



A C S S

M E E T I N G

Australian Composite Structures Society

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ACSS / CRC-ACS Joint Meeting, Melbourne

STRAIN INVARIANT FAILURE THEORY FOR PREDICTING THE STRENGTH OF ALL MATERIALS, METALS AS WELL

Dr L. John Hart-Smith

*Retired from The Boeing Company
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The focus of this new lecture on the Strain Invariant Failure Theory (SIFT) failure criteria is to explain: (1) how it applies to ALL materials, with postulated examples of how it would apply for metals (both ductile and brittle); (2) what are the tests needed to establish the values of the invariants; and (3) examples of the application of SIFT for predicting the strength of composite laminates. SIFT is the first such theory that is actually capable of predicting matrix failures in composites. The talk will also explain how SIFT is consistent with all of the established work on fracture mechanics. It doesn't contradict it; what it does is to establish the conditions needed for fracture mechanics to become applicable, i.e. when do the first microscopic cracks occur? Traditional fracture mechanics ASSUMES that the cracks are already there. This is most unfortunate, since some 90 to 95 percent of fatigue life occurs BEFORE any cracks occur. SIFT does contradict all of the bogus interactive composite failure criteria in which it is wrongly assumed that the fibre/polymer composite can be considered to be homogeneous (and anisotropic). The recent delaminations during the 787 tests should make it obvious that the past understanding of matrix failures has been less than adequate. The key factor is that the internal residual stresses in the matrix can generate loads that cannot exist in a truly homogeneous material and the traditional composite analysis methods provide no means of accounting for these loads, which are about as intense as any of the externally applied mechanical loads. These internal thermal stresses also create a much greater sensitivity to operations at low temperature (high altitude) than is apparent from coupon tests. The past practice of adding a little more load and performing a test at room temperature to simulate a low-temperature test simply doesn't work; SIFT has explained why not. The lecture will conclude with an opportunity to discuss additional details.

Time: 10:45 am for 11:00 am
Date: Thursday, 10 December 2009
Venue: DSTO Administration Conference Room (Building 1/51)
506 Lorimer Street, Fishermans Bend, Victoria

Please contact the CRC-ACS Head Office (Ph: 03 9676 4900) for further details. The seminar will be preceded by the ACSS AGM. Proceedings will conclude at about 12:30 pm – all ACSS members are encouraged to attend both.

Dr Hart-Smith completed his education in his native Australia, obtaining a PhD degree in Engineering before joining Douglas Aircraft in Long Beach, California in 1968. Since then, he has worked extensively in analysis, testing, and design of both adhesively bonded and mechanically fastened composite joints, mainly under contract to the United States (US) Government. In addition, he has always sought reliable methods for predicting the strength of fibre/polymer composites, since he recognised as long ago as the early 1970s that the traditional methods were incomplete, at best; those taught the most were just plain wrong. He solved the fibre-failure problem in 1983, but made no progress with matrix failures (and neither did anyone else) until he collaborated with Dr Jon Gosse, who had recognised that the primary matrix failure mechanism was one of dilatation; together, they created SIFT. He was also the structures designer for the all-metal MIST fuselage barrel tested at Boeing Seattle, which survived five lifetimes of fatigue testing without even initiating a crack on the skins. He retired in 2008 from a combination of old age and stress from a management that had a different agenda for him that didn't match his skills.