ME 127 Final Portfolio

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Designing for AM

Lesson 1: When to use AM?

AM Considerations:

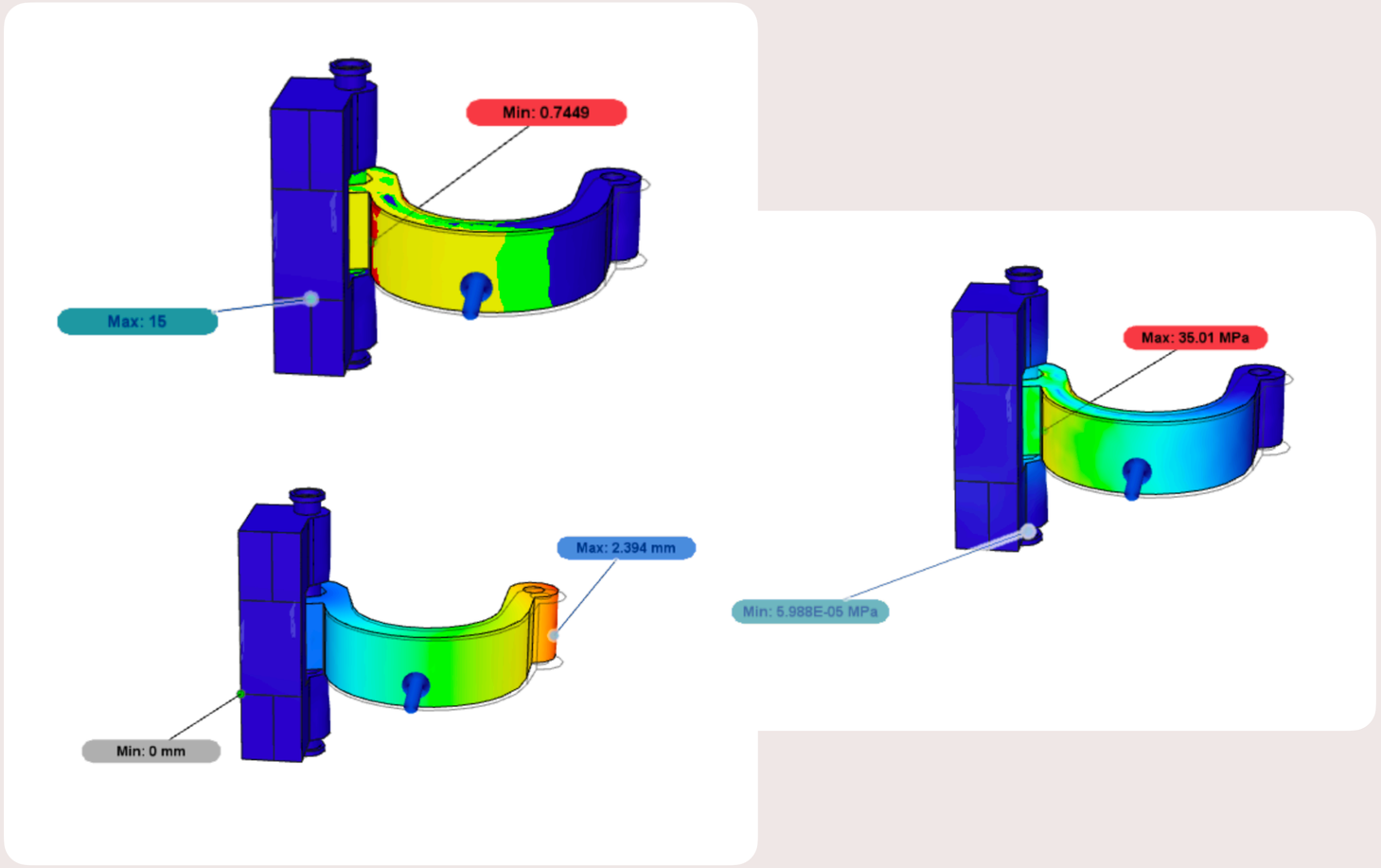
★ **Novel part**

★ **Complex geometries**

★ **Material suitability**

It is always salient to ask myself whether AM is the best process by which to fabricate my part. For my **dynamic face mask**, I asked myself whether my intended design and its components were truly **novel** and couldn't be purchased. The parts in my assembly were also **geometrically complex** and PLA was a **suitable material** for the product, making them perfect for 3D printing.

Lesson 2: Design Validation

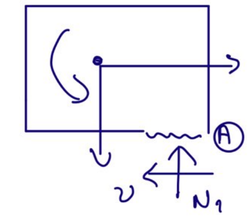


Key take away:

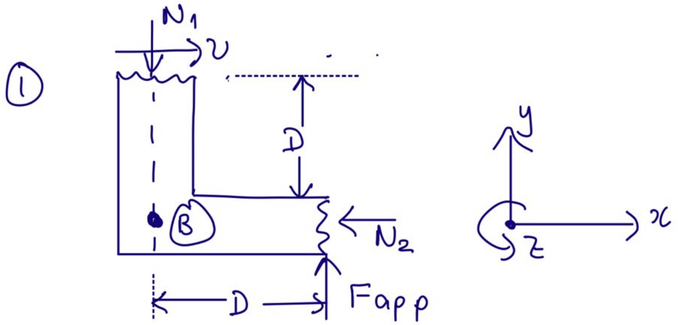
★Simulations are critical to producing robust, fabricated products

For my **stylus mount latch**, performing simulations was a critical part of refining my designs. I was able to **gain insights** into why my rapid prototypes failed. These simulations also helped me think about how I could leverage aspects of AM, such as layer strength (and therefore the print orientation), to maximize the strength of my part.

Lesson 2: Design Validation



Find N_1 to find stress at (A)



When $F_{app} = 15N$

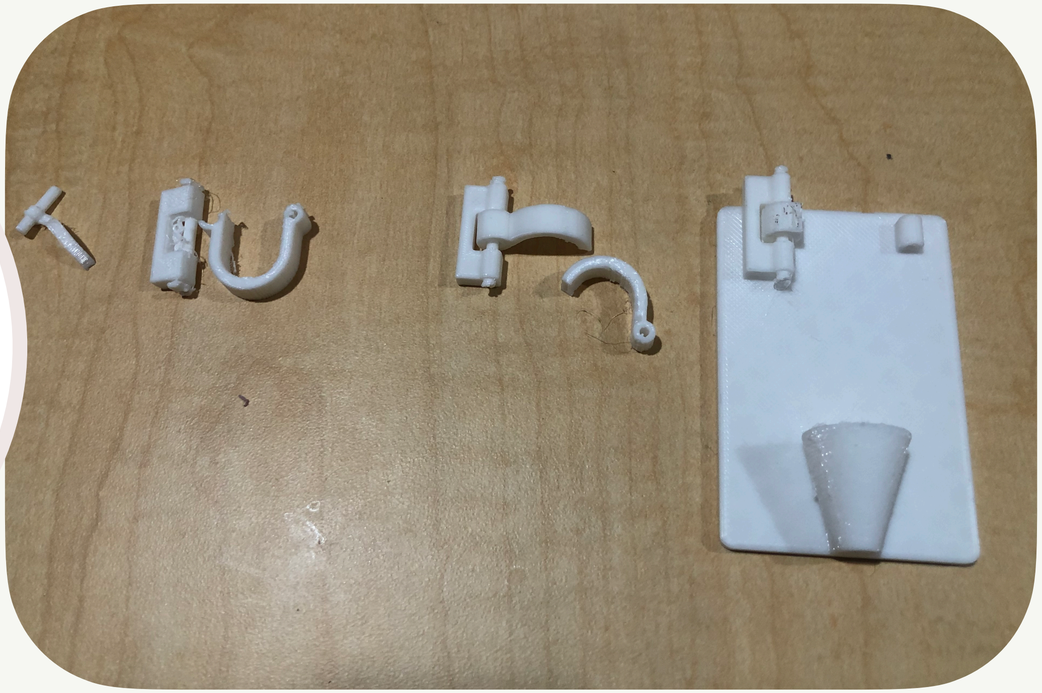
$$\sigma = \frac{15N}{.000635m^2} = 23622.047\ Pa \approx 0.236\ MPa$$

When $F_{app} = 27N$

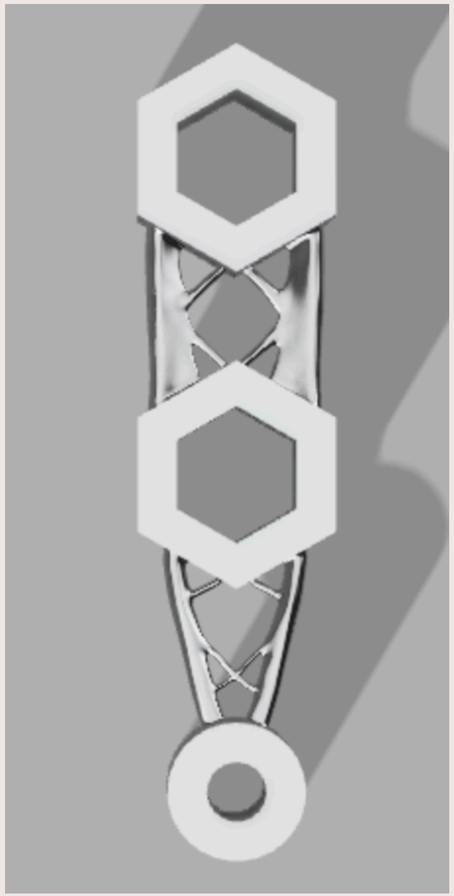
$$\sigma = \frac{27N}{.000635m^2} = 42519.685\ Pa \approx .0425\ MPa$$

Bonus!

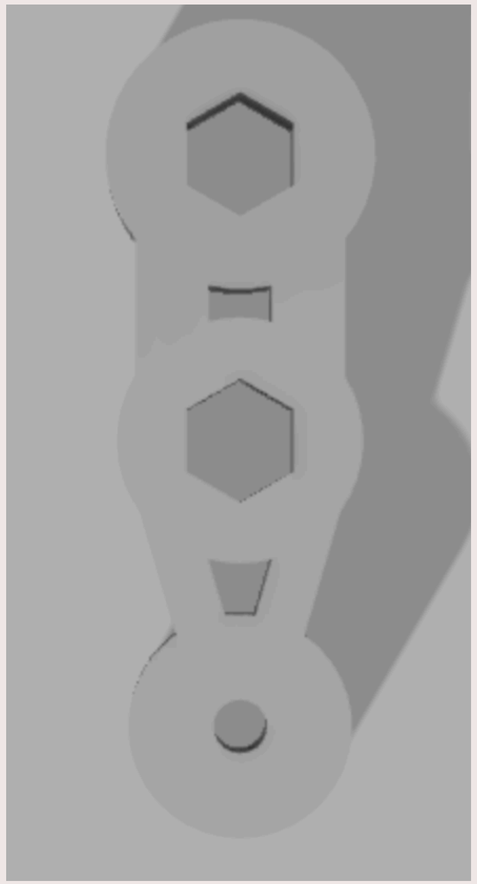
★ **Rapid prototyping & performing hand calculations are necessary before performing time-costly simulations!**



Lesson 3: Algorithmic Design



Generative Design



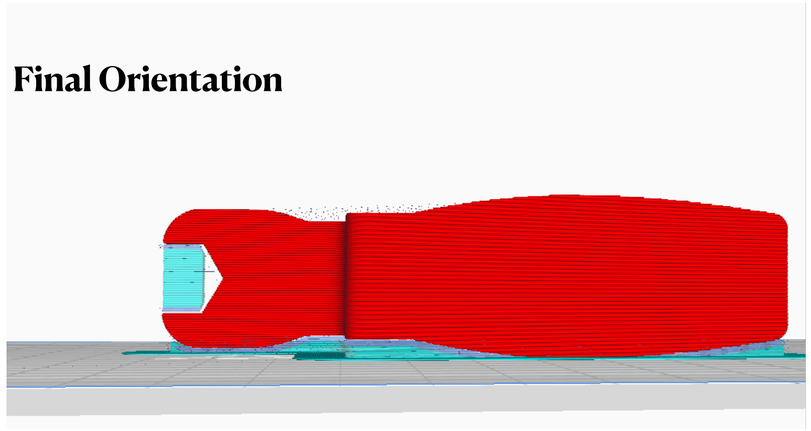
Shape Optimization

Key take away:

★Algorithmic design is a powerful tool used to create designs that meet structural & mass specifications

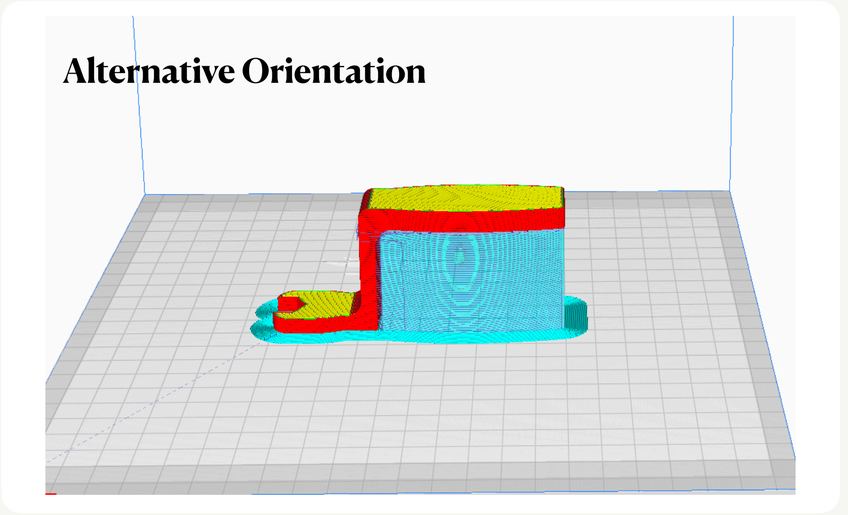
I explored the use of **generative design** and **shape optimization** to create a strong and light weight vise speed handle. Both design frameworks helped me think critically about the load cases in the event of use (and misuse!) Generative design was an exciting and powerful tool that allowed me to select a design that was both **mass efficient** and **strong**. While algorithmic design is a powerful, the outcomes should (ideally) be refined to meet other design specifications, such as usability.

Lesson 4: Print Orientation



Key take away:

★ **FDM prints are higher resolution and stronger in xy**



Time

Orientation also has a significant impact on time taken to complete the print. The orientation of my part allowed me to maximize strength while also keeping the **print time down**.

Material Use

Orientation can also have a dramatic impact on the **amount of support material used**. Considering how my orientation would impact the amount of material used for the supports was crucial.

Final Projects

Project 1: Space Wrench

The space wrench was my first attempt at designing for AM. During my design process, I leveraged my understanding of the material properties as well as the print orientation to maximize build strength for an FDM process. Thinking about how to orient my print on the print bed also made me aware of how orientation affects material use and print time. Picking a print orientation has been crucial to minimizing the print time of larger, more complex parts and assemblies. This is a key consideration each time I attempt to fabricate anything.

Project 2: Dynamic Mask Stand

Making the dynamic mask stand allowed me to take advantage of one of the exciting aspects of AM: printing an assembly place. With AM, I was able to explore and achieve the goal of printing an assembled mechanism. While this is an exciting outcome of AM, it took me several tries to get the amount of clearance between each component just right. Additionally, this project was also my first time deviating from the default slicer settings. I learned how to alter my print supports to attain mechanism functionality and minimize the need for post-processing.

Project 3: Haptic Mouse Stylus Mount

The haptic mouse stylus mount allowed me to build upon my experiences with printing mechanisms. I was able to refine my designs through printing rapid prototyping. This was essential to validate whether the simulations that I performed and subsequent CAD changes improved the functionality of my mechanism.

Reflection

Reflection

ME 127 introduced me to several concept ideas that are critical for leveraging the benefits of additive manufacturing. While I was aware of simulations from my mechanical design course, through the class, I was able to glean the necessity of simulations to the design process. I was also challenged to think about how each of my design choices would either be suitable for AM or not. This often prompted me to re-think design features or re-design my part completely. Before the class, I did not think about how my design choices and judgements when using the slicer would affect the quality of my print. Now, I have the ability and foresight to leverage the capabilities of AM to make robust, high quality final products. This is an essential skill that I will carry forth as a designer and engineer.