

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.

1. REPORT DATE (DD-MM-YYYY)		2. REPORT TYPE Technical Papers		3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER 2362	
				5e. TASK NUMBER MIG 2	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048				8. PERFORMING ORGANIZATION REPORT	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited.					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT A	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON Leilani Richardson
a. REPORT Unclassified	b. ABSTRACT Unclassified	c. THIS PAGE Unclassified			19b. TELEPHONE NUMBER (include area code) (661) 275-5015

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

36 separate files are enclosed

133
111

62

MEMORANDUM FOR PRR (Contractor/In-House Publication)

FROM: PROI (TI) (STINFO)

02 Aug 2000

SUBJECT: Authorization for Release of Technical Information, Control Number: **AFRL-PR-ED-TP-2000-159**
Liu, C.T. (AFRL/PRSM); Wang, L., Atluri, S.N. (UCLA), "Analysis of Subinterface Cracks"

International Conference on Computational Science
(Anaheim CA, 21-25 Aug 00)

(Statement A)
(Submission Deadline: 16 Aug 00)

1. This request has been reviewed by the Foreign Disclosure Office for: a.) appropriateness of distribution statement, b.) military/national critical technology, c.) export controls or distribution restrictions, d.) appropriateness for release to a foreign nation, and e.) technical sensitivity and/or economic sensitivity.

Comments: _____

Signature _____ Date _____

2. This request has been reviewed by the Public Affairs Office for: a.) appropriateness for public release and/or b) possible higher headquarters review.

Comments: _____

Signature _____ Date _____

3. This request has been reviewed by the STINFO for: a.) changes if approved as amended, b.) appropriateness of distribution statement, c.) military/national critical technology, d.) economic sensitivity, e.) parallel review completed if required, and f.) format and completion of meeting clearance form if required

Comments: _____

Signature _____ Date _____

4. This request has been reviewed by PR for: a.) technical accuracy, b.) appropriateness for audience, c.) appropriateness of distribution statement, d.) technical sensitivity and economic sensitivity, e.) military/national critical technology, and f.) data rights and patentability

Comments: _____

APPROVED/APPROVED AS AMENDED/DISAPPROVED

LAWRENCE P. QUINN
Technical Advisor
Rocket Propulsion Division

DATE

20021119 133



Analysis of Subinterface Cracks

C.T. Liu
Propulsion Directorate

AFRL/PRSM
10 E. Saturn Drive
Edwards AFB, CA 93524-7680

L. Wang & S.N. Atluri
Center for Aerospace Research & Education
University of California at Los Angeles
Los Angeles, CA 90095-1600

Approved

Distribution Statement: Cleared for Public Release

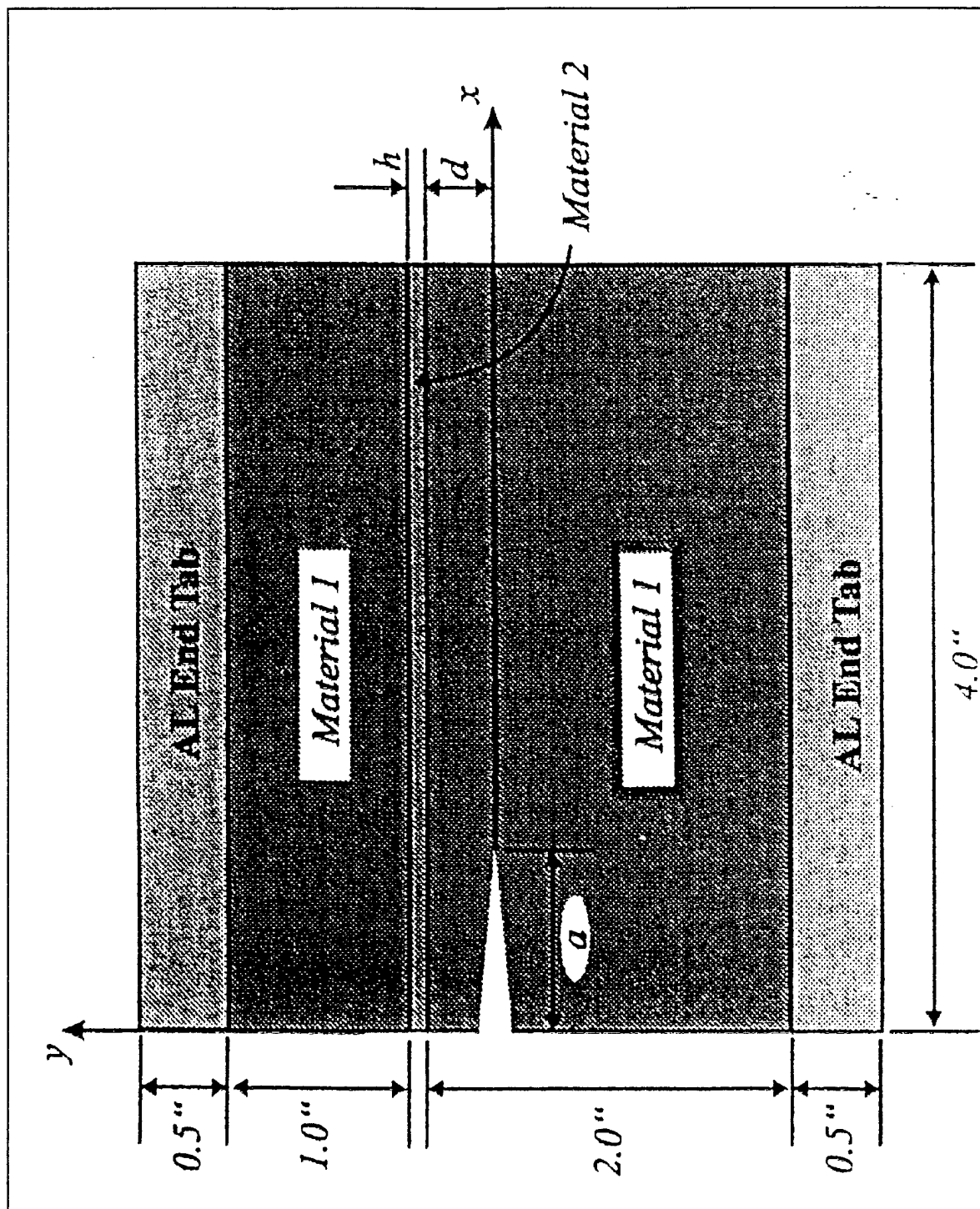


Objectives

- **Determine the Accuracy of the Numerical Modeling Results.**
- **Investigate the Effects of (a) Crack Length and Location and (b) Adhesive Layer Thickness and Material property on Mode I Stress Intensity Factor.**



Specimen Geometry





Definitions of the Analyzed Cases

No.	E (ksi)	h (in)	d (in)	a (in)
1	700	0.10	0.15	0.10
2	700	0.10	0.15	0.50
3	100	0.05	0.15	0.10
4	100	0.05	0.15	0.50
5	100	0.05	0.30	0.10
6	100	0.05	0.30	0.10
7	100	0.20	0.15	0.10
8	100	0.20	0.15	0.50
9	100	0.20	0.30	0.10
10	100	0.20	0.30	0.50
11	1000	0.05	0.15	0.10
12	1000	0.05	0.15	0.50
13	1000	0.05	0.30	0.10
14	1000	0.05	0.30	0.50
15	1000	0.20	0.15	0.10
16	1000	0.20	0.15	0.50
17	1000	0.20	0.30	0.10
18	1000	0.20	0.30	0.50



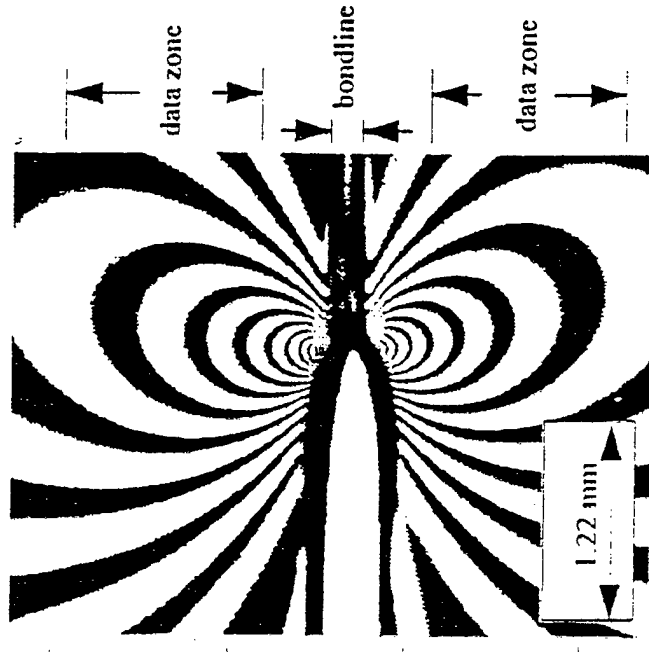
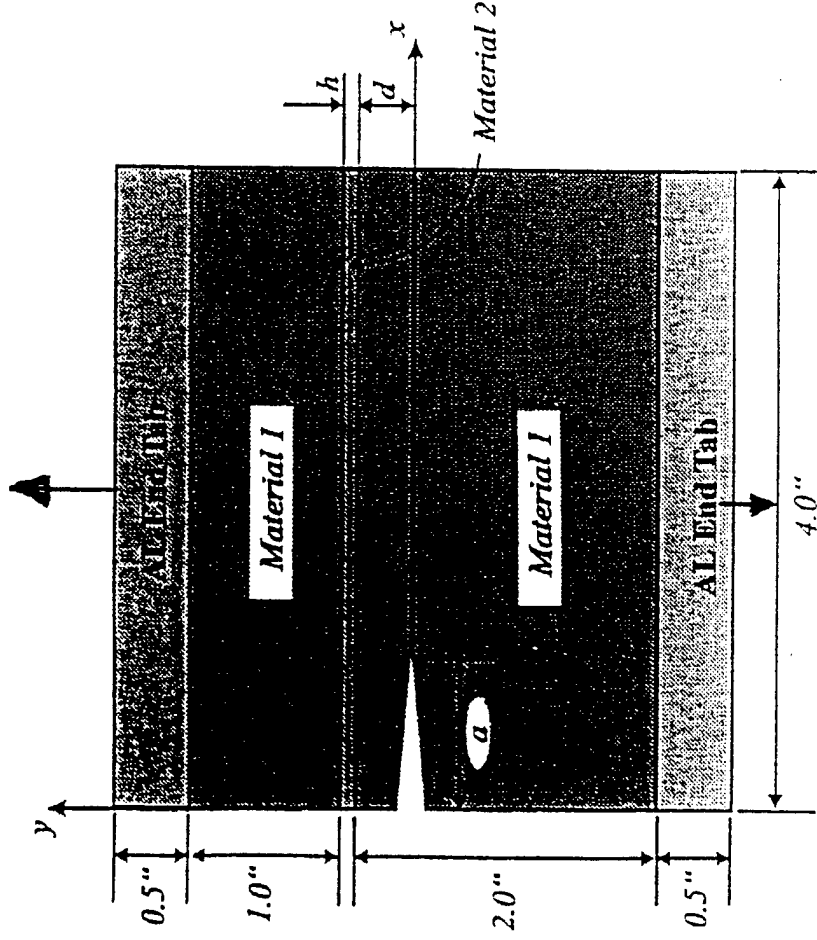
Summary of the Analyzed Cases

No.	E (ksi)	h (in)	d (in)	a (in)	K/K _o
1	700	0.10	0.15	0.10	0.8958
2	700	0.10	0.15	0.50	0.8702
3	100	0.05	0.15	0.10	0.9795
4	100	0.05	0.15	0.50	0.9187
5	100	0.05	0.30	0.10	0.9551
6	100	0.05	0.30	0.10	0.9134
7	100	0.20	0.15	0.10	1.1429
8	100	0.20	0.15	0.50	1.0478
9	100	0.20	0.30	0.10	1.0687
10	100	0.20	0.30	0.50	1.0401
11	1000	0.05	0.15	0.10	0.8918
12	1000	0.05	0.15	0.50	0.8636
13	1000	0.05	0.30	0.10	0.9083
14	1000	0.05	0.30	0.50	0.8648
15	1000	0.20	0.15	0.10	0.8972
16	1000	0.20	0.15	0.50	0.8699
17	1000	0.20	0.30	0.10	0.9137
18	1000	0.20	0.30	0.50	0.8720



Comparison of Experimental and Numerical K_I/K_{I0}

A1980



Near Tip Fringe Pattern

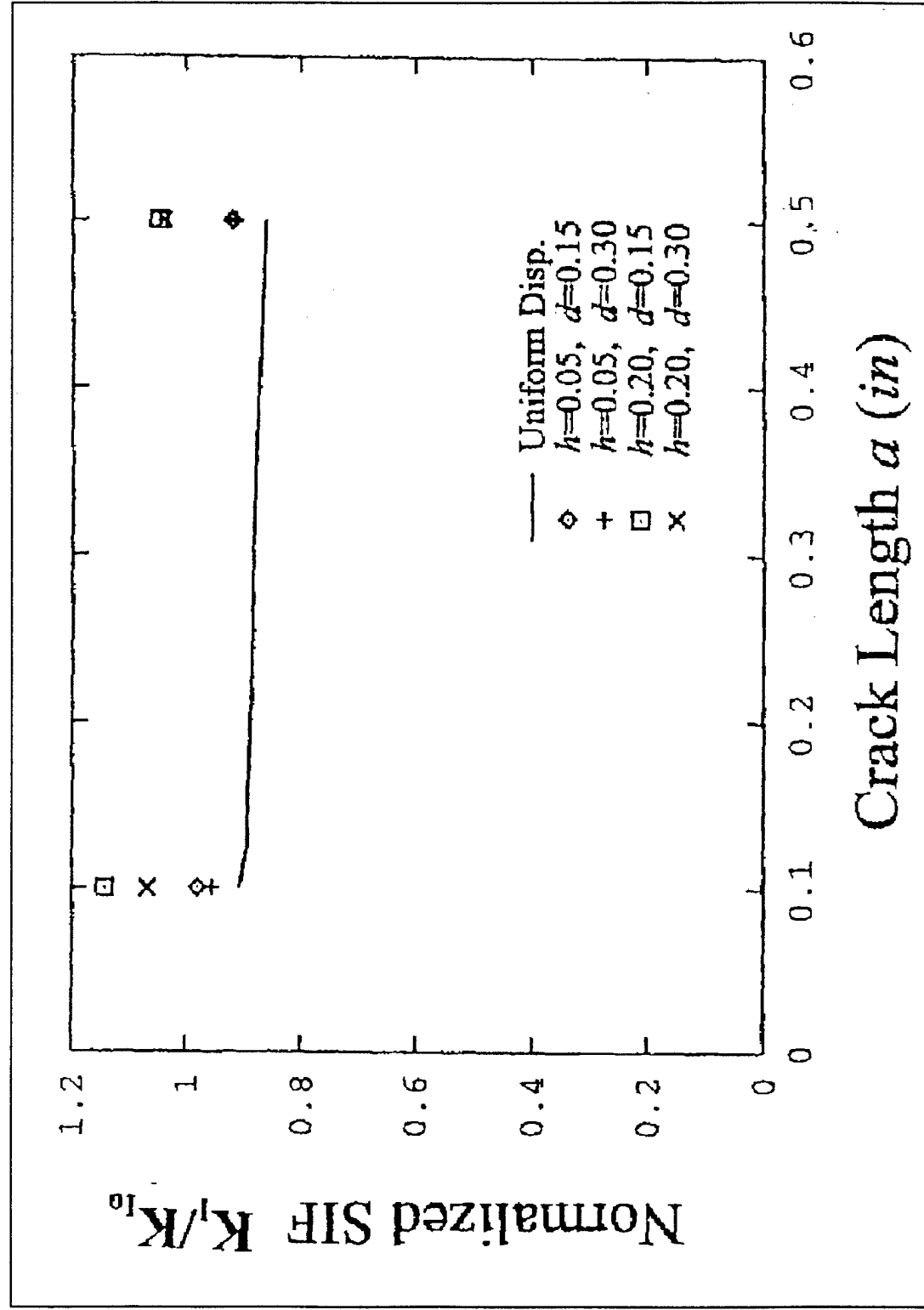
$$\left(\frac{K_I}{K_{I0}} \right)_{\text{Exp}} = 0.8960$$

$$\left(\frac{K_I}{K_{I0}} \right)_{\text{Numerical}} = 0.8958$$



Normalized SIF Versus Crack Length

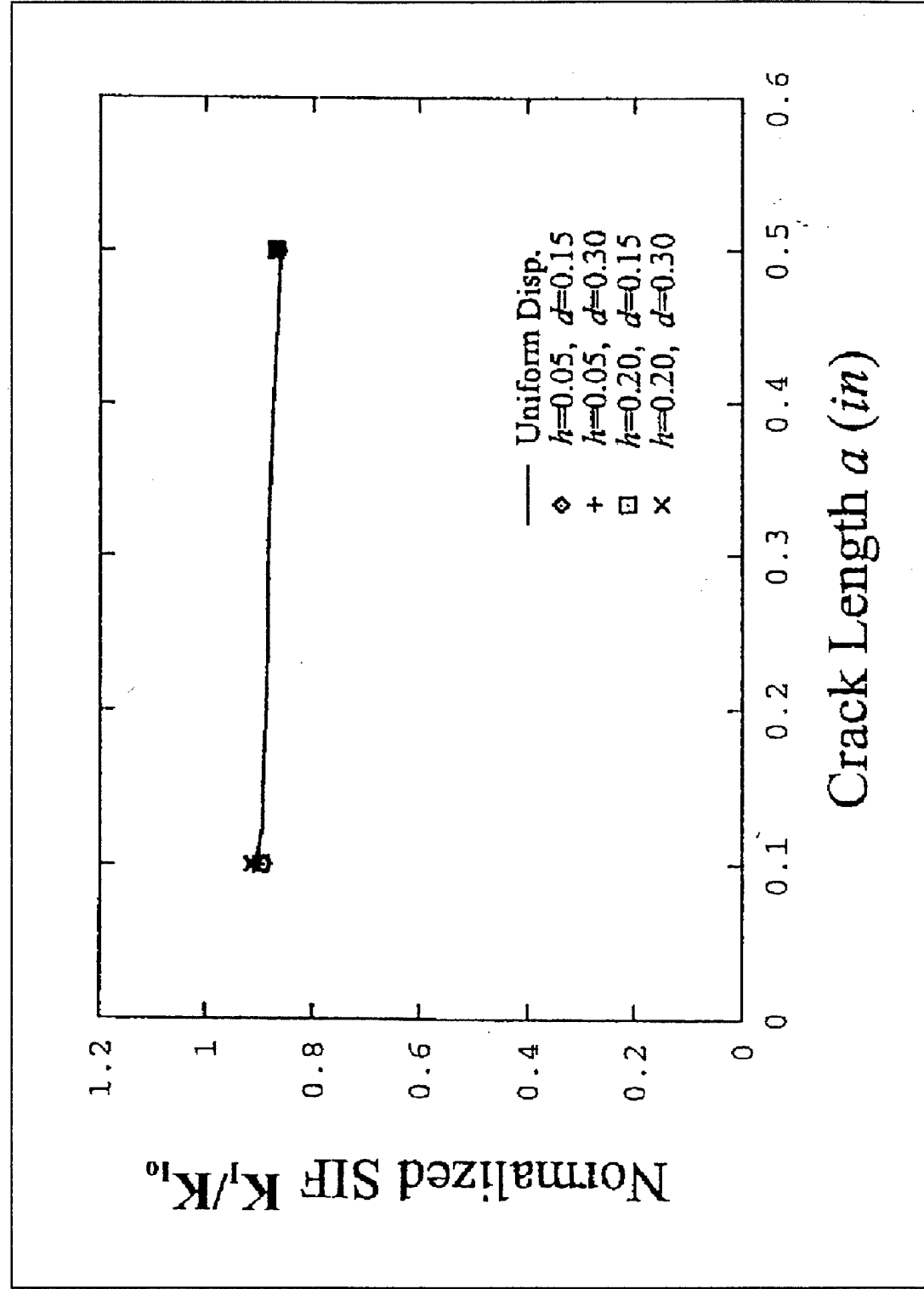
(adhesive layer is softer than material 1)





Normalized SIF Versus Crack Length

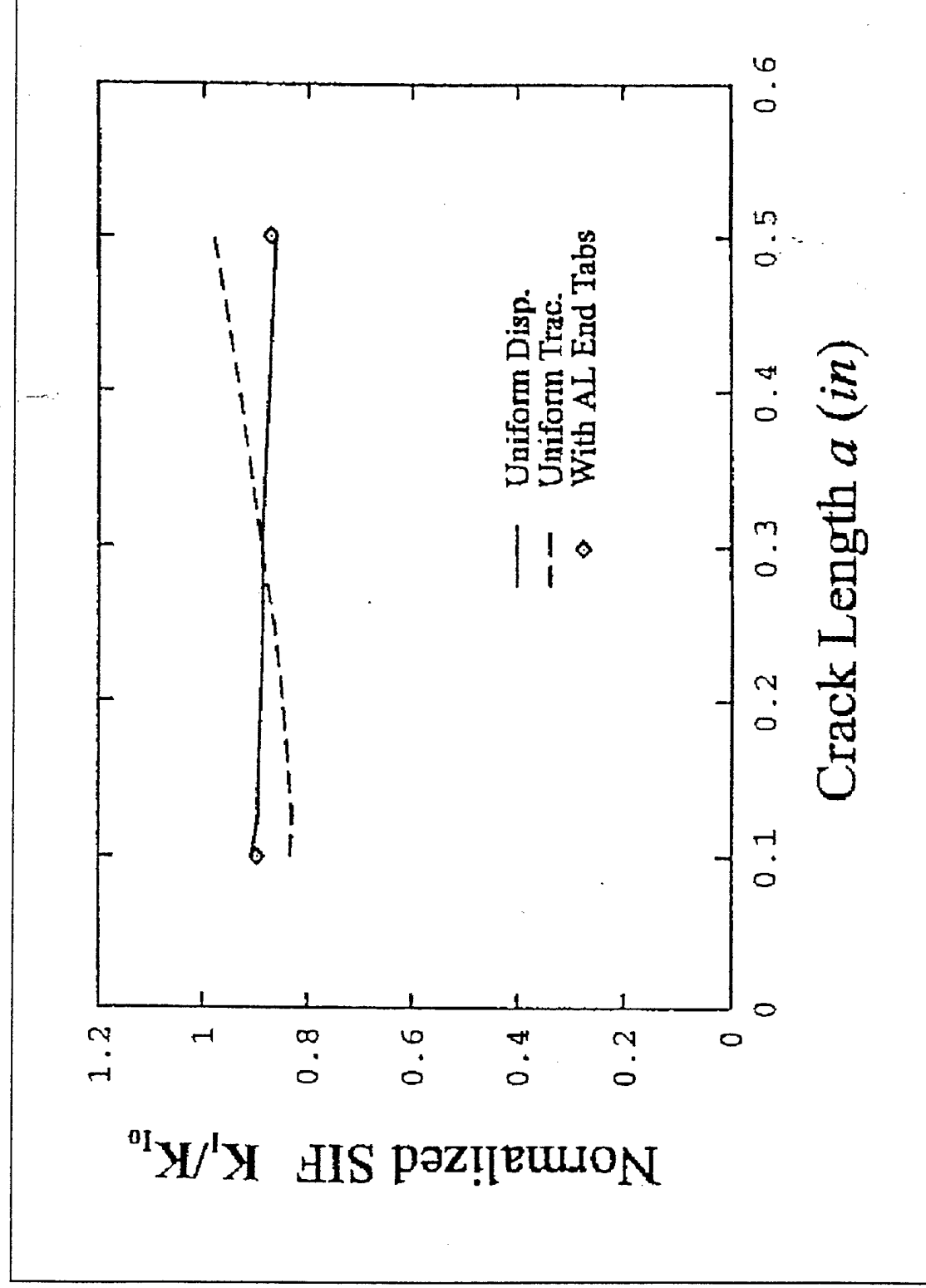
(adhesive layer is stiffer than material 1)





Normalized SIF Versus Crack Length

(adhesive layer has same material property as material 1)





Conclusions

- For all the cases analyzed, the Mode II stress intensity factor is negligibly small.
- By comparing with the homogeneous specimen, a softer (stiffer) adhesive layer has a significant (insignificant) effect on the normalized Mode I stress intensity factor, ^{whereas a stiffer layer has an insignificant effect.}
^{* in correct use of parentheses}
- For a soft adhesive layer, the normalized Mode I stress intensity factor increases with increasing ^{an} the thickness of the adhesive layer.
- For a stiffer adhesive layer, the normalized stress intensity factor is insensitive to the thickness of the adhesive layer.