ELASTIC PLASTIC CRACK MECHANICS

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ABSTRACT

Recent developments in elastic plastic fracture mechanics are reviewed. These include the J-integral and its application, as well as recent work on predicting the crack surface opening profile and criterion for continuing quasi-stable crack growth for ductile solids.

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SUMMARY DISCUSSION
(J. Rice)

Brian Defacio (Ames Laboratory): I would like to know if in your paper the theory
is based upon (inaudible).

Jim Rice: The theory is based on this rate independent model. You can, in fact, do
analogous things for strong idealizations of great dependent materials like, say,
nonlinear viscous materials. But if you try to get very fancy about constitutive
relations, you quickly lose any kind of path-dependent integrals. The thing is,
no one really believes materials behave that way. As long as, in Eshelby's
terms, if we don't call the material's bluff -- or I guess it's the opposite: if
the material doesn't call our bluff, it's a simple approach which lets you attack
very complex problems. So, why not use it.

Tom Collins (Air Force): When you start putting this "R" in there, you lost me. How
does R vary from material to material? Can you relate that to some material
characteristic?

Jim Rice: We think the R is simply an indication of the plastic zone size, so in fact
it's something that you have calculated. It's a function of J. Complications
come in only when you go to fully plastic geometries in cases where you have con-
tained plasticity. We have at present a fair idea of how that parameter varies
with J. Is that what you meant by R? Or did you mean the resistance curve itself?

Tom Collins: Why you related it. You have to be very careful on something like that.
It's just an adjustable parameter. And so often in this game you begin to develop
sight simulations, and the more you do it the more you believe it's the correct
thing.

Jim Rice: I'm not sure we are making contact here. The R I introduced --

Tom Collins: This is capital R.

Jim Rice: Capital R is just part of the continuum mechanical solution. So, there is
nothing in there. The thing to worry about is the crack growth criterion itself.
Based on that requirement that in a certain sense the crack ought to look similar
near the tip as it grows. Maybe there is no good reason for that. Especially
if you consider cases where the plastic zone size at the start of the growth might
be enormously different, very much smaller than that after a lot of growth.

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