SEED Library

Overview
Penn State University’s Students for Environmentally-Enlightened Design (PSU SEED) are creating a library, fully contained in a shipping container, to provide books to residents in refugee camps. The three major components of the library are the interior, canopy, and electrical system. This team is solely responsible for the canopy portion of the project. The main goal of this project was to design a canopy that would relieve the library and its surroundings from excessive heat by providing shade.

Objectives
The objective for this project is to design a canopy that will provide shade for a library, based in a 40 foot shipping container. The canopy must not puncture the container, provide means for attaching solar panels, mitigate theft, and fit inside the container.

Approach
- The team discussed the overall needs with the project sponsor to determine the direction the project should take
- Sketches were first made to brainstorm ideas on how to attach arches to the container
- SolidWorks CAD drawings evolved from sketches and were refined through experimentation and discussion amongst team members
- An early corner lock was crafted from aluminium in order to test for the design’s fit on a real shipping container
- CAD drawings were heavily refined over the semester up until materials were finally ordered, since the budget would not allow for extended physical prototyping
- Excess material was ordered so as to allow for further experimentation and minor mistakes in machining or welding
- Test fitting was done on a 20’ shipping container on campus after all parts were fabricated at the Learning Factory
- Alpha prototype test fitting went very smoothly on 20’ shipping container; further parts were designed and built to accompany existing parts
- Wooden frame was designed and built to serve as a means of transporting material from the Learning Factory to BJC, and also as a means of displaying beta prototype in Design Showcase

Outcomes
- The team designed a usable and successful design for solving the problem of creating a canopy to provide shade
- Surface temperatures showed a drop of 25% under canopy versus in direct sunlight
- The design is not overly expensive; $900 was enough for the material to build two complete sets of both double- and single-arches along with two lengths of wooden slats
- The design allows for connectivity to solar cells at any position along the arches
- The canopy system can be assembled by four people in several hours with minimal tools needed, and without the need to modify or puncture the shipping container
- All material will fit inside the shipping container when disassembled