have already been manufactured and the number is still growing.

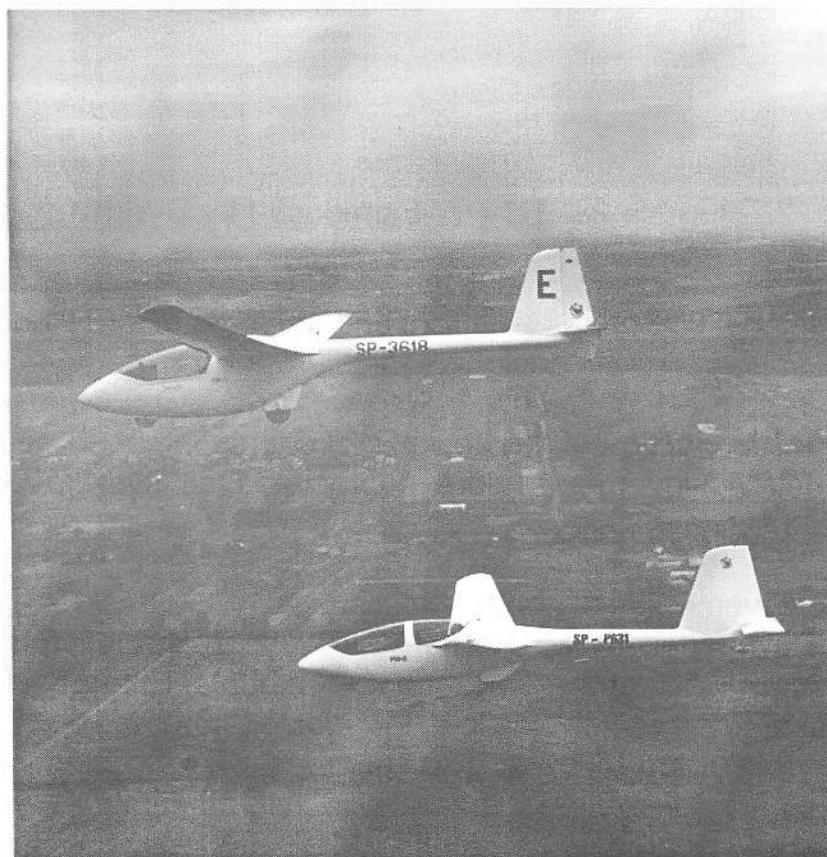


Figure 22. PW-5 & PW-6, a couple of gliders designed by WUT

In 1996 the WUT team constructed the prototype of PW-6 (Fig. 22). It is a two-seater glider with the tandem pilots' seats, that takes advantage of the knowledge in the field of aerodynamics and design gathered when constructing

and performing the flight tests of PW-5 Smyk. The glider also entered a series production in PZL Świdnik factory and it seems that there is a demand for that glider on the world market.

In 2001 an advanced design of PW-5 called PW-5 B1 (Fig. 23) entered a series production in a small enterprise founded in 1989 - DWLKK. It employs mainly the engineers who were engaged in the ULS Project when studying at WUT. In the years 1991-1994 the DWLKK produced 16 pieces of PW2d Gapa D - one of the designs resulting from the ULS Project. Basing on the experience gathered, up till now 12 pieces of PW-5 B1 training glider have been produced.



Figure 23. B1-PW-5 produced by DWLKK

It should be emphasized that the WUT team (one can hardly call them a typical team since it comprises lecturers and students of WUT and aims mainly at education of young aircraft designers and production engineers) not only has managed to reach a high technological world level but was also capable of starting a series production of the designs, of course in cooperation with industrial partners. Their achievements were appreciated all over the world. It is an unquestionable success.

The achievements of both Mr Edward Margański's factory and the University team headed by Mr Roman Świtkiewicz, though remarkable, cannot compensate for the lack of the Sailplane Experimental Enterprise. In my opinion, however, those achievements allow for looking ahead in an optimistic way, especially in view of the fact that good prospects for the development of gliding sports in our country and all over the world in the XXI century are unquestionable.

Acknowledgements

I would like to thank Mr. Miroslaw Rodzewicz, Ph.D. for a very efficient collaboration in preparing this lecture.

Photos: album of sailplanes from the book of Adam Skarbinski "Dzieje lotnictwa..." Bielsko - 2002, and private collection of Ryszard Witkowski.