DAMAGE TOLERANCE OF AIRCRAFT PANELS

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ABSTRACT

The basic concepts of damage tolerance criteria for civil aircraft are briefly reviewed. As a result of the traditional usage of riveted joints in the aluminium alloy fuselage of civil aircraft, one advantage of this type of joints is the existing experience concerning their design and maintenance. When subjected to cyclic loading, riveted joints suffer fatigue damage, including multiple site damage - MSD. Thus a second item of this presentation will concern modeling of MSD and of residual strength in riveted structures. Means to improve the strength of those joints will be presented and relevant results will be discussed. Alternatives to riveting are being considered aiming at economies in fabrication time, cost and weight. One such alternative is welding, particularly laser or friction stir welding (LBW or FSW). However, open issues concerning the use of integral structures in aeronautics include the damage tolerance problem, since the integral nature of the structure provides a continuous path for crack growth. The third topic of the presentation will address the fatigue behaviour of integral stiffened panels focusing on the influence of residual stress fields. Modelling fatigue crack growth requires the knowledge of stress intensity factor solutions for the relevant structural geometry, loading and crack configuration. Results obtained using the virtual crack closure technique - VCCT and ABAQUS finite element package are presented. Residual stresses play an important role in the behaviour of integral structures. Therefore, the fatigue crack growth behaviour of stiffened panels was modelled using modified stress intensity factor solutions that take into account the residual stresses and appropriate fatigue crack propagation laws. The presentation concludes with remarks on open issues requiring further research before a more widespread usage of integral structures is made by aircraft manufacturers.