Wind Silo Structure Design

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ABSTRACT

Perpetual Industries wants to come to market with a wind silo, as shown in Figure 1. This design is very robust and is designed to be used in blockchain crypto currency mining ,although, there is strong potential to be marketed to the average person. for most people. In order to proceed with the development of the Vertical Axis Wind Silo, a base structure that is unique, structurally sound, visually appealing, easy to manufacture, cost effective, and can be scaled taller using modular components is needed. Currently, there is a scale model and a functioning model available for testing. The company is quickly approaching a test phase with the silo in a real-life environment, hence the need for a well-designed base. Once the structure is erected, testing in different types of weather can commence to determine the structure the team will design can withstand the needed forces and other environmental requirements.

Figure 1: Wind Silo

CONSTOMER NEEDS/SPECS

Perpetual Industries was very clear in communicating that Wind Silo structure needed to be very robust and be able to withstand even the harshest climates while still being modular in both height and width to fit future Wind Silo models. A list of customer requirements and specifications have been listed below in Table 1.

Table 1: Customer Requirements and Specifications

Requirements		Specifications
Affordable		Size = 10' Minimum
Safe		Weight = > 1,000 lbs.
Reliable		Scalable Design
Modular		Material = Galvanized Steel
Durable		Easy Assembly
Productive		Expected Life = 40 Years

DESIGN CONCEPTS

The design process involved each team member producing multiple different designs and then the team ranking the designs created using a house of quality to determine which designs best fit the customer needs. The team took the four highest ranking designs, as shown in Figures 2-5, and further developed the concepts to a point where the concepts could be presented to Perpetual Industries. The sponsor decided to continue using the Quick Erect Concept shown in Figure 3, as the basis for the final design.

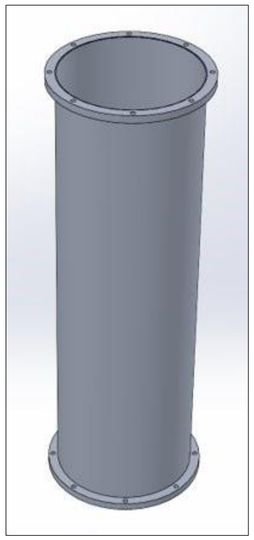

Figure 2: Modular Tube Concept

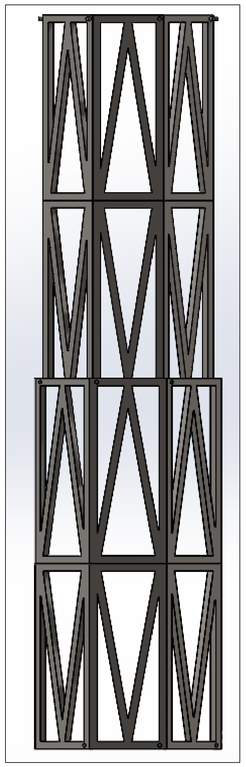

Figure 3: Quick Erect Concept

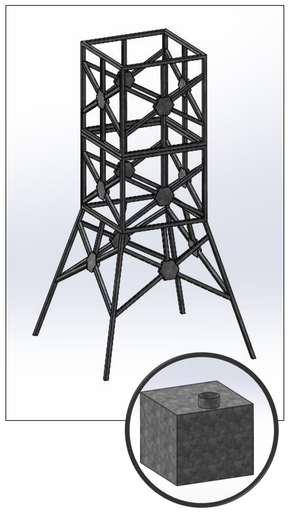

Figure 4: Bunker Concept

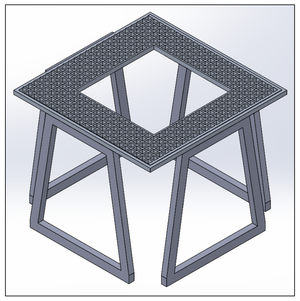

Figure 5: Box Concept

TEST RESULTS

The team ran finite analysis on the structure. This is the final stresses that the structure could endure. The FEA analysis is shown in Figure 6.

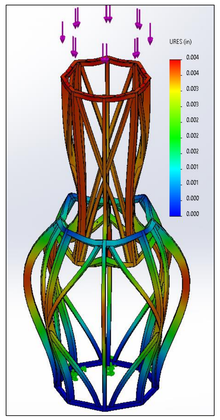

Figure 6: SolidWorks FEA Analysis

Figure 7: 3D Printed Wind Silo

The team also 3D printed a 15% scale model of the Wind Silo Structure shown in Figure 7. This model was printed to test the clearances between Layer 1 and Layer 2 subassemblies. The model also allowed the team to better understand the fit and function of the different subassemblies and better understand the aesthetics.

FINAL DESIGN

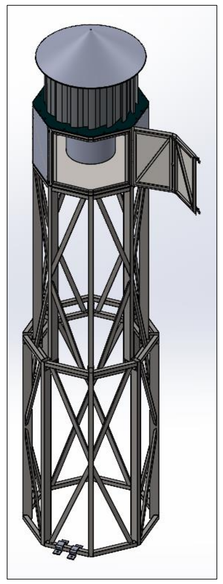

Figure 7: Final Design Erect

After consulting with Dr. Jenkins and Jeff Rhodes regarding the design concept, the team produced a modular structure shown erect in Figure 7 and collapsed in Figure 8.

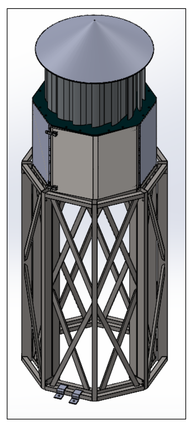

Figure 8: Final Design Collapsed

CONCLUSION

To see the project to completion the team has completed the following steps and processes to reach a completed Wind Silo structure. The team developed a list of customer needs and specifications the silo need to meet. The team completed and complied intellectual property research to ensure there were not any infringements. The team brainstormed potential ideas and then developed those ideas into four concepts to take into system level design. After system level design, Perpetual Industries decided to continue forward with the Quick Erect design. The team then developed a working 3D model of the structure implementing changes along the way as requested by the sponsor. Next, the team completed some testing to ensure that the design is safe and meets the needs and requirements of the sponsor. Finally, the team presented Perpetual Industries with the 3D models and drawings necessary for the team's concept to be realized and produced.

In the future, the design will need further refinement after the first prototype is produced to make manufacturing processes more effecting. The sponsor will also need to make the necessary changes to switch the material to aluminum from steel once prototyping progresses.

LESSONS LEARNED

Throughout the year, the team has learned:

- Designs are always changing.
- Communication is vital in creating a product.
- Time management should always be high priority.
- The small details can make a significant difference.
- Planning allows for more efficient output from the team.

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