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I. INFLUENCE OF SPECIMEN THICKNESS ON FRACTURE TOUGHNESS OF MILD STEEL

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Abstract —The fracture toughness parameters of mild steel were investigated experimentally by using cracked specimens with varying thickness starting from 12, 15, 20, 25 mm. The coupled effects of specimen thickness and delamination upon fracture toughness and the mechanism of delamination are revealed; the general role of delamination and geometry configurations on fracture toughness is found out; the initiation stress intensity factors and fracture toughness are determined. Hence effects of variation of thickness is seen, SENB side edge notch bend specimen is used for this experimental work. This experiment is carried out in two control either load control or displacement control depends upon the requirement.

I. INTRODUCTION

In actual scenario, all components and structures will have crack irrespective of the material they are made of. The discontinuity or defect may be manmade such as a notch, a hole, or it may already exist within a component due to manufacturing defects like slag inclusion, welding procedure, etc. In all these cases, the designer wants to know about the possibility of the crack to grow further before allowing them to continue in their service. It is here we seek the aid of what is called Fracture Mechanics that plays an important role in designing the components and structures and evaluating their life. It also helps in finding the upper limit of the load applied on a component for which the dimensions, location and orientation of the crack and loads are given. In this paper too we are calculating peak load for various specimen and with respect to that fracture toughness parameters are calculated.

II. METHODS AND MATERIAL

Mild steel specimen of length 150 mm and width 30 mm has been used with varying thickness. These specifications that has been adopted are as per American Society for Testing Material (ASTM). The displacement control test has been carried out having load capacity of 10 ton. Extension points are given to get tentative amount of peak load, after few trials these extension points has been increased so that actual peak load can be known. After importing the test results in excel peak load can be known at each point of displacement hence actual peak load can be known. Stress intensity factor is calculated using formulation given in E399 code. Extending this approach to get fracture toughness by assuming poisson’s ratio as 0.303. Similar procedure is adopted for same specimen having different thickness. Hence a comparative study can be done and behaviour change in fracture toughness properties can be studied. The experimental set up adopted for this test is of three point bending as shown in Figure 1

Figure 1 Three Point Bending Setup

III. RESULTS AND CONCLUSION

3.1. Results

From the above test, stress intensity factor for varying thickness is calculated, along with that fracture toughness can be known as shown in table below. One can clearly see that though peak load for higher specimen thickness is high but its stress intensity factor decreases with increase in thickness.

Table 1

Specimen No	Peak Load (kN)	Thickness (mm)	K_{IC} (MPa$\sqrt{m}$)
1	32.300	25	58.79
2	25.251	20	62.14
3	18.673	15	65.72
4	16.303	12	71.72

3.2 Conclusion

It is observed that study of fracture toughness parameters is carried out mostly on aluminum and concrete while the study is equally important for steel too. After water, steel is maximum used all over the world hence it is important to know about its behaviour change with respect to fractural point of view. From the results one can clearly conclude that as thickness increases stress intensity factor K_{IC} and fracture toughness J_{IC} decreases. The condition adopted here is of plain strain hence from the results we can say that if material thickness is less its fracture toughness will be more. Hence one can say that adopting lesser thickness is beneficial as surface area for formation of crack is less so chances of crack formation is less.

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