Where: Research Experience for Undergraduates (REU) @ McDonald Observatory.

University of Texas @ Austin

Project: Mirror Transportation Device

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Major: Aerospace Engineering

Mentor: David Doss

My project for this year's Research Experience for Undergraduates (REU) at the McDonald Observatory was to design a sound and simple-to-operate mechanism capable of handling a variety of fragile telescope mirrors varying in both size and weight. This mechanism must also be capable of resistance to corrosion due to the application of sodium chloride (NaCl) and water (H_20) during the wash-down phase of the mirror resurfacing/aluminizing process. It should also be relatively light, simple to construct, and produce a consistent amount of ease for operation regardless of which mirror is present. Finalizing the designing parameters are to have a design that minimizes material usage without affecting the carts structural integrity, and keeping construction costs to a minimum. The designing program specified to be used for this project was Autodesk's Inventor, which is a computer-aided drafting (CAD) program which focuses on producing 3-dimensional representations of objects, and assemblies from their 2-dimensional sketches. Though I will not be capable of physically observing the construction or operation of my design, the data from calculations and strain analyses guarantees that the cart (Figure 1) will be structurally sound, capable of withstanding an impulse force in excess of 300,000 lb (150 tons) from an impact under full load (supporting the heaviest mirror of 600 lb) with a velocity of 10 mi/hr and maintain its original shape. For the cart, the total dimensions are as follows: length = 5 ft, width = 3.5 ft, and height = 3.8 ft, with a center-of-gravity (CoG) of 2.5 ft above the ground, varying less than an inch per mirror assembly. The cart also has a weight of 420 lb unloaded.

This project was overseen by Dave Doss, a McDonalds Observatory employee who has over 30 years experience working with the mirrors at hand. After several meetings with him and his team of technicians, listening to their comments about characteristics they felt should be present in a good design while watching them work with current equipment, I learned exactly what they were looking for in the design of the mirror transporter/wash cart. This was a very beneficial source of information for they have experienced the previous methods, and will benefit the most from my projects results. In addition to learning how to use Autodesk's Inventor, I also learned how to communicate with the client, learning exactly what they desire, as well as what they believe should <u>not</u> be present in a good design.

A good design produces a product which is guaranteed to produce expected results, repetitively. It should be trustworthy, meaning it should consistently operate properly with no/minimal systematic failures, and should give piece-of-mind while being operated. It should also make the process of accomplishing desired results relatively easier than previous methods. The simpler the mechanisms functionality, i.e. the simpler it is to maintain and operate, while making the transporting and washing process of the mirrors more efficient, will be deemed a good design by its operators.

Previous to this summers' REU, there had been a mirror transporter/wash cart designed with similar constraints, that was specifically designed by University of Texas at Austin's (UT Austin) engineer

John Good for the handling of the hexagonal mirrors of the Hobby-Eberly Telescope (HET). This cart was extensively studied by me to identify how a design could be simplistic, while also meeting design specifications for optimum satisfaction. The understanding of this concept was ubiquitous throughout the designing process.

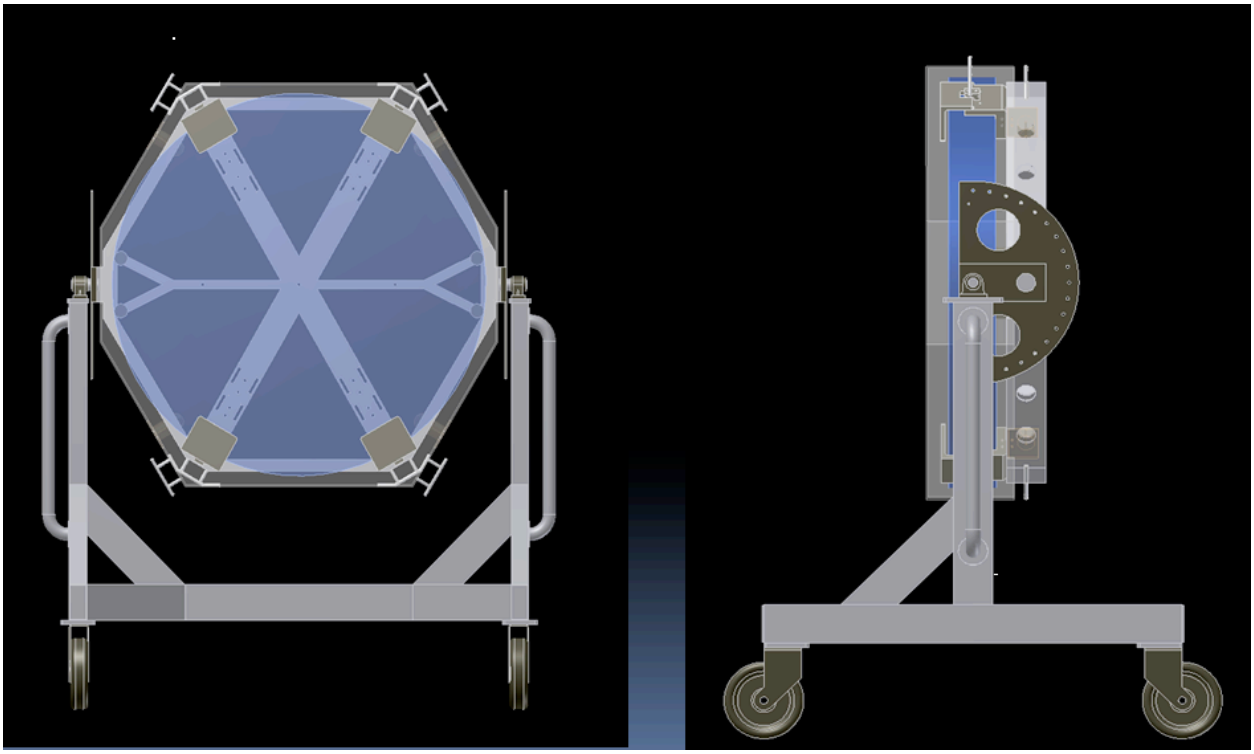

Figure 1: Front (left) and right view of transporting/wash cart loaded with heaviest mirror (f-9), with brace rotated 90°.