Our team’s goal this semester in ME 4500 was to come up with a solution to aid in the drying of an individual after bathing, showering, or any other activity that results in getting wet. Our main group of focus that we are considering this project for is the elderly and/or handicapped as they may have a difficult time performing this task due to limited range of motion. Another customer group includes spas and resorts.

**OBJECTIVES**

Our main objectives for this project include:
- Durable and Reliable System
- Long-term Cost Effectiveness
- Relatively Simple Home Installation/Adaptation
- Safe and Fast Drying

**EXITING DESIGN CONCEPTS**

- Upon doing extensive patent research we found three existing designs that have been developed over the past few decades. Most of these designs were a stationary system that was very large and limited.

**SELECTED DESIGN CONCEPT**

Our team chose to use a lead screw for the lift system and an air knife for the air delivery system. The lead screw design has a simple configuration in order to get the lift moving, easily maintained, and robust. Our design utilized a Roton Hi-lead screw due to our vertical application as well as an Exlar Servo Motor for ease of programming. As for the air blowing subsystem, we utilized a high CFM output centrifugal blower in order to produce a high velocity output.

**ANALYTICAL METHODS (CAD/CAE/ETC.)**

For our design project it was necessary to evaluate several different design concepts for the air knife manifold design. In order to do this we researched different air knife shapes and gathered information from different air knife manufacturers. Ultimately we found that two commonly chosen shapes: the diamond and the teardrop. Additionally we determined that a triangular shaped manifold would likely compare well to the others and be much easier to manufacture. In order to evaluate these three different shapes, we modeled them in NX 10.0 and ran CFD analysis in ANSYS Fluent. In the end, the results were relatively similar and the speed at the outlet of the triangle manifold fell between that of the diamond (least efficient) and the teardrop (most efficient).

**DEVELOPMENT**

The flow-chart above is showing our prototype development process. Our group started off with a patent search on existing products, then we generated multiple concepts to select. After we evaluated our design using Pugh Analysis, we generated a detailed CAD Design. At the same time, we wrote the DV&R and FMEA report. Since our prototype contains 3 subsystems, our fabrication was divided into 3 parts. While we assembled the prototype, we conducted testing for multiple cycles. Our group managed to complete testing for all systems with no major issues.

**RESULTS & DISCUSSIONS**

After manufacturing and assembling our prototype, we tested our systems for both individual and combined functionality. Initially we were worried about binding in the guide rails. To counter this we used 4 guide rails for the lift system. During testing we did notice some friction issues and some catching as the plate moved up and down. After lubricating the rails, the noise and friction was reduced. The controller functioned properly during our testing and did not have any connectivity or software issues. For the air knife sub-system we chose to use a flexible tube and remote mount the blower. Overall, the air velocity at the outlet was sufficient to dry one’s body in a reasonable time. Another test was done to evaluate the noise and vibration of the blower and the entire system. Our team decided collectively that the noise and vibration surpassed our desired levels.

**CONCLUSION**

Our team was successfully able to prove our design concept through a working prototype. Our goal was to provide a system that was easy to use and provided assistance for drying that some people may not be able to complete themselves. Aside from the accomplishment of completing a working prototype, our group was exposed to the many important tasks that are required to complete a product from conception. Moving forward, we suggest further research into cost effective but efficient blower motors as well as reduction in size to the controller components. We would also suggest changing the material of our air knife to aluminum for reduced weight and corrosion properties.

**ACKNOWLEDGMENT**

We would like to thank Sean Murphy and Brad Carver from Welker Engineered Products for helping out with the machining and motor programming. Also, the team at Wico Metal Products for the welding and fabrication assistance of our air knife.

**TEAM MEMBERS**

Scott McLaren, Robert Carver, Jeremy Gates, Henry Li