Leif Paulson

CEE3090

Final Report

Last semester, the solar oven sub team I was a part of began construction of two smaller ovens, one for our use, and the other to be given to the ESW chapter. The purpose of our work was to have two ovens that would be able to be used in solar elevations similar to Ithaca's. The design we chose was based on an oven Professor Vanek had previously used. We made some alterations to the design based on Professor Vanek's insight, as well as, some changes our team decided to make on our own. We finished the semester with one completed oven, and the second oven still needing a fair amount of work.

The main goal I wanted to accomplish this semester was to design and build a reflector assembly for the completed oven, and decide on the direction of the second incomplete oven, as I put some thought, along with Tim, into alterations in future construction that could benefit its overall design.

The reflector assembly closely followed the design of Professor Vanek's previous design, which can be seen in the attached appendices. It was made by attaching four, square panels and four, trapezoidal panels to a square frame.

The pieces for the frame were cut lengthwise at an angle of approximately 30 degrees using the band saw. This allowed for the panels to be screwed directly into the frame and lay at an angle in order to best reflect sunlight into the oven. The four square panels and four trapezoidal panels were attached together by brackets. Since the quarter inch plywood provided a significant torque on the frame, the bracketing proved to create a rigid structure made up of the panels that took a large amount of force off the frame. The long run durability of the frame is somewhat of a concern, and future thought may be put in to create a more durable design as to better support the weight of the panels; however, the current design seems to be fairly solid. In another effort to reduce the torque put on the frame, steel cable was attached to opposite panels. Although the cables need not be in tension all the time to reduce torque from the weight of the panels, its main use is to oppose extra torque from the wind hitting the panels and bending them further back. The completed reflector assembly sits on top of the glass frame oven as shown below.

As of now, the assembly sits on the lip that the front panel of the oven makes with the wood frame containing the glass. Future plans are to attach a latching system to the assembly that will secure it to the oven. At this point, even without the latching system, the reflector system seems to be fairly secure. This is due to the plywood panels being taller than the edges of the frame, and it should be kept in mind for future design, as it helps the stability of the reflector.

Apart from construction of the reflector assembly, this semester I worked on thermally insulating the first completed solar oven. As it was designed to be able to take the glass, in its frame, in an out of the oven so it could be easily replaced, it also provided some small cracks in which heat could escape. In order to fill these cracks I laid string along the surface creating the leak and put thermally resistant tape on top of it. This allowed for the two surfaces to seal better, keeping in more heat.

Regarding future construction, we feel that rather than have the glass in a removable frame, that can be taken in and out of the oven easily, it would be more beneficial to have the frame built into the oven, and be able to easily slide the glass in and out by only having to remove one edge of the frame. By doing this, we will be reducing the number of spaces that heat can escape. There will be less thermal leakage, and less areas to seal. No final design has been made yet, but having the frame of the glass built into the oven is a change in design that will benefit the efficiency of the ovens.

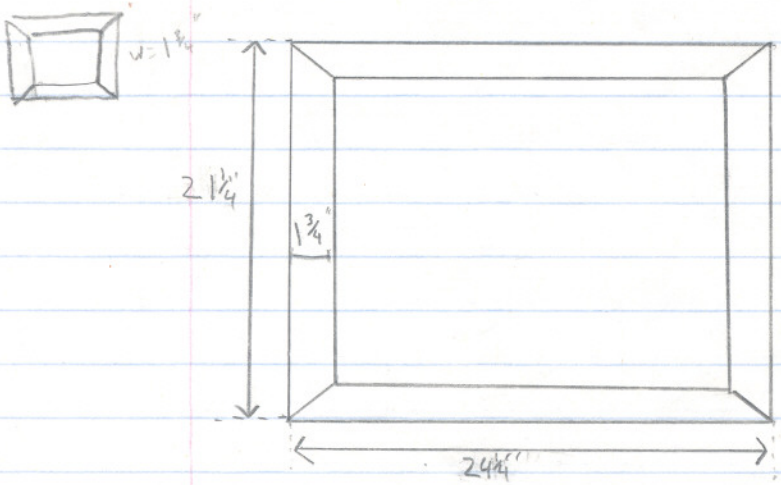
Attached are the plans for the solar reflector I built, along with the plans for the previous one that I used to design my own.

Appendices

Reflector Assembly

Leif Paulson
Spring 2011

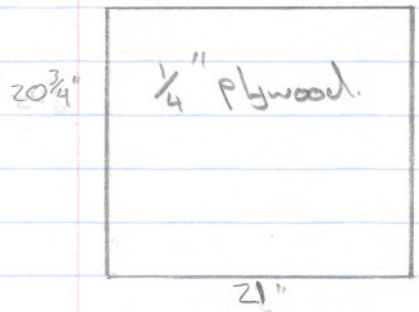
Frame



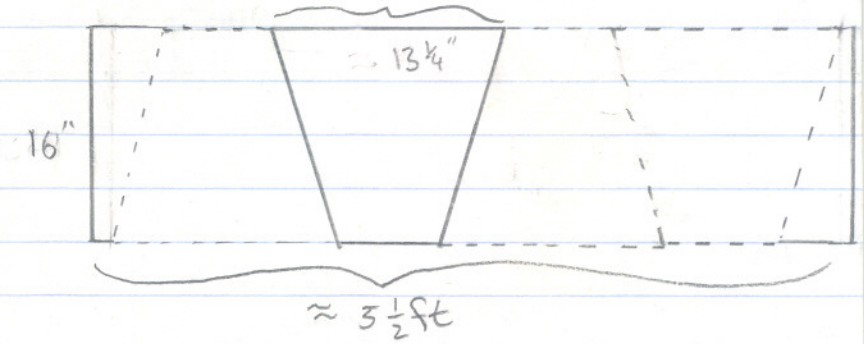
quantity of plywood
4 - 24½" x 24½" pieces ≈ 17ft²

* frame made from 2x2 pieces cut at an angle lengthwise so panels could be screwed in and sit at angle to capture sunlight →

R/L/F/B

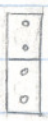


Trapezoid panels.



Brackets

16 →

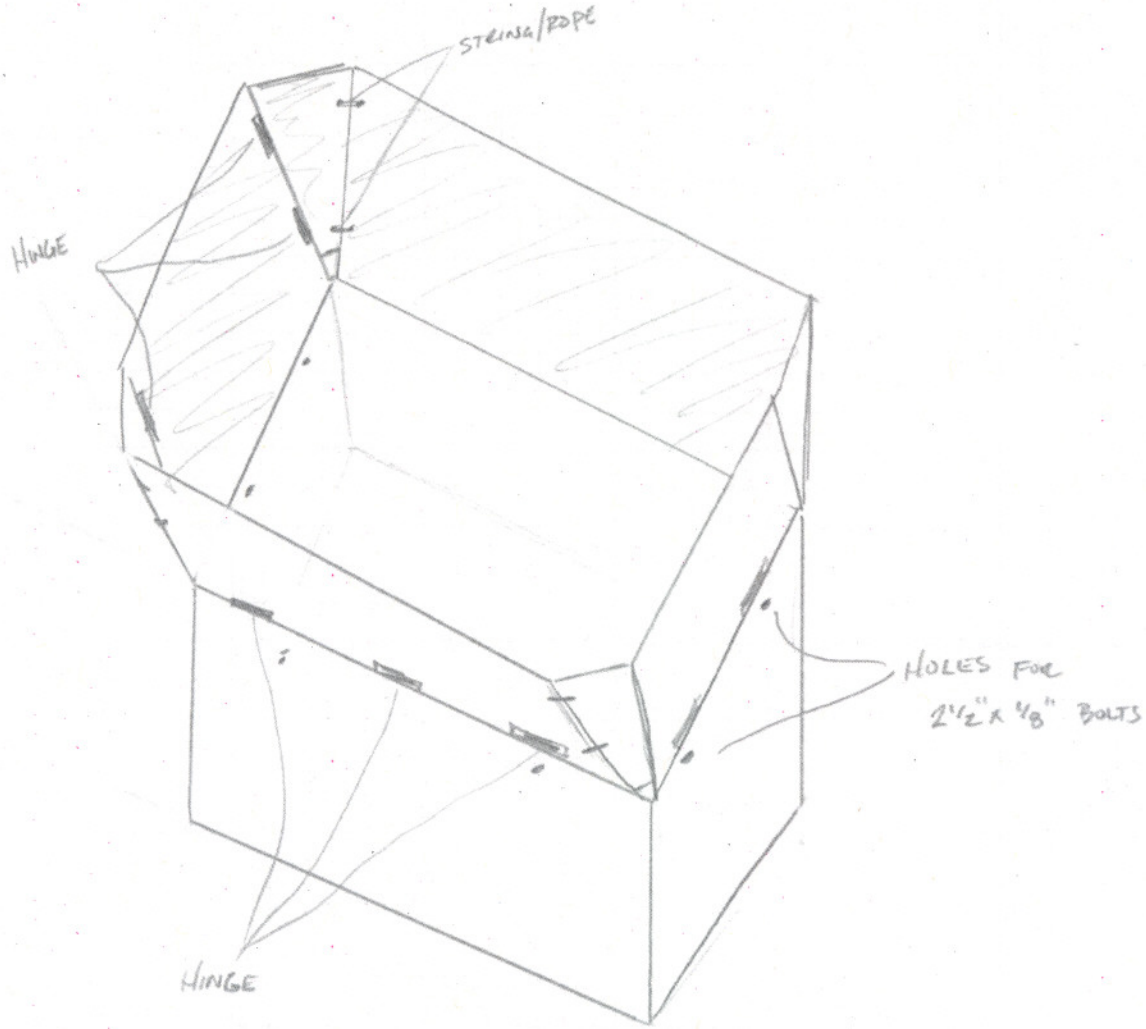


side <

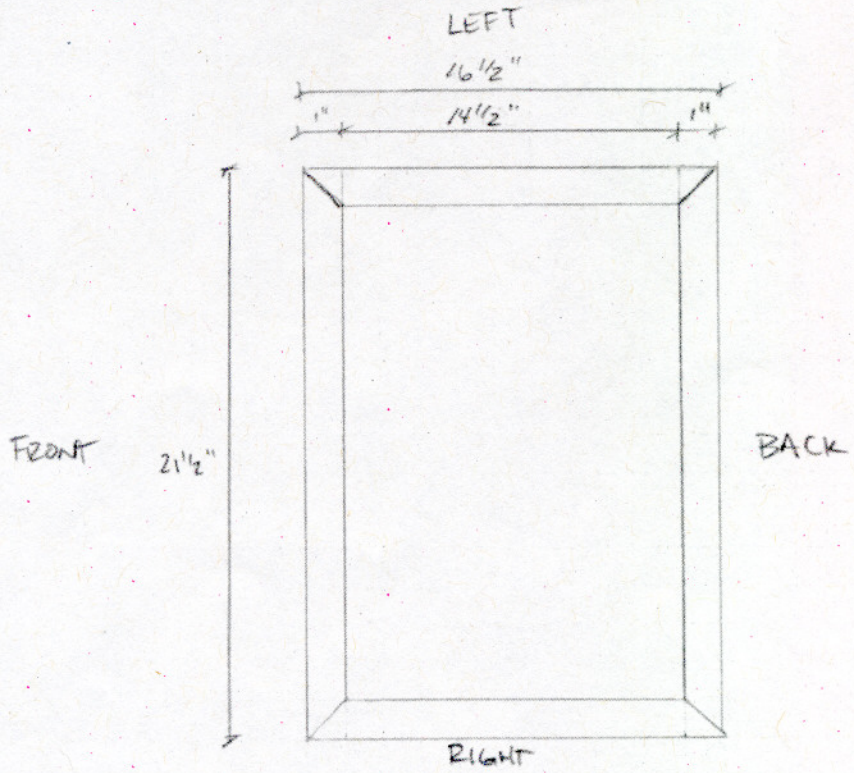
* brackets originally 90°, were bent into more oblique angle with hammer

* panels will be fastened by screws to the frame and trapezoidal pieces will be fastened on both sides by brackets as to try to make panels and trapezoidal pieces as rigid as possible to take force off frame.

Old Reflector Design



11/22/04



DIMENSIONS

REFLECTOR FRAME

FRONT 21 1/2" x 1" x 3"

BACK 21 1/2" x 1" x 2 1/2"

LEFT 16 1/2" x 1" x 1/4"

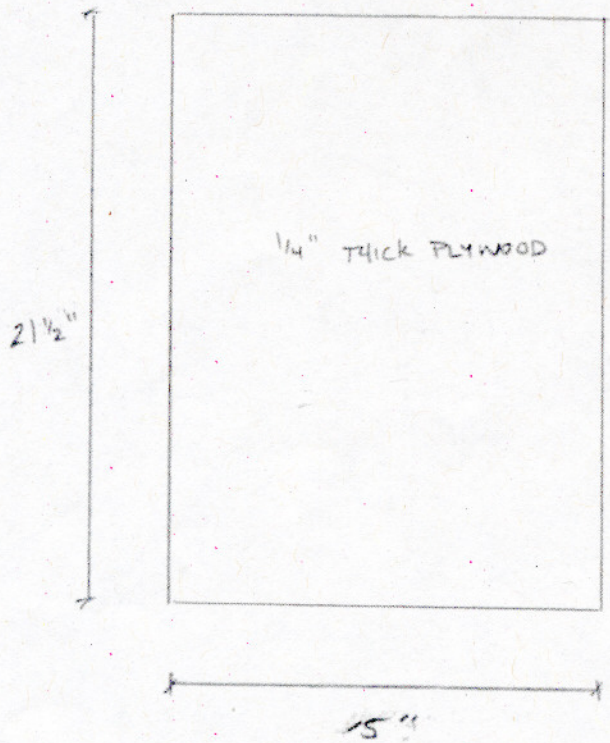
RIGHT 16 1/2 x 1" x 2 3/4"

★ BOTH SIDE PANELS WILL HAVE THE TRAPAZOIDAL PANELS PERMENATLY ATTACHED WITH HINGES, AND ALL PANELS WILL BE PERMENATLY ATTACHED TO THE REFLECTOR FRAME WITH HINGES.

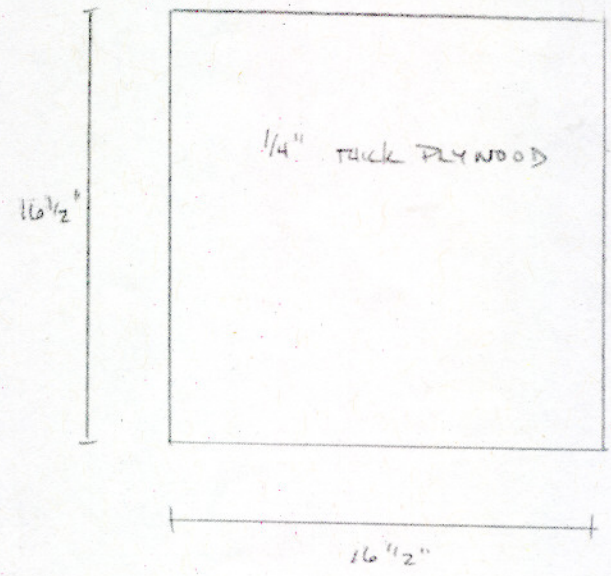
WHEN THE REFLECTOR NEEDS TO BE USED THE PANELS THAT ARE NOT PERMENATLY ATTACHED TO ONE ANOTHER WILL BE TEMPORARILY ATTACHED WITH SOME TYPE OF HARDWARE IN ORDER TO ENSURE REGIDITY.

THE REFECTOR FRAME WILL SIT ON TOP OF THE GLASS FRAME AND WILL HAVE HOLES IN LINE WITH HOLES IN THE SIDE, FRONT AND BACK PANELS SO THAT BOLTS MAY BE USED TO ATTACH THE REFLECTOR TO THE OVEN.

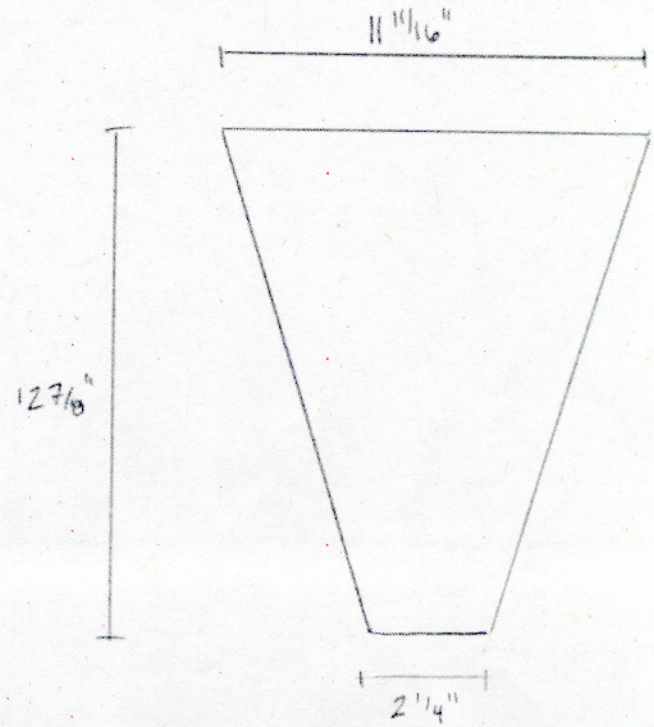
11/22/04



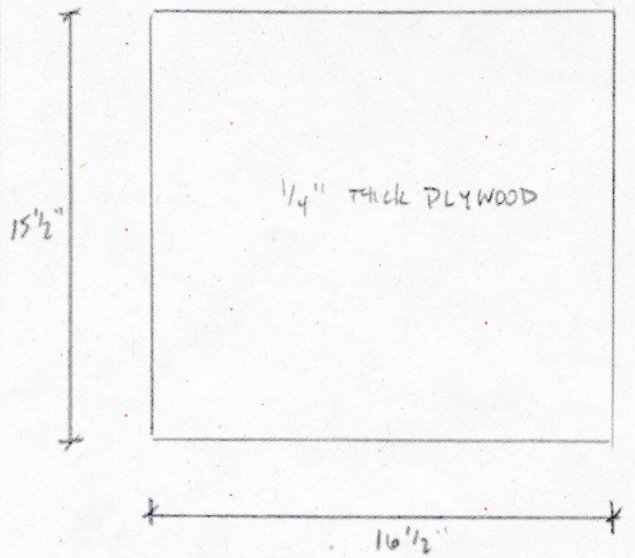
BACK REFLECTOR PANEL



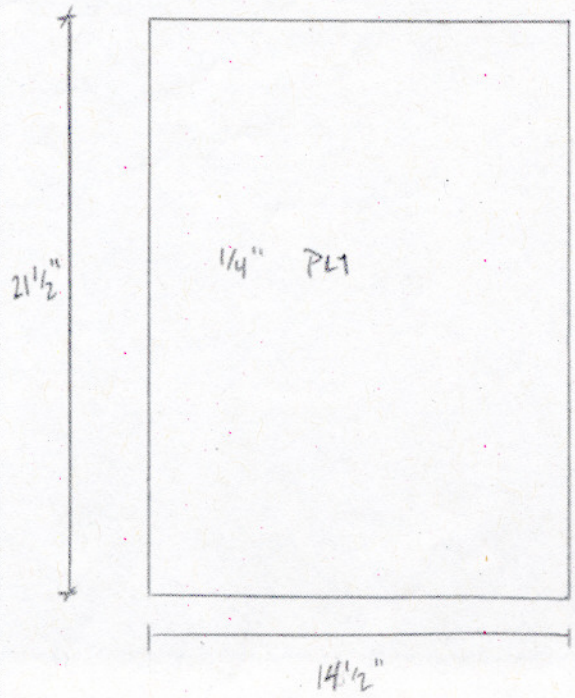
LEFT REFLECTOR PANEL



TRAPAZOID PANELS QNT 4



RIGHT REFLECTOR PANEL



FRONT REFLECTOR PANEL