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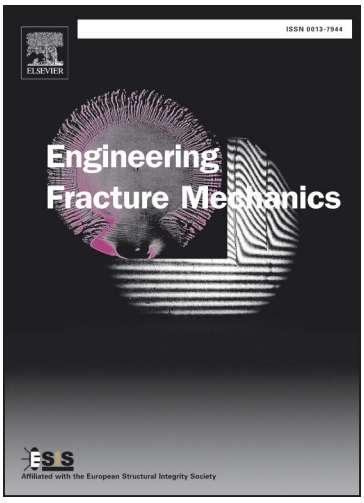

Fracture mechanics criterion of time-dependent crack initiation from interface free-edge in adhesively bonded butt joints

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PII: S0013-7944(17)30553-2
DOI: http://dx.doi.org/10.1016/j.engfracmech.2017.08.017
Reference: EFM 5651

To appear in: *Engineering Fracture Mechanics*

Received Date: 23 May 2017
Revised Date: 7 August 2017
Accepted Date: 8 August 2017

Please cite this article as: Takahashi, Y., Inoue, K., Takuma, M., Saitoh, K-i., Sato, T., Fracture mechanics criterion of time-dependent crack initiation from interface free-edge in adhesively bonded butt joints, *Engineering Fracture Mechanics* (2017), doi: http://dx.doi.org/10.1016/j.engfracmech.2017.08.017

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Title:

Fracture mechanics criterion of time-dependent crack initiation from interface free-edge in adhesively bonded butt joints

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Abstract:

The time-dependent crack initiation from the interface free-edge of adhesively bonded axisymmetric columnar butt joints (epoxy/SUS, edge shape: 90°/90°) was investigated in detail. With the change of applied stress level, σ_n, the butt joints exhibited crack initiation life, t_C, that varied about four orders of seconds ($10^2 \sim 10^6$ s). Such a clear time-dependent life property was then studied in terms of the fracture mechanics. The near-edge stress/strain field at the crack initiation was numerically evaluated with the finite element method (FEM) by applying the time-hardening creep law to the epoxy resin. It was found that the critical asymptotic stress field along the interface represented by the combination of two parameters, λ_σ^{cr} (creep stress singularity index) and K_σ^{cr} (creep stress intensity factor), satisfies a unique relation irrespective of (σ_n, t_C) sets. The same tendency was also confirmed when the near-edge *total* strain field parameters were employed. These results indicate that the K-λ criterion, originally developed for static fracture problems, still holds its validity in the time domain.

Key words: Interface; Free-edge; Crack initiation; Time-dependent; Fracture criterion

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