

MIE 313 - Custom Wrench - Fall 2024

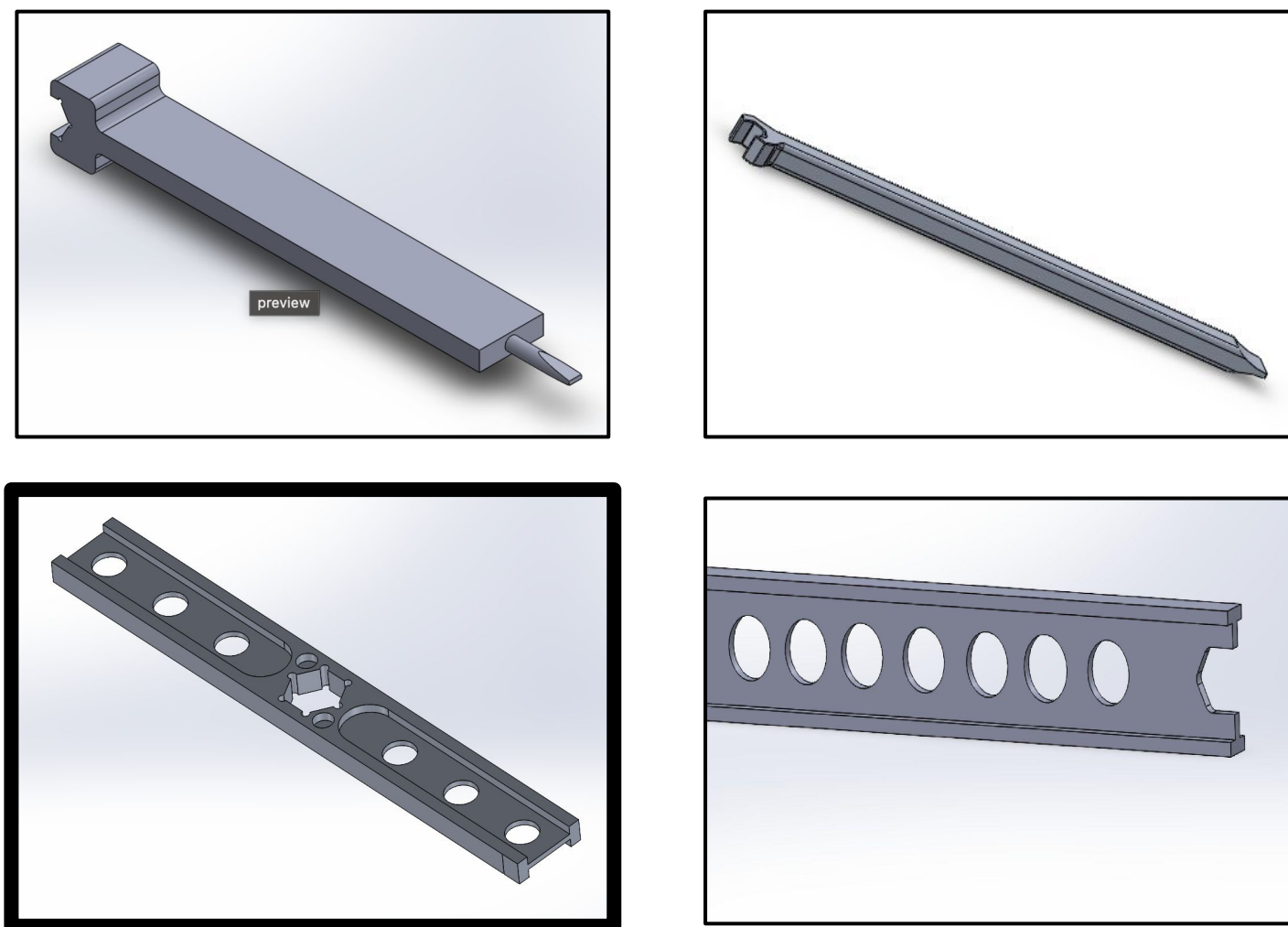
Motivation

- Tasked with creating ultra lightweight biking wrench between 6 and 10 inches long made from 6061-T6 Aluminum.

Specifications

- Less than 35.6 grams
- No plastic deformation when subjected to 160 in-lbs torque
- Added functionality in wrench design

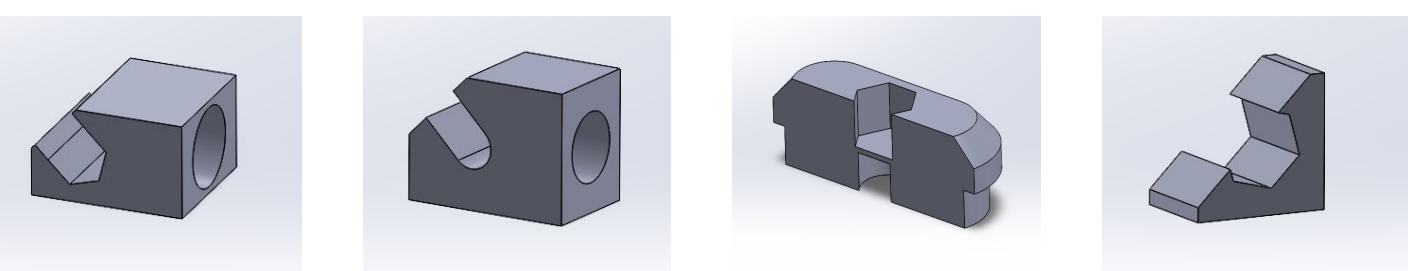
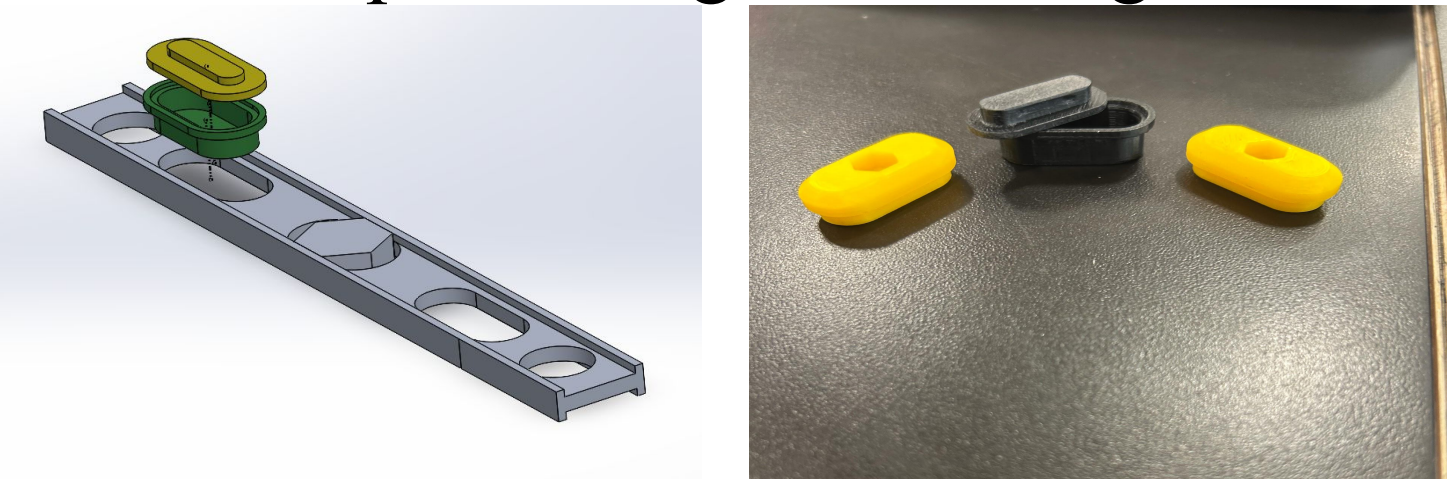
Initial Designs



Selected Design

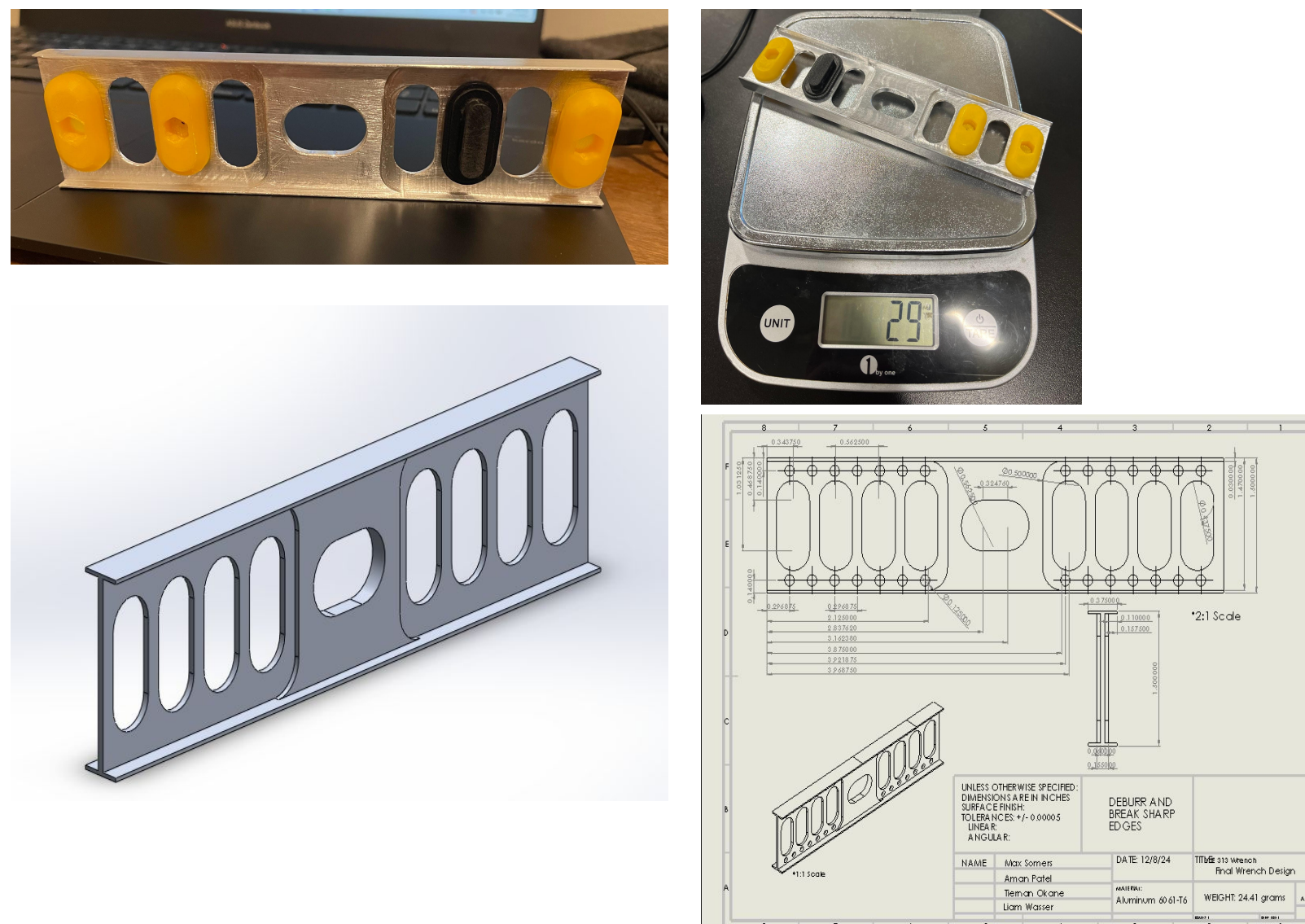
Added Functionality

- 3D printed ABS material capsule slots for a modular tool
- Insert slots to store spare parts
- Tried implementing allen wrench key holder but due to design sizing constraints, could not be implemented
- Instead, added another capsule designed to hold hex nut bits, allowing more user customization
- Each capsule weight ~1-1.25 grams

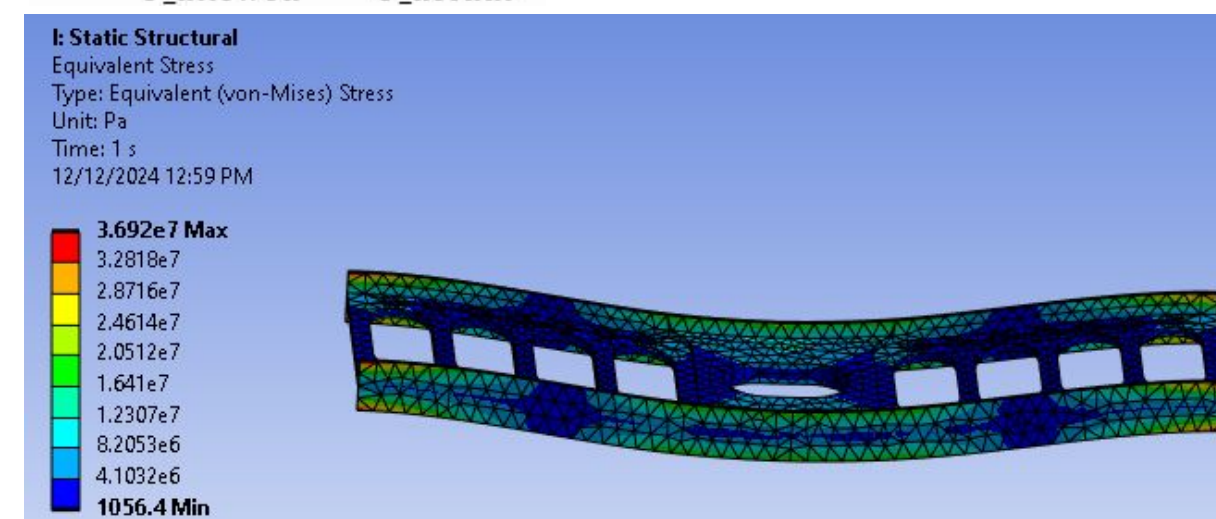


Final Design

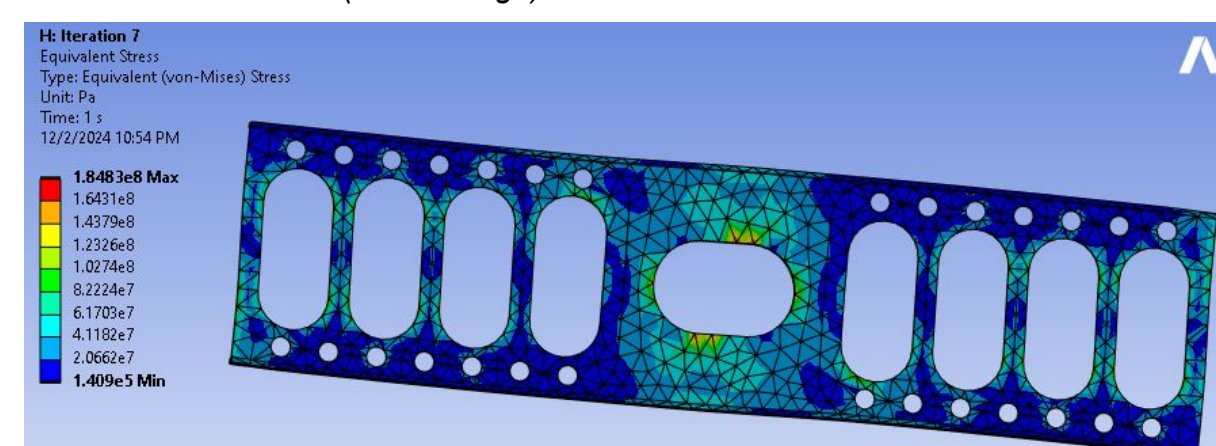
- Iterated selected design by applying more width thickness and vertical slots increasing the shear stress tolerance
- Added functionality in wrench design
- ~ 29 grams with functionality
- No plastic deformation when subjected to 160 in-lbs torque



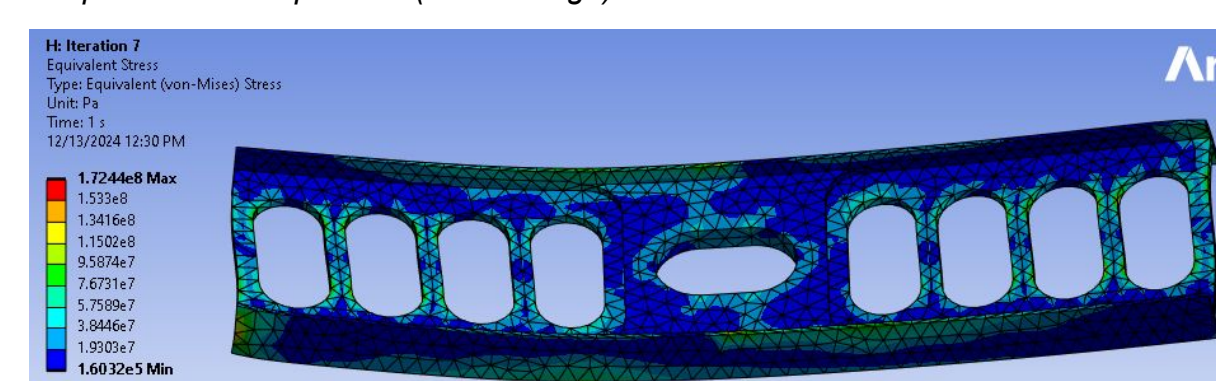
$$FS = \frac{\sigma_{failure}}{\sigma_{allowed}} = \frac{\sigma_{failure}}{\sigma_{actual}} \quad \text{Where } \sigma_{failure} = 276 \text{ MPa}$$



Three Point Bend Test (Final Design) - FS of 7.46



Perpendicular Torque Test (Final Design) - FS of 1.49



Combined Three Point Bend and Perpendicular Torque Test (Final Design) - FS of 1.6

Group 4:

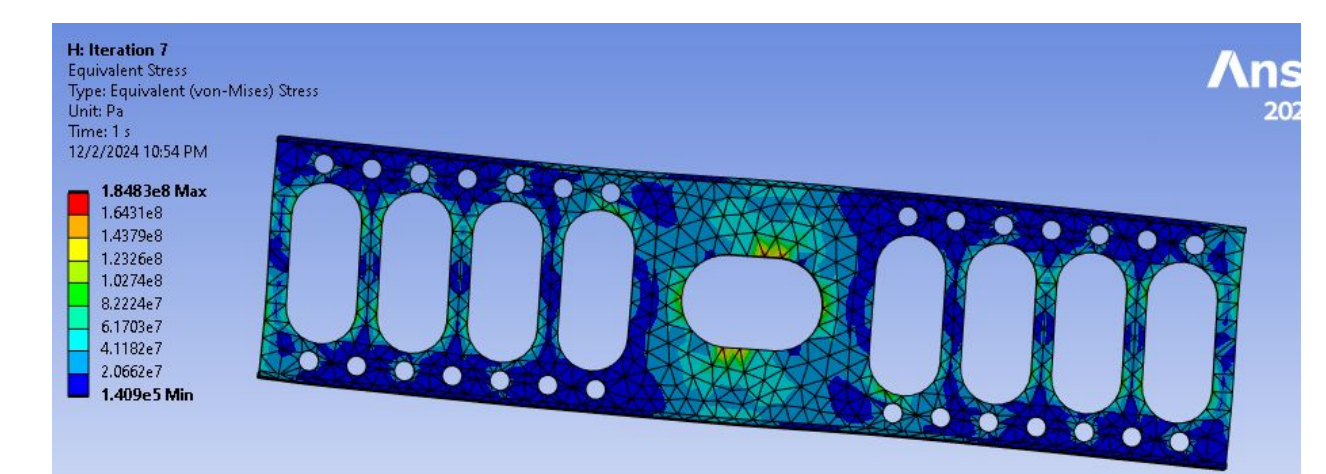
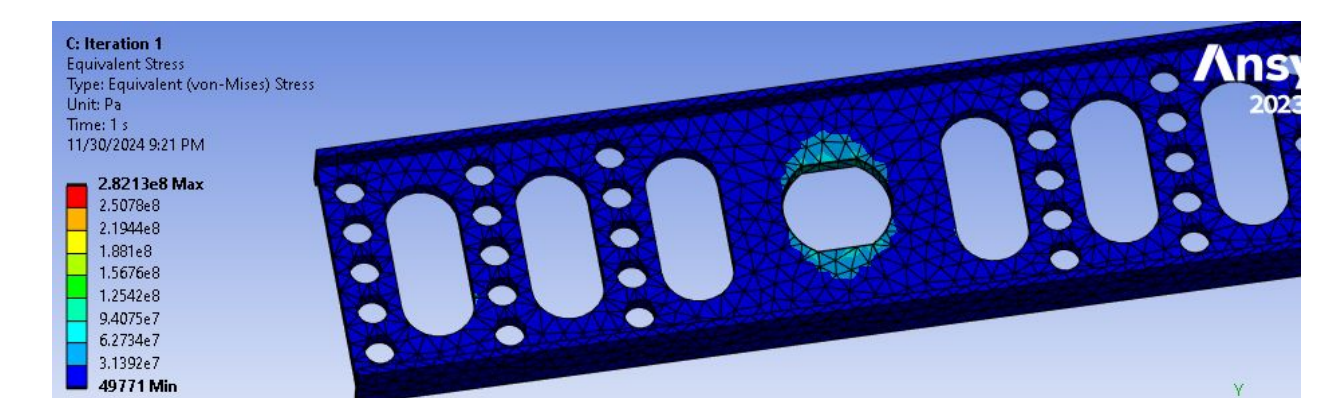
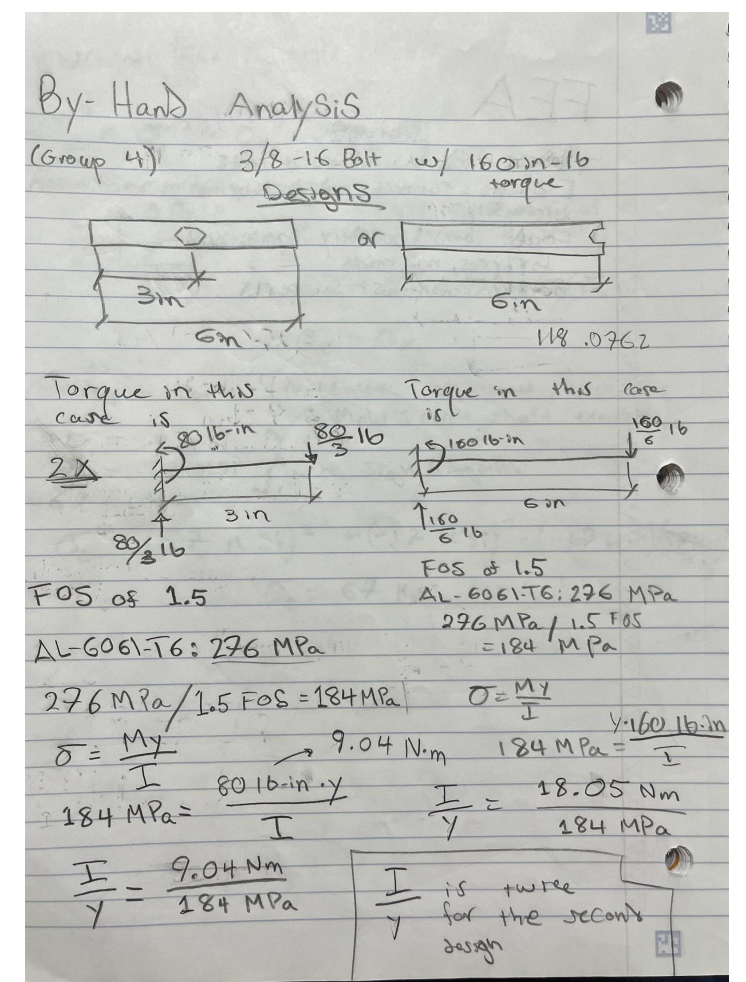
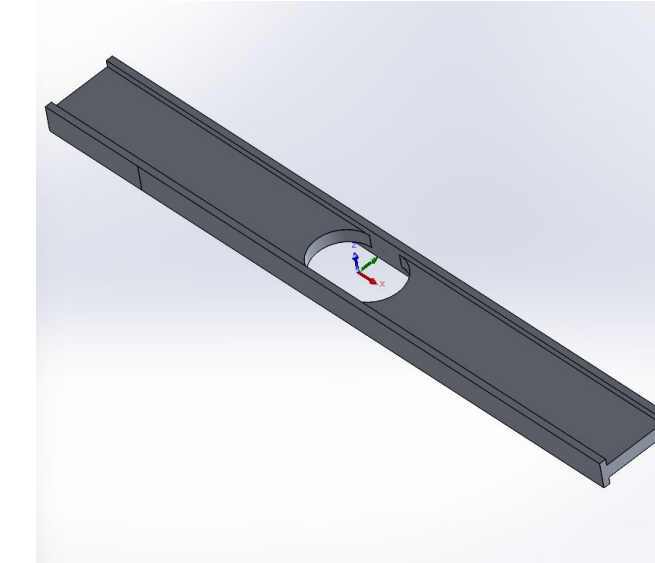
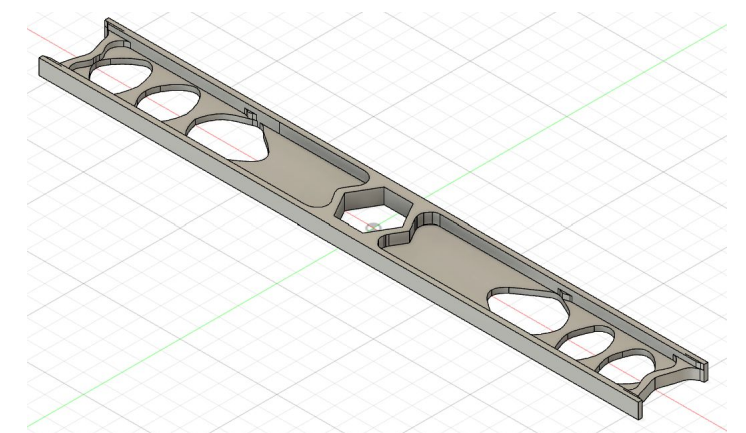
Aman Patel, Liam Wasser,
Tiernan O'Kane, Max Somers

Bolt: 3/8-16

Torque: 160 in-lbs

Design Iteration

- Generative Design
- By hand analysis
- Design for manufacturability
- FEA testing to achieve factor of safety 1.5



Testing

- Our Wrench passed the three point bend test, with only 0.47 mm of deformation. The functionality test was also passed with no damage to our wrench

