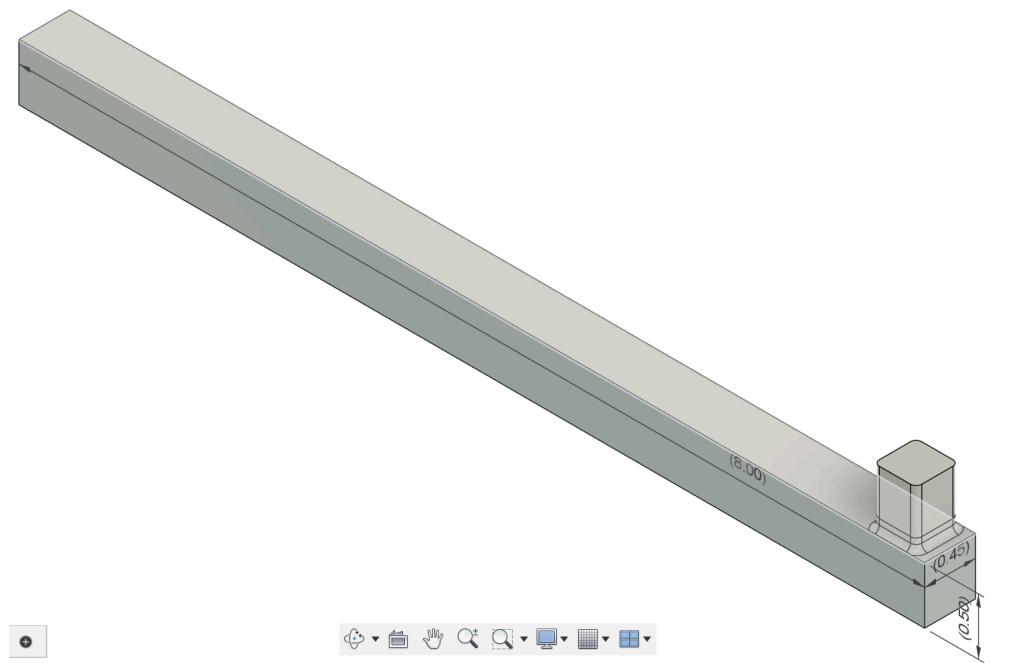


1. Image(s) of CAD model. Must show all key dimensions.



2. Describe the material used and its relevant mechanical properties.

Material: Titanium Ti-6Al-4V (Grade 5), Annealed

Subcategory: Alpha/Beta Titanium Alloy; Metal; Nonferrous Metal; Titanium Alloy

Material properties:

Young's modulus: 16.1E6

Poisson's ratio: 0.35

Tensile strength: 148E3

Fracture toughness: 74.6E3

Fatigue strength: 90E3

--- inputs ---

b,h = 0.450 , 0.500 in

c = 1.00 in

--- results ---

sigma (ksi) = 32.00

strain (ue) = 1739

tip defl (in) = 0.1696

SF_yield = 4.62

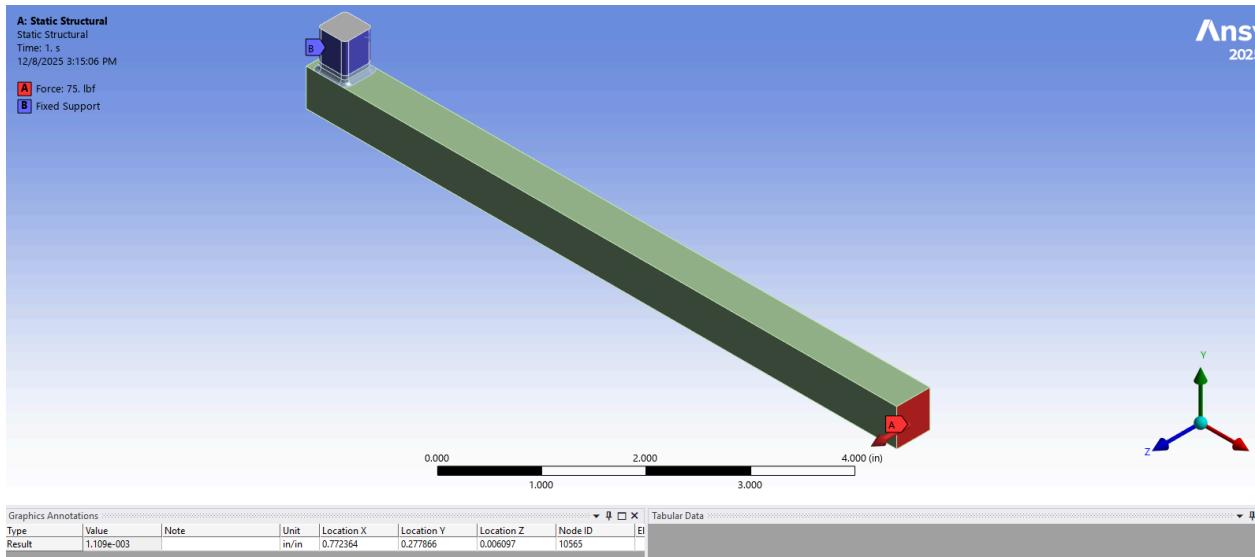
SF_K = 5.87

SF_fatigue = 2.81

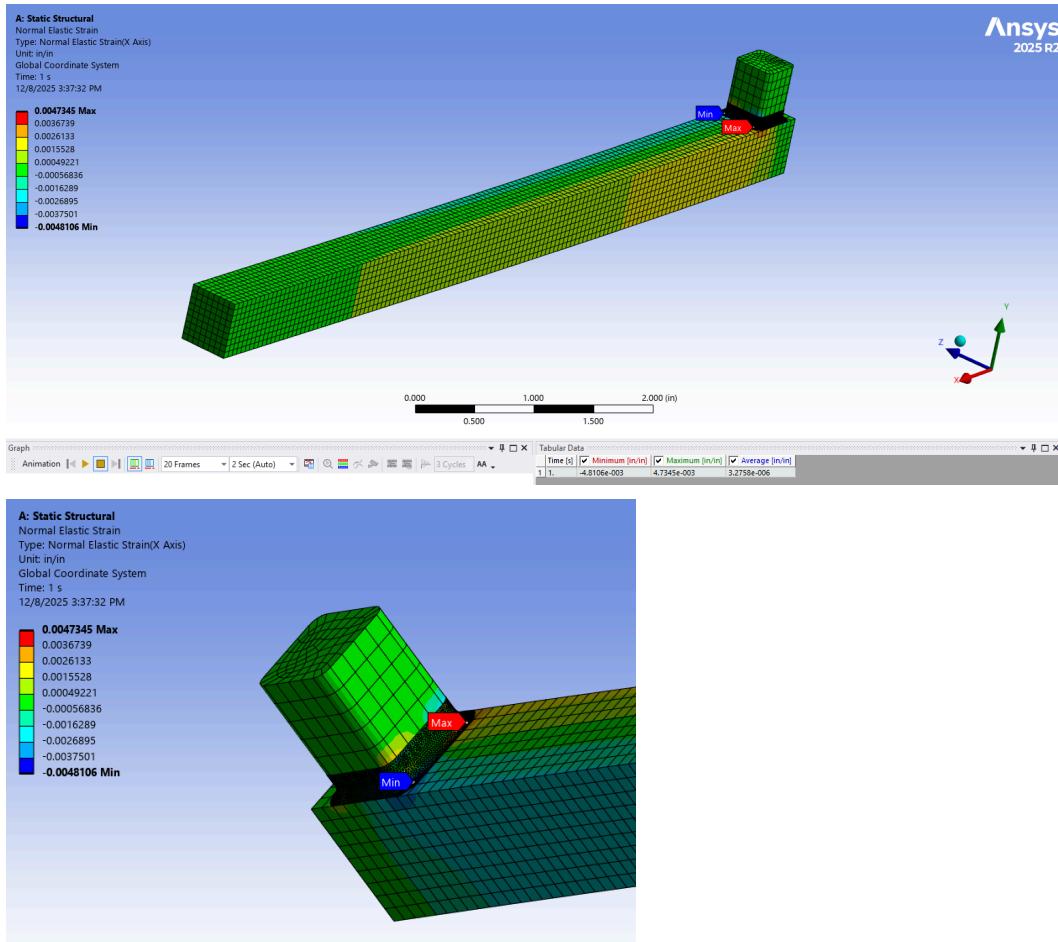
output (mV/V) = 1.739

sens (mV/V per in-lbf) = 0.00290

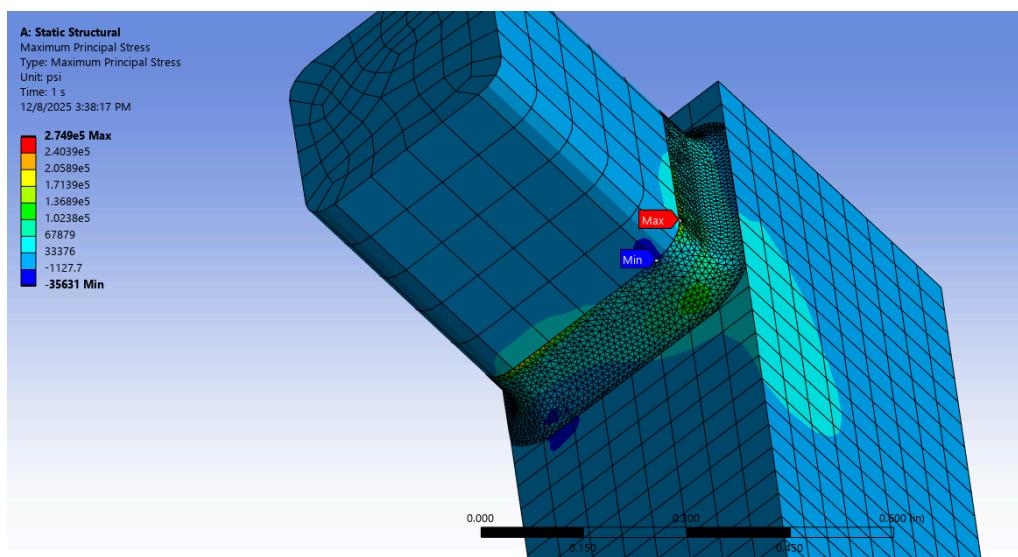
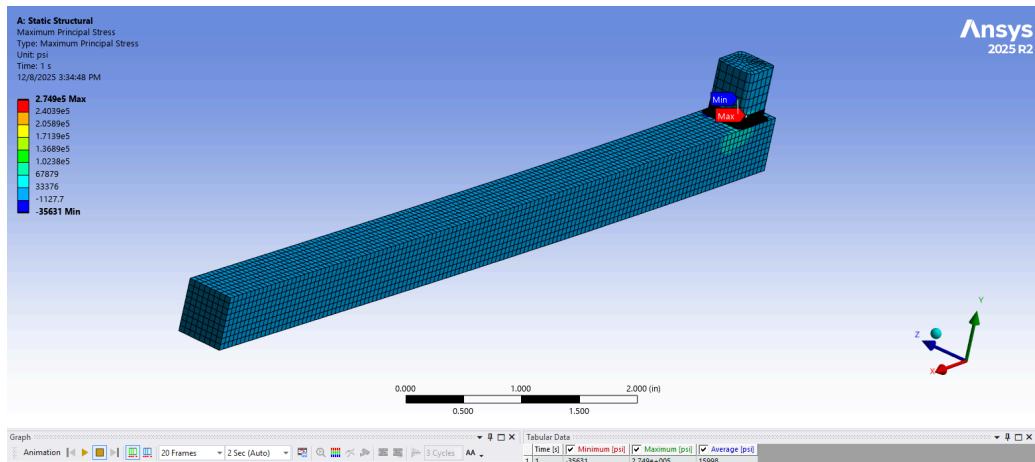
3. Diagram communicating how loads and boundary conditions were applied to your FEM model.



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

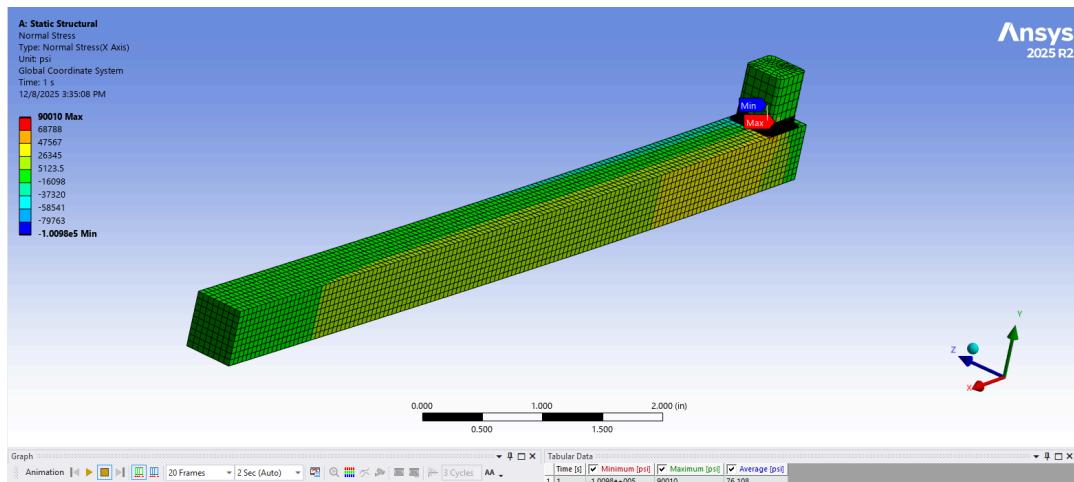


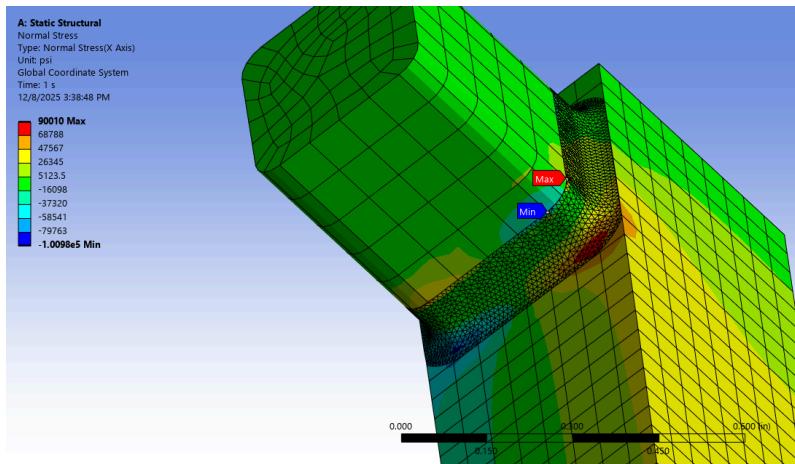
5. Contour plot of maximum principal stress from FEM



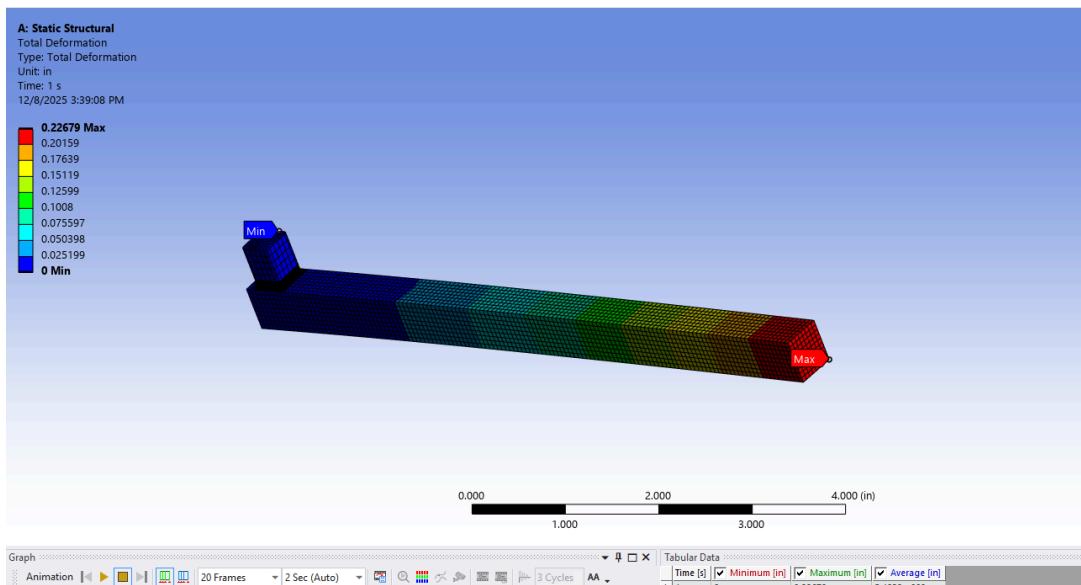
6. Summarize results from FEM calculation showing maximum normal stress (anywhere), load point deflection, strains at the strain gauge locations

Normal stress: Max= 90010 psi Min=-100980 psi

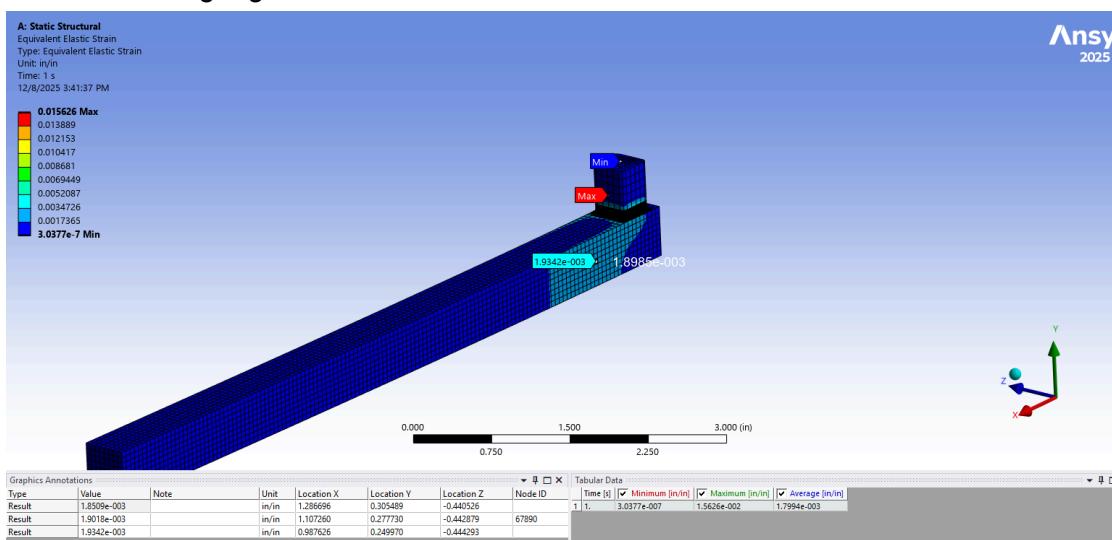




Tip deformation: 0.22679in



Strain at strain gauge: 1934microstrain



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

Torque wrench sensitivity is directly correlated with outputs:

$$\text{Output} = k \cdot \text{strain}/2 = 2 \cdot 1.934/2 = \mathbf{1.934 \text{mV/V}}$$

8. Strain gauge selected (give type and dimensions). Note that design must physically have enough space to bond the gauges.



For this design, a single-element linear metal-foil strain gauge is selected so it can be aligned with the principal bending strain on the wrench arm and still comfortably fit on the machined flat.

- Type: 350 Ω constantan foil, single axial element
- Gauge length: ~3 mm
- Grid width: ~2 mm
- Overall backing footprint: about 5 mm \times 3–4 mm

This size is small enough to bond fully on the available flat area of the torque wrench handle, while still long enough to average the local strain field and give a stable, repeatable signal.