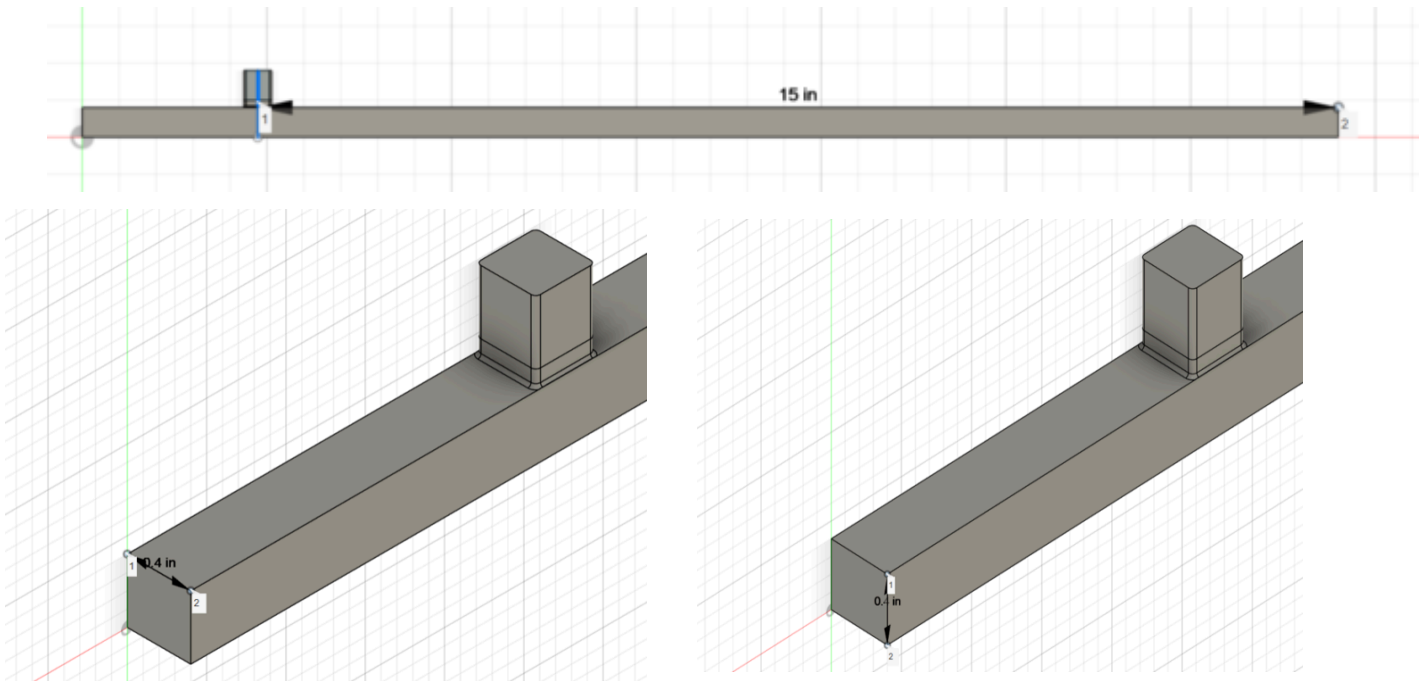


Wrench Design

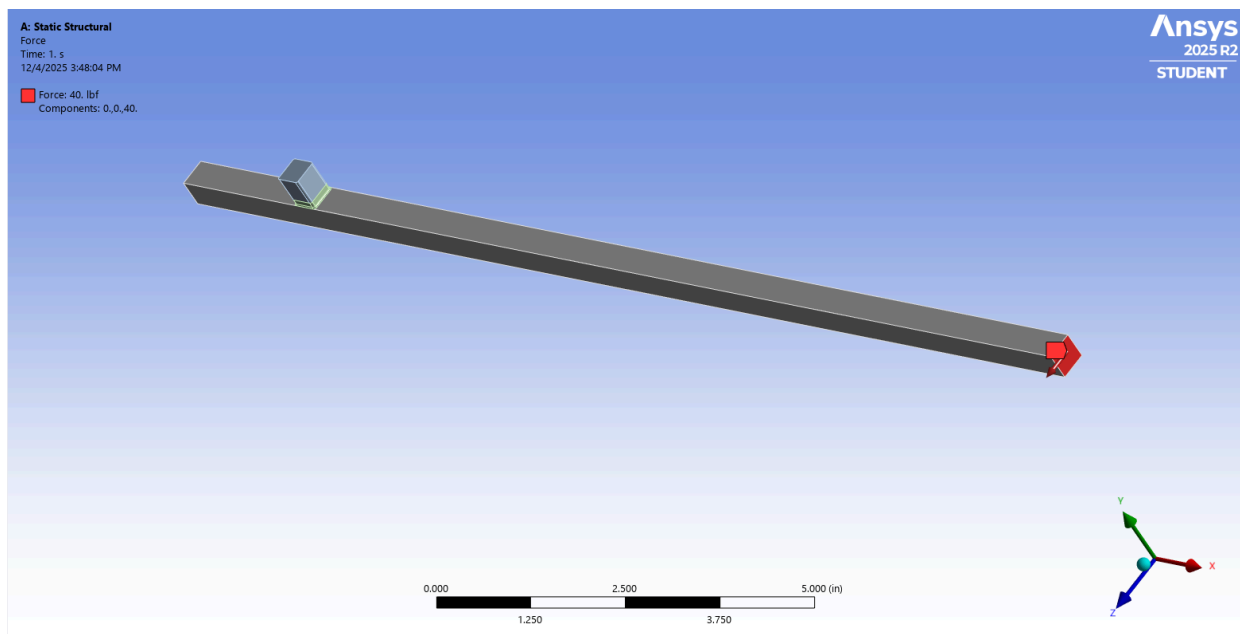
1. Cad picture dimensions: $L = 15\text{ in}$, $B = 0.4\text{ in}$, $H = 0.4\text{ in}$

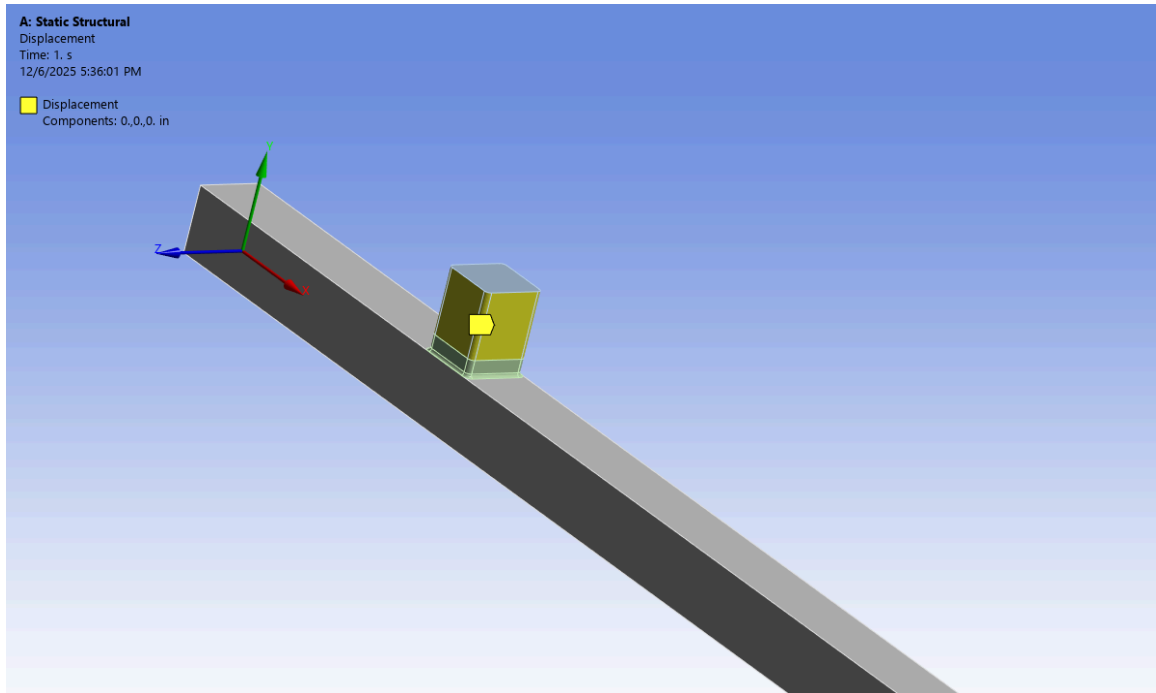


2. Material

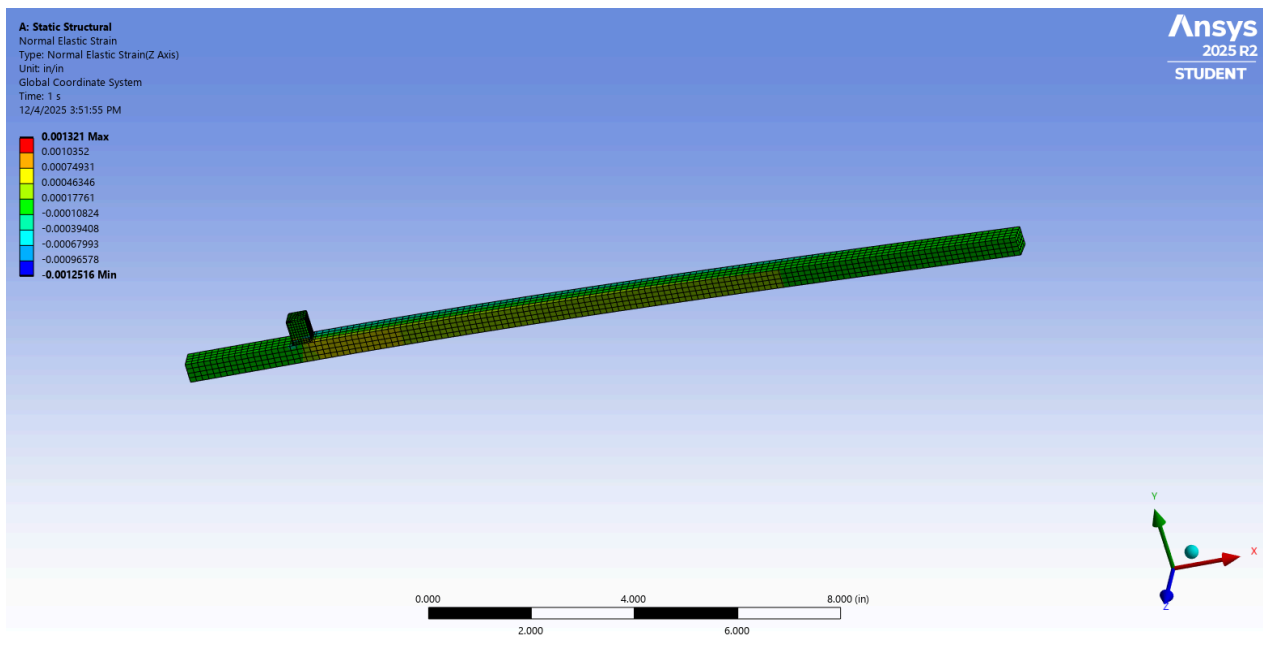
I decided to use AISI 6150 low alloy steel, oil quenched & tempered at 425C, which is typically the material used to make wrenches. In addition, the properties of this material seemed very strong a yield strength of 173-212 ksi and a fracture toughness of 28.2-51 ksi.in^{0.5}

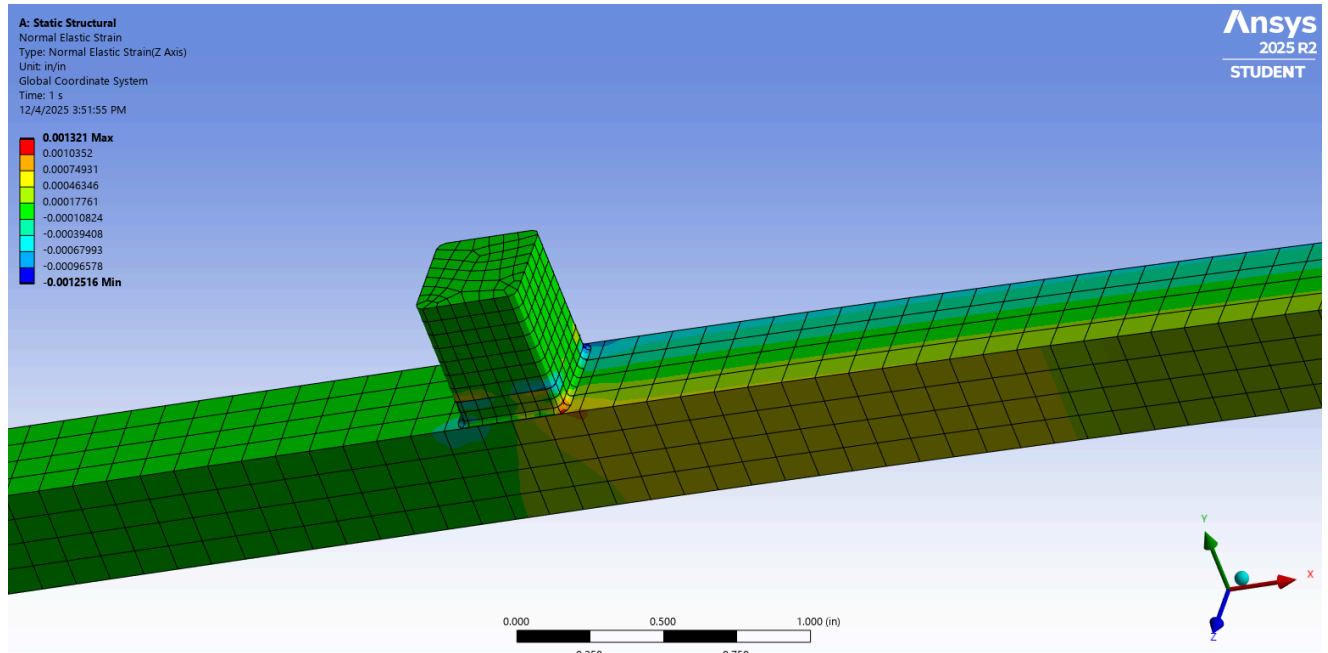
3. How load was applied and boundary conditions



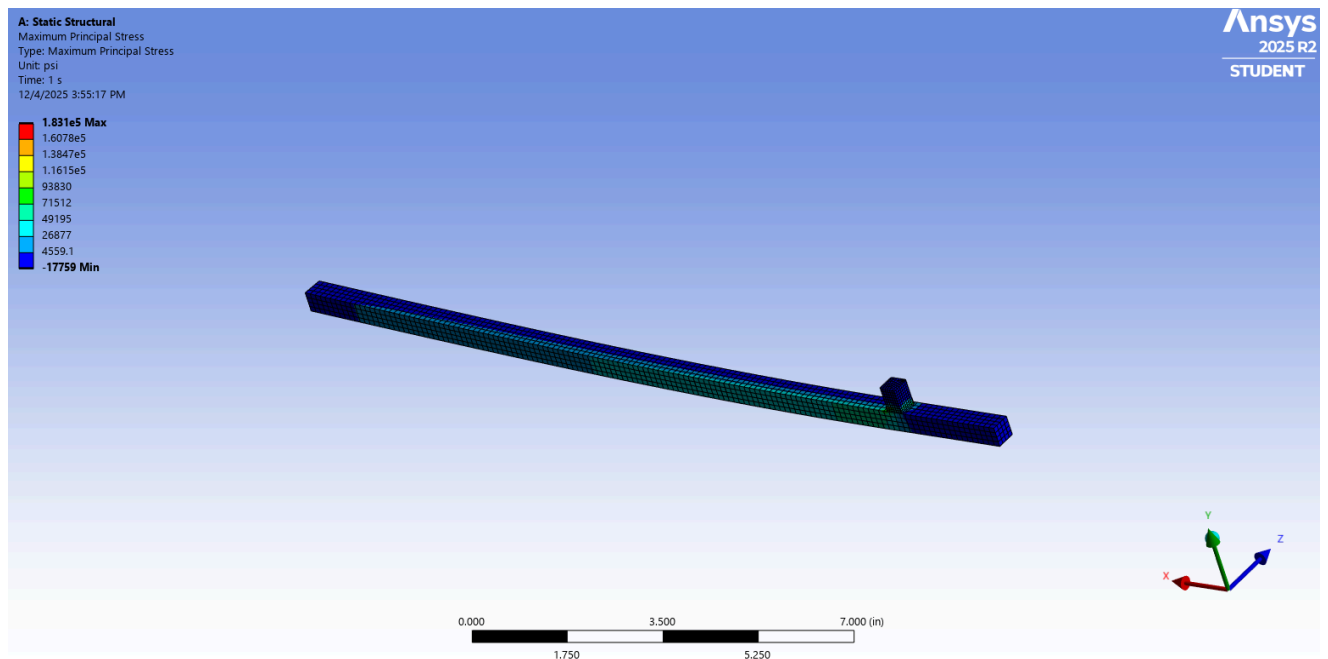


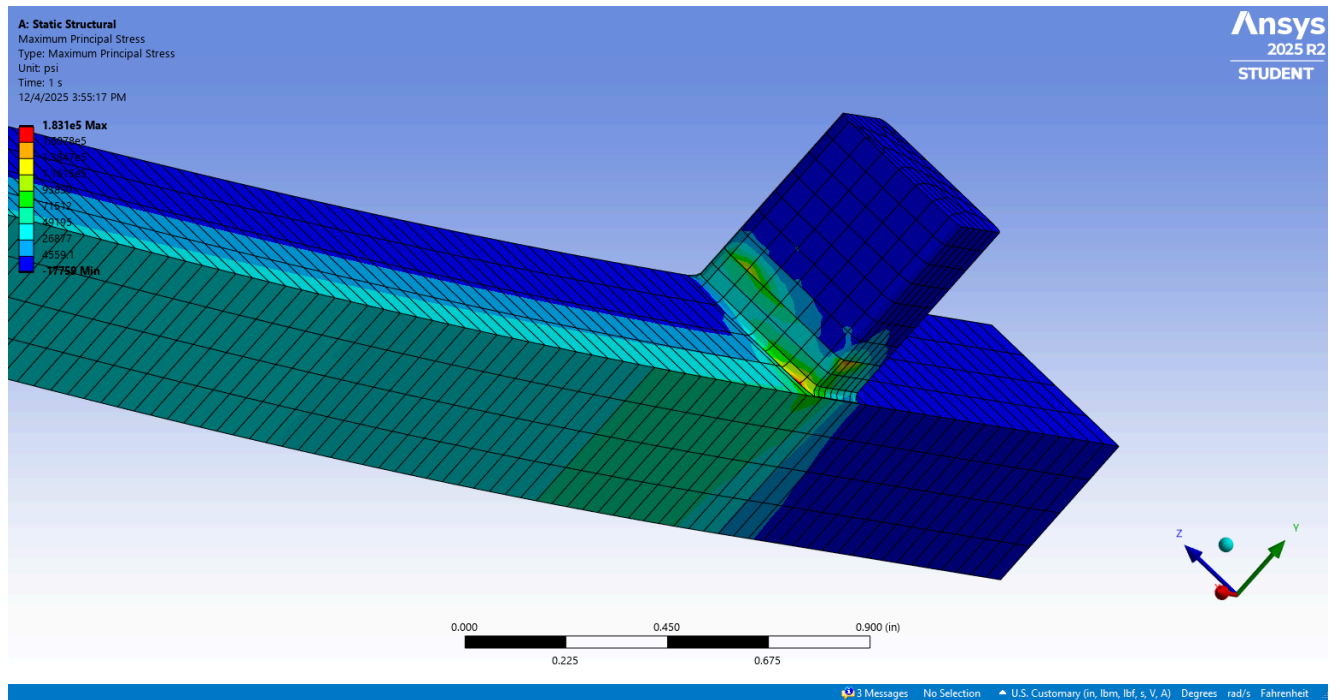
4. Normal strain contours



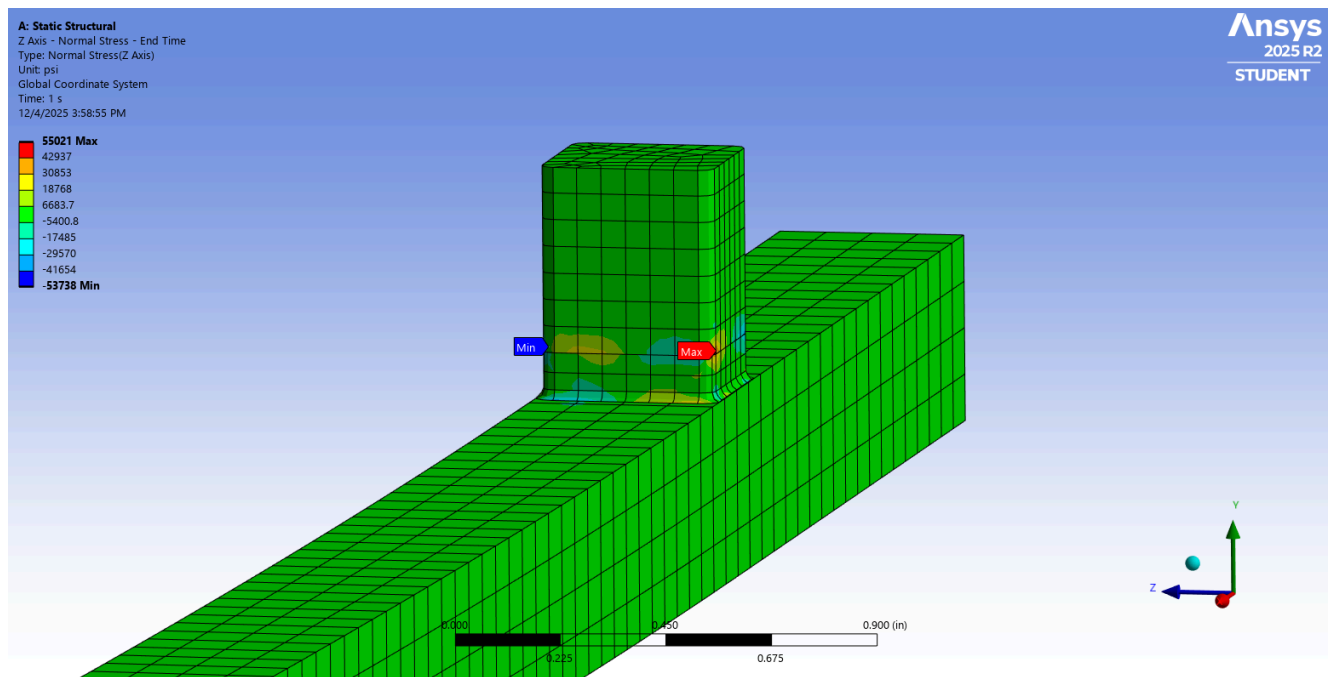


5. Max principle stress

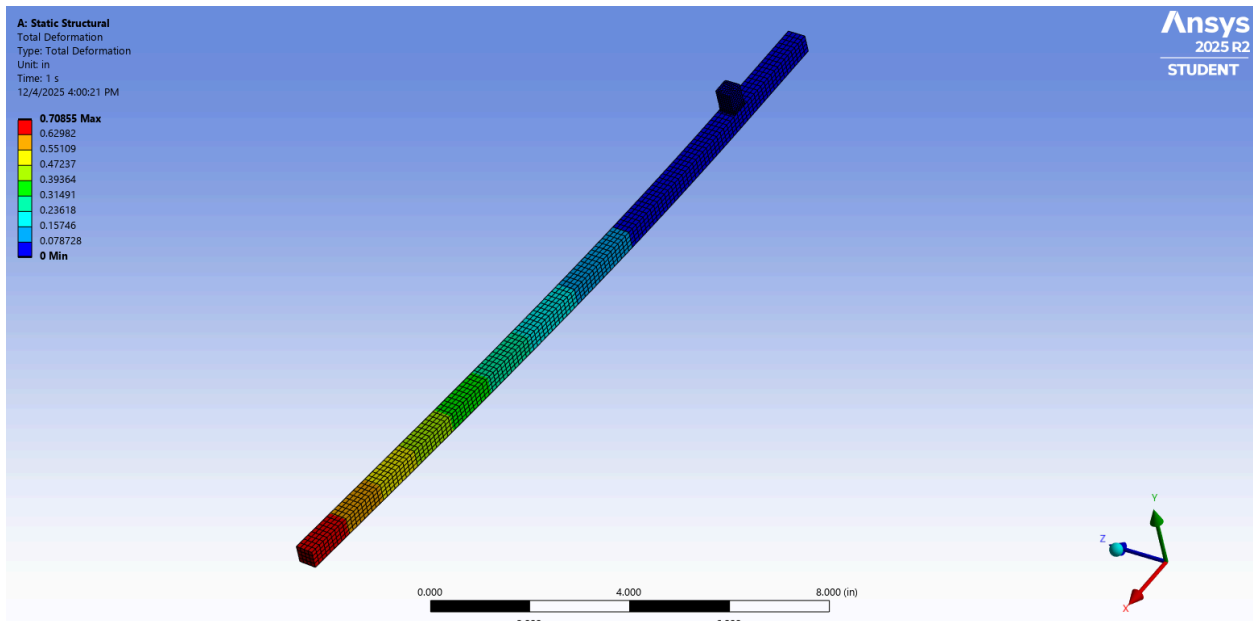




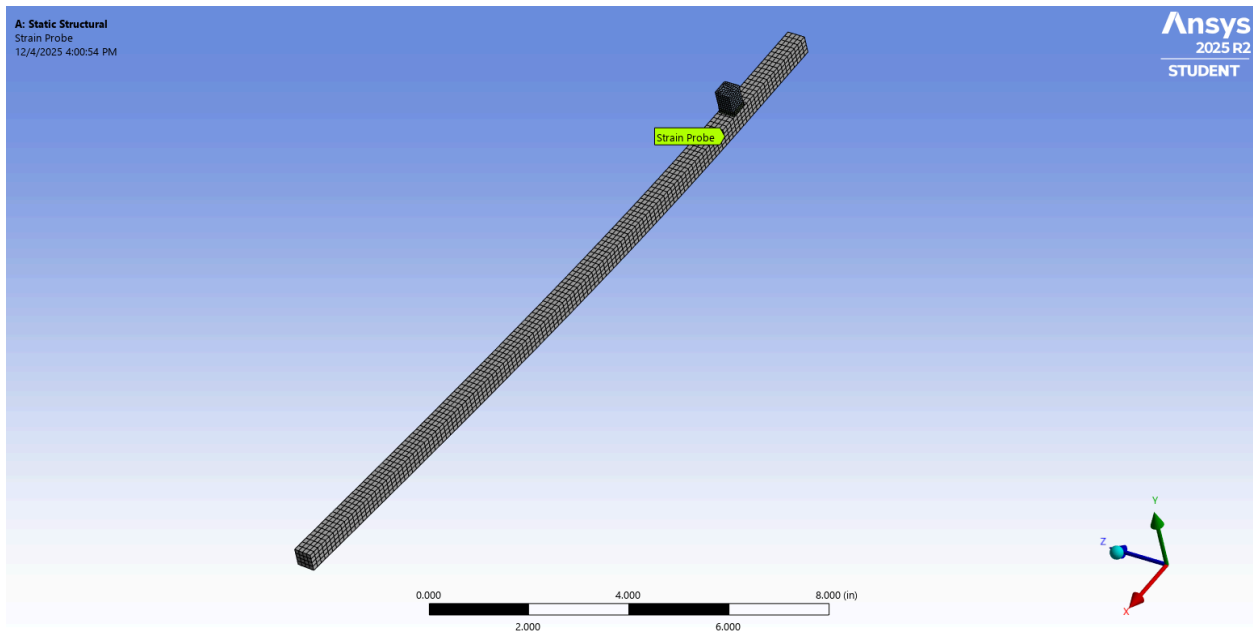
6. Max normal stress



Load point deflection



Strain at strain gauge



Results		
<input type="checkbox"/>	Normal - X Axis	1.7991e-003 in/in
<input type="checkbox"/>	Normal - Y Axis	-5.1172e-004 in/in
<input type="checkbox"/>	Normal - Z Axis	-5.1307e-004 in/in
<input type="checkbox"/>	XY Shear	-9.8493e-006 in/in
<input type="checkbox"/>	YZ Shear	-9.7371e-007 in/in
<input type="checkbox"/>	XZ Shear	1.1444e-006 in/in
<input type="checkbox"/>	Equivalent (von-Mises)	1.7988e-003 in/in
<input type="checkbox"/>	Maximum Principal	1.7991e-003 in/in
<input type="checkbox"/>	Middle Principal	-5.1157e-004 in/in
<input type="checkbox"/>	Minimum Principal	-5.1323e-004 in/in
<input type="checkbox"/>	Intensity	2.3123e-003 in/in

Our handcalculations:

AISI 6150 Low Alloy Steel (our design)

$\sigma =$

5.6250e+04

deflection =

0.7224

SF_strength =

4.3022

SF_cack =

2.0150

SF_fatigue =

1.5986

strain_output =

1.7979

The results from the FEM calculations show that the max normal stress is 55.021 ksi, the load point deflection is 0.70855in, and the strain at the gauge is 1.7991 e-003in/in. These values are basically identical to our hand calculations using our code which showed that the max normal stress is 56.25 ksi, the load point deflection is 0.7224in, and the strain at the gauge is 1.8 e-003 in/in

7. Torque wrench sensitivity= $1.7979 \times 10^{-3} \times 1000 = 1.7979 \text{ mV/V}$

8. Pick a gauge

We will use a standard 5.46 mm (0.215") half-bridge ribbon lead compensated for steel strain gauge.

Link: https://sea.omega.com/th/pptst/SGT_Half-Bridge-Uniaxial.html?bt=cart

