

# Torque Wrench Design

## CAD Model



Figure 1: CAD model of overall torque wrench with dimensions.

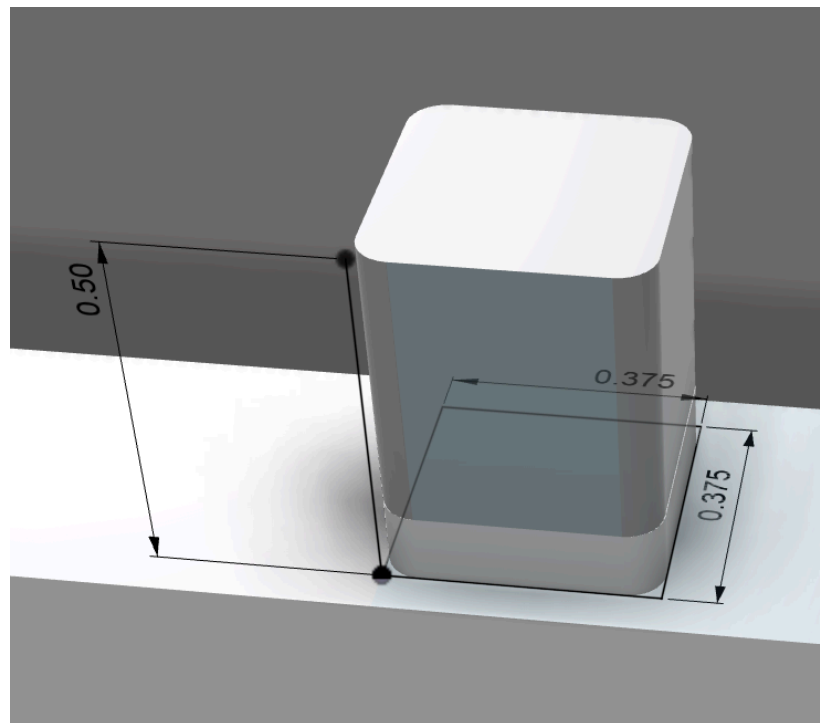


Figure 2: CAD model of drive with dimensions.

## Material Information

**Material Name:** titanium, alpha alloy, Ti-5Al-2.5Sn-0.5Fe, annealed

### **Mechanical Properties:**

Young's modulus (psi)	16E6
Yield strength (ksi)	118
Fracture toughness ( $\text{ksi}\sqrt{\text{in}}$ )	88
Fracture strength for $10^6$ cycles (ksi)	70

# From FEM Analysis

## Load and Boundary Conditions in FEM Model

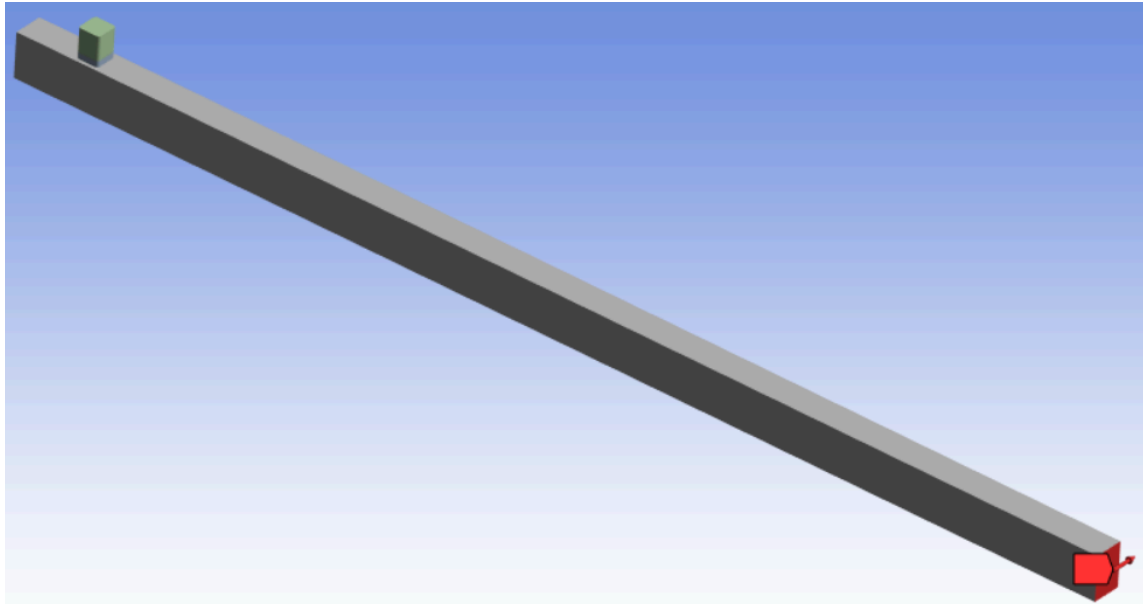


Figure 3: Model with load at end of wrench.

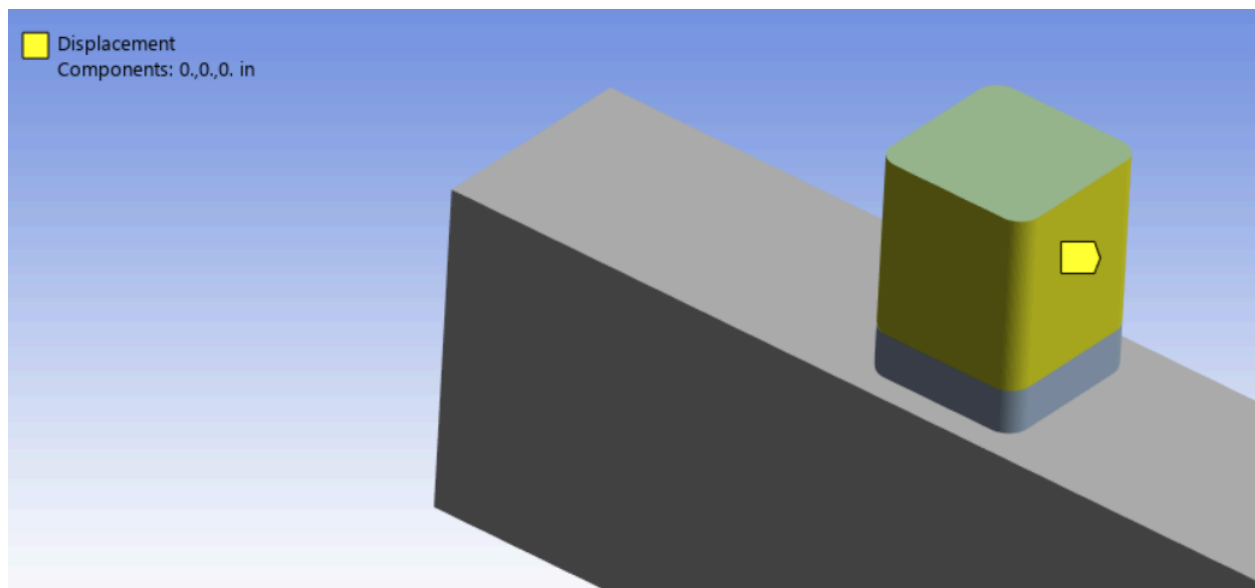


Figure 4: Model with fixed drive.

## Normal Strain Contours

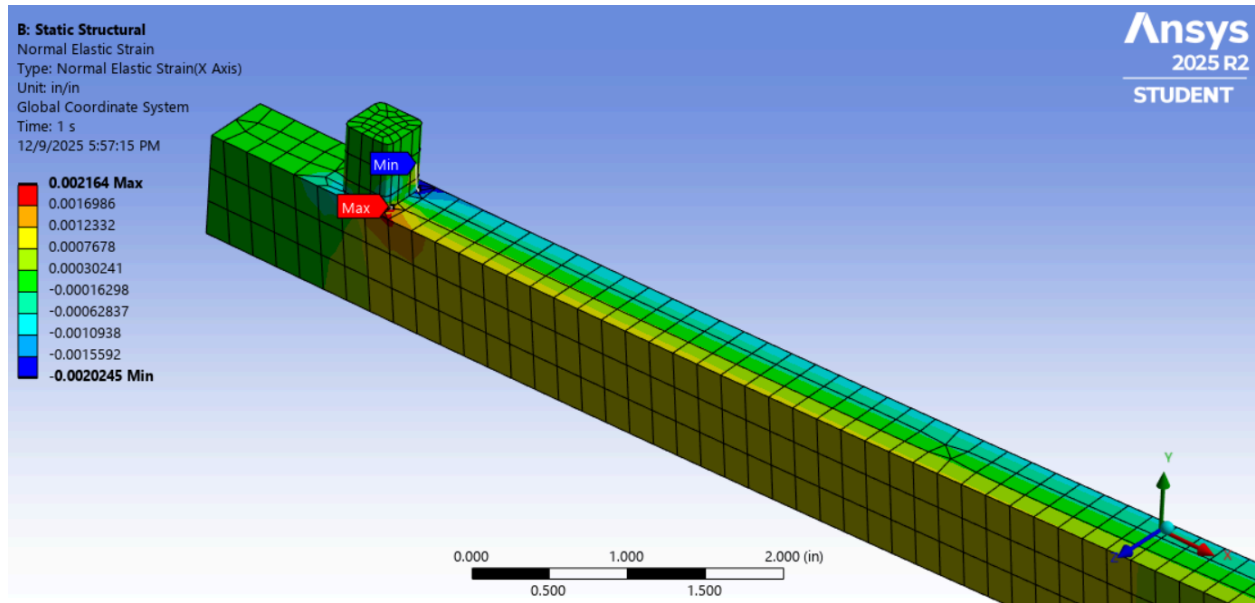


Figure 5: Normal strain contours at upper half of the wrench.

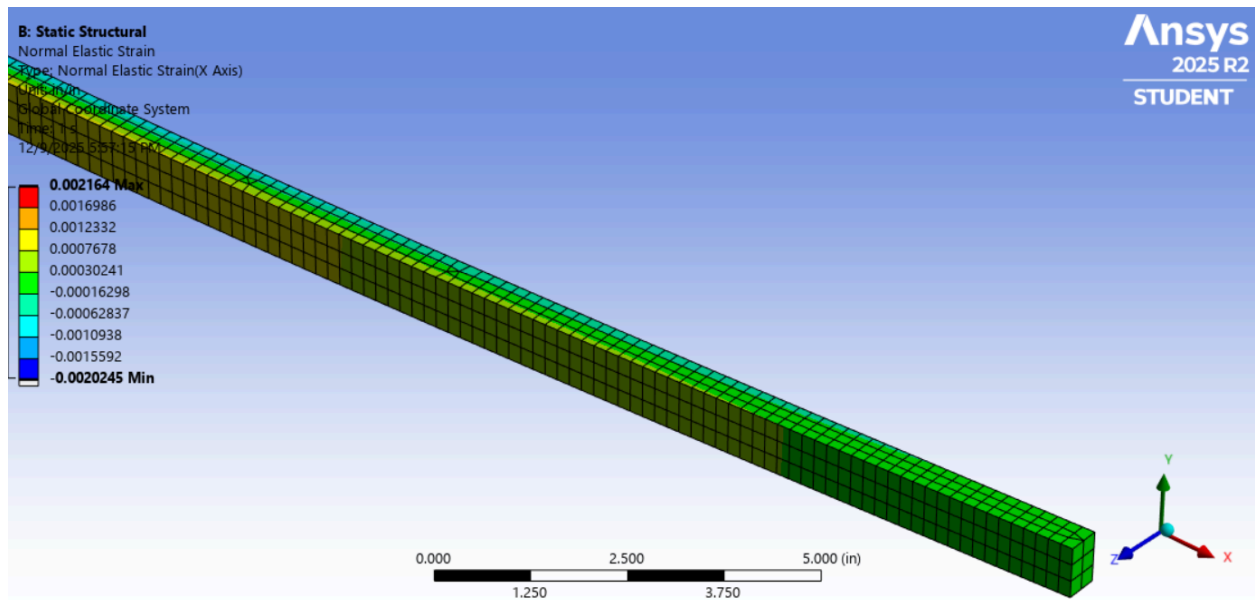


Figure 6: Normal strain contours at lower half of the wrench.

## Maximum Principle Stress Contours

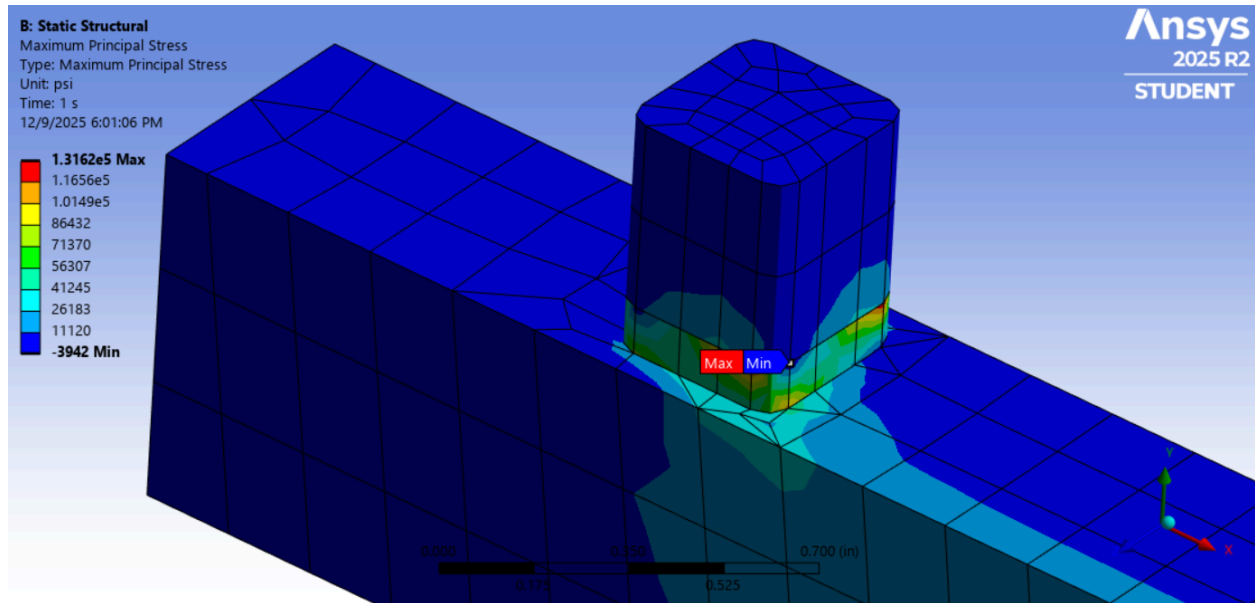


Figure 7: Maximum principle stress contours near the drive.

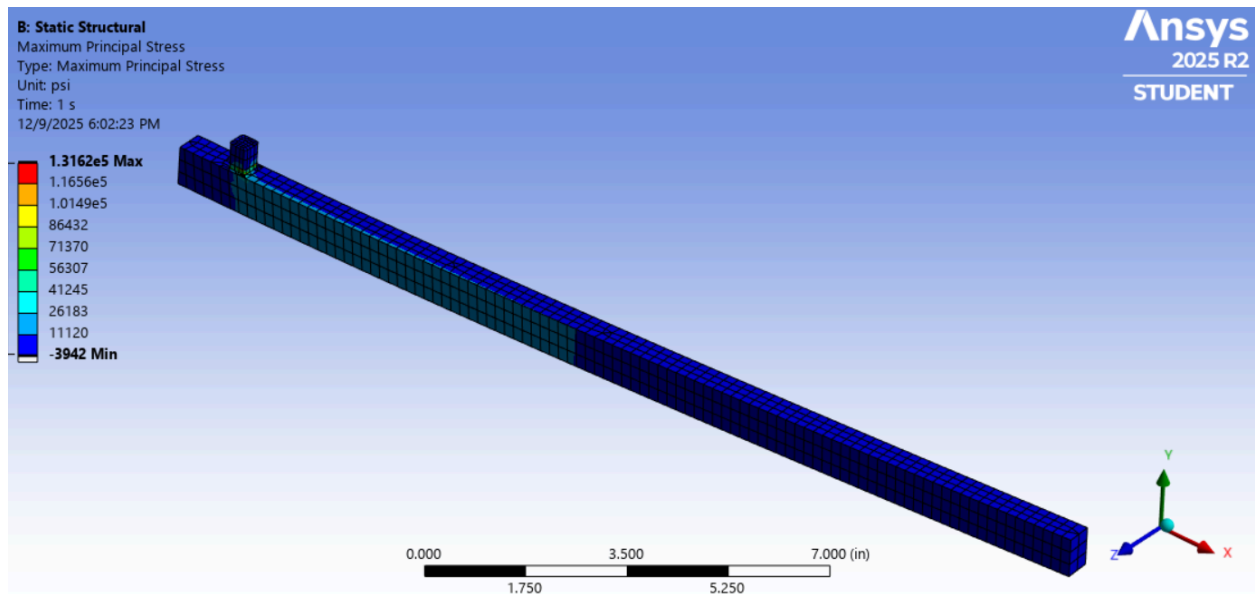


Figure 8: Maximum principle stress contours of the entire torque wrench.

## FEM Calculations

Maximum Normal Stress

Overall Maximum: 68.8 ksi

Near the area where hand calculations are tabulated:  
19.2 ksi

Load Point Deflection 0.60677 inch

Strains at Strain Gauge Location  
X:  $-1.15\text{E-}3$  in/in  
Y:  $-3.71\text{E-}4$  in/in  
Z:  $-3.80\text{E-}4$  in/in

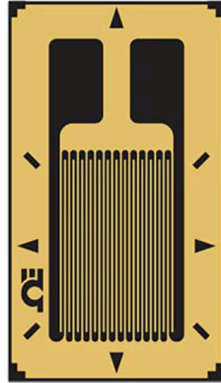
## Torque Wrench Sensitivity

$1.15\text{E-}3$  in/in = 1.15 mV/V

## Strain Gauge Selection

### SGD-3/350-LY13

3 mm Grid Length, 1.5 mm Grid Width 120  $\Omega$  Resistance, ST STC Number



The gauge type is linear pattern leads/pads at one end of the grid.

The strain gauge is about 7 mm  $\times$  4 mm (0.276 in  $\times$  0.157 in). This will fit onto the proposed design and will reserve room for more gauges if needed.