

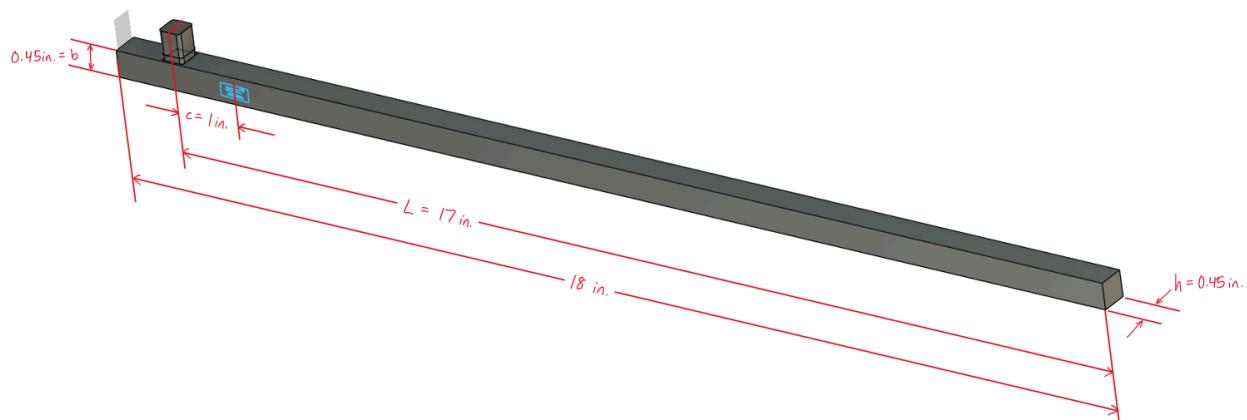
MAE 3270 Final Homework

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5.2 Your Design:

5.2.1 Results:

1. CAD Model



2. Material used and its relevant mechanical properties

Chosen material: Intermediate alloy, Fe-5Cr-Mo-V aircraft steel, quenched & tempered

```
% dimensions to determine:  
L = 17; % (inches)  
h = 0.45; % (inches)  
b = 0.45; % (inches)  
c = 1.0; % (inches)  
I = (b*h^3)/12; % moment of inertia (inches^4) - based on chosen geometry  
  
% chosen material:  
name = 'Fe-5Cr-Mo-V'; % Young's modulus (psi)  
E = 31.E6; % Poisson's ration (dimensionless)  
nu = .375; % tensile strength -- use yield or ultimate strength depending  
on material (psi)  
su = 240.E3; % fracture toughness (psi sqrt(in))  
KIC = 120.E3; % fatigue strength from Granta for 10^6 cycles  
sfatigue = 125.E3;
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Mechanical properties of Fe-5Cr-Mo-V and our chosen dimensions

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>> FinalHW
Chosen material: Fe-5Cr-Mo-V

Stress and deflection analysis:
load point deflection = 0.546 in
max normal stress = 39.51 ksi

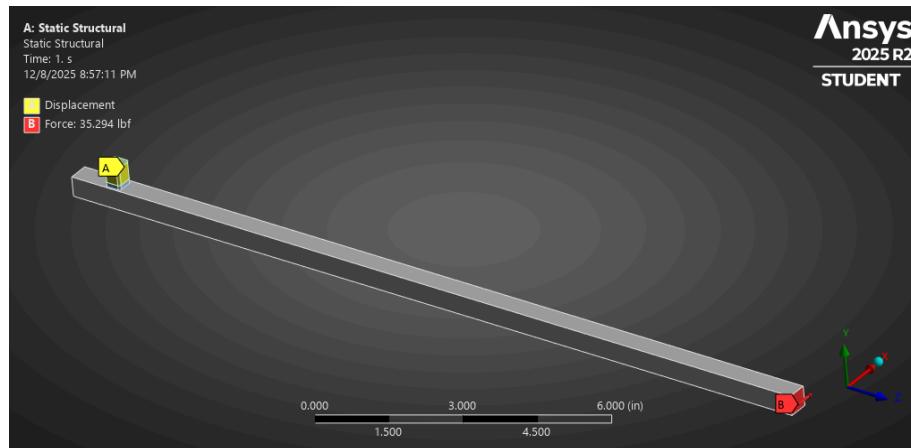
Safety factor results:
safety factor for strength = 6.08
safety factor for crack growth = 7.65
safety factor for fatigue = 3.16

Strain gauge results:
strain at gauge = 1199 microstrain
output = 1.20 mV/V at 600 in-lbf using half bridge

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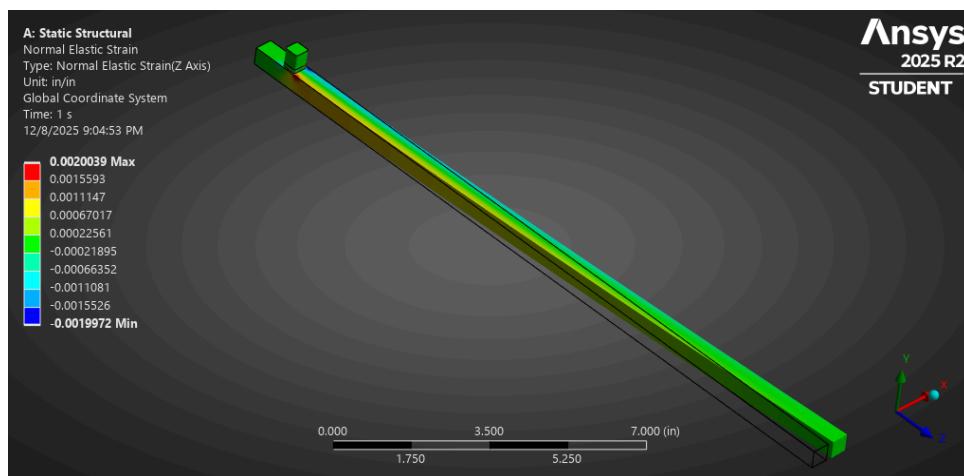
Results of hand calculations with our chosen dimensions and material

3. Diagram of how loads and boundary conditions were applied to the FEM model

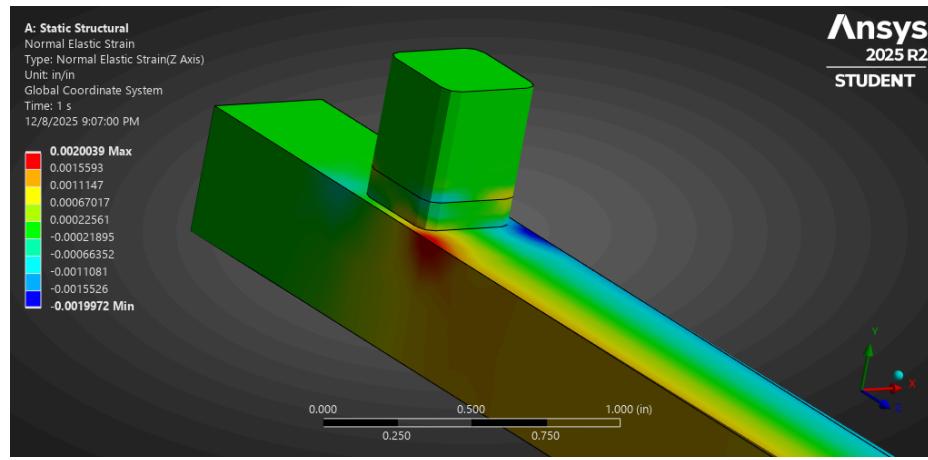


Note: "A" displacement is clamped boundary condition and "B" is applied force

4. Normal strain contours from FEM

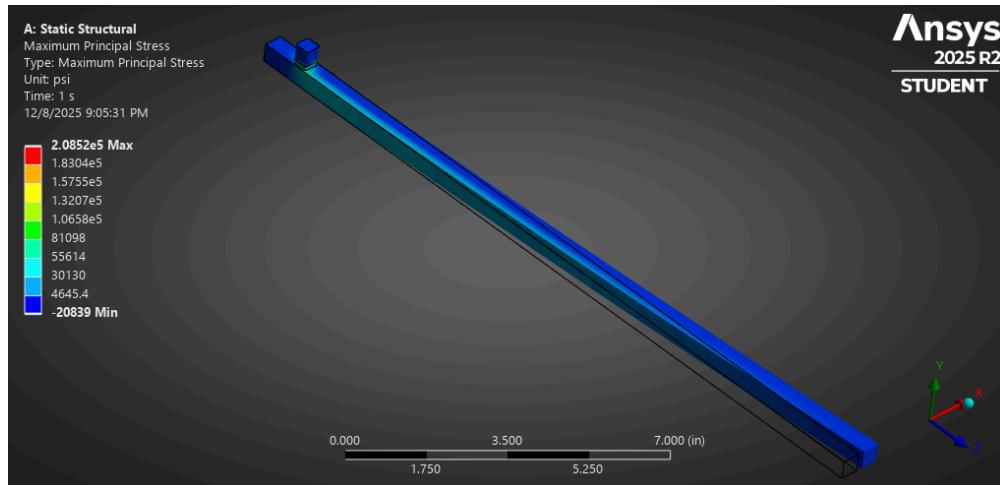


Zoomed out normal strain contour

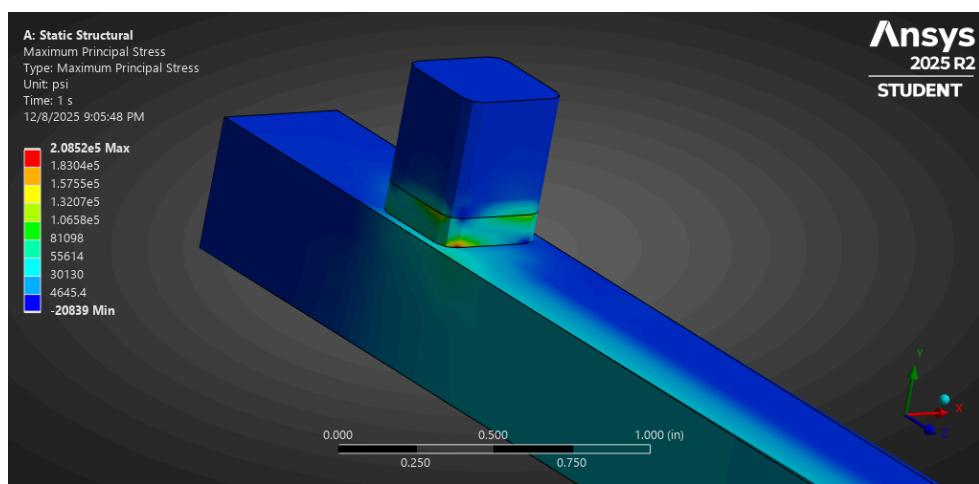


Zoomed in normal strain contour

5. Contour plot of maximum principal stress from FEM

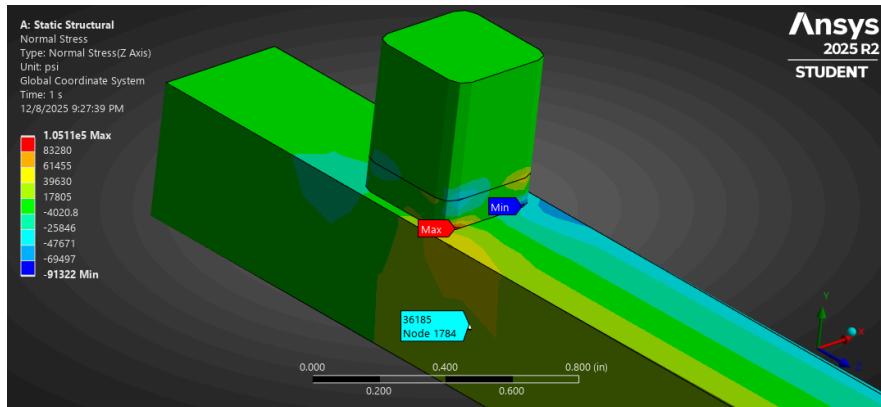


Zoomed out maximum principal stress contour

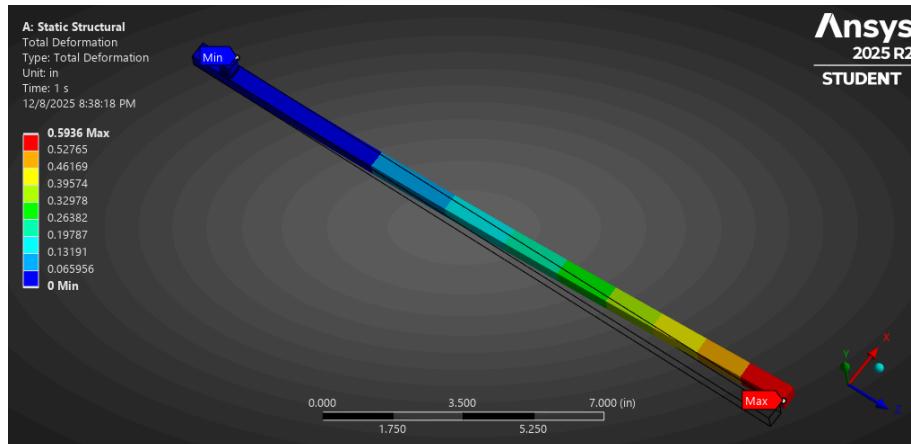


Zoomed in maximum principal stress contour

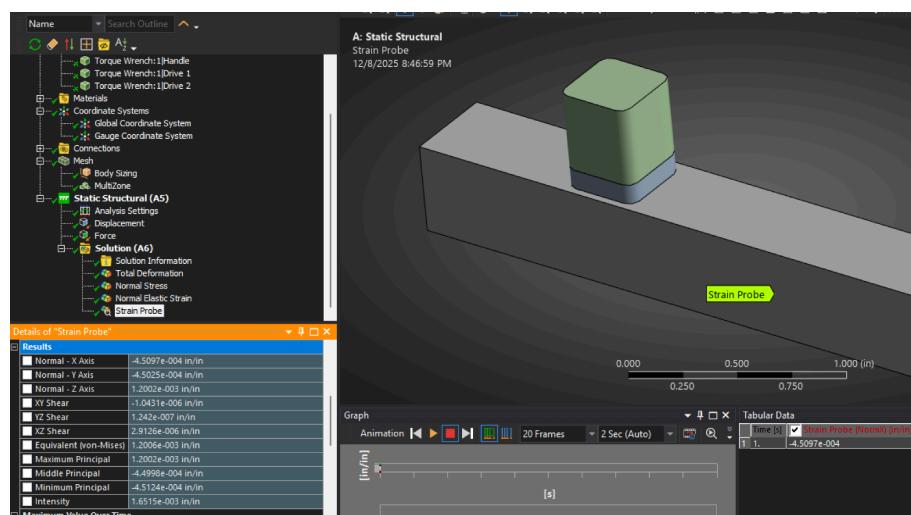
6. Results from FEM calculation



Maximum normal stress = 105.11 ksi



Load point deflection = 0.5936"



Strain at strain gauge = 1200.2 microstrain

7. Torque wrench sensitivity in mV/V using strain from FEM analysis

```
% Strain gauge  
strain = 1.2002e-3;  
output = 1000 * (2 * strain / 2);
```

```
Strain gauge results:  
strain at gauge = 1200 microstrain  
output = 1.20 mV/V at 600 in-lbf using half bridge
```

Torque wrench sensitivity = 1.20 mV/V at 600 in-lbf

8. Strain gauge selected (type and dimensions)

Selected strain gauge: [SGD-2/350-LY11 Linear Strain Gage on DwyerOmega](#), 350 °C Resistance

Gauge Type:

Miniature linear pattern, measurement of stress concentration

Dimensions:

Grid length = 6 mm

Grid width = 6.3 mm = 0.248 in.

(Note: The grid width is less than the width of the torque wrench, b)