

**Date:** February 12, 2008  
**To:** Dr. Stephen Batill and Dr. Michael Stanisic  
**From:** Rachel Paietta  
**Subject:** Trade Study Proposal

Individual Trade Study Proposal: Structural Support Study

*Purpose*

The purpose of this study is to design the structural support system for the solar collector, stirling engine and generator. After determining the basic layout of the support with the design team, I will size the components, select materials and pick the most stable layout for the design to withstand forces of wind gusts as well as the weight of the components themselves.

*Engineering Analysis Tools*

Through the application of solid mechanics theory and the Pro-Mechanica module of Pro-Engineer I will optimize the diameter of the hollow links we have chosen as a function of load bearing capability and cost. This process naturally entails choosing materials to analyze because the best dimensions and cost for each material will differ. PVC, aluminum and brass are the pipe materials I have currently chosen to analyze, but the study is not necessarily limited to these. The other element of this design space is the angle of the triangular trusses. I will be using an isosceles triangle truss design, so choosing one angle of the structure will determine the other two angles of the triangle as well. By doing a sensitivity analysis on the angle of the truss structure and how well it minimizes stress for both horizontal and vertical loading conditions I will determine the best angle for our design.

*Information Developed*

This study will develop technical analyses that will provide the basis for determining the dimensions, geometry and material of the support structure used to hold the collector, engine and generator. Once the optimal dimensions are chosen, a cost analysis will provide the last step in finalizing the design and in making an appropriate prototype of our system.

*Influence of the Study*

A stable support structure is an important element of an effective solar power unit because frequent movement of the trough will decrease the efficiency of the entire system. This study will provide a complete design for the truss support and will provide the foundation for the entire compact solar power system.

*Task Schedule*

The study will begin with construction of a CAD model for the support structure coupled. After establishing the model, I will make three material profiles for PVC, brass and aluminum to be used in the analysis with ProMechanica by 2/16. The first analysis performed will be a sensitivity analysis of the load bearing capability of the structure depending upon the angle of the triangular truss. The angle at which the structure can support the best combination of vertical and horizontal loading will be the angle for the design. These results will be checked and compared to hand calculations done using principles of statics and simple truss theory. This will be completed by 2/18. The next analysis will be an optimization of the material and link diameters by applying the same loading conditions used in the previous analysis and sizing the links specifically for the material. This design variable will also be checked with solid mechanics calculations to check the ProMechanica calculations. Once the diameter dimensions are set, a cost comparison will determine the final design variable (material selection), and the structure design will be completed. The target completion date for this study is 2/21 provided that no show stoppers are encountered through the process.