M E 325 Exam 1 Problem 1

Group 6

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A 0.004 inch edge crack is found in a machine component fabricated from amaterial with the following properties:

Sut = 185 kpsi

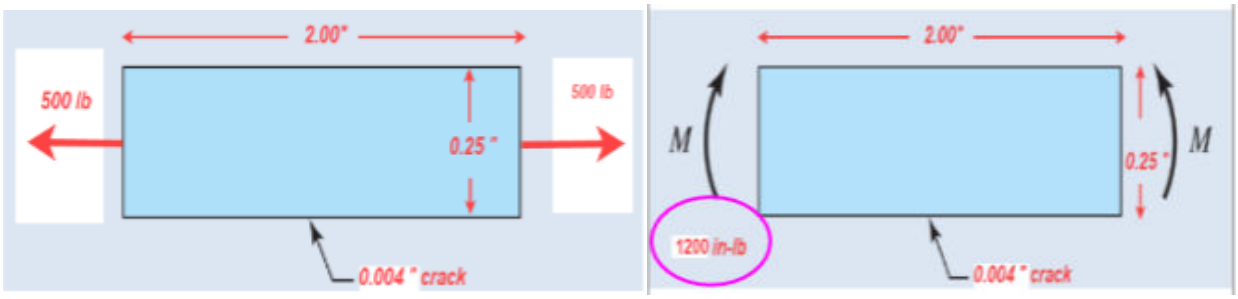
Sy = 170 kpsi

KIC = 73 kpsi √in

C = 3.8 ×10−11 incylcekpsi √in

m = 3

The part has a cross-section that is 1/4 inch wide and 1/2 inch thick and its length is 2.00 inches. A normal force varies from a value of 500 lb to 0 lbs and a bending moment is applied that varies between a maximum value of 1200 in-lb and a minimum value of 0 in-lb. Both loads result in tensile stresses that cause mode I loading. The geometry correction factors for both the axial force and the bending moment can be assumed to be β = 1.07



Determine:

1. af, the critical crack length

2. N, the number of cycles, N, until the critical crack length is reached.

3. nyield, the factor of safety against yielding

4. σc, the critical stress based on LEFM analysis

Submit:

•Results generated by the software of your team's choice.

•Along with numerical results, include the symbolic equations used to gen-

erate them

Clearing all values from the command window.

```
clc
clear all
```

Inputting the given variables and parameters.

```
Sy = 170;
Sut = 185;
c = 3.8*10^-11;
m = 3;
Width = 0.25;
Length=2;
Thickness = 0.5;
Moment = 1200;
Tension = 500;
Kic = 73;
Beta=1.07;
Area=Width*Thickness;
a=0.004;
```

Calculating the Moment of Inertia

```
I1 = (Length*Width^3)/12;
```

Stress in Kpsi for Moment and Tension Loading

```
Sigma = (((Moment*Width/2)/I1)+(Tension/Area))/1000;
```

From the chart beta was found to be 1.07 for our ratio

```
af = (1/pi)*(Kic/(1.07*Sigma))^2;
```

Because of the parameters of the problem and af exceeds 0.25, we will use 0.25 in place of it to calculate the cycles to failure.

```
Nf =(-1/(Beta*Sigma*sqrt(pi*0.25))^m+(1/(Beta*Sigma*sqrt(pi*a))^m))/c;
```

Factor of Safety Due to Yielding

```
FS_Yield=Sy/Sigma;
```

Factor of Safety including crack length

```
Ki=1.07*Sigma*sqrt(pi*a);
FS_Crack=Kic/Ki;
```

Calculating Critical Stress

```
Critical_Stress=FS_Crack*Sigma;
```

Outputting Desired Values/Answers

```
W= sprintf('Critical Crack Length = %s in',af);
disp(W)
```

```
Critical Crack Length = 3.904513e-01 in
```

```
X = sprintf('Number of Cycles to Critical Crack Length = %s',Nf);
disp(X);
```

```
Number of Cycles to Critical Crack Length = 6.510709e+07
```

```
Y= sprintf('Factor Of Safety Against Yielding = %s ',FS_Yield);
disp(Y)
```

```
Factor Of Safety Against Yielding = 2.759740e+00
```

```
Z= sprintf('Critical Stress = %s Kpsi',Critical_Stress);
disp(Z)
```

```
Critical Stress = 6.086031e+02 Kpsi
```