

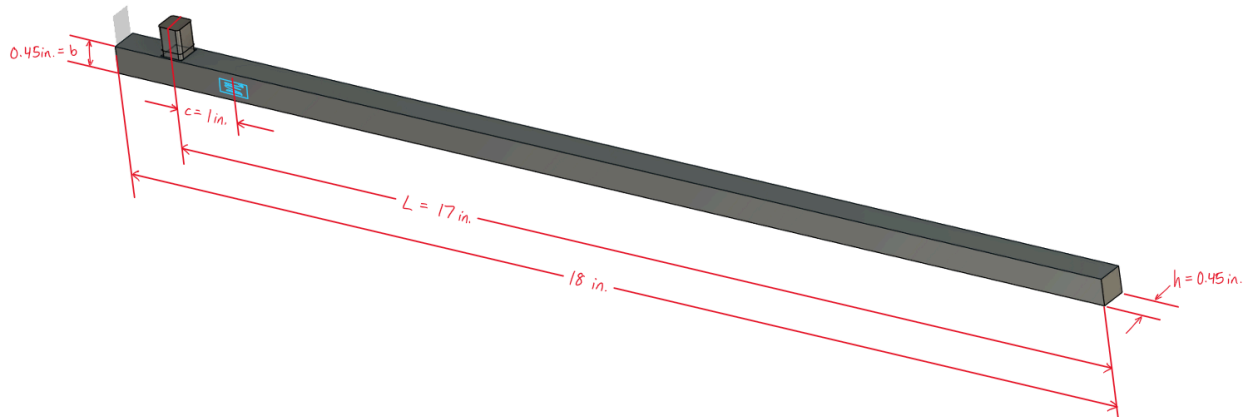
# MAE 3270 Final Homework

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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';
E = 31.E6;                            % Young's modulus (psi)
nu = .375;                            % Poisson's ration (dimensionless)
su = 240.E3;                          % tensile strength -- use yield or ultimate strength depending
on material (psi)
KIC = 120.E3;                         % fracture toughness (psi sqrt(in))
sfatigue = 125.E3;                    % fatigue strength from Granta for 10^6 cycles
```

Mechanical properties of Fe-5Cr-Mo-V and our chosen dimensions

```

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

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

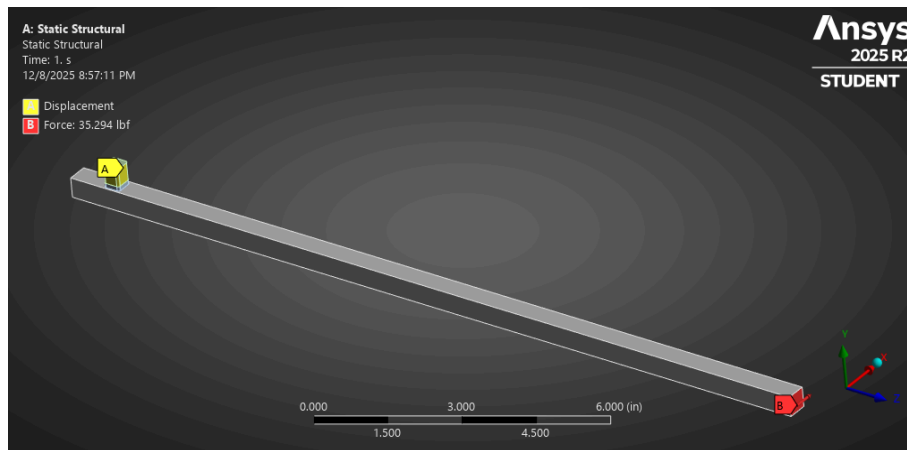
Safety factor results:
safety factor for strength = 6.08
safety factor for crack growth = 7.65
safety factor for fatigue = 3.16

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

```

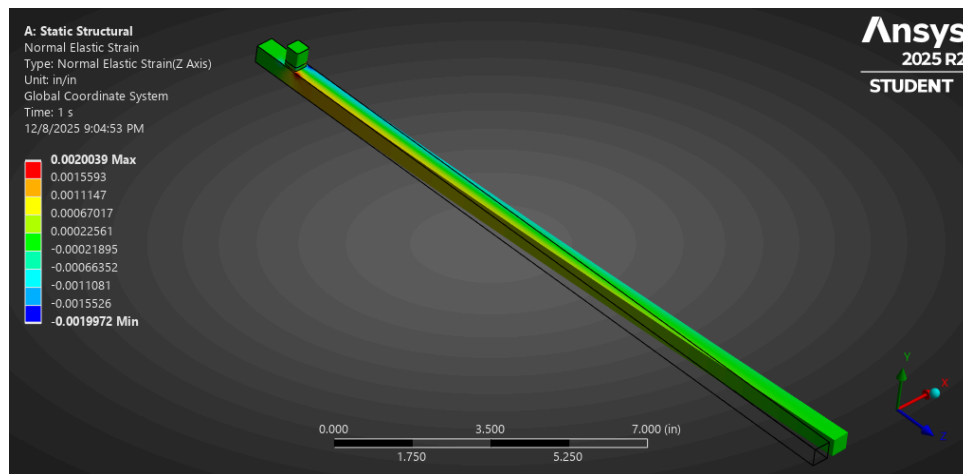
Results of hand calculations with our chosen dimensions and material

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

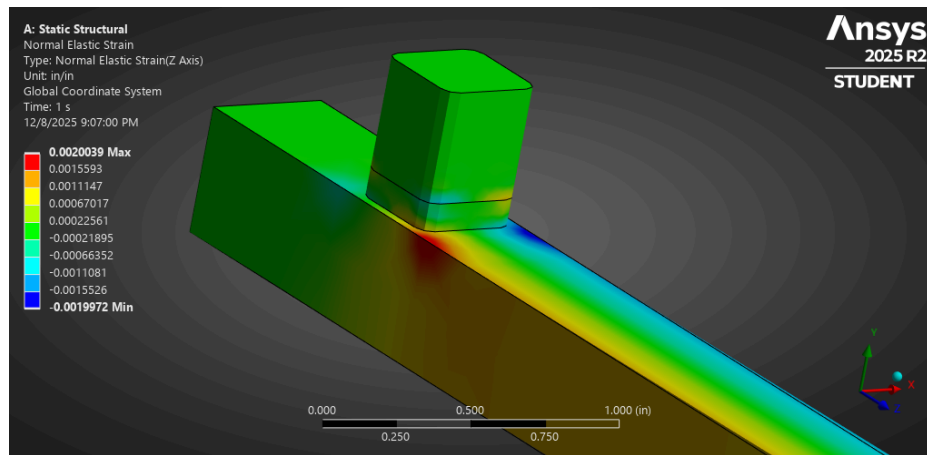


Note: “A” displacement is clamped boundary condition and “B” is applied force

- Normal strain contours from FEM

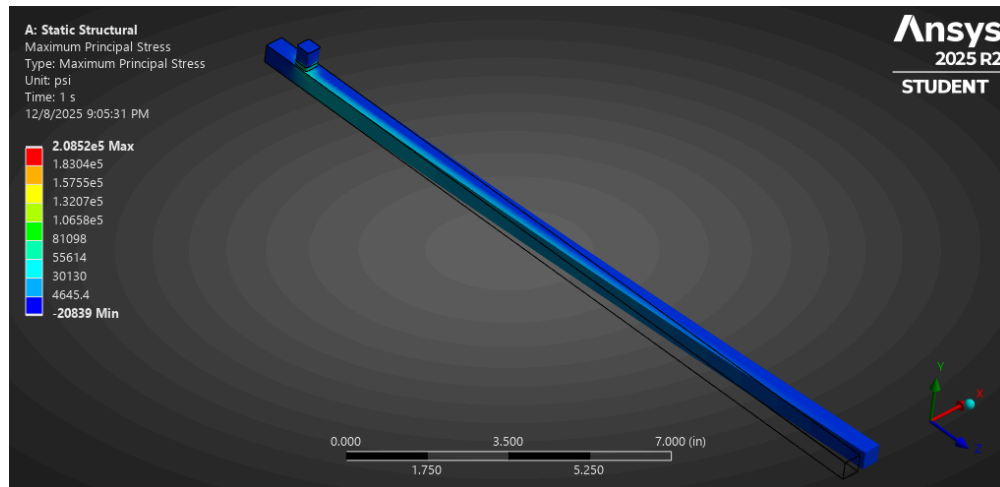


Zoomed out normal strain contour

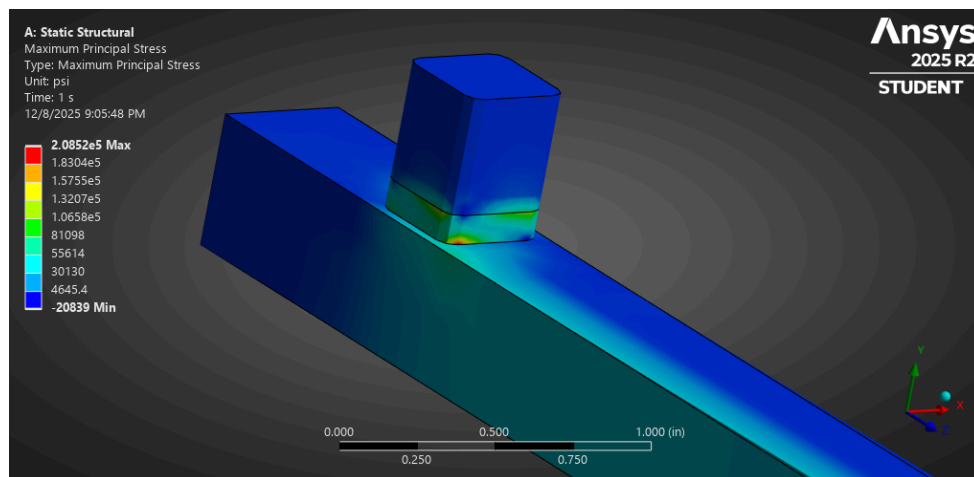


Zoomed in normal strain contour

##### 5. Contour plot of maximum principal stress from FEM

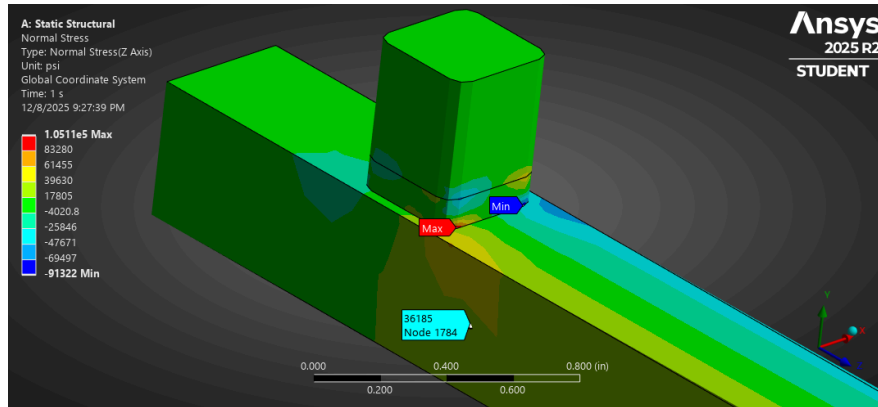


Zoomed out maximum principal stress contour

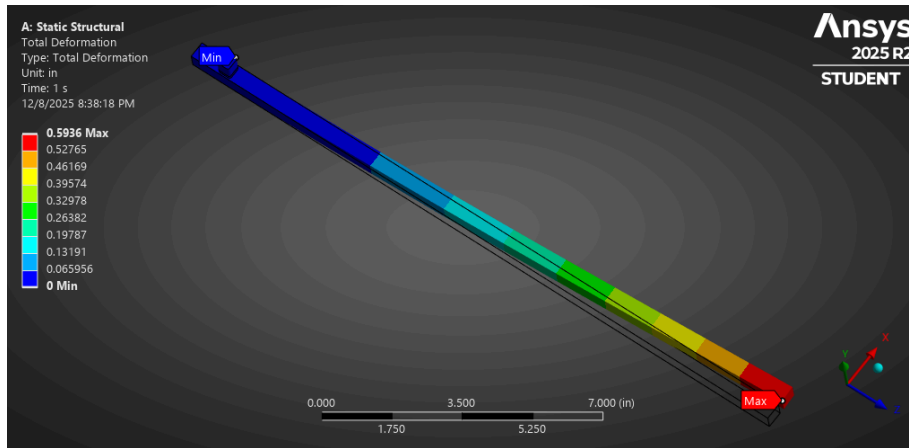


Zoomed in maximum principal stress contour

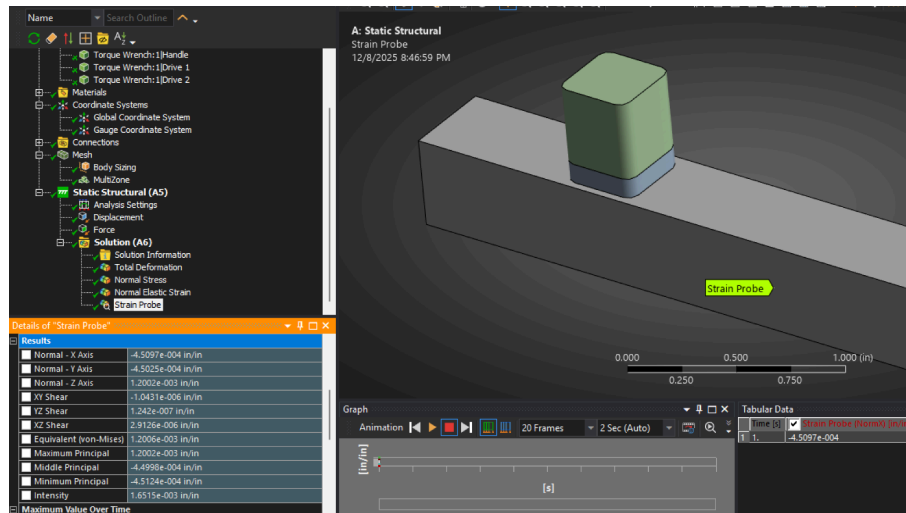
## 6. Results from FEM calculation



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  $\Omega$  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)