OSTIV Congress, Monday, 11 August 2008

The first paper of the day was written by Professor Jozsef Gedeon, "A New Approach to Fatigue Damage Calculation," and because Professor Gedeon was unable to attend the congress, was presented by Christoph Kensche. Although fatigue is critically important in the design of gliders, much work needs to be done before it is fully understood and integrated into the design process. At the present time, fatigue life is typically predicted on the basis of the Palmgren-Miner Rule, in which the failure of the structure is determined from a relationship between the stress level and the number of loading cycles. This relationship is determined experimentally for a specimen by periodically loading it at a single stress level. Unfortunately, there is a fair amount of uncertainty in this one-stress level fatigue test. In the paper, it is proposed to reduce this uncertainty by using a two-stress level test to obtain the fatigue failure data.

The second paper of the day, "Lifetime assessment of GFRP gliders," was given by Fabian Grasse. It was noted that as many GFRP gliders and aircraft have reached, or are close to reaching, their 12,000 hour service life. Because of this, it is hoped that a better understanding of fatigue limits can help to extend the lifetimes of these aircraft. Thus, a large-scale component, life-cycle fatigue testing program was initiated. An internal inspection of the test structure was performed using x-ray refraction after every 6000 equivalent hors of flight time. In particular, the effort concentrated on exploring the idea that micro-cracks that can be observed by this technique, can give useful information about the load history of the structure. It was found that the micro-crack fracture process does agree well with the global fracture mechanics. In addition, a simple grey-scale (the ratio of the background brightness to the sample) technique offers a much simpler and less costly process than x-ray refraction, but can give results that are comparable. The grey-scale technique gives a good correlation with the damage of wing structures due to fatigue loading. Finally, fibre-breaking grid (FBG) sensors were found to show promise for the health monitoring of composite structures. It was concludes that visual inspection of composite structures is not suitable for damage determination, but that the techniques described could provide non-visual inspection techniques for CFRP aircraft that would probably allow the extension of their service lifetimes.

After the break, "Requirements for Pilot Reserve Systems for Gliders and Motorgliders," was given by Frank Thurecht. In this presentation, the development of a rocket-powered, pilot-extraction system, SOLTEIRA, was described. In this system, a single control actuation initiates the entire sequence of canopy release, pilot extraction, and finally decent under a conventional parachute. The design constraints to extract the pilot safely and within human limits were detailed, and the design of the system detailed. The system has been subjected to extensive experimental testing, and work continues to develop this system into one that is practical and certified.

Before lunch, Christoph Hass, of Akaflieg Berlin, gave a presentation on the Idaflieg, the association of the active Akafliegs that are located at ten different German academic institutions. The Akafliegs are involved in the design and construction of sailplanes, each typically directed at exploring one ore more innovative research concepts. The Akafliegs play a critical role in the training and experience of future aerospace engineers in Germany. Among the annual events hosted by the Idaflieg is the winter meeting, during which presentations on ongoing projects are given, and the summer meeting of flight testing, which is supported by DLR. At the summer meeting, the speed polars of new gliders are measured, the handling qualities of gliders are evaluated, and finally, individual research projects are flight tested. After the overview of the Idaflieg, the various current projects of the Akafliegs were described.

After lunch, the paper of Dr. Günter Ambros, "The winch launch – the underestimated risk," was presented by Professor Ernst Schoeberl. The free-body equations describing the winch launch of a sailplane were presented, and the critical forces and the load factors considered. A number of potentially dangerous situations were described for every phase of the launch. At the point, the procedures for a safe launch were presented. Briefly, it was specified that during the initial stage of the launch, that the stick be held forward in anticipation of the nose-up moment caused by the cable. During the transition from take-off to climb, a gradual transition should be flown, and the airspeed held at approximately 1.6 Vmin. The climb phase should not be too steep, with an angle to the horizontal of about 45 degrees. Finally, after the midpoint of the climb, the stick should be slowly eased forward such that the release is made in level flight. It was further noted that in crosswinds, it is safer to compensate for wind drift using the ailerons, as using the rudder can cause the inner wing to stall.

After this, another paper on winch launching, "Evaluation of cable force during winch launch," was presented by Prof. Dr. Richard Eppler. In the presentation, the procedure to achieve safety, as well as the highest possible altitude, was described. The launch is dependent on only two controllers; the pilot sets the elevator angle of the glider, and the winch driver the speed of the winch (cable/rope force). The relationship between the climb angle and the necessary cable force/cable angle were carefully described. Because of lift must always be greater than the weight, the stall speed during the launch will be always greater than the stall speed in free flight. Except for the initial start, in which too much cable force can lend to a pitch up and early stall, the optimum climb is that which uses the maximum cable force allowable by the weak link, although this information is typically unavailable to the winch operator. Because for both the start and the climb it would be useful for the winch driver to know the cable, a cable force measurement device is under development. The measurement device itself, which is already commercially available, is located in the cable and the tension information presented to the winch driver. There seems little doubt that providing the cable force to the winch driver will improve the safety of launching, as well as allowing the responsibilities of the pilot and the winch driver to be clearly differentiated.

The next paper, “Preliminary study of a crash stage for occupant's protection in an emergency landing,” was given by P. Astori. This paper describes a research program in which finite element analyses were performed on a baseline glider fuselage and one designed to have a crashworthy cockpit area. Five crash scenarios were considered in this study and simulations were performed for both a rigid glider, as well as one that is able to absorb impact loads by being deformable. In all cases considered, the crashworthy glider was predicted to give a notable reduction in the impact deceleration experienced by the cockpit. The paper concluded with a number of manufacturing recommendations that should result in safer cockpits.

Adrian’s paper is entitled:

“An informal Survey of Flying Comfort of Glider Pilots”

This paper detailed an extensive survey of pilot comfort/discomfort made of large number of single seat pilots at Lasham where about 10% of UK pilots fly regularly
Pilots were asked to respond to a number of questions about their perceived comfort while flying on a scale where zero represented very good and ten represented so uncomfortable the pilot would not be able to continue flying. These numbers were then presented as bar charts but halved to read zero to five.

Almost all pilots were dissatisfied with the comfort of their glider’s cockpit comfort–ability with responses ranging from 0.62 to 3.8 out of 5 where zero means perfectly comfortable.
Sources of discomfort all related to the small size of modern glider cockpits with over half the respondants reporting that their cockpits were just too small for them to ever be completely comfortable. It was reported that whilst cockpits have become smaller, the size of pilots has been steadily growing, not only in girth and weight but in height also. Various authorities report that average height of the Caucasian populations increases by 10 mm every ten years.At the same time the size of cockpits has been getting smaller and smaller as designers squeeze out the last bit of performance whilst the pilots are squeezed in! A further cause of discomfort is caused by increasing numbers of instruments being fitted to instrument panels reducing the amount of leg room available.
Adrian showed a template of his foot compared with that of his wife’s which is only half as long. Modern gliders have easily adjustable rudder pedals longitudinally but no adjustment vertically and almost all consist of a round bar. It was shown that a simple flat piece of multi–ply with a support for the heel will markedly improve comfort by supporting the foot properly. If the foot is not supported properly the load is moved to the leg and if the leg is not supported the discomfort is moved to the knee or further up the thigh and even to the lumbar. No cockpit seats were reported as having adequate lumbar support.

Taller pilots have trouble with their feet whereas smaller pilots reported trouble from the knees up. This is caused by unsupported muscle tissue. Try holding an otherwise unsupported limb out horizontal for very long!
Lastly enough data was available to show that those pilots flying long hours at a time did more of it and had done much to improve comfort where possible than those flying much less in both duration of flight and number of flights seemed to be uncomfortable.

The conclusions were: Lack of Comfort strikes all pilots and results in lower flight ours with lower leg support a major contributor.

Colin Jackson and other's paper is entitled:

"A Simple Comparison of the Characteristics of Energy absorbing Foams for use in Safety Cushions in Glider Cockpit Environments.

Colin and others set out to compare some energy absorbing foams and devised a simple hammer blow apparatus.

Foams tested were Dynafoam (Sunmate) types x firm, tempur, xfirm soft and Comfor C47 and C 45
The apparatus consists of a concrete pad onto which is placed a hi speed Tekscan 9500 Pressure measuring pad then the foam to be tested and a thin layer of lycra. The hammer which swings down to hit the pad has a ball end like a ball pane hammer and a B &K 4384 accelerometer mounted on it.
Tests were made at 12 ˚C 16˚C and 26˚C and various hammer blow strengths.but stopped if it appeared the hammer was going to bottom out and damage the foam.

The tests showed that the confor 45/47 material was superior to thedynafoam/summate

The Tekscan is used in hospitals for finding where the pressure points are on patients having to be immobilized for lengthy periods and the associated software makes a pressure map in color The intense pressure points show up as bright yellow patches.