Team 2- Biaxial Tensile Tester

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Agenda

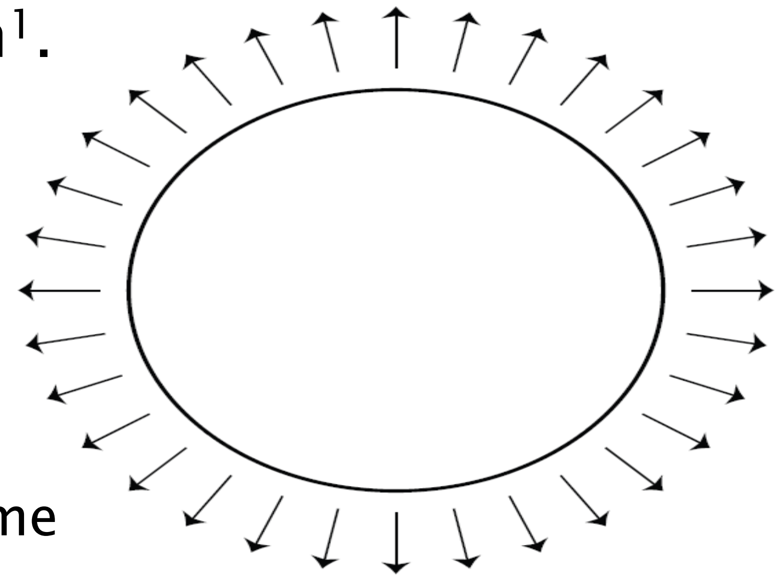
- Background/ Project Scope
- Specimen Geometry
- Material Testing
- Device Modifications
- Assembly
- Cable Testing
- Grip Testing
- Procurement
- Further Plans

Material Characterization

- In order to model materials, accurate predictions of properties are needed
  - **Uniaxial tension**
    - Easy to obtain with standard tensile test
  - **Pure shear**
    - Done with planar tension test
  - **Uniaxial Compression**
    - Inaccurate due to the friction between the load plates and the specimen
    - Causes a mixed state of compression, shear, and tensile strain[1]

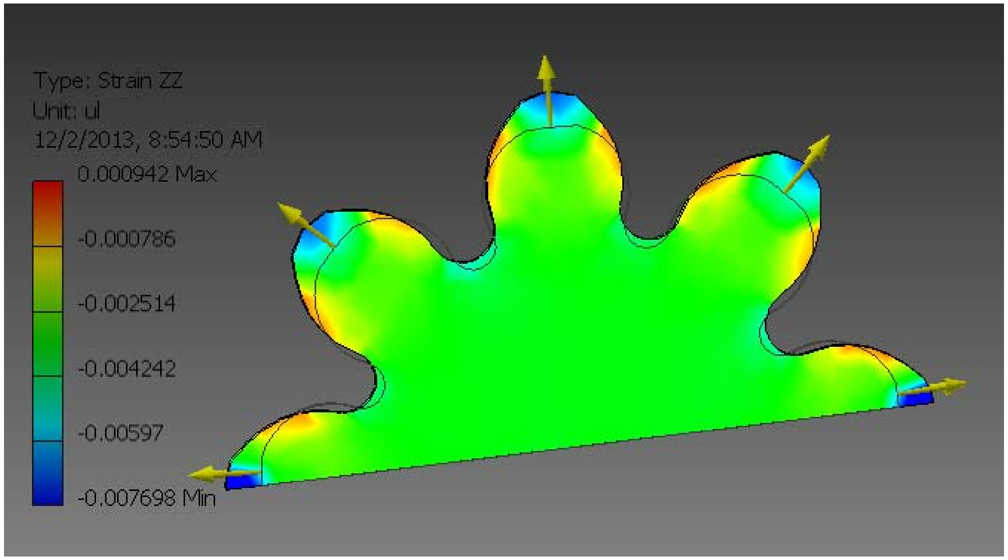
Why Equal Biaxial Tension?

- A biaxial tensile strain is equivalent to a uniaxial compressive strain[1].
- Mohr's Circle
  - Becomes a point circle
  - No shear forces are present[3]
- Poisson's Ratio nearly 0.5
  - Means a process of constant volume
  - $\gamma = -\frac{\epsilon_z}{\epsilon_x}$
- Free of the frictional effects[2]

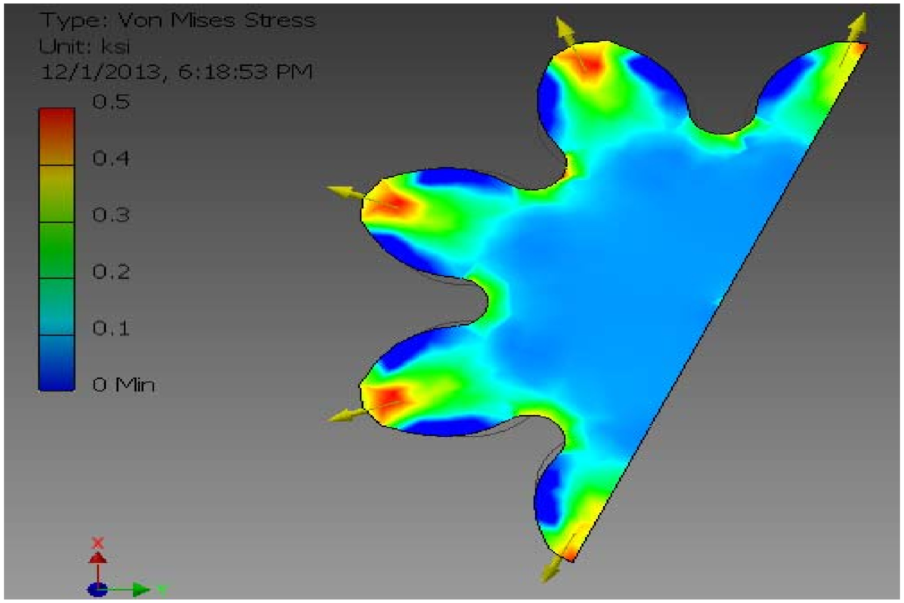


Ideal Equal Biaxial Stress State[1]

Final Specimen Geometry



The strain profile in the ZZ plane after load is applied

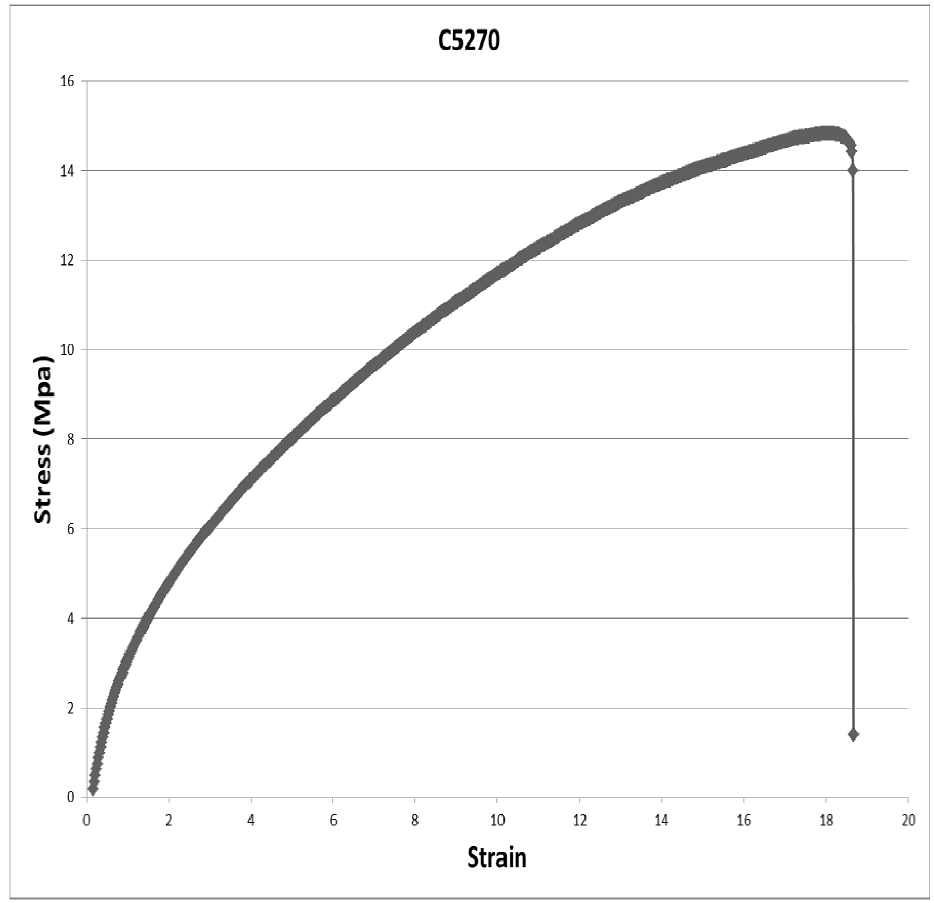


The resulting Von Mises Stresses as force was applied radially

Nicole Walsh

Material Testing

- The stiffest material, Gasket C5270, was tested in the traditional dog bone shape
- Maximum stress was found to be 14.8 MPa
- The max stress was used with a conservative cross-section of our sample geometry
- This gave an estimation of the maximum load to be used on our device of 1.054 kN



Device Changes

- Cut down diameter of all plates by 5 inches
  - Reduces weight by ~50 lb
- All other components remained the same except the carriers
  - Location is only part modified due to reduced baseplate
- Carriers had to be modified to fit cable that was decided upon

Grip Testing

- Mock grips constructed for use in MTS machine
- Testing for capability of grasping without slip
  - If slip occurs, surfacing metal to increase friction will be attempted first.
  - If slip still occurs, movement of clamping hole to increase grip surface area will be attempted
  - Testing for optimal torque

Cable Testing

- Initial testing of dyneema rope revealed knot slipped, eyebolt broke at 400lbf
  - New knots being investigated
  - Stronger eyebolt ordered
- Steel cabling has been acquired
- Mechanical fasteners being investigated
- Attachments for MTS machine fabricated

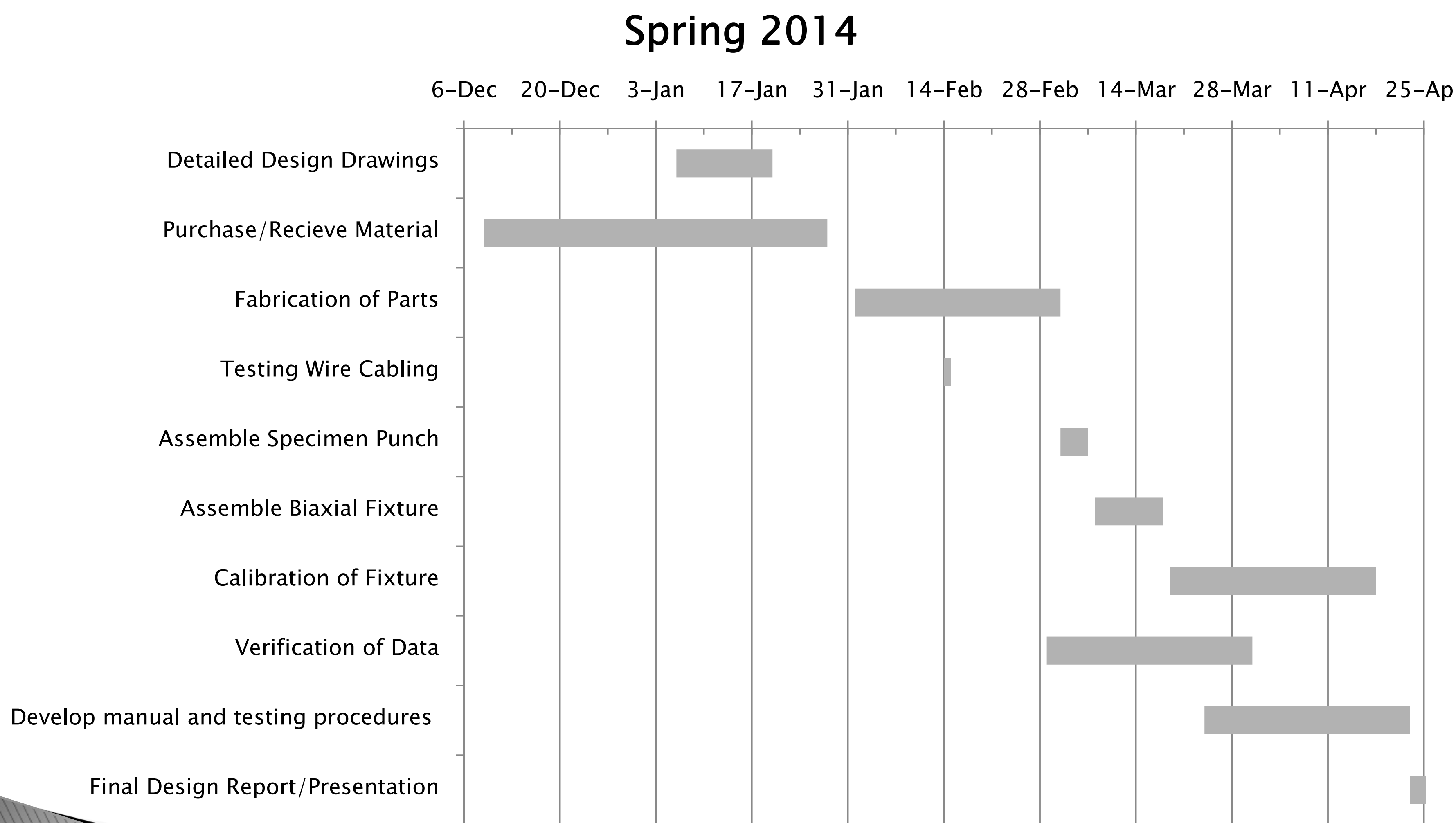
Budget

- Procured
  - Aluminum for plates, supports and carriers
  - Hardened linear rods and bearings
  - Threaded rods for attaching top and middle plates
  - Hardware for grips, supports, pulleys
- Remaining Items
  - Cables
  - Cable attachments
  - Machining
  - Strain gauges
- Remaining Budget
  - $678.46

Future Work

- Cables to be tested
- Machining to start immediately
- Test remaining gasket materials in uniaxial tension
- Once device is built, begin proof testing
- Calibrate device to operate successfully
- Make changes if necessary
- Create working instructions for user

Gantt Chart



Ben Hainsey

References

1. http://www.axelproducts.com/downloads/CompressionOrBiax.pdf
2. Callister, W.D. (2007). *Material Science and Engineering, An Introduction;* 7th ED. York, PA: John Wiley & Sons, Inc.
3. Day, J. and Miller, K. (July 2000), Equibiaxial Stretching of Elastomeric Sheets, An Analytical Verification of Experimental Technique. *Equibiaxial Stretching, Rev 2. 1-8.*

Questions?
Comments?
Suggestions?