PURDUE UNIVERSITY

CAPSTONE EXPERIENCE 2015

Mobile Solar Thermal Delivery Platform

Agricultural & Biological ENGINEERING

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Problem Statement:

The purpose of this project is to build and test a prototype of a Mobile Solar Thermal Delivery Platform using a high output solar panel, SunQuest 250™ manufactured by Solar America Solutions (SAS). The unit is intended to be a versatile multipurpose device for use on farms (greenhouses, crop drying, livestock building, etc.), or in any mobile low space heat application such as meeting tents, military field stations or emergency relief tents. The main focus with this first prototype is on the mobile heat source assembly. The prototype will be further developed and optimized by a team (Ileleji and Co.) in collaboration with SAS to fit various applications.

Main Project Goals and Deliverables:

- Design Prototype
- Build Working Prototype
- Test Prototype
- Collect, and evaluate the data from prototype testing

Budget	
Component	**Cost ($)**
Pump	93.30
Plumbing	168.93
Heat Exchanger	133.92
Heat Transfer Fluid	175.00
Heat Dissipater	100.00
Fan	79.95
Mounting platform	100.00
Miscellaneous Expenses	78.75
Collector unit Aluminum frames	470.32
Total Project Cost:	$ 1,400.17

Background:

Solar America Solutions is based out of Indianapolis Indiana and provided two Sunquest 250 collection units for the project. Each of these collection units has a 4 ft. by 7 ft. footprint with 88 sq. ft. of collection area. Each collection unit is capable of producing 35,000 btu/hr from collecting Ultraviolet Light and converting it into heat energy.

Alternative Solutions:

One alternative solution was to use the same system shown in Figure 1, but with the addition of a liquid storage tank for storage of additional 50% propylene glycol/ 50% water heat transfer fluid as a means of storing up heat energy for later use. This potential system design will be further pursued in the next phase of product development. Components will include carrier fluid storage tank and expansion tank. Other design aspects that will be included are a sturdy protective transport shell, trailer , and UV panels to power the pump and fan, making the unit self-powered.

Another potential solution was using both Sunquest 250 units in the final construction of the prototype, but the maximum production of 70,000 btu/hr was considered to be too dangerous, and excessive for the first prototype. To properly accommodate that heat load, more funding, construction time, and testing time would be needed.

Final Design and Solution:

There were some slight adjustments made during the final construction of the prototype that vary from the AutoCAD design. Only one Sunquest 250 collection unit was used, but the plywood platform was kept at 16 ft. long to accommodate for the addition of the second collection unit in later prototype designs carried out by future design teams under Dr. Ileleji.

Also the 7 ft. bare element heat dissipater was placed inside the ductwork to recapture any excess heat left in the heat transfer fluid after passing through the 12 in. by 18 in. fin, and tube heat exchanger, instead of just letting that heat energy dissipate into the open air.

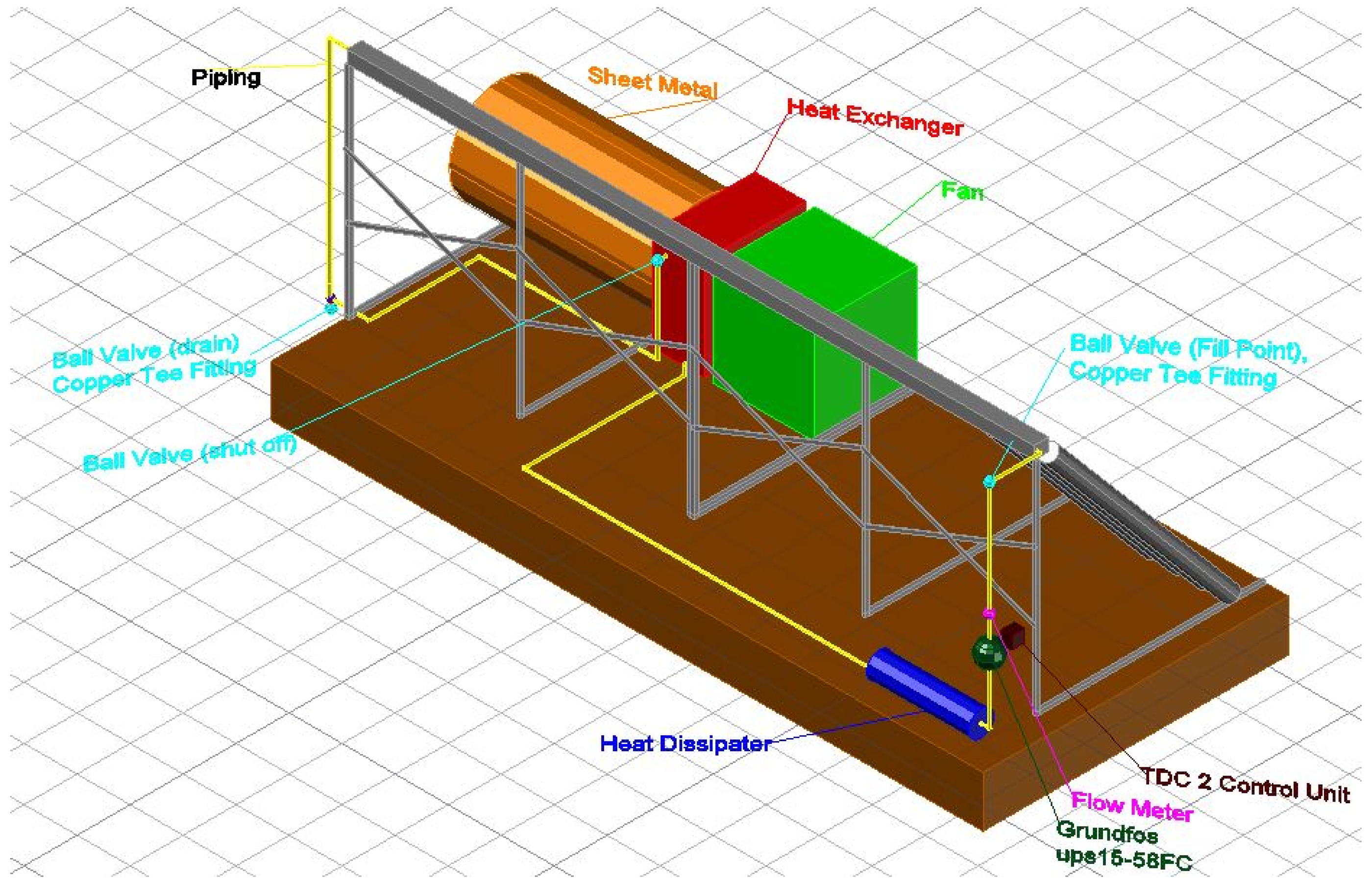

Figure 1: The fourth version of our design produced in AutoCAD.

Figure 2: Rear view of the completed prototype.

Figure 3: Front view of the completed prototype.

Testing and Experimentation:

The first test of the heat delivery system was on a cloud covered day with an ambient air temperature of 59°F. Even with these poor conditions, peak fluid temp. reached 109°F, and the outlet air temp. peaked at 80°F.

Time (hrs, min)	Airflow (cfm)	Sensor 1 Temp (°F) Collector Inlet	Sensor 2 Temp (°F) Collector Outlet	Sensor 3 Temp (°F) Air Outlet
0:00	148	75	75	71
0:10	148	95	91	69
0:20	148	84	86	77
0:30	148	109	109	71
0:40	148	86	87	80
0:50	148	104	104	69
1:00	148	87	89	77
1:10	148	82	84	77

Global Impact and Sustainability:

Only the fan, the TDC 2 control unit, and the Grundfos pump need a power source. Leaving the main source of energy being consumed collected from UV light. Meaning this system's carbon footprint is relatively low. With this system being unique in design, and with no set market yet, there are potential commercial, residential, agricultural, and military applications for this mobile heat delivery system. Unlike conventionally powered heat delivery systems, this system's main energy source is never depleted.

Sponsor:
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