

Deliverable C:
Group 8
Design Criteria
Prioritised Design Criteria

Introduction

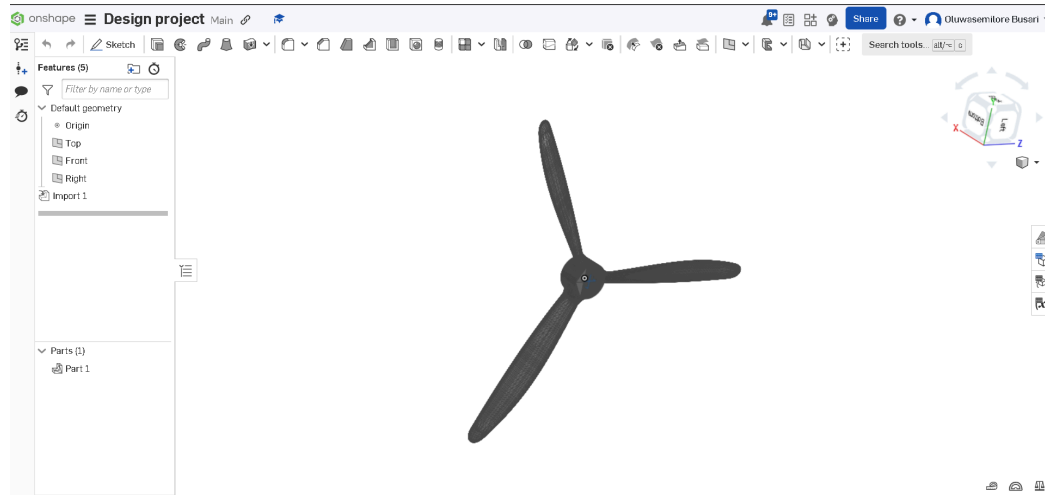
This deliverable must focus on converting the client's expectations and our interpreted data of the client's expectations into real ideas that can be defined in our prototype. Benchmarking and grasping a basic understanding of what tools should be used in our prototype according to and respecting safety limits and specifying and gaining an understanding of the specifications of our project. Also in recognizing where our group is at with our design stage and updating the Trello board to recognize any roadblocks that may be ahead to ensure tasks are completed on time within reason.

1. Safety
 - a. In the case of testing for hazardous materials, chemical exposure, high temperatures, high pressure, and high speed rotating components. We must ensure that our prototype complies with safety regulations.
 - b. Additionally implementing various safety features for equipment protection.
2. Repeatable results within the system
 - a. Ensuring that the data is accurate, and there is consistency within the test results.
3. Carefully controlled parameters
 - a. Ensuring there is a feature of control within the acceleration of the erosion.
4. Flexibility of the erosion test setup
 - a. Having the ability to test the erosion resistance of a wide range of materials.
 - b. Having the ability to operate at standard atmospheric system pressure and temperature under 40 degrees.
 - c. Having control over the rotation speed for various testing conditions.
 - d. Avoid using materials prone to corrosion in the setup.
5. The flexibility of operating conditions for testing
 - a. Capability to operate at different rotation speeds (e.g. 10rpm).
 - b. Versatility in testing erosion resistance on different components and parts.
 - c. Ability to expose materials to harsher conditions to reproduce long-term effects.
6. Versatility
 - a. Ability to test on different components and parts.
 - b. Exposing materials to harsher conditions (to reproduce the long-term effects).

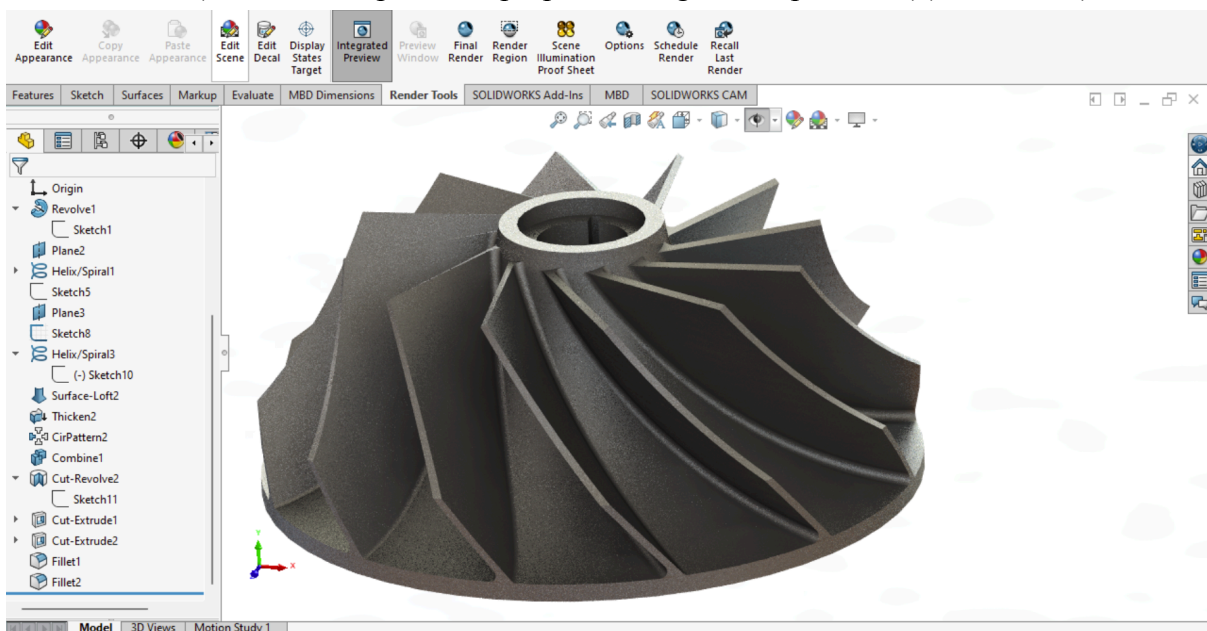
Technical Benchmarking

- <https://www.cnl.ca/facilities/high-pressure-water-test-loop-facilities/>

- (Similar to the current project, a water erosion system used to test nuclear components by CNL)
- <https://www.sciencedirect.com/science/article/pii/S0734743X09000517#:~:text=In%20the%20wet%20steam%20stage%20of%20a%20steam%20turbine%2C%20the,the%20mechanical%20reliability%20of%20turbine>



- (A study of water drop erosion on steam wind turbines, study explains how water droplets come in contact at high speeds with turbine blades lead to erosion with time)
- <https://www.sciencedirect.com/science/article/pii/S0043164809002075?via%3dIhub>
 - (erosion resistance on engineering materials in various test conditions)
- <https://www.sciencedirect.com/science/article/pii/0301679X81901018>
 - (Study involving centrifugal erosion testing)
- <https://www.sciencedirect.com/science/article/pii/S0043164815001106>
 - (Large study done on centrifugal erosion)
- <https://www.sciencedirect.com/topics/engineering/impeller>
 - (Article on Impellers, a propeller designed to spin water)(Seen below)



<https://deepblue.lib.umich.edu/bitstream/handle/2027.42/84210/CAV2009-final156.pdf>
(study from the University of Michigan)

Target Specifications

- The versatility of testing 3 different materials with various properties.
- Reproducibility
 - Being able to achieve test result deviation of less than $\pm 5\%$
- Sediment Capacity
 - Mass depends on the type of materials that can be accelerated at a time
- Climate Considerations
 - Ability to withstand seasonal variations (accounting for rainfall patterns, temperature fluctuations, wind speeds, etc.)
- Budget and Resource Availability
 - Expected prototype budget: \$100
 - Expected project cost: \$100
- Sediment Retention
 - Retain 95% of sediments within the system
 - Install basins that collect eroded material to monitor sediment accumulation over time
- Long Term Stability
 - Should last at least 1 year without visible signs of erosion on the system structure
- Erosion Efficiency
 - The propellor should rotate at a speed of around 10 rpm (ideally higher)
- System Temperature
 - The temperature of the system should be no higher than 40 degrees Celsius
- System Pressure
 - The pressure of the system should be kept at atmospheric conditions

Reflection Upon Client Meeting

After the event of the client meeting, we found that the client strongly reinforced the importance of safety within erosion testing. Consequently, the safety category was then prioritized as well as the consideration of methods to change the viscosity of the water within reasonable safety limits to accelerate the erosion. The client mentioned that the water being our liquid could be used with salt or additives such as cornstarch to increase viscosity aiding in accelerating the erosion process. Another important consideration was that we have revised and understood the size and shape of the propeller to cater to our needs based on the fact that we should adhere to a 10 rpm range suggested by the client. Lastly, we have not put much means into tracking and monitoring the results of our data before the meeting. We are now figuring out how to accurately track our results and stay consistent yet efficient.

Updated Needs

Items needed for prototype:

-(6") 3 blade propeller

<https://cad.onshape.com/documents/bdc4690ea852c3f631a1828d/w/451bac945ec12a1830017c82/e/279f7b0648cb6c98c802d43f?renderMode=0&uiState=65bd4ba9fc66723b907e03c9>

-Glass see-through tank

https://www.petsmart.ca/fish/tanks-aquariums-and-nets/aquariums/aqueon-standard-glass-rect-angle-aquarium-5345486.html?gad_source=1&gclid=Cj0KCOiAwvKtBhDrARIsAJj-kThvTF2epMNPgA26hHXjb9NcjNBXNcXyxYLxT1azCTetYdSzmc7mrEaAuqKEALw_wcB&gclid=aw.ds

-A small electric motor that can propel the fan up to 10 rpm

-Some type of filter

- This can be done with a simple fish tank filter (around 15 dollars)

https://www.amazon.ca/Finnex-PF-7-Aquarium-Power-Filter/dp/B082JJL75/ref=asc_df_B082JJL75/?tag=googleshopc0c-20&linkCode=df0&hvadid=459389502145&hvpos=&hvnetw=g&hvrnd=13125373597523261688&hvpon=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9000668&hvtargid=pla-1012268577294&psc=1&mcid=3f700aefdc7f382e9df3764f4da84173

- Small Weight scale to compare the erosion results before vs after

https://www.canadiantire.ca/en/pdp/starfrit-digital-kitchen-scale-5-kg-0424076p.0424076.html?gclid=Cj0KCOiAwvKtBhDrARIsAJj-kTixyVT72BDXJzLUSdQ8Tv-sdHnMYjb6FjFhq01NxRGVQOWNVkkd0NUaAuMpEALw_wcB&gclid=aw.ds#store=174

-Water temperature control

- (Seeing this will be indoors, a simple thermometer is all that should be needed)

https://www.amazon.ca/Neptonion-Thermometer-LCD-Digital-Temperature-Reptiles-Like/dp/B07RBPV8Q4/ref=sr_1_1_sspa?crd=3F9RBWSQQ50J8&keywords=fish+tank+thermometer&qid=1706904418&sprefix=fish+tank+the%2Caps%2C221&sr=8-1-spons&sp_csd=d2lkZ2V0TmFtZT1zcF9hdGY&psc=1

Project constraints:

Budget

- Up and only up to \$100.00

Water must be within safe temperatures

- +/- 10 degrees from room temperature

Choosing the correct type of material for the test specimen

- Should closely match the purpose of the test.

The scale of the test

- A full-scale test would be impractical requiring tests on a smaller scale that has to be accurately extrapolated to real-world scenarios

Testing environment

- A controlled environment where the testing apparatus or equipment can be housed and operated safely.

Time

- Although the test is accelerated, it must run long enough to provide meaningful data, which can still be a lengthy period)

Structural Longevity

- Precisely measuring erosion rates to predict the lifespan.

Size can't be too big

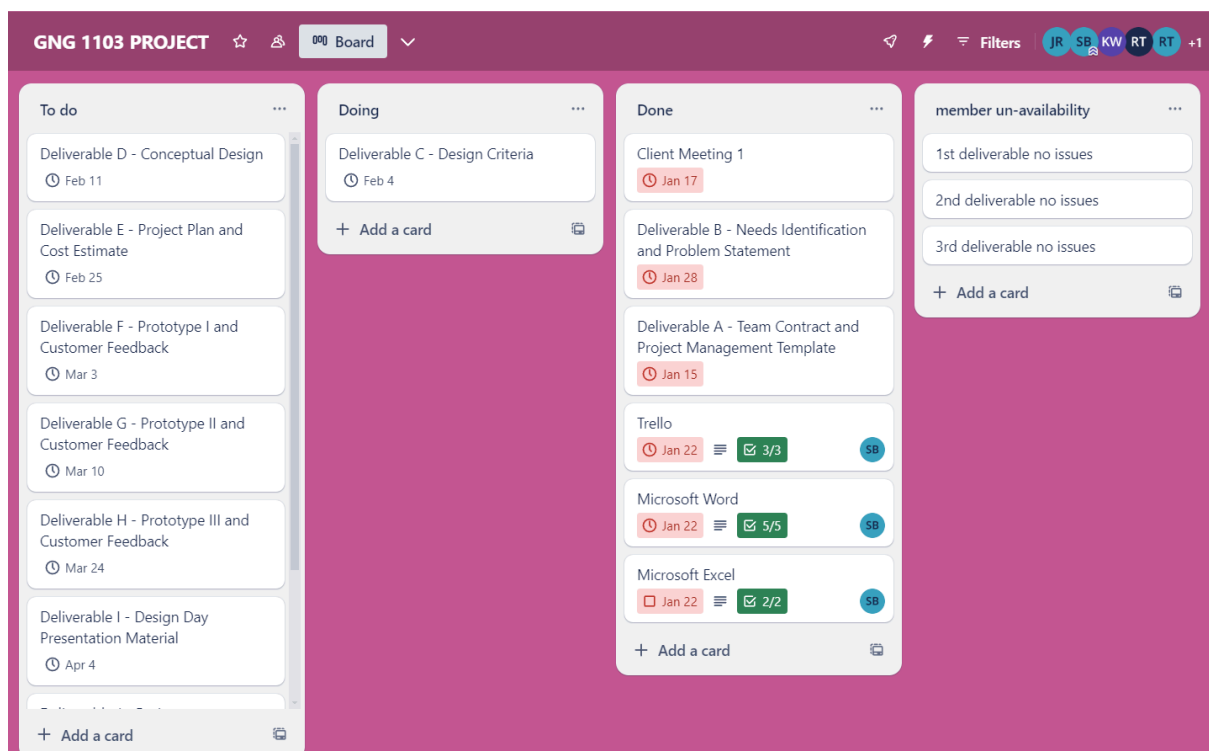
- no more than 7 Gallons

Current cost is \$63.72

We are currently \$36.28 below budget.

Conclusion

With the information gathered during the client meeting, as well as research and benchmarking done by our team, we have formulated the current design criteria and target specifications as seen above. As we stand we are within the established budget and have a prototype design in the early stages of development. The meeting with the client provided reassurance that safety was our priority, our team's benchmarking has led us to have a planned prototype, and our team's workspace on Trello has kept us organised as a group. The process is running smoothly thus far and will continue to do so with these guidelines in place.



These are the Trello tasks completed to our best ability.No feedback has been given thus far therefore no peer evaluation or responsibility can be given or distributed