



**FINAL YEAR PROJECT REPORT
ADVANCED DIPLOMA IN MECHANICAL ENGINEERING
SCHOOL OF ENGINEERING
MARA INSTITUTE OF TECHNOLOGY
SHAH ALAM**

**EFFECT OF LOADING RATES TO THE FRACTURE
TOUGHNESS ON CARBON MANGANESE STEEL
ASTM 516 GRADE 70**

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JUNE 1996

ABSTRACT

Material resistance to fracture or fracture toughness can be determined from experimental testing. The experimental condition in toughness measurement should be relevant to the service application. Where with same fracture toughness at high loading rate is suitable to high strain application while low loading rate is useful at low strain application. The experimental technique has a major influence on design for crack growth that is unstable, fatigue and time dependent in steel that are homogeneous.

The testing is according to BS 5762 : 1979 on ASTM 516 Grade 70, which is commonly used in pressure vessel structure. The test is done at room temperature, constant displacement 12 mm/s and transition load. The result is analysed for fracture toughness value determination.

The result for K_{1C} from CTOD testing is found to be invalid. Hence J integral method should be done to determine the K_{1C} , according to the ASTM standards E813-81, " J_{1C} , A Measure of Fracture Toughness". J_{1C} was found 115 N/mm^{1/2}. This value is slightly higher for such materials. This might be due to the blunting ahead the notch and testing is done without precracking.

<u>CONTENTS</u>	<u>PAGES</u>
ABSTRACT	i
ACKNOWLEDGEMENTS	ii
CONTENTS	iii
NOMENCLATURE	v
CHAPTERS	
1.0 INTRODUCTION	1
1.1 An Overview	1
1.2 Fracture Mechanic Concept	3
1.2.1 Material Toughness	3
1.2.2 Crack Size	4
1.2.3 Stress Level	4
2.0 THEORETICAL BACKGROUND	6
2.1 Introduction to Linear Elastic Fracture Mechanic (LEFM)	6
2.2 The Griffith Theory and Modifications	8
2.2.1 Irwin's Stress Intensity Approach	10
2.3 Equivalence of Energy Balance and Stress Intensity Approach	12
2.4 Introduction to Elastic-Plastic Fracture Mechanics (EPFM)	13
2.4.1 Crack Tip Opening Displacement (CTOD)	14
3.0 DYNAMIC FRACTURE MECHANICS	19
3.1 Introduction	19
3.2 Dynamic Fracture and Crack Arrest	20
3.3 Rapid Loading of Stationary Crack	22
3.4 Rapid Crack Propagation and Arrest	23

4.0 EFFECT OF LOADING RATE ON FRACTURE TOUGHNESS	27
5.0 TENSILE TEST	33
5.1 Tensile Test Theory	33
5.2 Discussion	35
5.3 Tensile Test Result	36
6.0 LITERATURE REVIEW ON CRACK TIP OPENING DISPLACEMENT (CTOD) TESTING	40
6.1 Background of CTOD Testing	40
6.2 Specimen Requirement and Dimensions	41
6.3 Fatigue Precracking	44
6.4 Instrumentation	45
6.5 CTOD Testing	46
6.5.1 Procedure Testing	47
6.6 J_{IC} Testing of Metals	49
6.6.1 J_{IC} Measurements	49
6.6.2 Heat Tinting	51
7.0 ANALYSIS	52
7.1 Condition K_{IC} (K_Q)	52
7.1.1 Calculation for K_Q	55
7.2 Crack Tip Opening Displacement (CTOD)	56
7.3 Calculation of J Integral	57
8.0 DISCUSSION	61
9.0 CONCLUSION	67
REFERENCES	69
APPENDIX	

NOMENCLATURE

<u>SYMBOL</u>	<u>TERM</u>	<u>UNIT</u>
a	Nominal crack length	mm
b	Remaining uncracked ligament	mm
B	Specimen thickness	mm
E	Young's modulus	MPa
G_c	Critical energy release rate	mm^{-1}
J	Path independent contour integral	mm^{-1}
J_{IC}	Fracture toughness at crack initiation	$\text{N}/\text{mm}^{1/2}$
K_I	Plane strain intensity factor	$\text{MPa}\cdot\text{m}^{1/2}$
K_{IC}	Critical value of plain strain intensity factor	$\text{MPa}\cdot\text{m}^{1/2}$
P	Load	N
P_L	Limit load	N
r_y	Radius of region of plasticity	mm
T	Test temperature	$^{\circ}\text{C}$
t_p	Time to plastic deformation	s
v	Crack tip velocity	ms^{-1}
V_f	Clip gauge opening at specimen failure	
mm		
V_g	Clip gauge opening displacement	mm
V_p	Plastic component of clip gauge displacement	mm
W	Specimen width	mm
x,y,z	Co-ordinate system	
z	Knife edge height	mm