October 2011

WAYPOINTS

"Structural failures of aircraft components are always severe and often costly both in material and life. The most common component failure that we can encounter is a structural failure due to fatigue."

Read Jack Dueck's article about fatigue on page two.

Bring your summer airplane pictures and stories. This month's meeting will be a show and tell.

Electronic versions please.

WAYPOINTS

Newsletter of the EAA Chapter 1410
High River, Alberta, Canada

www.eaahighriver.org

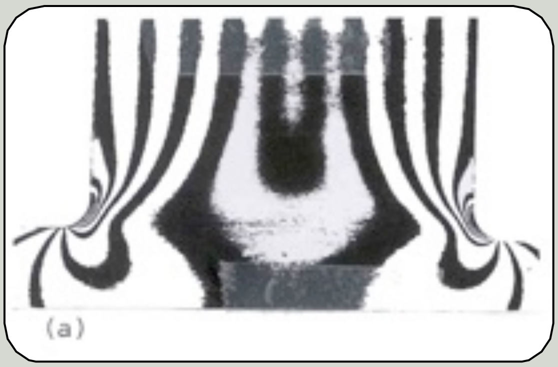
Who We Are

We are an enthusiastic group of like-minded individuals from various backgrounds who share a passion for recreational aviation in Southern Alberta and we offer the chance to meet others who combine fun with learning.

EAA's HOMEBUILT AIRCRAFT COUNCIL REPORT, September 2003

by Jack Dueck, TC, FA, HAC

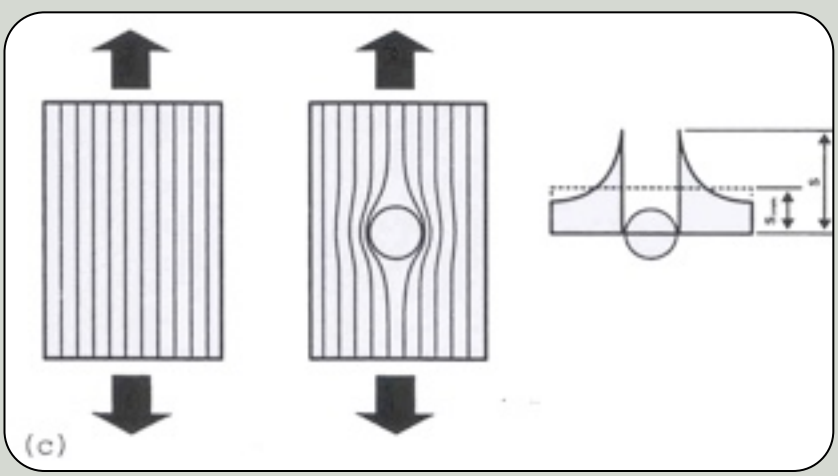
EAA's Homebuilt Council is tasked with encouraging and promoting the safety component in the **education** and **recreation** pursuits of our hobby. Can you think of any other avocation in life that includes as large and diverse a set of learning disciplines as does ours?



(a)

Structural failures of aircraft components are always severe and often costly both in material and life. The most common component failure that we can encounter is a structural failure due to fatigue. For a component to fail under fatigue, two determining elements must be present: The first is the range of the applied cyclic stresses, ie. the maximum minus the minimum stress value in any cycle. The second is the number of cycles the component exposed to in its life.

We can do little to reduce life cycles of a component. We can affect the 'stress range' component of this duo by addressing stress concentration reduction strategies to reduce the magnitude of the stress range.



(c)

A stress riser is any discontinuity or change of section, such as holes, notches, bends, grooves, or any defects such as scratches, weld arc strikes, etc. At any of these, there will be a concentration of stresses, or a localized stress that is greater than the average or the nominal stress imposed through component loading.

In Figure (a), we see a photoelastic model under tensile load. Notice the crowding together of the fringe lines at the radii fillets where a high stress concentration is obvious. The tighter the radius, the greater the stress concentration.

Figure (c) shows a graphical depiction of a tensile loaded specimen. On the left, the internal stress lines are shown as smooth parallel lines. This stress distribution is shown graphically on the right by the dotted horizontal line about halfway up the ordinate. Now when we drill a hole in the specimen as shown in the right hand model, the stress lines obviously cannot carry through the hole, so they must crowd up on each side of the hole. Graphically, the stress distribution is shown by the increasing upward sloping line to a peak left of the hole, followed by the downward sloping line away from the peak on the right hand side of the hole. Notice that the peak stress values are substantially higher than the sample without the hole. Notice also that the stress concentration distribution range starts below the nominal (without the hole) and reaches a value three times its initial value.

Most homebuilt aircraft kit's building instructions place a heavy emphasis on the importance of deburing edges and rounding and radiusing corners. We know that on brittle components such as Plexiglas canopies, if edges aren't sanded smooth and care taken when drilling holes, any surface defect can and will quickly result in cracks and

Please Update your web member profiles

On our web site, in the member's section, there are many pictures and profiles that are quite dated (clecoed aluminum parts which are now beautiful flying machines). The updates should be sent to Paul Gregory (eaahighriver@shaw.ca) Please supply: Name, project or aircraft, facts about your project and area of aviation interest.

How to Join Our Chapter

Attend our next chapter meeting. Ask for anyone and they will be pleased to help. All the required forms will be made available for you to fill out. You must be a current member of EAA International, so please have your EAA membership number. If you are not a member, you can join EAA at the meeting.

Contact us by post at
EAA Chapter 1410
Box 5280, High River, Alberta
T1V 1M4
Or by email at
eaahighriver@shaw.ca

We can send you the registration forms if you like. Contact Marv Fenrick (see the last page with the list of the executive).

FOR SALE

- Tail/wing/fuselage for an RV-6 that I acquired a few years ago (original kits from the 80's), as well as a bunch of tools, misc. parts and other stuff that may be of interest to someone in the chapter. Due to work and family commitments I haven't got started on the project, and likely won't.

Jeff Griffiths (403) 374-1950 jeff@griffiths-sheppard.com

- T-hanger for sale. This hanger is the lowest priced hanger and most economical to operate at Spring Bank. Total monthly cost, including natural gas, electrical, insurance, and lease is about $100. There is nothing else. The capital cost for the hanger is $105,000 which you can get back at any time.

Don Rennie (403) 874 0876 rennie.don@shaw.ca

damage. One doesn't usually associate such concerns to aluminum or steel components. Many metals become brittle under cold temperature conditions such as experienced in higher elevated flights in colder seasons. A small temperature decrease can change a ductile metal into a brittle one.

Component design can greatly influence stress concentrations. In Figure (b), we have two different steel thicknesses joined by a full penetration double groove weld. Chamfering the thicker section to that of the thinner section in front of the weld reduces the stress concentration factor significantly. The recommended chamfering slope is 2.5/1. Try to visualize the flow of stresses through a component, and the concept becomes clearer.

(b)

Any abrupt change in section is considered poor design, since it introduces stress concentrations.

In Figure (d), a fitting is designed to transfer loads from a surface to which it is bolted with four fasteners to an end flange under tensile loading. Where this fitting (shown on the left) is bolted to the plate surface, an abrupt change of section is encountered. (To understand this concept, consider equal loading between all four bolts. Consider the first bolt as introducing a finite number of stress lines. At the second bolt these lines will double, and so on. Although the fitting section doesn't change, the stress lines introduced have the same effect.) By tapering the fitting (shown on the right), the transitional sectional change effect is significantly reduced, and corresponding stress concentrations are lowered, (notwithstanding a significant resultant reduction in weight.)


(d)

Ever wonder why AN bolts have rolled rather than cut threads? (Rolled threads have a smoother radius at their minor diameter than cut threads.) The actual fatigue reduction factor in rolled threads over cut threads is in the order of 28 percent.

Now go out there to your project and sand the edges, the lightning holes. Round the corners of your fittings and components. Be aware and look for notches, scratches, and defects. Stop those stress risers. Your extra efforts will enhance both the safety and the appearance of your airplane.

Sources: (a) Faires, Design of Machine Elements, MacMillan Company
(b) Fatigue-Fundamentals, Gooderham Centre for Industrial Learning
(c) Fatigue-Fundamentals, Gooderham Centre for Industrial Learning
(d) Anderson, Aircraft Layout and Detail Design, McGraw-Hill

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