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ADDITIONAL RESPONSE: Additional Discussion of "Mixed Mode Ductile Fracture Using the Strain Energy Density Criterion*," by E.E. Gdoutos**

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In his current and earlier [1] discussions of our paper Gdoutos has charged that we use unmatched hypotheses which are arbitrary and lack physical reality. We do not wish to enter into a philosophical argument of this kind but merely to point out that both hypotheses, which we believe are physically significant, can only be tested by comparing prediction with experiment.

We attempted to check the validity of the criterion based on the maximum dilatational strain energy using two aluminium alloys known as LY12-CZ and LY12-CS*. The materials possessed similar magnitudes of yield stress but differed in ultimate stress and maximum elongation. The predicted angles of crack initiation were found to be close to the measured values.

We appreciate the fact that the validity of a new hypothesis should not be considered as established without further enquiry. A follow-up investigation has since been conducted on thin plates of 3.175 mm thickness made up of aluminium alloy 2024-T3. The angles of crack initiation were assessed using a nonlinear finite element analysis on embedded inclined crack angle β of 30, 45, 60, 75, and 90 degrees. In addition, thin plates containing these embedded angled cracks were manufactured and the crack initiation angle measured. Table I summarizes the results of the predicted crack initiation angles using both the maximum strain energy density and maximum dilatational strain energy density together with those experimentally determined. It is quite evident from the table that the criterion based on the proposed maximum dilatational strain energy yields satisfactory results for the crack initiation angle in mixed mode ductile fracture, thus providing additional evidence for its validity. Further investigation on the application of the hypothesis to materials other than aluminium alloys is in progress and initial results are encouraging.

Regarding the other comments made by the discussor there is another point which needs clarification. This concerns the predicted angle of crack initiation of approximately -30 degrees from an inclined crack of $\beta = 30$ degrees located in a thin aluminium plate.

The angle of crack initiation as defined in the earlier discussion by Gdoutos [1] was measured from the line of the inclined crack to the line of fracture, θ_c, Fig. 1. In our original paper this angle was defined as θ_c', Fig. 1. Once this is realised the calculated crack initiation angle θ_c' agrees with the predicted angles of θ_c described in our discussion paper [2] after appropriate transformation.

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**This issue, immediately preceding.

REFERENCES

[1] E.E. Gdoutos, Discussion of Mixed Mode Ductile Fracture Using the Strain Energy Density Criterion, *International Journal of Fracture* 30 (1986) R53-8.

[2] C.L. Chow and Jilin Xu, Reponse on Discussion of Mixed Mode Ductile Fracture Using the Strain Energy Density Criterion, *International Journal of Fracture* 30 (1986) R59-R62.

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Table I. Angle of Crack Initiation

Embedded angle β, deg.	Predicted critical angle of crack initiation θ_c, degree		Measured critical angle θ_c, degree
	$(\frac{dW}{dV})^{max}_{min}$	$(\frac{dW}{dV})^{max}_{v}$	
30	-66	-76	-76.9
45	-62	-60	-61.4
60	-32	-46	-43.6
75	-19	-19	-19.9
90	0	0	0

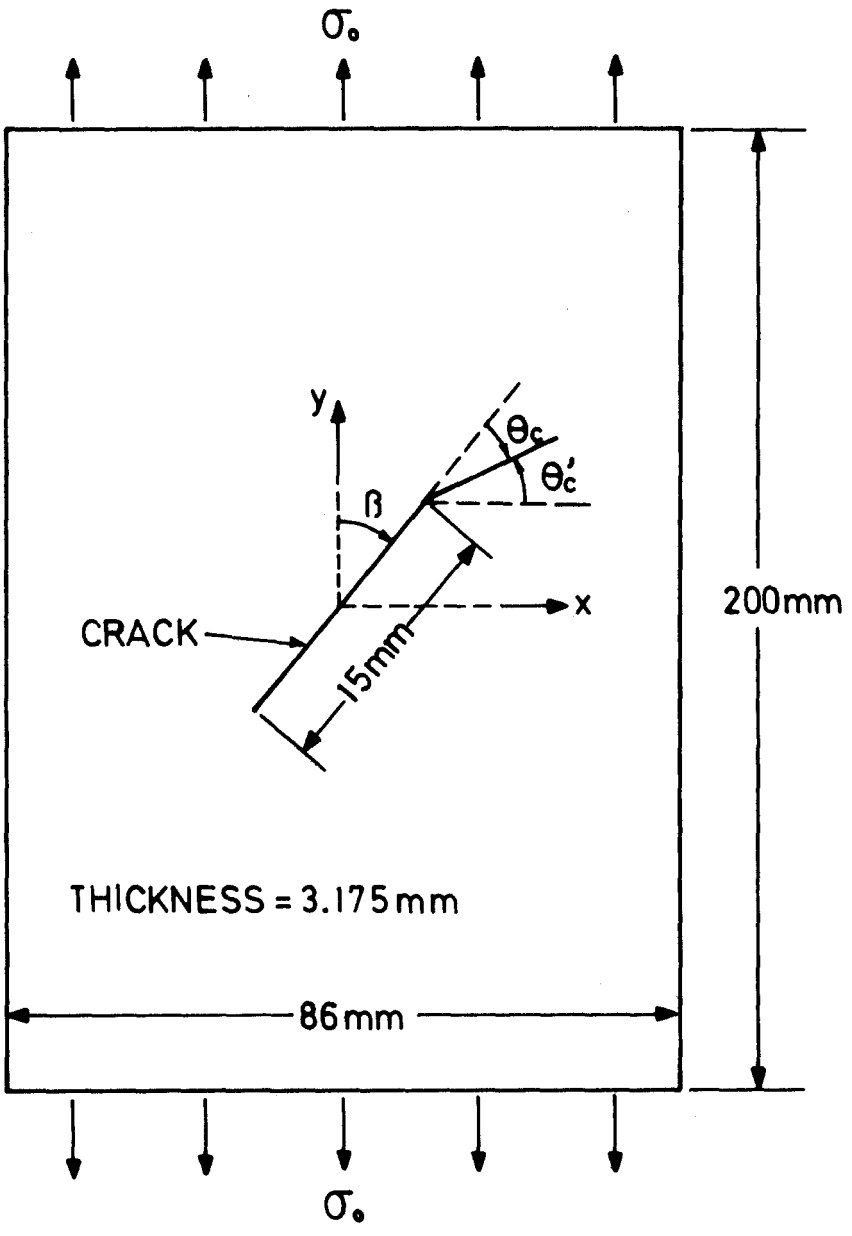

Fig. 1. A mixed mode cracked plate.