MAE 3270
Final Homework Analysis
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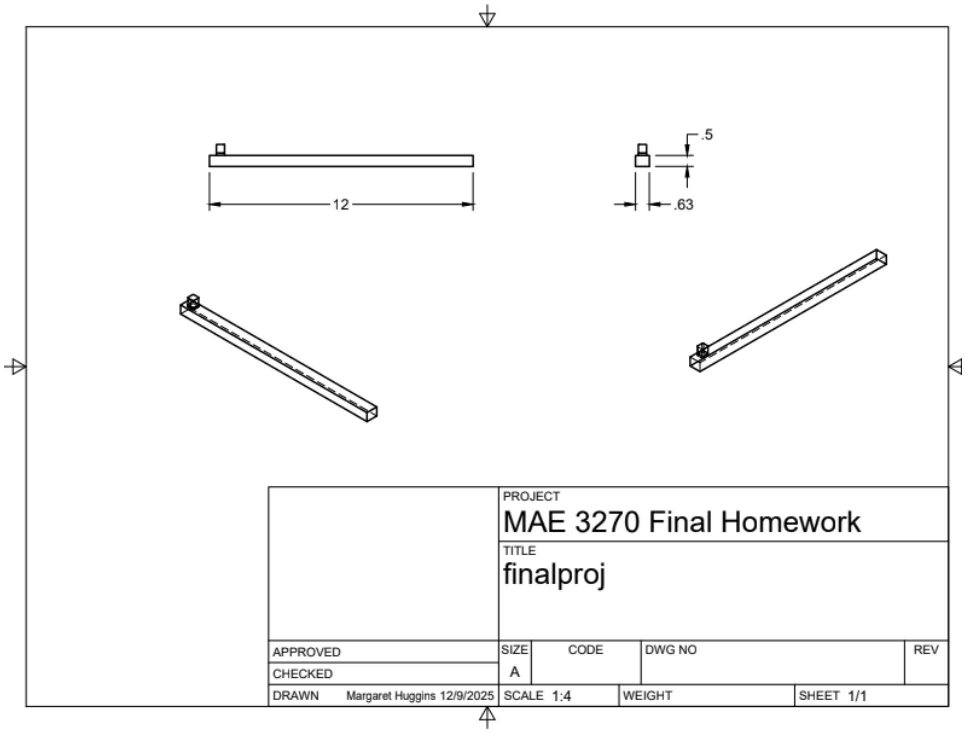
12/10/2025

5.1.2 Results:

1. **Image of CAD model:**

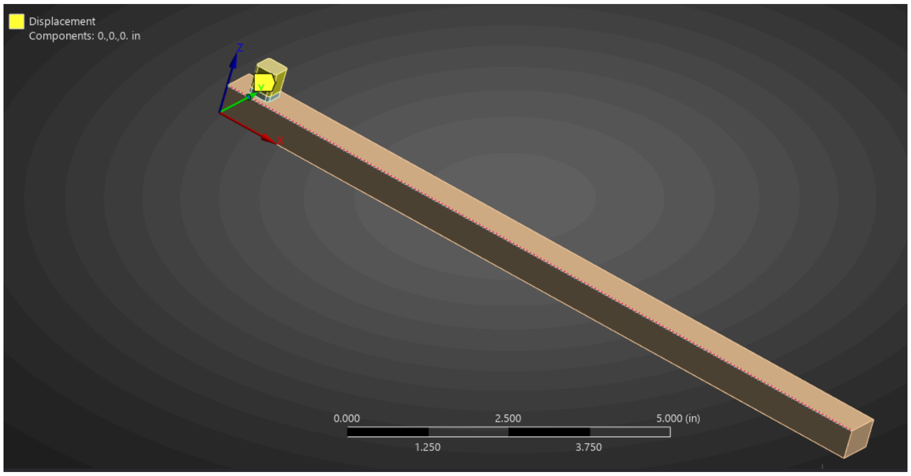


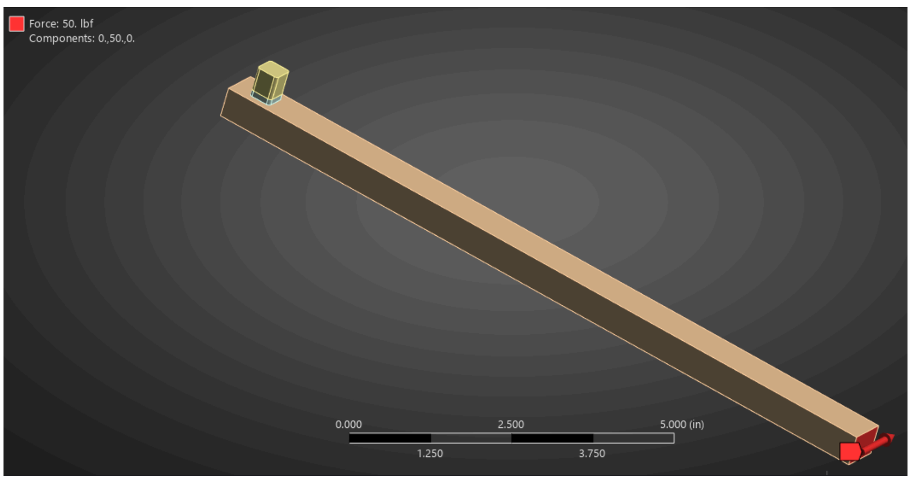
2. **We used Titanium Alloy, Ti-6Al-4V, annealed**

which has the following material properties:
Young's Modulus: 16×10^{6} psi
Poisson's Ratio = .31
Tensile Strength = 125×10^{3} psi
Fracture Toughness = 76.4×10^{3} psi*in$^{1/2}$
Fatigue Strength for 10^{6} cycles = 52×10^{3}

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

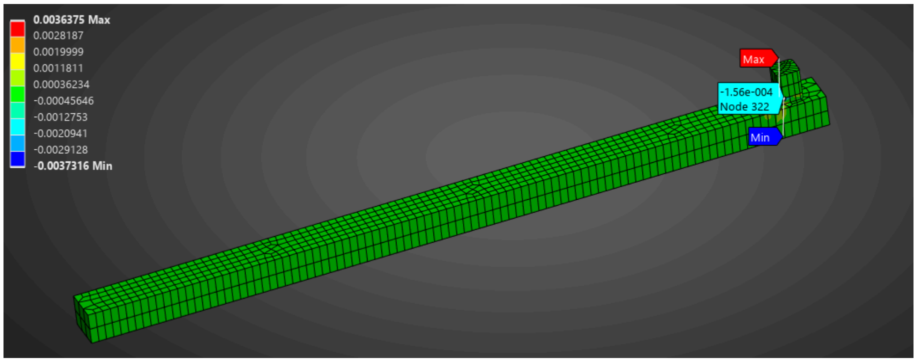
We clamped the model on all sides at the top of the bit portion (as highlighted in yellow) and applied a load of 50 lbf to the yz face of the wrench handle.

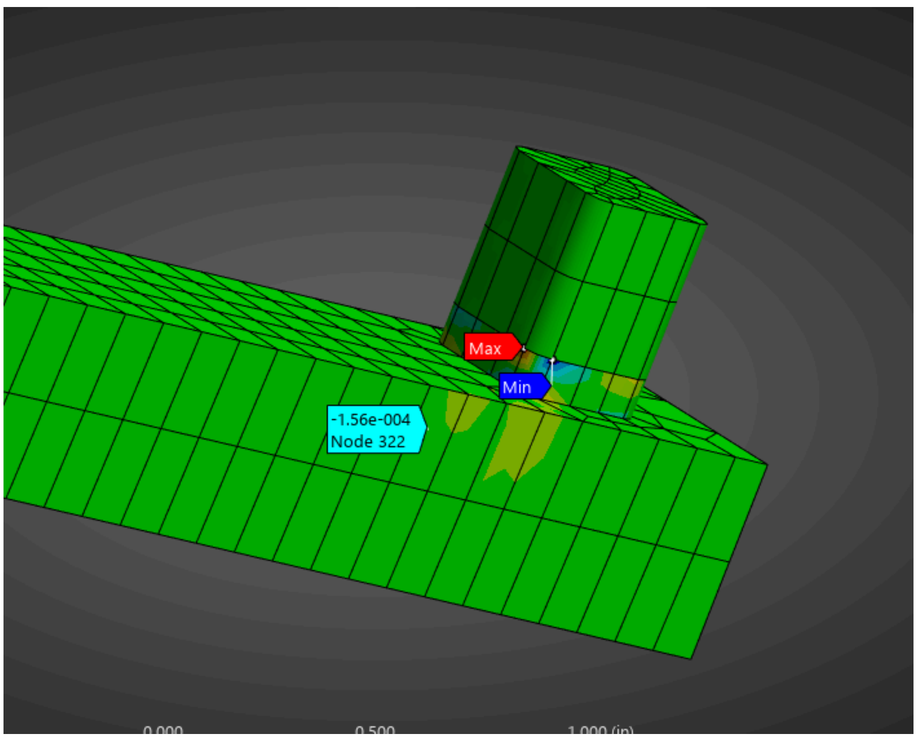




4. **Normal strain contours (in the strain gauge direction) from FEM**

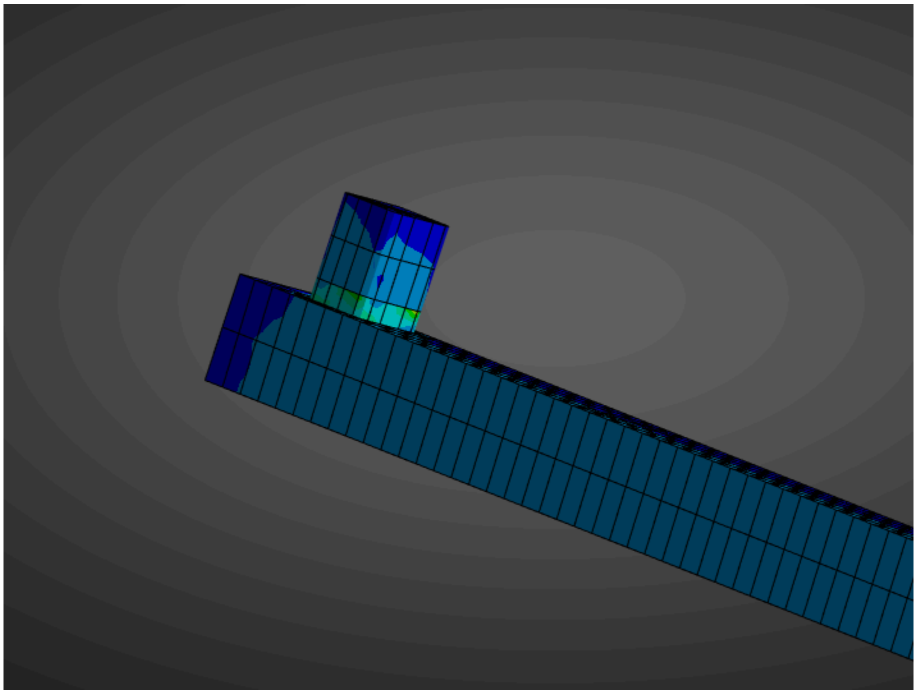
The strain is roughly constant throughout the entire model except for around the connection between the clamped and unclamped portion of the bit.

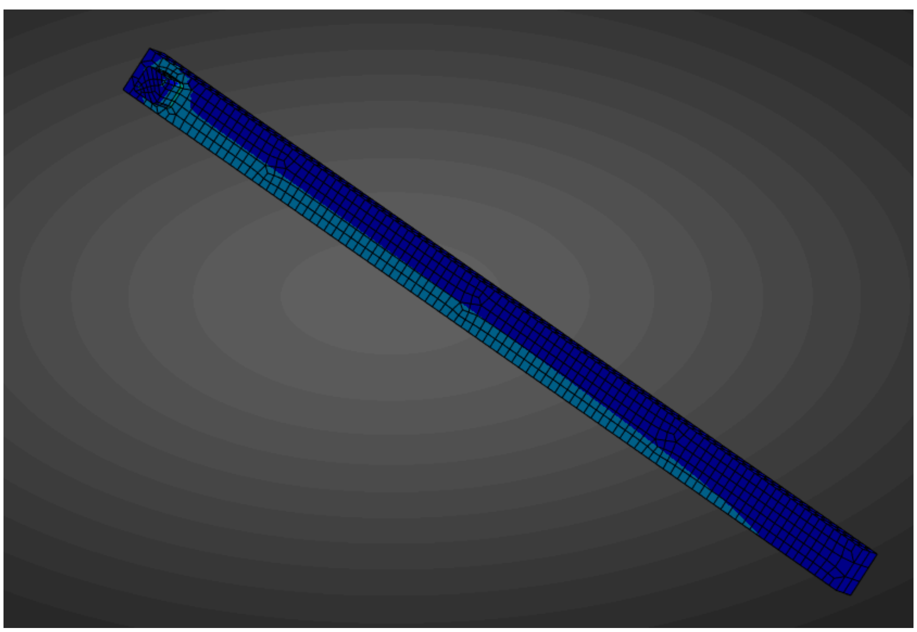


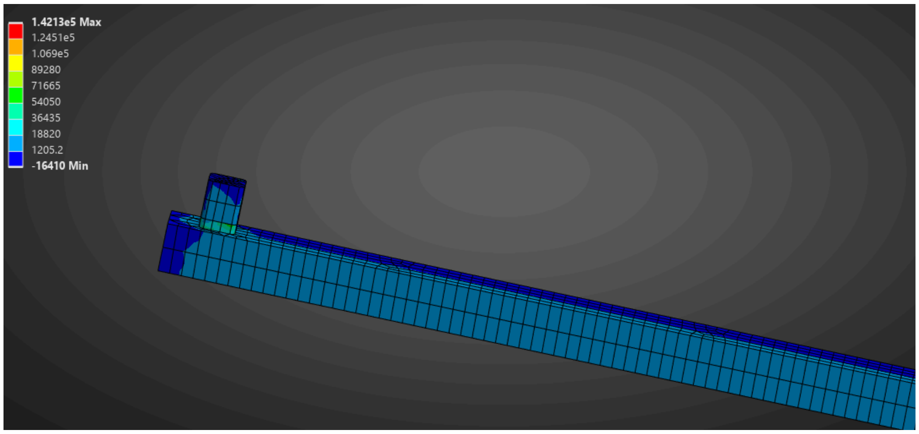


5. **Contour plot of maximum principal stress from FEM.**

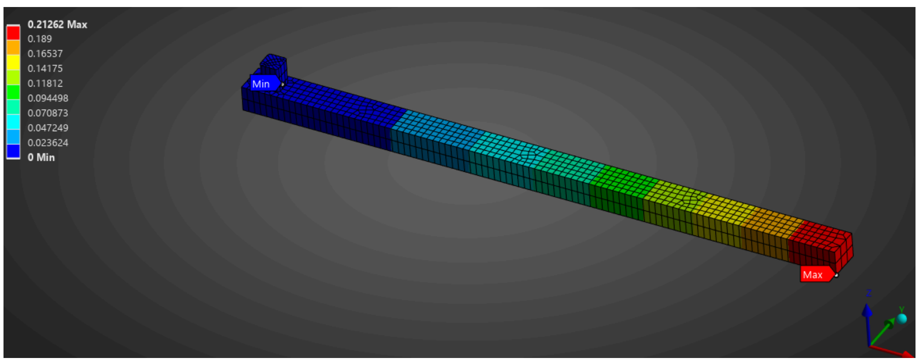
The wrench handle is half in tension and half in compression, this aligns with what we know about applying force to fixed beams. Furthermore, the maximum stress appears in the body that serves as the connection be







6. **Summary of the results from FEM calculation showing maximum normal stress (anywhere), load point deflection, strains at the strain gauge locations**



Maximum Normal Stress: 14213 psi

Strain at Strain Gauge location: $9.8497\text{x}10^{-4}$ in/in (985 microstrain)

Deflection of load point: 0.21262 in

7. **The Torque wrench sensitivity in mV/V using strains from the FEM analysis is 0.985 mV/V**

This is slightly less than the required sensitivity, however the calculated sensitivity was larger than 1 mV/V.

8. **Strain gauge selection:**

We selected the SGD-5/350-LY43 Linear strain gauge. This gauge has a carrier area of 9.8 x 5.2 mm^2 or 0.386 x 0.205in^2, meaning it will fit comfortably within the wrench handle. This is a linear pattern strain gauge.