To: Dr.Oman
From: BID - Team 16
Date: February 22, 2019
Subject: Hardware Review 1

The following document lays out the contents that were discussed at the team's first hardware review with Dr.Oman. There were three main aspects for the team with this review: computer-aided design (CAD) models of prototypes, the testing fixture, and the design of experiments. Each will be laid out below in further detail.

CAD of Each Prototype

Each member of the group has come up with different bio-inspired ventilation designs to test the design of experiments. These models include a flower vent actuation design, a fibonacci design, a termite mound design, and a pine cone design.

Flower Vent Actuation - Kyle Matsuoka

This vent style is bio-inspired based on how flowers blossom. This design has "pedals" that can open and close like how a flower blossoms it's pedals. Ideally, the actuation would occur based on springs that pull the "pedals" up when the pressure is high, and bring the "pedals" back down when the pressure is low. Figure 1 and 2 show different views of the flower vent.

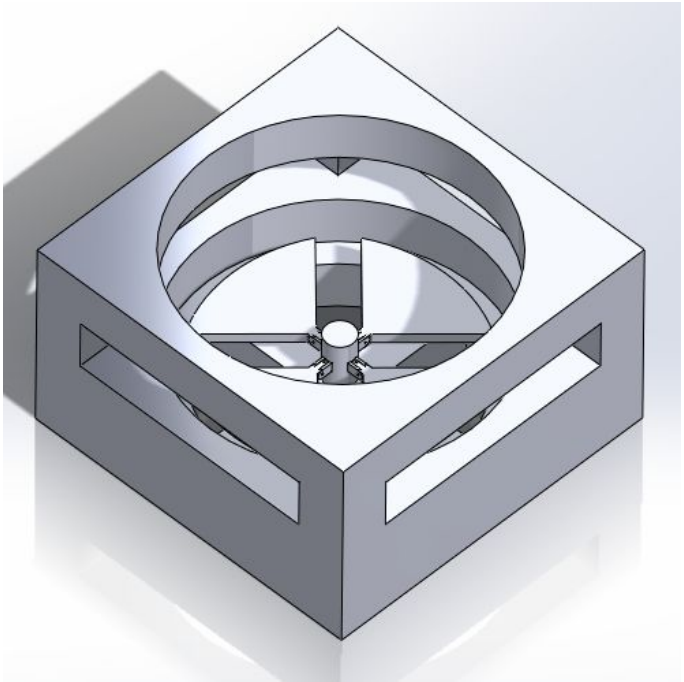

Figure 1: Isometric view of flower actuation vent style

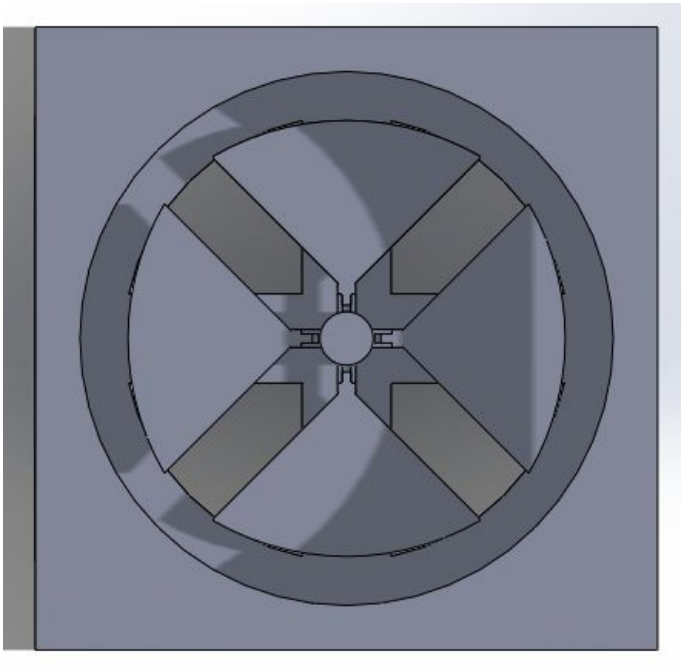

Figure 2: Top view of flower vent

Fibonacci Design - Taylor Mellon

The Fibonacci sequence is the most recurring sequence in nature. It can be seen in human and plant anatomy. The team felt it was necessary to build a design that incorporated this sequence into a prototype design. The design can be seen below inf figures 3 and 4.

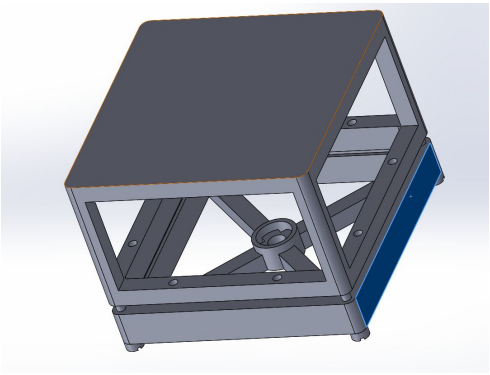

Figure 3: Casing for fibonacci blade

Figure 3 shows the vent casing for the fibonacci fan blade (figure 2). This design incorporates supports for bearings to allow the blade to freely spin, slots for O-rings, and a way to attach the vent and making sure it is sealed.

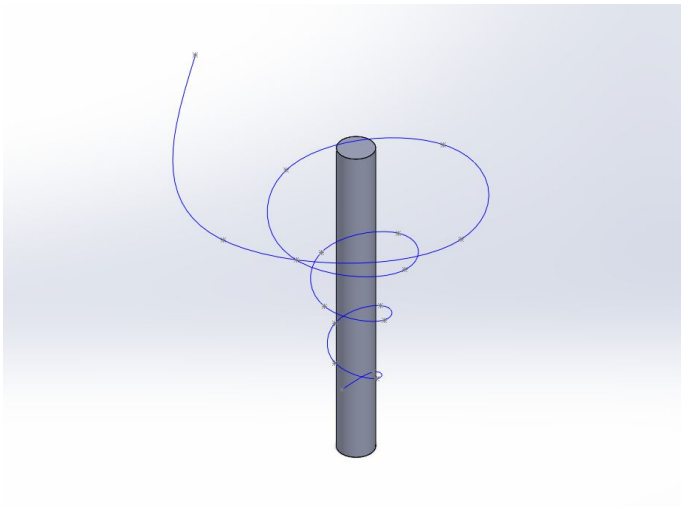

Figure 4: Layout for Fibonacci Fan/ Turbine Blade

Seen in figure 4 is the part which has been started for the fibonacci fan/ turbine blade. It can be seen that I have a path for the sequence but I am still unable to figure out how to project this onto the shaft.

Termite Hill Vent Design- Talon Mills

The termite hill design aims to incorporate the idea of free ventilation by mimicking the design and style of how termites vent their mound. This is comprised of a main chamber that is tapered along its vertical profile. As it narrows towards the top of the hill other chambers or shoots connect the main chamber out to the surface of the mound. The prototype as seen below in figures 5-6 incorporated these ideas into a small scaled prototype.

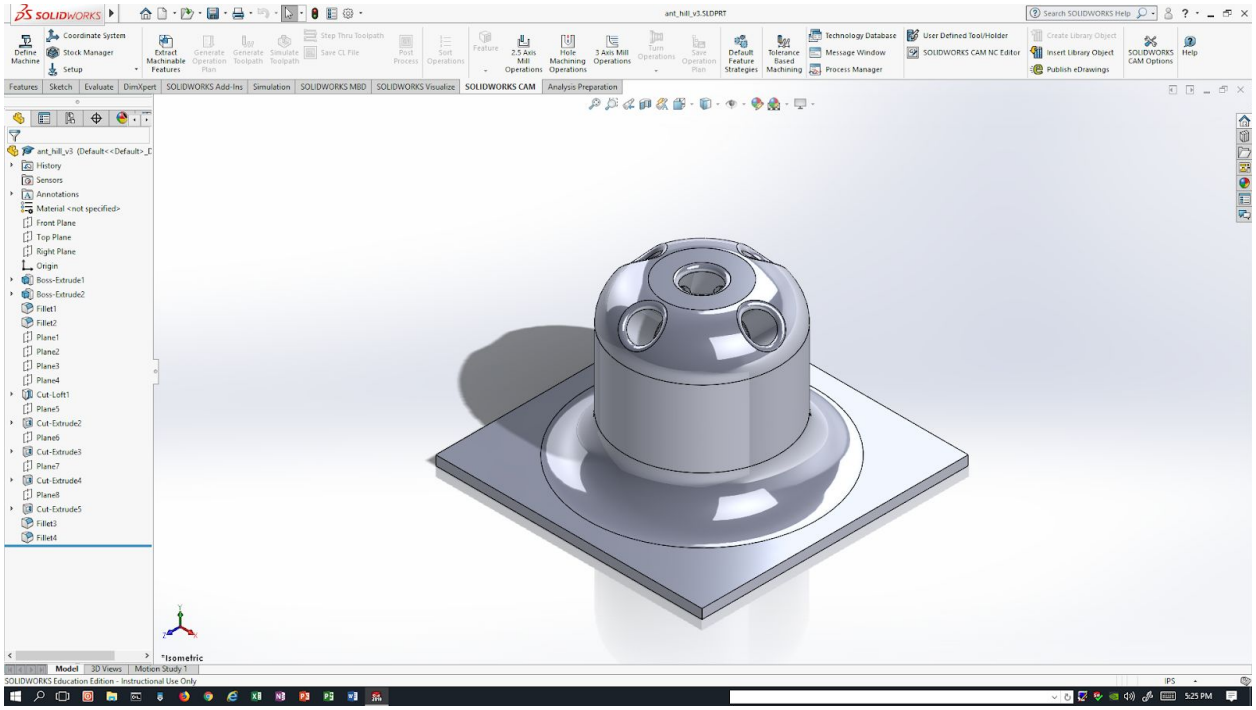

Figure 5: Isometric view of the termite prototype.

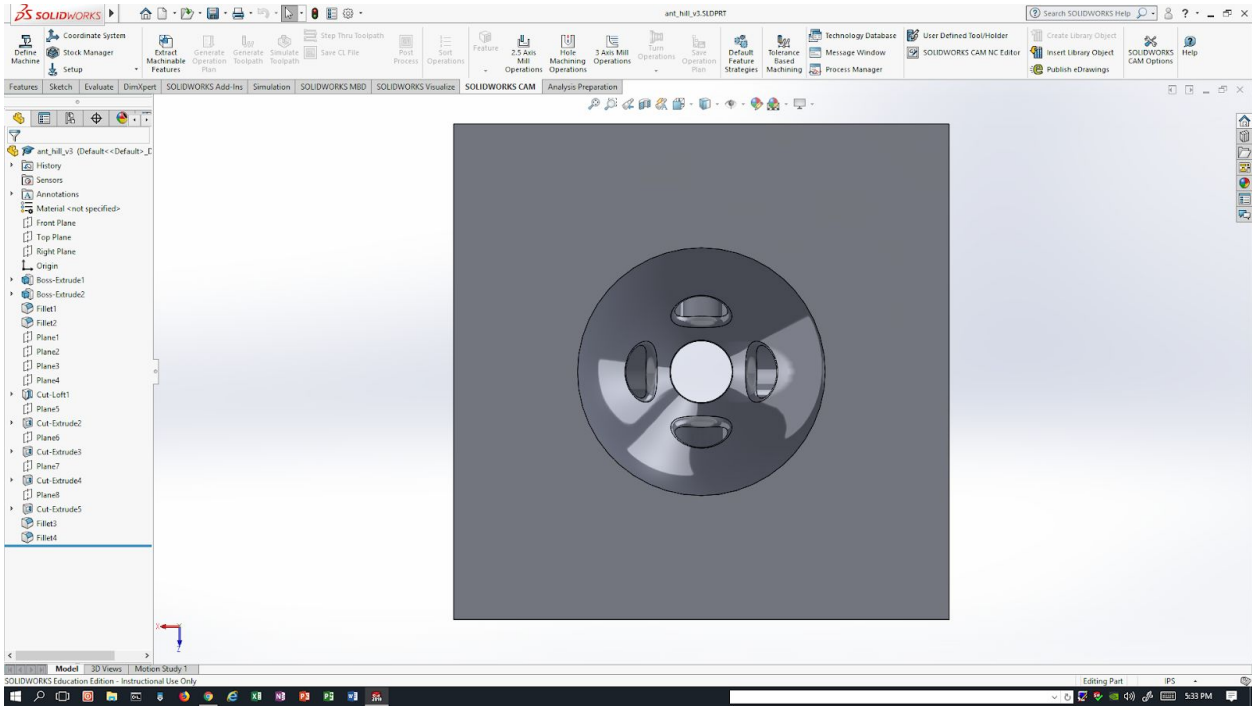

Figure 6: Bottom view of termite prototype, the taper of the main channel and shoots can be seen.

Pine Cone Design - Hani Alharbi

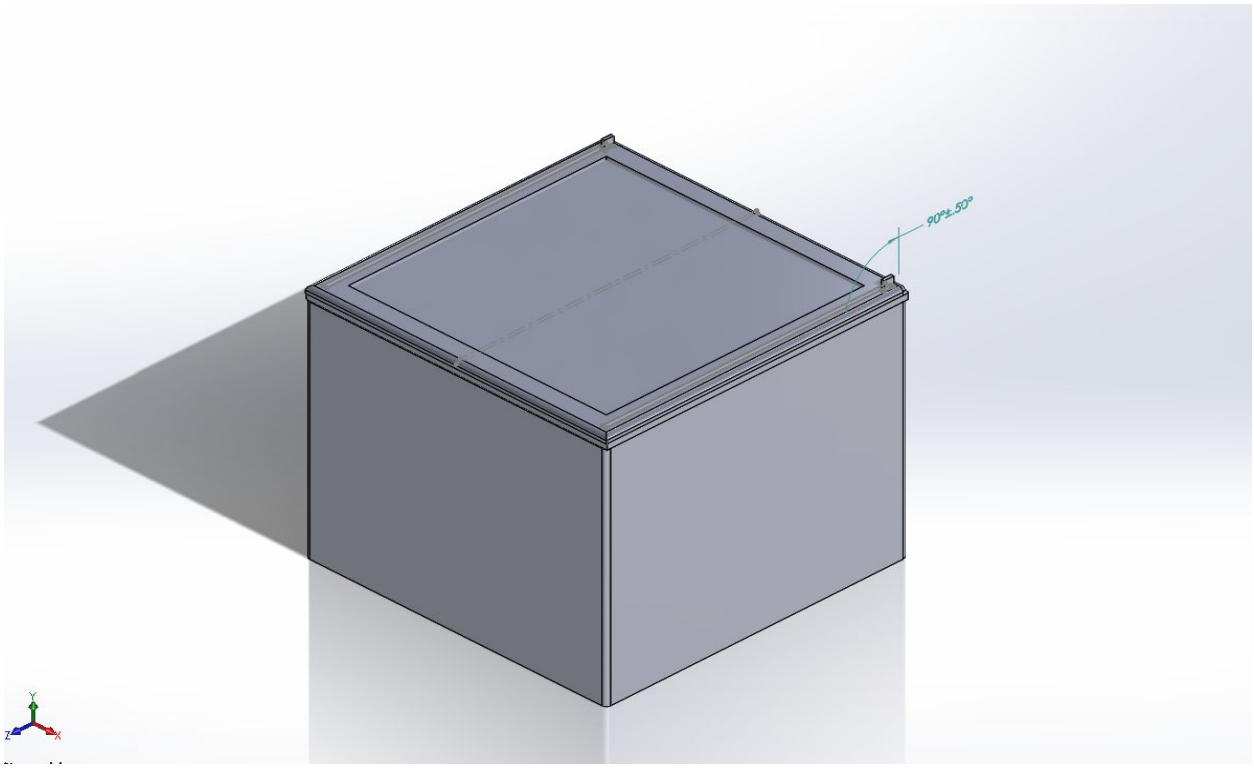

Figure 7: Isometric view of pine cone design closed roof

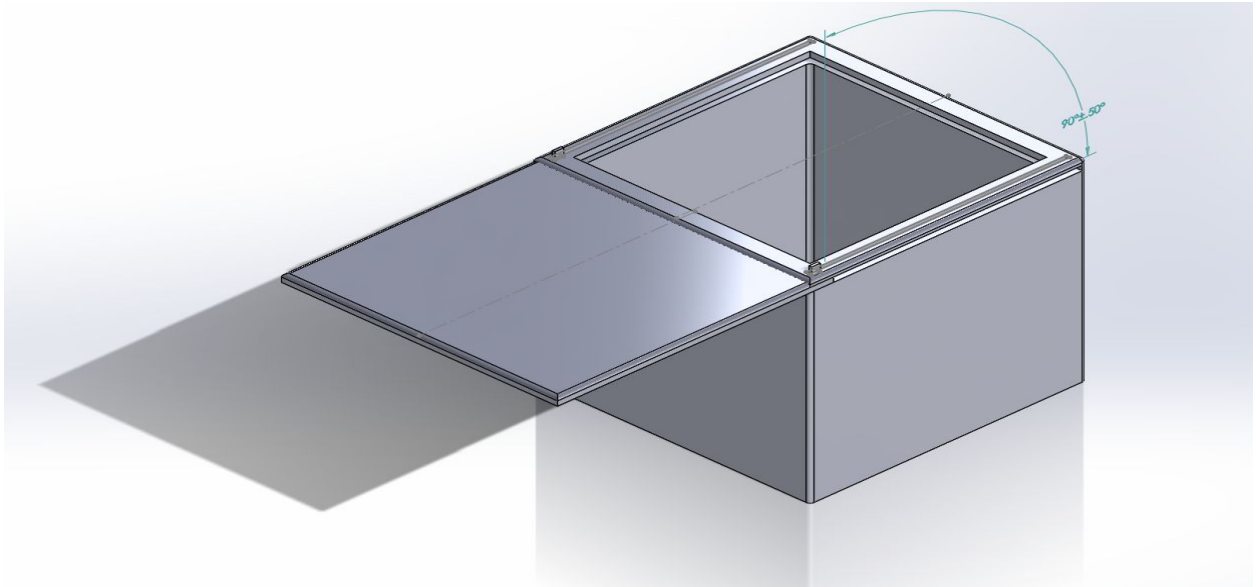

Figure 8: Isometric view of pine cone design opened roof

The design represents pine cone which is bio-inspired from nature. While the pine cone gets humid it opens to cool down, and once it cooled down it closes again. Figure 7 shows the roof while it is closed that means the pressure is as what is required. Whereas, figure 8 shows an opened roof because if the building needs ventilation it will be easy and fast to vent it.

Testing Fixture

The testing fixture will be made of plexiglass which will be 12”x12”x12” creating 1ft^3 of pressurized air to test each vent prototype with. The plexiglas chamber will be pressurized with a bike pump via a valve stem which will be fixed to the box by drilling a hole and epoxying it to seal the chamber. A pressure gauge will be attached to the box in a similar manner with inserting it into the side of the box and sealed air tight. The vents will be attached and tightened to the top of the box using 4 screws and an o-ring to create an airtight seal. The testing chamber and sealing method can be seen below in figure 7. The opening for the vents in the top of the box will be cut to 6”x6” and will allow for ½” overhang to seal the vents to the top of the testing chamber.

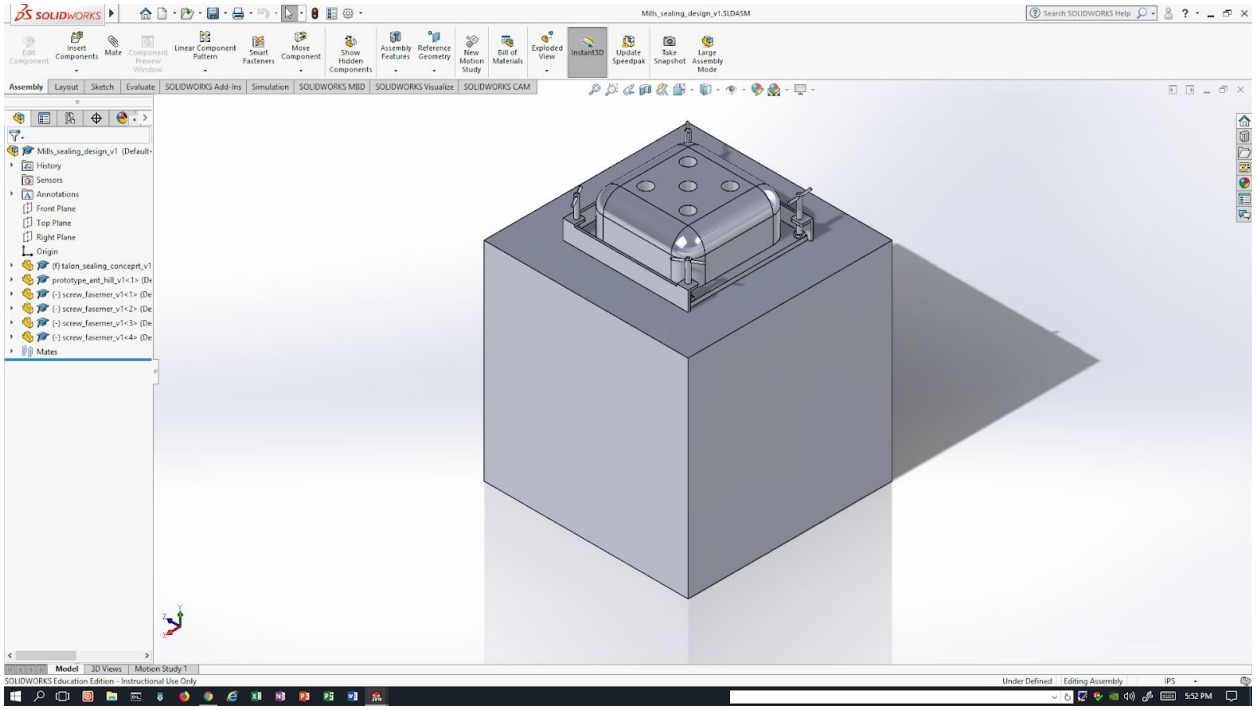

Figure 9: The basic model of the testing chamber and vent attachment method.

Design of Experiments

The design of experiments (DoE) the group will be conducting can be split up into three different categories: what will be analyzed, what should be analyzed, and what the group hopes to analyze. The first design DoE the group will conduct will be to analyze how the different ventilation styles will relieve pressure from the pressure chamber. The second DoE that the group should analyze will be to analyze how well each ventilation style will reduce the pressure

from the pressure chamber with a constant application of pressure. The third DoE that the group hopes to analyze is analyzing how each ventilation style will reduce the temperature of the pressure chamber. A further explanation of the DoE is laid out in a separate document attached to this assignment.

Conclusion

The team has presented the prototypes, design of experiments, and the testing fixture. Along with this two more documents will be attached to the assignment which are the full design of experiments and the bill of materials that was created for what has been completed till now. The team knows that issues will arise and other materials purchased or changes made to the design of experiments but hopefully enough thought was put into each of these to not veer from them to a major extent.