CRACK PROPAGATION IN BUCKLING PLATES: TEST RESULTS AND A SIMPLIFIED NUMERICAL APPROACH

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Abstract

The paper presents first experimental and numerical results of cracked aluminium panels subjected to cyclic shear load. Experiments have been performed to investigate the influence of buckling on accidental damages. It can be shown that the principal stress of the neutral axis of the plate has significant influence on the crack propagation. A simplified numerical approach is presented and compared to the experimental results.

Keywords crack propagation, accidental damages, buckling, stability, testing, numerical analyses.

1. Introduction and Motivation

It is well known that modern lightweight structures face the following two problems among others: stability and damage tolerance. To improve the safety of those structures it is important to understand these phenomena and to predict the structures behaviour for varying conditions. For metallic structures both problems have been treated by many scientists but mainly separately due to their critical loading conditions: Compression, shear forces or torsion are the main reasons for stability failures while fatigue cracks or accidental damages grow mainly under tension load. Therefore results of tests or simulations have been published concerning in general either stability problems or damage tolerance behaviour of metallic structures. The combination of both has been mostly excluded even though the combination of buckling and cracks is likely considering accidental damages, for example in fuselage side shells where shear is the major stress.

Some works concerning the combination of buckling and damages can be found in the literature: Numerical analyses of cracked shear panels have recently been published by Alinia et al. (2007a, b). The focus was laid on the influence of cracks - located either in the centre of a panel or close to the edge - on the buckling and post-buckling behaviour. They concluded that small cracks, up to 10 % of the panel width, have no significant influence on the critical stress or ultimate strength of the panel and therefore may be ignored for buckling and post buckling predictions. But they become more defective if they coincide with the tension field of the shear panel. Obodan et al. (2006) presents numerical and experimental results for the influence of curvature on fracture parameters of thin-walled elements with cracks. It is shown by numerical and experimental analysis that the