NORTHERN ARIZONA UNIVERSITY

# MSMA LATERAL LOADING DEVICE

## ENGINEERING ANALYSIS

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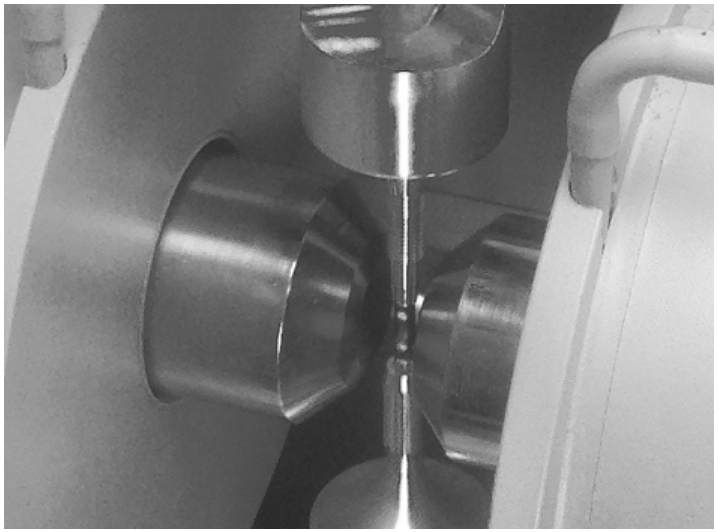
# Overview

I. Project Description and Analysis Breakdown
II. Electromechanical vs. Piezoelectric Design
III. Analysis
    a. Actuator and Sensor Towers
    b. Base
    c. Screws
IV. Material Selection
V. Project Planning
    a. Gantt Chart
VI. Conclusion

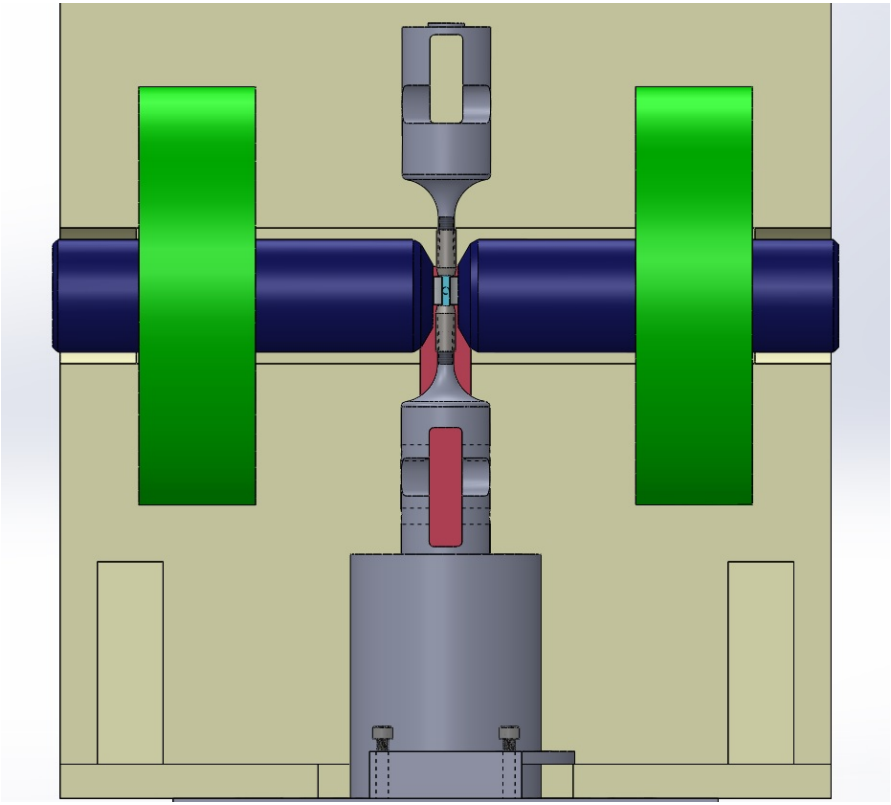
- **Project Description**
  - Dr. Ciocanel
    - Conducts research on Magnetic Shape Memory Alloy (MSMA) [3]
    - Construction of a device capable of laterally loading for under $2500
    - Fit within 10mmx12mm area under a magnetic field
    - Provide feedback control

Experimental Setup for MSMA Testing



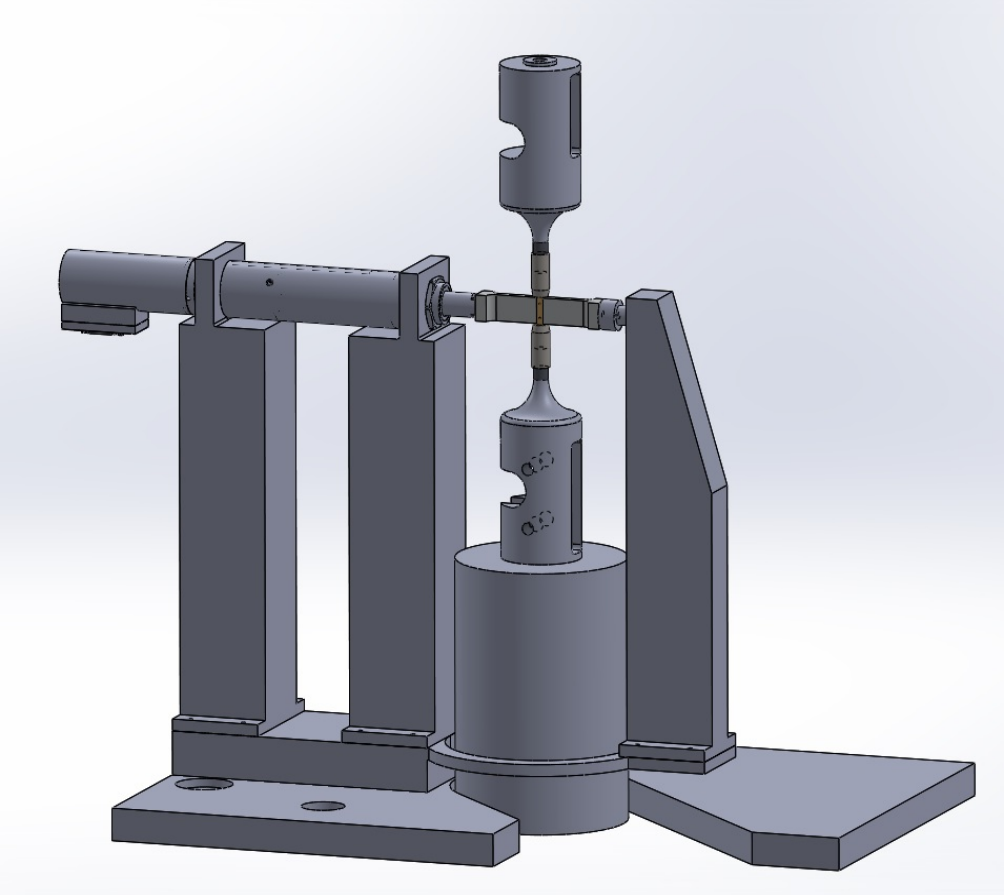
- **Analysis Breakdown**
  - Force Sensor [1] [5]
    - Similar size
    - Similar mounting position
    - Capable of handling fatigue
  - Actuator
    - Similar forces
    - Similar cyclic fatigue
  - Mounting
    - Different geometries
      - Base, Towers, Screws

Solidworks Model of Instron Machine



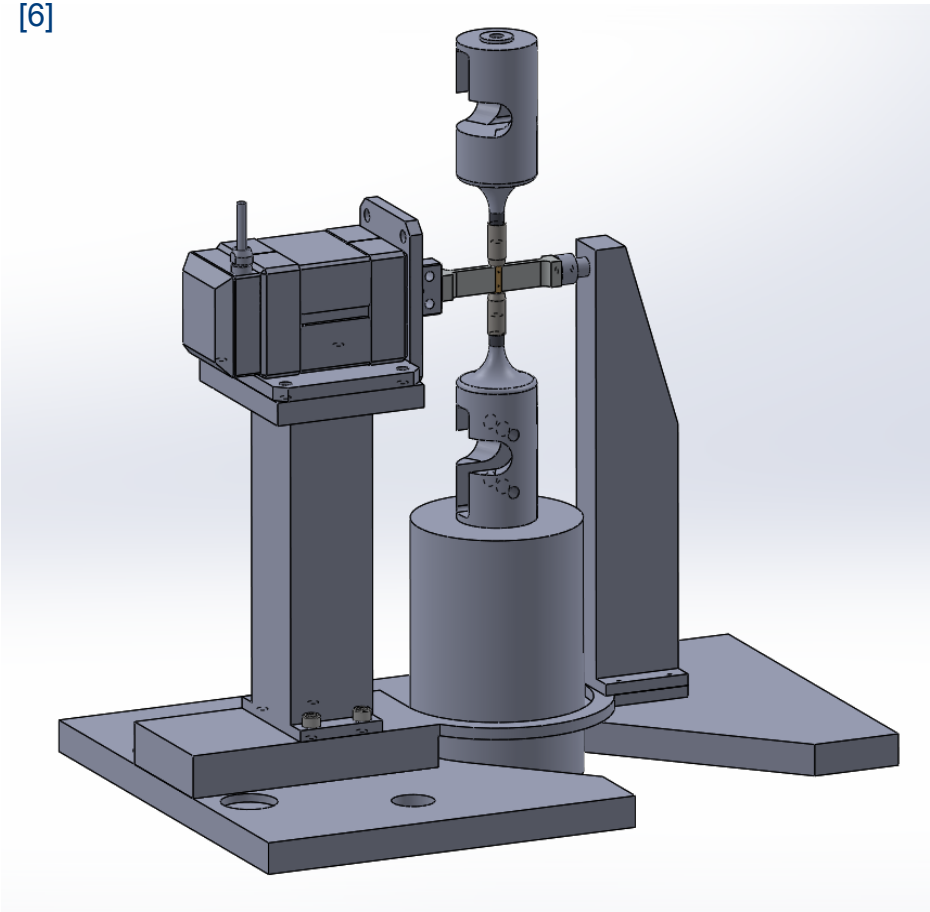
- **Electromechanical Design Setup**

Solidworks Model of Electromechanical Mounting Design [2] [4]



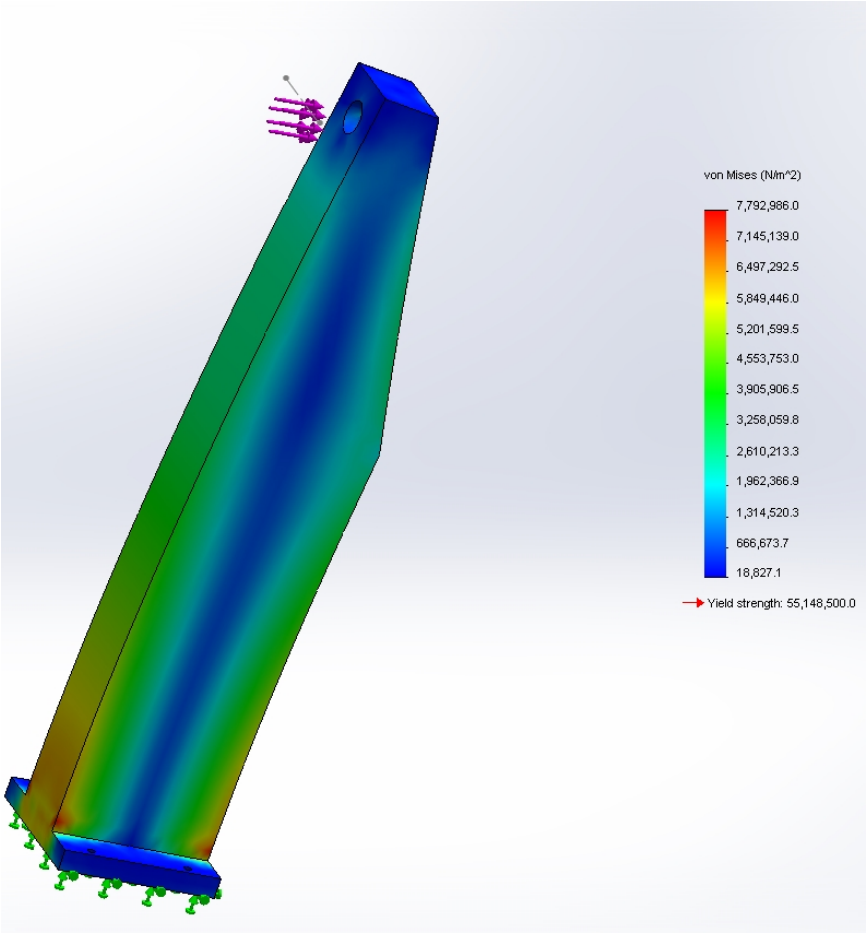
- **Piezoelectric Stack Design Setup**

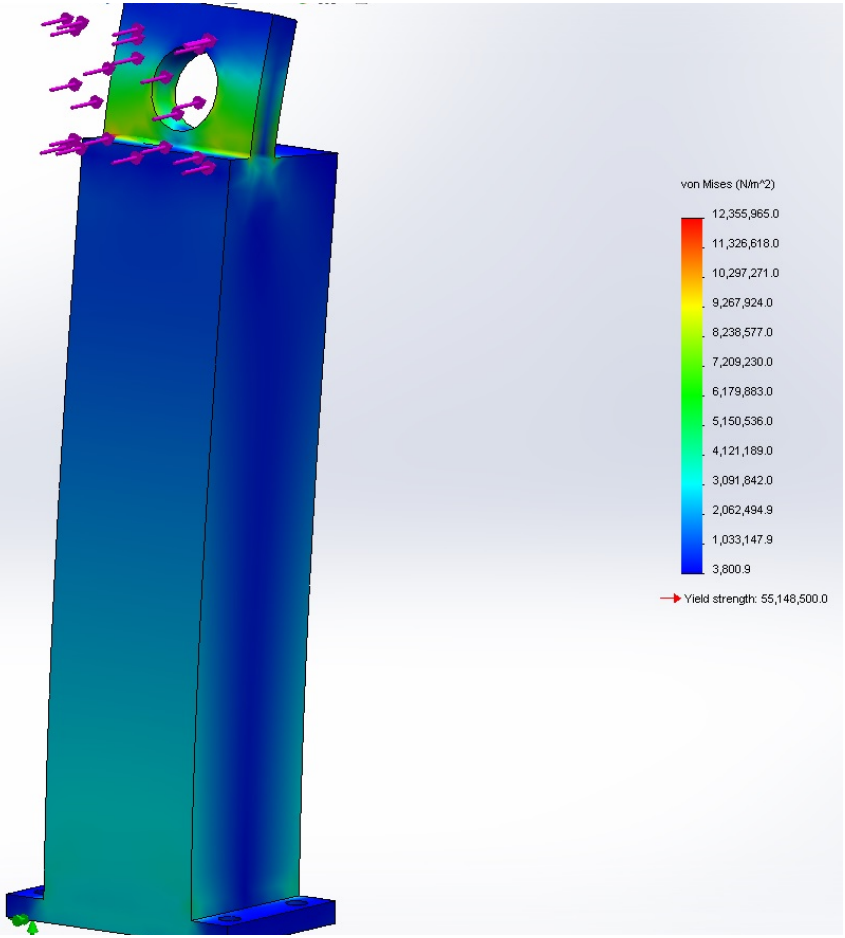
Solidworks Model of Electromechanical Mounting Design [2] [6]



- **Analysis of Towers**

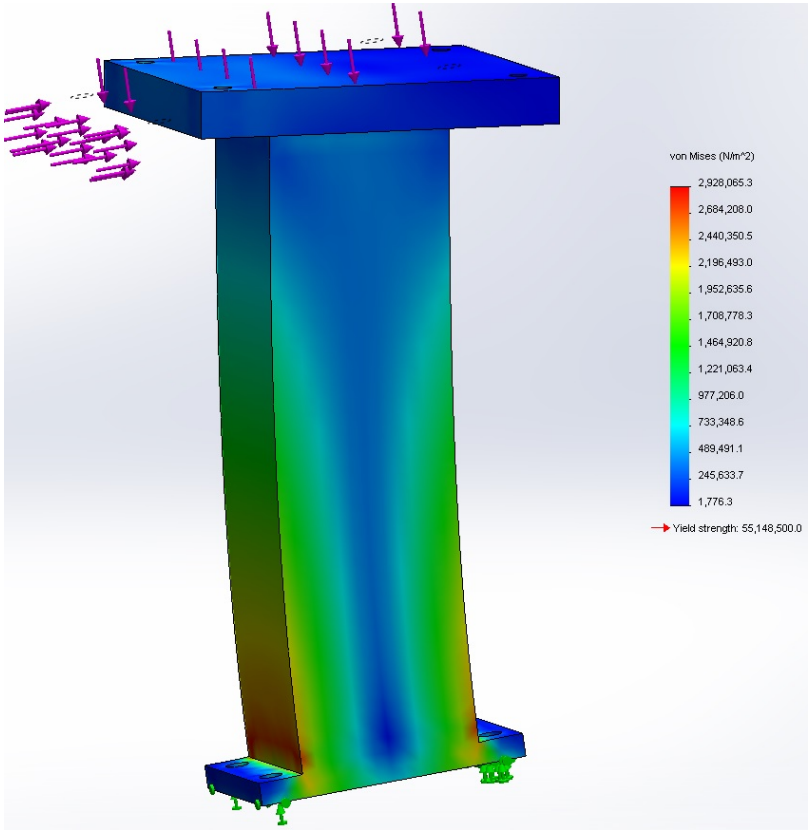
  Finite Element Analysis of sensor, electro-mechanical actuator towers

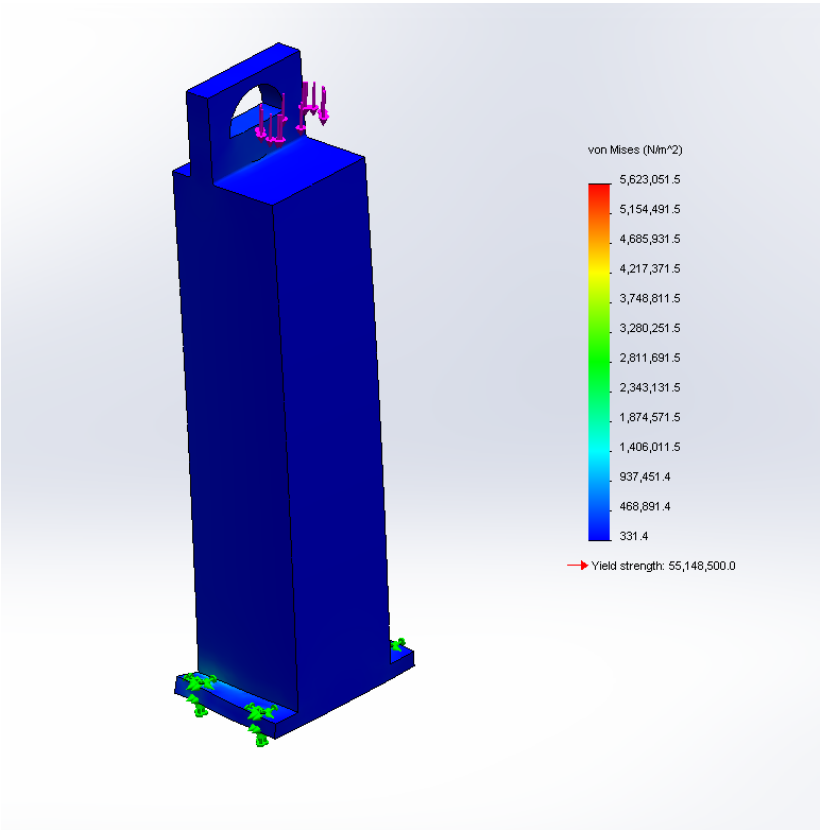


- **Analysis of Towers (cont'd)**

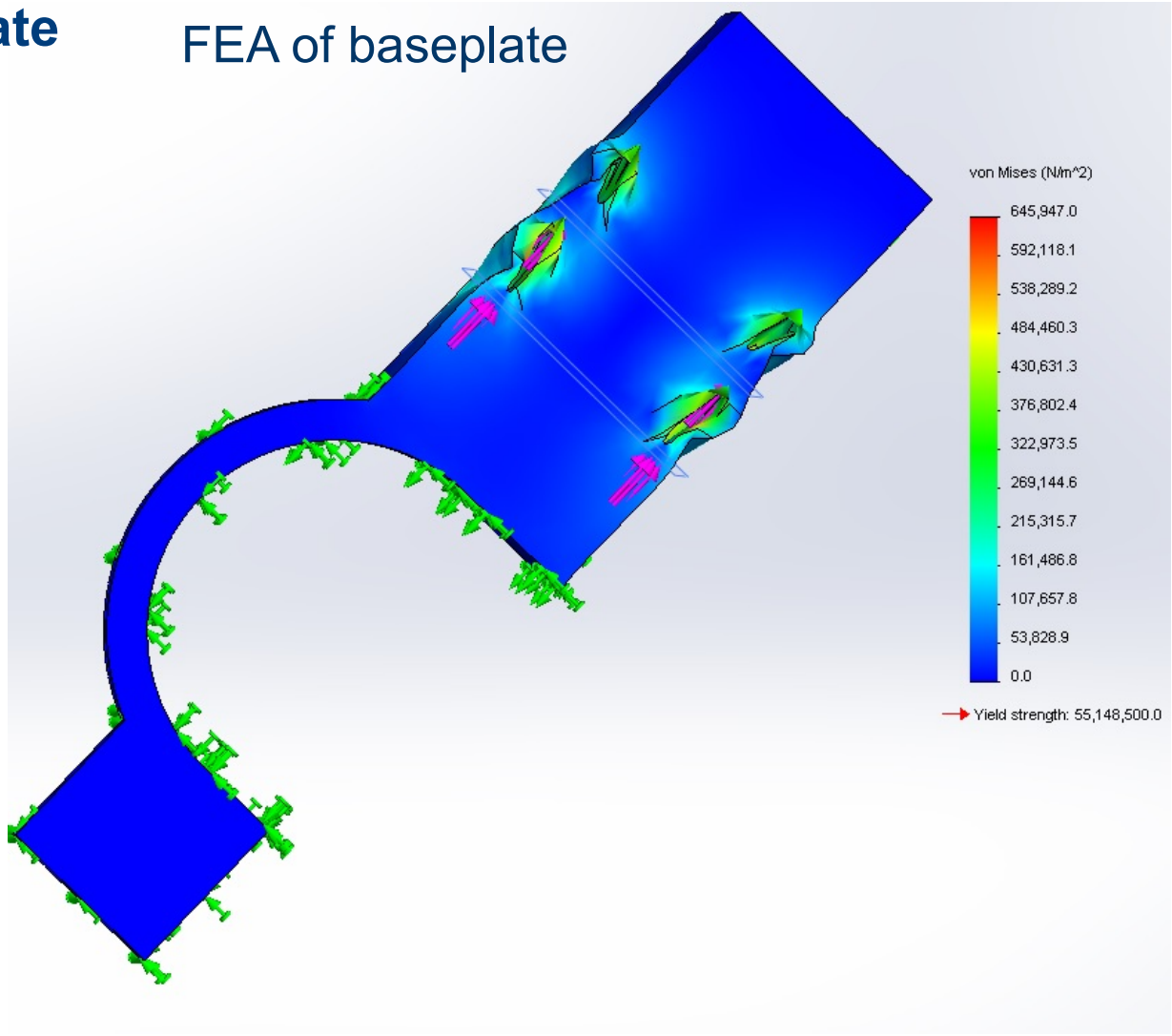
FEA of piezo actuator, secondary electro-mechanical actuator towers



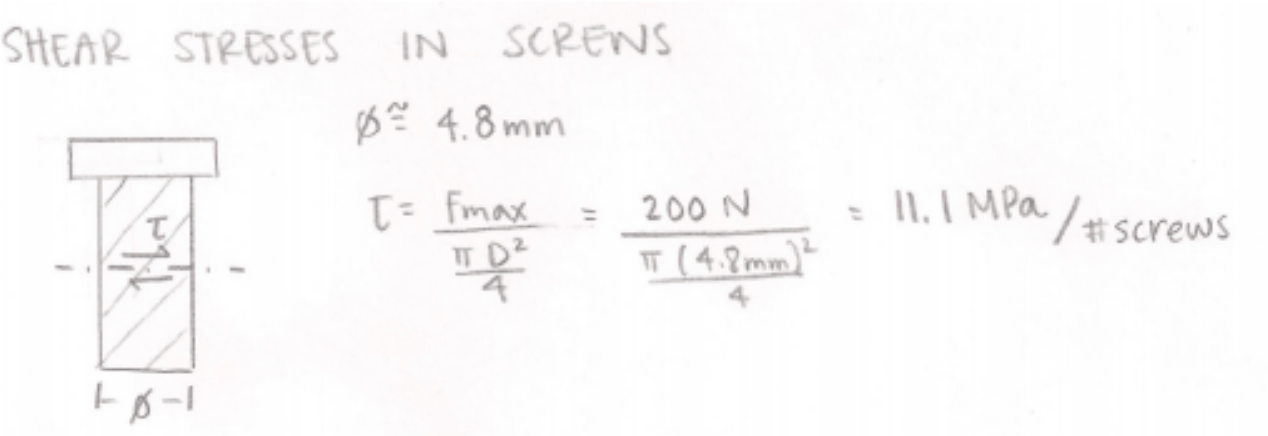



- **Analysis of Baseplate**

FEA of baseplate



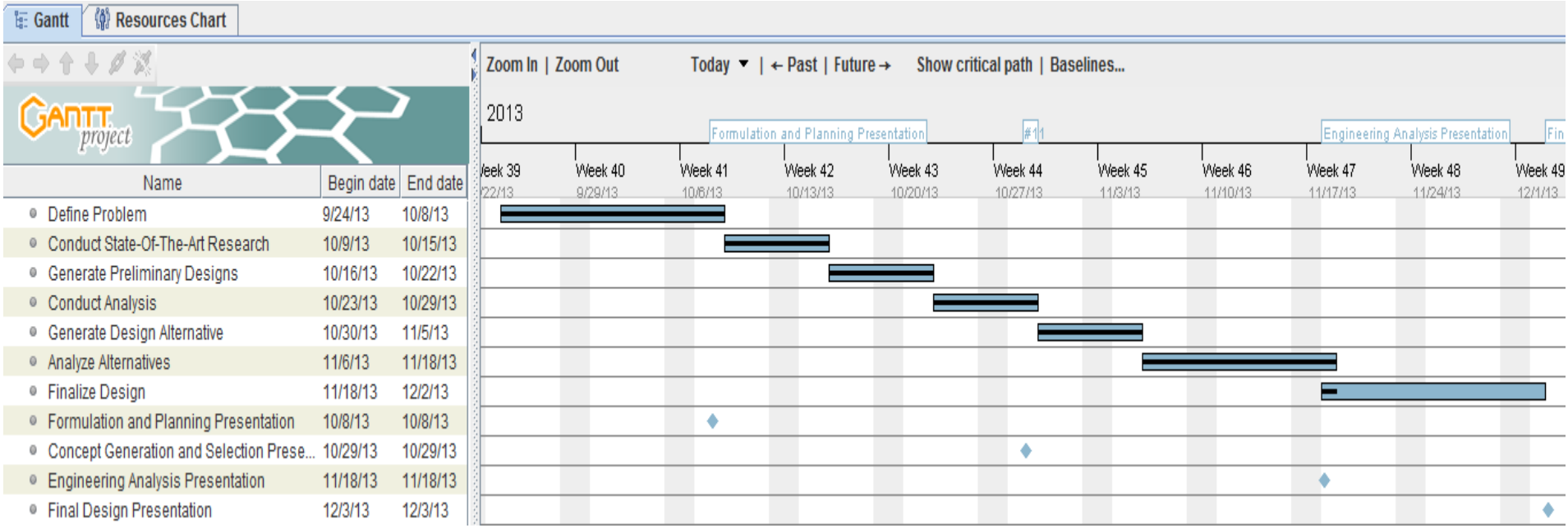
- **By-Hand Analysis of Screws**



- Material Selection
  - Base/Towers: 6061 Aluminum
  - Screws: 8-18 Stainless Steel
    - Cheap, common material
    - Yield strength exceeds maximum stress
    - Non-magnetic
    - Good machinability (base/towers)

# MSMA Lateral Testing

## Project Timeline



## Conclusion

- Create a device that laterally loads within a small area. We have selected basic product types and created two unique mounting setups.
- Aluminum and 8-18 Stainless Steel were selected as materials for mounting construction.
- The by-hand and finite element analyses show adequate material properties.
- Next our team will continue searching for low price products and construct a final design after consulting client.

# •References

[1] “9313AA1VP 1-Component Force Link - Kistler." *9313AA1VP 1-Component Force Link - Kistler*. Kistler, n.d. Web. 7 Nov. 2013.

[2] Garcia, Matt, Randy Jackson, Jeremy Mountain, Qian Tong, and Hui Yao. *Material Testing Fixture*. *Material Testing Fixture*. Dr. Ciocanel, 2012. Web. 15 Nov. 2013. <http://www.cefns.nau.edu/capstone/projects/ME/2013/DFMTM/index.html>.

[3] Leo, Donald J. *Engineering Analysis of Smart Material Systems*. Hoboken, NJ: John Wiley & Sons, 2007. Print.

[4] "M-238 Heavy-Duty DC-Mike Actuator." (2006): 1-34. *Www.pi.ws*. Physik Instrumente (PI) GmbH & Co. KG, 2006. Web. 12 Nov. 2013.

[5] "Model 11." *Model 11*. Honeywell International Inc, 2013. Web. 6 Nov. 2013.

[6] "N-216 NEXLINE Linear Actuator." *PIEZO NANO POSITIONING*. Physik Instrumente (PI) GmbH & Co. KG, n.d. Web. 15 Nov. 2013.

QUESTIONS?