Solar Tracking Structure Design

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Team 07

Needs Identification, Product Specification and Project Plan

Document

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INTRODUCTION

The current solar energy system consists of 8 solar panels, which are located up at the shack behind the engineering building. Currently the 8 solar panels are held rigidly in place on at an angle. In order to increase the efficiency of the solar panel, solar tracking systems have been created, which are devices for orienting the sun light by using the either light sensor or the gear box system for rotating the solar panel based on the time of day. Solar panels convert the solar radiation into electrical energy. If we can add a solar tracker on to the current system, the collection of the sun radiation will be increased due to increasing the incident radiation rate.

The client for this project is Dr. Tom Acker, Professor of Mechanical Engineering at Northern Arizona University. He is currently the director of NAU's Sustainable Energy Solutions Group. His research field includes renewable energy systems, thermal-fluid systems analysis, and statistical thermodynamics.

NEEDS

During our meeting with Dr. Acker he spoke about why he wanted us to design a solar tracking system for the solar panels up at the shack. What we gathered is that Dr. Acker wants us to design a more reliable solar tracking apparatus then is currently available.

Some of the reasons Dr. Acker wants a more reliable solar tracking system are:

- Current solar tracking systems are too expensive for the school to purchase.
- Unreliable because the often break down.
- Since they break down often they are hard to maintain.
- Over by the student family housing there is currently a broken solar array tracking system that could possibly use our design.

PROJECT GOAL

The team is to design a reliable solar tracking device. This device will track the sun. The tracking device is to capture solar rays utilizing the solar panels. After the solar rays are captured, it will be converted into useable power in the shack between the Engineering Building and Forestry Building.

OPERATING ENVIRONMENT

Presently, there are a number of solar tracking designs on the market with different methods of tracking the sun. Our design will use either sensors or a timing device. Our system will be stationed at the shack that is located between the Engineering Building and the Forestry Building. The location currently has plenty of trees that surround the place. This location will be shady in the mornings and evenings, but there is an ample amount of sunshine during the day.

OBJECTIVES

The objectives of solar tracking system are for the construction to be inexpensive, require low maintenance, efficiency, manufacturability and a high build quality. If the system is inexpensive it will be available to more groups and organizations to purchase. Low maintenance equates to less part replacement, less repairs, less time spent on maintenance and overall more cost efficient. The whole point of using a tracking system is to make the solar panels more efficient. If the tracking system took more energy than produced by the system it would be useless and counterproductive, so one of our objectives is to have an efficient tracking system. The design of the tracking system should include the ability to be mass produced if in the future we decide to market the system. A high build quality will help insure the longevity of the system. The secondary objectives include removal of snow and the ability to handle the weights of different solar panels. By meeting these objectives, it will help make the tracking system be successful. The objectives as well as how they will be measured are shown in Table 1 below.

Table 1: Objectives and Their Measurement

Objective	Measurement Basis	Units
Inexpensive	Unit cost of production	Dollars
Efficiency	Amount of useable amps per midday sun	Amp/hour
Low Maintenance	Time until first replacement parts	Days
Manufacturability	Number of moving parts	Parts
Build Quality	Stress times strain	N/m^2
Snow Removal	Area with out snow	m^2
Handle different weights	The weights of the solar panels	N

CONSTRAINS:

Constrains indicate the non-permissible conditions of the solar tracking system and the non-permissible range of the design and performance parameters. The first constraint is the system weight. Since the light weight will reduce the cost of the material as well as the power needed for tracking system itself. The weight of the tracking system should be in a reasonable range. Another important constraint is the budget. There are some commercial solar tracking systems on the market, but the costs are usually high. So the new solar tracker needs to be built with a small budget in mind. Since the working space is fairly small, the solar panels will be placed close to each other. In order to have higher efficiency, the panels should not shade each other after adjusting. Considering the weather in Flagstaff, the solar tracking system must be able to work during winter as well as survive strong winds.

Objectives (Outline):

The actual Gantt chart is available for review in the appendix of this report.

1. Gather group information (9/5/13 to 9/11/13)
2. Meet with client (10/2/13)
3. Needs and problem identification (10/3/13 to 10/4/13)
4. Project plan (10/4/13 to 10/7/13)
5. Research (10/3/13 to 10/23/13)
    a. Solar panels
    b. Design development
    c. Existing designs
6. Numerical modeling (10/24/13 to 11/5/13)
7. Choose final design (11/8/13)
8. CAD drawings (11/19/13-11/26/13)
    a. Computer analysis
9. Project proposal

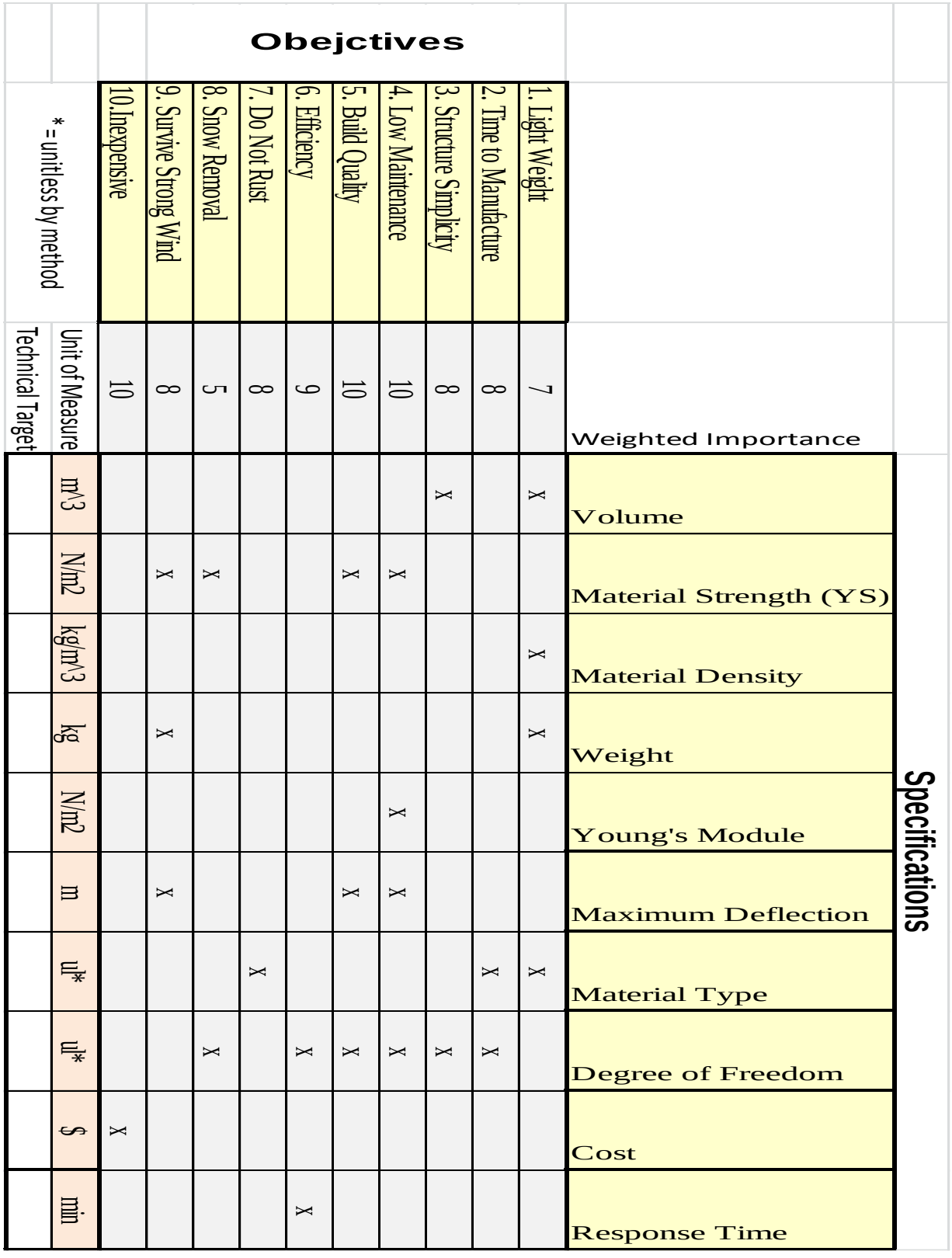
CONCLUSION

Solar tracking systems are both costly and could use improvements in energy efficieny. They also are limited to the tracking angle they can achieve. The objectives of this project were defined as being energy efficient with low maintenance requirements. There were also secondary objectives such as the ability to operate with different weighted solar panels. Another secondary objective should be that the solar tracking system should be operational even when snow is present. The project is constrained by the weight, budget, limited space and must be able to move the solar panels. The solar tracking device will track the movement of the sun such that it optimizes the efficiency of the solar panels and must be able to operate in varying weather conditions.

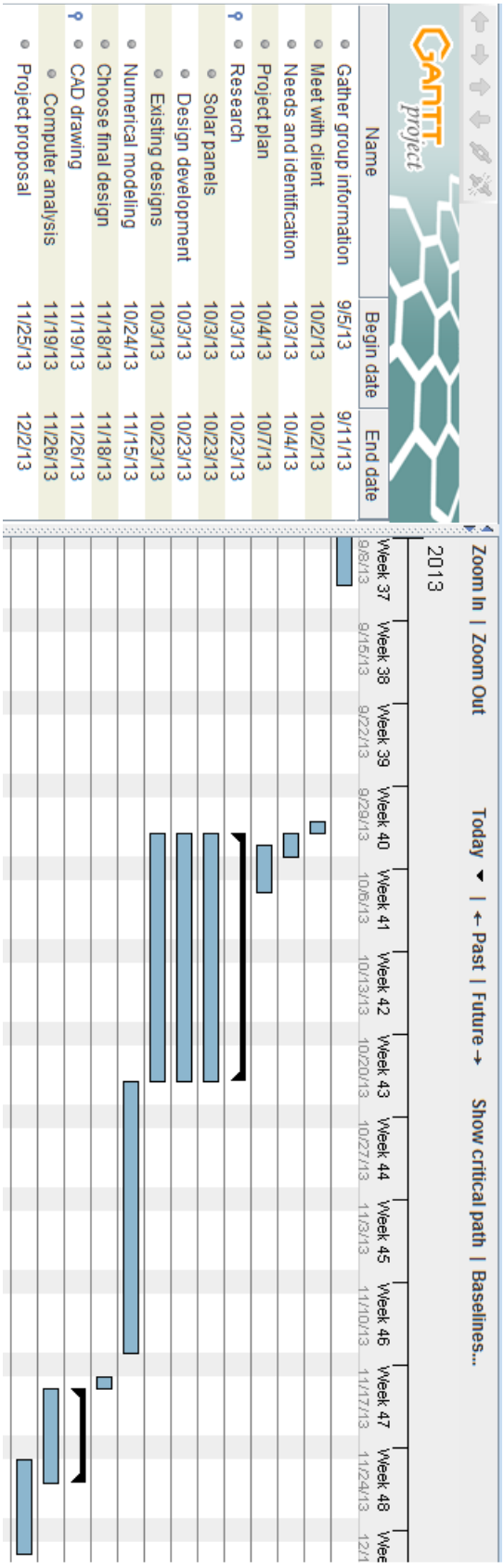
References

1. Beckman, A. William, Duffie A. John, “Solar Engineering of Thermal Processes”, third edition, John Wiley and Sons, Inc, Hoboken, New Jersey, 2005
2. http://nau.edu/Sustainability-360/Sustainability-Experts/Thomas-Acker/

APPENDIX
QFD Matrix



Gantt Chart


GANTT project
Name
Begin date
End date
Gather group information 9/5/13 9/11/13
Meet with client 10/2/13 10/2/13
Needs and identification 10/3/13 10/4/13
Project plan 10/4/13 10/7/13
Research 10/3/13 10/23/13
Solar panels 10/3/13 10/23/13
Design development 10/3/13 10/23/13
Existing designs 10/3/13 10/23/13
Numerical modeling 10/24/13 11/15/13
Choose final design 11/18/13 11/18/13
CAD drawing 11/19/13 11/26/13
Computer analysis 11/19/13 11/26/13
Project proposal 11/25/13 12/2/13
Zoom In | Zoom Out
Today
← Past | Future →
Show critical path | Baselines...
2013
Week 37 9/8/13
Week 38 9/15/13
Week 39 9/22/13
Week 40 9/29/13
Week 41 10/6/13
Week 42 10/13/13
Week 43 10/20/13
Week 44 10/27/13
Week 45 11/3/13
Week 46 11/10/13
Week 47 11/17/13
Week 48 11/24/13