Theoretical and Applied Fracture Mechanics 88 (2017) 51–63

A numerical study of the effect of single overloads on plasticity induced crack closure

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a b s t r a c t

In this work, the effect of single overloads on plasticity induced crack closure is studied. An elastic-plastic finite element model was developed and the crack opening level was calculated from the contact forces along the crack flank. The effects of the loading parameters and stress state are analysed, and the mechanisms behind crack closure variations are identified. An overload is a traumatic event that eliminates material's memory relative to the load history. Crack tip blunting is the mechanism behind this memory loss, since it eliminates crack closure. Material hardening has a major relevance on the evolution of plastic blunting, which was evident in the variation of the CTOD parameter. On the other hand, the overload produces strong plastic deformation ahead of the crack tip, giving rise to conditions for the rapid generation of crack closure higher than before the event. The peak of crack closure was found to increase linearly with the load increase above the maximum baseline value. The crack is totally closed for overload ratios of about 2.5. Empirical models were developed for the peak of crack closure, for the delay of this peak and for the stabilization distance after the overload. Finally, the stress state was found to have a major effect on crack closure level after an overload.